Dear Friends,

As you enter the Sala Europa in the Symposium, the great statue of Pulcinella, reproduced on the cover of this book, will greet you with open arms at the front of the stage. His welcome is warm and affectionate - very Italian and, even more so, Neapolitan.

Adriana and I have chosen Harlequin in honour and in remembrance of Giovanni Ruggiero and to fill in part the gap he has left. We have entrusted Harlequin with giving the welcome Giovanni Ruggiero would most certainly have given himself, had he still been among us. We are most grateful to the sculptor Lello Esposito for allowing us to display his work.

Marco and Adriana Leonardi

"It is the only moment we can dream ..." Pierre L. Lasjaunias

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THE NEURORADIOLOGY JOURNAL
formerly RIVISTA DI NEURORADIOLOGIA
Official Journal of:
AINR - Associazione Italiana di Neuroradiologia
The Neuroradiologists of Alpe-Adria
ANRS - Albanian Neuroradiological Society
PANRS - Pan Arab Neuroradiology Society
Radiological Society of Saudi Arabia, Division of Neuroradiology
ISNR - Indian Society of Neuroradiology
Indonesian Society of Neuroradiology
Neuroradiology Section of the Radiology Society of Iran
Israeli Society of Neuroradiology
Malaysia College of Radiology Neuro Interested Group
Neuroradiology Section - Pakistan Psychiatry Research Center
Section of Neuroradiology - Polish Radiological Society
The Neuroradiologists of Romania
Section of Neuroradiology of Serbia and Montenegro
SILAN - Sociedad Ibero Latino Americana de Neurorradiologia
Neuroradiology Section of Singapore Radiological Society
Slovenian Society of Neuroradiology
Neuroradiological Society of R.O.C. - Taiwan
TSNR - Turkish Society of Neuroradiology

Indexed in: Google Scholar (http://scholar.google.com)
EMBASE (http://www.scopus.com)

Scopus Overview: Scopus is the largest abstract and citation database of research literature and quality web sources. It's designed to find the information scientists need. Quick, easy and comprehensive, Scopus provides superior support of the literature research process. Updated daily, Scopus offers: • Nearly 18,000 peer-reviewed journals from more than 5,000 publishers, including coverage of: 1) 16,500 peer-reviewed journals (inc > 1200 Open Access journals); 2) 600 trade publications; 3) 350 book series; 4) Extensive conference coverage (3.6 million conference papers). • 38 million records, of which: 1) 19 million records include references going back to 1996 (78% include references); 2) 19 million pre-1996 records go back as far as 1823. • Results from 435 million scientific web pages. • 23 million patent records from 5 patent offices. • "Articles-in-Press" from over 3,000 journals. • Seamless links to full-text articles and other library resources. • Innovative tools that give an at-a-glance overview of search results and refine them to the most relevant hits. • Alerts to keep you up-to-date on new articles matching your search query, or by favorite author. Scopus is the easiest way to get to relevant content fast. Tools to sort, refine and quickly identify results help you focus on the outcome of your work. You can spend less time mastering databases and more time on research.
Dear Friends,

Welcome to Bologna!

It goes without saying, but I feel I must tell you how happy I am to welcome you all and how grateful I am to those who offered me this great opportunity. I was entrusted with the presidency of the Symposium Neuroradiologicum during the XVII SNR chaired by Luc Picard in Paris. As was the custom, the decision was taken by the Past Presidents and WFNRS executive members. It was a moving moment at the time, but it is even more so today now that the real work of the XIX Symposium is about to begin.

Preparation for the meeting has been long and arduous taking up much of my time in the past four years, and I have dedicated every spare minute of my working day to planning the Symposium in the past twelve months. It was no easy task bringing together all the aims of a meeting designed to combine updates with proposals for the future, offering all participants the chance to present their work openly and make more time than ever available for a lively broad-based discussion involving more than two hundred moderators.

I emphasize that the Symposium program was not a top-down decision but an integration of all the proposals received from meeting participants and members of the Scientific Committee, to whom I am indebted. The program is a balanced mix reflecting the myriad aspects of our discipline. The Symposium is an ideal opportunity to highlight the great contribution Neuroradiology has made to the diagnosis and interventional treatment of CNS disease: a contribution of which we can be truly proud. Plainly this does not preclude ongoing research to enrich our knowledge further and perfect our techniques, as will be seen from the many studies to be presented at this meeting.

Many young neuroradiologists have registered for the Symposium. They are rightly responsible for the future of our discipline, building on the foundations we have left them and hopefully in continuity to strengthen Neuroradiology further. Let us never forget that first and
foreground we are physicians and our only true task is to do everything in our power for our patients to attenuate their suffering, save their lives and enhance their quality of life. Diseases of the nervous system constitute one of the most difficult areas of medicine, difficult because so much remains unknown and difficult in terms of diagnosis and treatment and the dramatic effect of neurological deficit on quality of life.

My sincere thanks go to all contributing authors and all the moderators. The success of the meeting is in their hands and will depend on discussion. Discussion will serve to catalyze the scientific outcome through a broad rational analysis of all the works presented and the conclusions that all participants will be able to take away with them.

I have been helped by many, especially by Pierre Lasjaunias, who I shall always miss. Anton Valavanis has been invaluable in offering his help, advice, stimulation and support as a friend and as a brilliant neuroradiologist. I owe much to Luc Picard as a teacher and much more besides, an example to us all and a dear friend. Like all Italian neuroradiologists, I am indebted to Giovanni Ruggiero the founder of Italian Neuroradiology and Symposium President in 1961.

I shall not even attempt to list the many, many people without whose help I should never have accomplished the task of organizing this event that I hope will meet with your approval. My thanks also go to the sponsor companies that believed in the project and have supported us despite the current economic climate.

I would like to stress how much I have relied on all the meeting organizers: Mara Carletti and her team, all my colleagues at Bellaria Hospital who have seen less of me in the past year and have helped quell my anxiety.

Last but not least, I must thank my wife, Adriana, for being a pillar of strength, with her advice and patience and accepting all the daily constraints imposed by my constantly being on the computer! Thank you all!

Marco Leonardi
President of the XIX Symposium Neuroradiologicum
Bologna, 4th October 2010
XIX Symposium Neuroradiologicum
The World Congress of Diagnostic & Therapeutic Neuroradiology
Bologna, Italy - 4-9 October 2010

The President
Marco Leonardi
Professor of Neuroradiology
Bologna University, Bellaria Hospital

Symposium Vice President
Anton Valavanis
Professor of Neuroradiology
University Hospital of Zurich

Symposium Honorary President
Prof. Giovanni Ruggiero †

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Mandapalli Adinarayana Rao, India
Raffiela Agati, Italy
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Symposium Neuroradiologicum

Previous and Future

I ANTWERP, 1939
President: Rudolph Thienpoint

II ROTTERDAM, 1949
President: George Ziedses Des Plantes

III STOCKHOLM, 1952
President: Erik Lindgren

IV LONDON, 1955
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V BRUSSELS, 1957
President: Donald L. McRae

VI ROMA, 1961
President: Giovanni Ruggiero

VII NEW YORK, 1964
President: Juan Taveras

VIII PARIS, 1967
President: Herman Fischgold

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President: Ingmar G. Wickbom

X PUNTA DEL ESTE, 1974
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XII WASHINGTON, 1982
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President: Luc Picard

XVIII SIDNEY, 2006
President: Michael Sage

XIX BOLOGNA, 2010
President: Marco Leonardi

XX ISTANBUL, 2014
President Elect: E. Turgut Tali

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Paolo Ambrosetto, Italy
Cosma Andreula, Italy
Shigeki Aoki, Japan
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Antonella Bacci, Israel
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Massimo Dall'Olio, Italy
E. De Divitiis, Italy
Roberto De Blasi, Italy
Philippe Domearel, Belgium
Imran Demirci, Turkey
Fabio De Santis, Italy
General Information

Date and Location

XIX Symposium Neuroradiologicum
4-9 October, 2010
Palazzo della Cultura e dei Congressi
Piazza della Costituzione, 4 - 40128 Bologna, Italy
http://www.bolognacongressi.it/

The conference center is located in the trade fair district at 10' by car from the railway station and 20' from the city historic center.

Onsite Secretariat & Registration Opening Hours

<table>
<thead>
<tr>
<th>Day</th>
<th>Opening hours</th>
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</thead>
<tbody>
<tr>
<td>Monday, 4 October</td>
<td>12.00 - 20.00</td>
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<tr>
<td>Tuesday, 5 October</td>
<td>07.30 - 18.00</td>
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<td>Wednesday, 6 October</td>
<td>07.30 - 18.00</td>
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<td>Thursday, 7 October</td>
<td>07.30 - 18.00</td>
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<tr>
<td>Friday, 8 October</td>
<td>07.30 - 18.00</td>
</tr>
<tr>
<td>Saturday, 9 October</td>
<td>07.30 - 13.30</td>
</tr>
</tbody>
</table>

Continuing Education Credits

The XIX Symposium Neuroradiologicum is accredited by the The European Union of Medical Specialists (UEMS) to provide continuing medical education for physicians. The Council notified 27 European credit points to the Symposium Neuroradiologicum. Credit Points are valid all over Europe, the United States and Canada (reciprocity agreement with the American medical Association). Italian CME will be also provided to the Italian Participants.

Registration

Congress Fees (including VAT 20%)

<p>| | |</p>
<table>
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<tbody>
<tr>
<td>Registration Fee</td>
<td>Euro 800,00</td>
</tr>
<tr>
<td>Resident/Trainee*</td>
<td>Euro 400,00</td>
</tr>
</tbody>
</table>

Notes: *Letter confirming status is required

The registration fee includes: admission to the scientific sessions, book of abstracts, entrance to the exhibition, lunch & coffee break, welcome reception, UEMS credits

Payment should be made by cash or credit card (VISA - MAESTRO - MASTERCARD).

Certificate of Attendance

The certificate of attendance will be distributed to all participants requiring it, please ask the Secretariat.
Meeting Rooms

The Symposium is composed of many different scientific sessions:
- 30’ Morning Seminars to be held in the Parallel Rooms
- Morning Plenary Sessions to be held in the Main Hall “Europa Auditorium”
- Parallel Sessions to be held in the different Congress Halls
- Meet the Expert to be held in the Red Hall (access limited to a small number of participants, please check availability at the registration desk)
- How I Do It: Nyck Bryan in the Blue Hall, on Thursday 5 October
- Sponsored Satellite Symposia

Social Program

Monday, 4 October 2010 - 19.15
A welcome reception will be held in the exhibition pavilions (1st and 2nd level), all attendees are invited to join the buffet.

Friday, 8 October 2010 - 20.30
The Farewell Dinner will be held on Friday 8 October 2010 in the magnificent Palazzo Albergati. Palazzo Albergati is a sumptuous, country dwelling named after the Bolognese family. It is one of the most significant examples of 17th-century Emilian architecture. The building is surprisingly impressive because of its remarkable size and the unique contrast between the austerity of its exteriors and the unexpected Baroque-style spatial effect of its interiors. Combined with its 130,000 square meters park and place the Italian ‘Haute Cuisine’ is a mark of distinction in Bologna and its surroundings. All the guests are welcome to enjoy a top quality various menu that respects most of the dietary requirements (special requirements can be easily indicated in the registration form).

SHUTTLE SERVICE
A daily shuttle service to/from the Conference center has been provided, please check the schedule at the registration desk.

USEFUL INFORMATION AND CONTACTS

The Airport Guglielmo Marconi is about 6 Km far from Bologna city center.
The Airport Shuttle connects the airport to Bologna center (Via Ugo Bassi) and the Railway Station (One way fare: € 5 - tickets can be purchased on board).
http://www.bologna-airport.it/uk/?LN=UK
The Railway Station in Bologna: Piazza Medaglie D'Oro n. 4, Bologna
http://www.ferroviedellostato.com
Public Transportation: Buses to/from the city centre: #25, 28; Buses to/from the Railway Station: #35, 38, 39; Information Office: tel +39.051.290290 - http://www.atc.bo.it
Taxi: C.A.T. tel. + 39. 051 534141 or CO.TA.BO tel. + 39 051 372727
Car Rental
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Europcar tel. 800 014410 - http://www.europcar.it
Hertz tel. 199 112211 - http://www.hertz.it
Police Station Radio operations centre: tel. +39.051.266626
Scientific Information

Audiovisual Equipment (for all the Speakers)

The Speaker Ready Room will operate throughout the duration of the Symposium. It is located on the 1st level near the Blue Hall. Please do not ask to use personal laptops, it slows down the scientific presentations. All presentations must be downloaded at the Speaker Ready Room. One of the purpose of this Symposium is publishing in a protected format (not possible copy or download) the presentations after the event as historical archive. Speakers will be kindly invited to authorize it. Those who are not in favour will have their files immediately cancelled.

The Speaker Ready Room is equipped with:
- Knowledgeable Attendants
- PCs and Printers for your Use
- Internet Access

Both main speakers and oral communication speakers are kindly requested to hand in all material of their presentation (pen drive, CD-ROM) at least two hours before their scheduled presentation time. If a presentation is scheduled early in the morning, speakers are kindly requested to check their presentation at the Slide Review Room the day before.

Poster Session

Posters will be displayed according to a rotation so that each poster will be exhibited for a total of 3 days:
- 1st group from Monday 4 October to Wednesday 6 October;
- 2nd group from Thursday 7 October to Saturday 9 October.

Authors are requested to fix their poster on the space assigned and dismantle it according to their scheduled group.

Poster Session Set-up/Tear-down Schedule:
Posters will be on display during the Poster Session Hours according to the following schedule:

Poster Session I (1st Group): Exhibit Hall 2 - from Monday, 4 October, 16.00 to Wednesday 6 October, 17.30
Poster Set-Up: Monday 4 October, 12.00-15.00
Poster Tear Down: Wednesday 6 October, 17.30-18.30

Poster Session II (2nd Group): Exhibit Hall 2 - from Thursday, 7 October, 20.30 to Saturday 9 October, 13.00
Poster Set-Up: Thursday 7 October, 7.30-8.30
Poster Tear Down: Saturday 9 October, 13.30-14.30

Online Electronic Poster!
Poster digital format of the registered presenters who sent their file are published on the Symposium website: http://www.symposiumneuroradiologicum.org!
While ensuring more visibility it allowed participants to read them before and after the Symposium and prepare for a personal meeting with the author in Bologna or for a later contact

Insurance
The Organizing Secretariat won’t be held responsible for any loss, accident and damage that might occur during the Congress and travelling: participants are recommended to insure against these events.
MONDAY, 4 October 2010

EURÓPA AUDITORIUM
ITALY HALL 1st Level
BLUE HALL 1st Level
INDIGO HALL 1st Level
GREEN HALL 2nd Level
MAGENTA HALL 2nd Level
VIOLET HALL 2nd Level
WHITE HALL 1 0 Level
WHITE HALL 2 0 Level
YELLOW HALL 0 Level
RED HALL 0 Level

8.30-9.00
Advances with Flat Detector Imaging in the Angiography Suite
M. MAWAD

8.30-9.00
Suspected Abusive Head Trauma in Small Children – The Role of Neuroradiology and of the Neuroradiologists
O. FLODMARK

8.30-9.00
LIVING MATTER: Simulation, From Gene to Body
K. FUJIKAWA

8.30-9.00
Neuropathology of Emergency
L. SIMONETTI

8.30-9.00
External and Middle Ear Imaging and Pathology
D. YOUSEM

8.30-9.00
Neuroradiology of Emergency
L. SIMONETTI

8.30-9.00
DTI of Brachial Plexus
G. PELLICANO

8.30-9.00
Functional Imaging of the Spine
V. HAUGHTON

9.15-9.45
Technology Development in Neuroradiology

10.00-11.30
Research in Neuroradiology

11.30-12.30
Molecular Imaging and Nano Technologies

12.30-14.30
Mars International Symposium: The Advanced Aneurysm Treatment

MONDAY, 4 October 2010

TUESDAY, 5 October 2010

EURÓPA AUDITORIUM
ITALY HALL 1st Level
BLUE HALL 1st Level
INDIGO HALL 1st Level
GREEN HALL 2nd Level
MAGENTA HALL 2nd Level
VIOLET HALL 2nd Level
WHITE HALL 1 0 Level
WHITE HALL 2 0 Level
YELLOW HALL 0 Level
RED HALL 0 Level
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>8.30-9.00</td>
<td>Current Status of Carotid Stenosis. The North American vs the European Perspective M. MAWAD</td>
</tr>
<tr>
<td>8.30-9.00</td>
<td>Phenotypic Identification of Neurological Malformations. Neuroanatomy of Syndromes E. TRIVUZI</td>
</tr>
<tr>
<td>8.30-9.00</td>
<td>Arterial Wall Understanding and Therapeutic Consequences K. TER BRUGGE</td>
</tr>
<tr>
<td>8.30-9.00</td>
<td>Magnetic Resonance Diffusion Tensor Tractography in the Brain: Its Application and Limitations S. AOKI</td>
</tr>
<tr>
<td>8.30-9.00</td>
<td>Cervical Disc Herniation and the Decompensate Cervical Spine M. BORTOLUZZI</td>
</tr>
<tr>
<td>9.15-10.40</td>
<td>Brain Tumors I 9.15-10.15 Aneurysms 5 10.15-11.30 Aneurysms 6 11.30-12.15 Aneurysms 7</td>
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<tr>
<td>10.40-12.20</td>
<td>Brain Tumors II 10.40-12.00 Aneurysms 6</td>
</tr>
<tr>
<td>12.30-12.45</td>
<td>Aneurysms 7</td>
</tr>
<tr>
<td>12.30-12.50</td>
<td>Conclusive Lecture A. Osborn</td>
</tr>
<tr>
<td>9.15-10.30</td>
<td>Stroke Imaging Standardization M. SASAKI</td>
</tr>
<tr>
<td>10.30-13.00</td>
<td>Carotids 2 11.30-12.30 HNV</td>
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<tr>
<td>11.30-13.00</td>
<td>Carotids 1 12.30-13.00 Aneurysms 8</td>
</tr>
<tr>
<td>12.30-13.30</td>
<td>Advanced Imaging Techniques for Stroke Management G. HEALY</td>
</tr>
</tbody>
</table>
The Achieva 3.0T TX automatically adjusts to each patient’s unique anatomy. Its MultiTransmit parallel RF transmission technology tailors the RF signals to provide consistent high image quality and reduced scan times – across a broad range of clinical applications. Make diagnoses based on information that is fast, robust and reliable. It just makes clinical and economic sense.

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*Because our innovations are inspired by you.
i Congressi

Legend:

- **Amirsys**: Book Corner, Ground Level
- **BMS Group**: Book Corner, Ground Level
- **Fogliazza Publishing**: Book Corner, Ground Level
- **Libreria Master**: Book Corner, Ground Level
- **Wisepress**: Book Corner, Ground Level
Legend:

- **AB Medica**: B21, B22, B23, Level 1
- **AMS Group/Arthrocare**: B3, Level 1
- **Bayer Schering Pharma**: B11, B12, Level 1
- **Boston Scientific**: B6, Level 1
- **Bracco Imaging**: B8, B9, Level 1
- **Carestream Health**: B27, Level 1
- **Codman Neurovascular - A Johnson & Johnson Company**: B20, Level 1
- **Endotech**: B1, Level 1
- **Esaote**: B7, Level 1
- **Uber Ros**: B14, Level 1
ev3
GE Healthcare
Guerbet
Micrus Endovascular
Penumbra-Crossmed

B10, Level 1
B5, Level 1
B24, B25, Level 1
B16, B17, B18, Level 1
B26, Level 1

Philips Healthcare
Siemens
Microvention / Terumo Italia
Concentric Medical

B13, Level 1
B19, Level 1
B15, Level 1
B4, Level 1
Palazzo della Cultura e dei Congressi

Second Level

Legend:

- Covidien  C17, Level 2
- Gem Italy  C7, Level 2
- NordicNeurolab  C11, Level 2
- Phenox  C16, Level 2
- Stryker  C6, Level 2
ACKNOWLEDGEMENTS

The President of the XIX Symposium Neuroradiologicum, The World Congress of Diagnostic & Therapeutic Neuroradiology, wishes to express his gratitude to all the companies who have given their support to the event.

Diamond Level

AB MEDICA/ BALT INTERNATIONAL/ MIC RUS ENDOVASCULAR 
BRACCO IMAGING

Gold Level

GUERBET

Silver Level

GE HEALTHCARE

Bronze Level

BAYER SCHERING PHARMA
BOSTON SCIENTIFIC
CODMAN NEUROVASCULAR - A JOHNSON & JOHNSON COMPANY 
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AMS GROUP/ ARTHRO CARE 
BMS GROUP
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CONCENTRIC MEDICAL
COVIDIENT ENDOTECH 
EV3 
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NORDIC NEUROLAB
OLEA MEDICAL 
PENUMBRA- CROSSMED 
PHENOX 
SIEMENS 
STRYKER 
MICROVENTION/ TERUMO 
UBER ROS 
WISEPRESS
Dear Colleagues,

Organizing XX. Symposium Neuroradiologicum, such a prestigious Congress in Istanbul in 2014, will be a great challenge as well as a pleasure for me and also for the Turkish Society of Neuroradiology. This meeting will cover the major recent developments in both diagnostic and interventional neuroradiology as well as neurosciences.

“There, God and human, nature and art are together, they have created such a perfect place that it is valuable to see.” is how Lamartine’s describes his love for Istanbul. This city is unique, by the way, he makes live all religions in peace and harmony and embraces two continents, with one arm reaching out to Asia and the other to Europe. Istanbul has been inhabited since the end of the 4th century B.C. Remains from Hellenic, Roman, Byzantine and Ottoman periods are scattered all around the city, to name few, Hagia Sophia, Basilica Cistern, Blue Mosque, Grand Bazaar, Topkapi Palace and Turkish Baths, making Istanbul a marvelous open air museum.

Located at the crossroads of East and West, Istanbul offers easy air connections to hundreds of cities around the world and is one of the world’s most exciting conference destinations. Istanbul’s outstanding infrastructure, including modern, luxurious accommodations with over 30,000 five-star rooms, state-of-the-art conference and exhibition venues makes it the logical and best choice for the XX. Symposium Neuroradiologicum. You can find more information at the website

www.symp-neuro2014istanbul.org

As we all know, a successful congress should have plenty of science, spotted with entertainment and relaxation. From the ubiquitous sounds of live, traditional Turkish music and dancing in restaurants throughout the city to cultural and artistic events, international festivals, and glitzy clubs and bars on the Bosphorus, Istanbul is a city that knows how to entertain, and it knows how to party. There is so much to do, from theatres, concerts and exhibitions to museums, historic and architectural tours. Istanbul also offers a wide variety of pre- and post-congress tour options, from cruises and overland expeditions to cultural tours or just relaxing on some of the Mediterranean ‘s finest beaches.

It will be our great pleasure hosting you in irresIstanbul in 2014.

Sincerely yours,

Prof. Dr. E. Turgut Tali
President of the XX. Symposium Neuroradiologicum
SCIENTIFIC PROGRAM

MONDAY, 4 OCTOBER 2010
Plenary Hall Sessions

17.00-19.10 EUROPA AUDITORIUM

17.00-17.30 Opening Ceremony, Welcome to Bologna
Paolo Ambrosetto Master of Ceremonies
Ivano Dionigi Rector of the University of Bologna
Sergio Stefoni President of the Medical Faculty of Bologna
Francesco Ripa di Meana Chairman, City Hospitals of Bologna
Cosma F. Andreula AINR President
Luc Picard WFNRS President
Targut Tali XX Symposium President
Marco Leonardi XIX Symposium President

17.30-19.10 Opening Session
Chairs: M. Leonardi, O. Flodmark

17.30-18.10 Thoughts on the Architectonic Organization of the Brain Applied to Diagnostic and Interventional Neuroradiology
A. Valavanis

18.10-18.40 Time is Brain. Still a Valid Concept for the Treatment of Acute Stroke Patients?
R. von Kummer

18.40-19.10 Discovering Bologna, the Secret Charm of a City
A. Ottani Cavina

19.15-20.30 EXHIBITION HALL Level 1 & 2
Welcome Cocktail Buffet
### MORNING SEMINARS

The Morning Seminars are held in PARALLEL SESSIONS from Tuesday to Saturday, at 08.30-09.00 a.m.

#### TUESDAY, 5 OCTOBER 2010

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<td>Advances with Flat Detector Imaging in the Angiography Suite</td>
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<td>M. Mawad</td>
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<td>Suspected Abusive Head Trauma in Small Children - The Role of Neuroradiology and of the Neuroradiologist</td>
<td>ITALY HALL</td>
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<td>Living Matter Simulation, from Gene to Body</td>
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<td>Causes and Imaging of Non-Hypertensive, Non Traumatic Intracranial Haemorrhages</td>
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<td>Neuroradiology of Emergency</td>
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<td>DTI of Brachial Plexus</td>
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<td>Functional Spine Imaging</td>
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<td>I.S. Choi</td>
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<td>Cerebrovascular Pathologies in North Africa</td>
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<td>Cerebral Palay - Neuroradiology Reveals the Patho-Physiology behind the Lesion</td>
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<td>Brain AVMs Understanding and Management</td>
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<td>The Stroke Unit: Angio-CT</td>
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<td>Possibilities of Magnetic Resonance Imaging in Systemic Lupus Patients</td>
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<td>Imaging of White Matter Diseases</td>
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<td>Biomechanics of the Spine</td>
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<td>Current Status of Carotid Stenting: The North American vs the European Perspective</td>
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<td>Phenotypic Identification of Neurological Malformations: Neuroradiology of Syndromes</td>
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Arterial Wall Understanding and Therapeutic Consequences
K. Ter Brugge

Stroke Imaging Standardization
M. Sasaki

Multiple Sclerosis New Techniques
M. Papathanasiou

Magnetic Resonance Diffusion Tensor Tractography in the Brain: Its Application and Limitation
S. Aoki

Cervical Disc Herniation and the Decompensate Cervical Spine
M. Bortoluzzi

FRIDAY, 8 OCTOBER 2010

08.30-09.00

Aneurysms Embolization, Selection of Technical Approaches
J. Moret
EUROPA AUDITORIUM

What Should a Clinical Neuroradiologist Know about Anisotropy and Optical Imaging?
Y. Ozsunar
ITALY HALL

Diffusion Tensor Imaging with Fiber Tractography: Assessment of Developing Brain and Aberrant Fiber Connections in CNS Anomalies
S. Lee
BLUE HALL

Dural Fistulas: Clinico-Anatomical Study and Therapeutical Strategies
A. Biondi
INDIGO HALL

Stroke Endovascular Therapy
G. Schroth
GREEN HALL

Cerebral Microbleeds, Associated Conditions and Clinical Relevance
H.R. Jäger
MAGENTA HALL

Probing Cerebral Hemodynamic Parameters with MRI: Basic Principles and Applications in Brain Tumor Diagnosis
A. Bjørnerud
VIOLET HALL

Spinal Instability
J. Van Goethem
WHITE HALL 1

Spinal Biopsy: How and When
G. Pellicanò
WHITE HALL 2

SATURDAY, 9 OCTOBER 2010

08.30-09.00

How to Prepare a Lecture or Communication, How to Keep the Audience's Attention, How to Have a Message Received
O. Flodmark
EUROPA AUDITORIUM

MRI Studies for Patients with Neurological Disorders and Implantable Cardiac Electronic Devices: Not What We Can Do - What We Should Do
D. Goldsher
ITALY HALL

New View on the CSF Circulation: CSF Is Produced and Absorbed by Brain Capillaries
D. Greitz
BLUE HALL

Recurrent Aneurysms, When to Treat?
I.S. Choi
INDIGO HALL

Whole Brain Perfusion/Dynamic CTA in Neurovascular Workup
S. Mukundan
GREEN HALL

Ultrasound in Neuroradiology
J. Krejza
MAGENTA HALL

Considerations on Advanced MRI Techniques in Studying Brain Gliomas
A. Bacci
VIOLET HALL

Spontaneous Intracranial Hypotension: Diagnosis and Percutaneous Therapy
M. Gallucci
WHITE HALL 1
TUESDAY, 5 OCTOBER 2010
Plenary Hall Sessions

09.15-12.30 EUROPA AUDITORIUM

Research in Neuroradiology
Chairs: L. Picard, R. von Kummer

09.15-10.00 Technology Development in Neuroradiology
S.W. Atlas

10.00-10.30 MR Venographic Patterns in Chronic Conditions
N.E. Van Vucht, J. Valk, P. Pevenage

10.30-11.00 A Plea for New Regulations on Randomized Clinical Trials in Surgical Treatments
E. Houdart

11.00-11.30 7 tesla Brain Imaging
M. Forsting

Molecular Imaging and Nano-Technologies

11.30-11.50 Molecular Imaging in Neuroradiology
C. Zimmer

11.50-12.10 Use of Nanoparticles for CNS Imaging and Therapy
J. Provenzale

12.10-12.30 Cell Tracking and Future Implications to Neuroimaging
J. Frank

PARALLEL SESSIONS

14.00-17.15 Tuesday, 5 October 2010 EUROPA AUDITORIUM

14.00-15.30 Stroke 1
Chairs: A. Fox, M. Bergui

14.00-14.30 25’ Continuous Aspiration Thrombectomy (CAT) in Acute Ischemic Stroke Treatment and the Penumbra System 054
R. von Kummer (disclosure; Lecture sponsored by a Grant Penumbra).

14.30-14.45 10’ Stroke in Young People: The Increasing Role of Advanced Images
D. Santa Cruz, A. Ojeda, M. Nallino, A. Uriarte

14.45-15.00 10’ Superficial Temporal Artery Calcification in Patients with End-Stage Renal Disease: Association with Vascular Risk Factors and Ischemic Cerebrovascular Disease

15.00-15.15 10’ Improved Detection of Hyperdense Middle Cerebral Artery Sign by Sagittal Reformations

15.15-15.30 10’ ROI Measurement of Middle Cerebral Artery: Is It a Primary Sign of Infarction?
G. Panagi, M. Kastania, I. Markaki, N. Stroumbakis, S. Fondara, E. Sgora, E. Panourgias

15.30-17.15 Stroke 2
Chairs: H.H. Henkes, L. Castellan

15.30-15.45 12’ Incremental Benefit of CT Perfusion for Certainty of Stroke Diagnosis over Unenhanced CT and CT Angiographic Source Images
A.J. Fox, J. Hopyan, A. Ciarello, D. Dowlatabadhi, P. Howard, V. John, R. Yeung, L. Zhang, J. Kim, G. Macfarlane, Ty Lee, Ri Aviv

15.45-16.00 12’ Hemorrhagic Transformation of Ischemic Stroke: Perfusion CT-Based Prediction
A.J. Fox, R.I. Aviv, C.D. Desterre, B.D. Murphy, J.J. Hopyan, B. Buck, V. Li, L. Zhang, S.P. Symons, T.Y. Lee

16.00-16.15 12’ Post Contrast CT Extravasation Is Associated with Hematoma Expansion in CTA Spot Negative Patients
A.J. Fox, A. Ederies, A. Demchuk, T. Chia, D.J. Gladstone, D. Dowlatabadhi, G. Bendavit, K. Wong, S.P. Symons, R.I. Aviv
16.15-16.30  10’  CT Perfusion and CT Angiography in Thrombolitic Therapy  
K. Pozsar, G. Szilagyi, G. Forrai

16.30-16.45  10’  Relation between Site of Occlusion and Outcome of Intravenous Thrombolysis in a Cohort of Patients 
Studied with CT Angiography  
C. Barbara, A. Stafla, G. Procaccianti, L. Simonetti, M. Leonardi

16.45-17.00  10’  Timing of CT Perfusion Abnormalities within and around Spontaneous Intracerebral Hemorrhage during the Transition from Acute to Subacute Phases  
E. Finardi, V. Ramponi, G. Roverisi, M. Borrelli, A. Saletti, A. Bernardoni, S. Sarubbo, C. Tamburino,  
F. Di Biase, A. De Vito, M. Cavallo, S. Cerulli, R. Tamarozzi

17.00-17.15  10’  New Markers of Prognosis in Stroke-Evaluation of Cerebral Perfusion by Computed Tomography  
M. Cordeiro, C. Nunes, G. Cordeiro, C. Moura, F.C. Alves

14.30-17.15  Tuesday, 5 October 2010  
ITALY HALL

14.30-16.00  Aneurysms 1  
Chairs: A. Mironov, N. Kocer

14.30-14.45  14’  Usefulness of 320-Row Area Detector CT, Focusing on the Detection of Aneurysmal Pulsation  
K. Katada, M. Hayakawa, K. Murayama

14.45-15.00  10’  Intracranial Vascular Fenestrations and Their Association with Aneurysms  
R. Sattenberg, A. Arauz, S. Arora, J. Heidenreich, R. Downs

15.00-15.15  10’  Assessing the Severity of Vasospasm after SAH using Dyna-CT to Measure Cerebral Blood Volume: Feasible Method for the Neuro-ITU Patient  
M. Kamran, Y. Deuerling-Zheng, I. Grunwald, J. Yarnold, J.V. Byrne

15.15-15.30  10’  Effect of Perianeurysmal Environment on Intraaneurysmal Flow  
I. Szikora, A. Ugron, M. Marosfoi, ZS. Berentei, GY. Paal

15.30-15.45  10’  Comparison of CT Angiography with Digital Subtraction Angiography in Small Cerebral Aneurysms  
N. Khandelwal, S. Dhana Rekha, V. Gupta, S.K. Gupta, P. Singh, S.N. Mathuria

15.45-16.00  10’  ‘De Novo’ Aneurysms: Radiologic and Clinical Analysis of Our Ten Years Experience  
G. Di Lella, P. Colelli, M. Rollo, B. Tirpakova, C. Colosimo

16.00-17.00  Aneurysms 2  
Chairs: D.H. Hwang, E. Cotroneo

16.00-16.15  10’  MR Angiography Follow-Up 5 Years after Coiling: Formation of De Novo Aneurysms and Growth of Untreated Aneurysms  
S. Forus, M.E. Sprengers, G.A. De Kort, B.K. Velthuis, R. Van Den Berg, W. Van Zwam, M. Sluzewski,  
G.J. Rinkel, W.J.J. Van Rooij, C.B. Majoie

16.15-16.30  10’  Prevalence of Asymptomatic Cerebral Aneurism in Acromegalic Patients  
R. Manara, V. Citton, S. Rizzati, I. Albano, A. Rebellato, E. Zanchetta, A. Della Puppa, G. Pavesi,  
G. Rolma, S. Dal Pos, C. Carollo, N. Sicolo, P. Maffei, C. Scaroni, C. Martini

16.30-16.45  10’  Atypical Ischemic Lesions in Patients with SAH Apart from Vasospasm  
M. Wagner, P. Steinbeis, E. Güresir, S. Weidauer, J. Berkefeld

16.45-17.00  10’  Venous Hypertension and Intracranial Aneurysmal Rupture  
F. Tsai

14.30-17.30  Tuesday, 5 October 2010  
BLUE HALL

14.30-15.15  Research 1  
Chairs: Z. Kulesar, A. Norbash

14.30-14.45  14’  Paradigm Shift for the Management of Brain Aneurysms  
A. Takahashi

14.45-15.00  14’  Reflections on Therapeutic Approaches  
K. Murphy
15.00-15.15 14’ New Endovascular Method for Transvascular Exit of Arteries or Veins by Catheter Technique the Extroducer
  J. Lundberg, S. Jonsson, S. Holmin

15.15 - 16.30  Research 2
  Chairs: W. Taki, A. Norbash, D. Prosetti

15.15-15.30 14’ A Live Swine Model for Development of Techniques Using Percutaneous Intraspinal Navigation
  P. Purdy, B. Welch, R. Novakovic, S. Miller, T. Fujimoto

15.30-15.45 10’ Effect of Olmesartan and Pravastatin on Experimental Cerebral Aneurysms in Rats
  N. Kimura, H. Shimizu, H. Eldawoody, T. Nakayama, A. Saito, A. Takahashi

15.45-16.00 10’ Creation of Surgical Terminal Aneurysms with Arteriovenous Fistula in Rabbits
  Y. Ding, D. Dai, R. Kadirval, D. Lewis, D. Kallmes

16.00-16.15 10’ Animal Experimental Application of a New Self-Expanding Stent in the Endovascular Therapy of Side-Wall Aneurysms. 6 Month Results
  A. Keuler, F. Requejo, K. Poerster, W. Mailaender, M. Schumacher

16.15-17.30  Research 3
  Chairs: M. Mawad, L. Pierot

16.30-16.45 10’ “How Healthy Is Interventional Neuroradiology?” The Heart Rate of a Neuro-Interventionalist during Procedures
  P. Brouwer

16.45-17.00 14’ Simulation & Robotics for Neurointervention

17.00-17.15 14’ Computational Simulation of Flow at Bleb of Aneurysms and Confirmation by Clinical Angiogram
  K. Fukasaku, M. Negoro, Y. Konishi, S. Noda, R. Himeno, H. Yokota, I. Nara, K. Fukui, Y. Shiokawa

17.15-17.30 14’ Intra-Arterial Contrast Injections for Measurement of Regional CBV Using C-Arm CT
  B. Aagaard-Kienitz, R. Yasuda, K. Pulfer, D. Consigny, K. Royalty, C. Strother

14.30-17.30 Tuesday, 5 October 2010
  INDIGO HALL

14.30-16.00  Spinal Cord AVFs 1
  Chairs: A. Thron, F. Causin

  G. Rodesch, S. Kominami, A. Krajina, R. Sellar, M. Soderman, R. Vandenberg, S. Condette Auliac

15.00-15.15 10’ Role of Contrast-Enhanced MR Angiography in Spinal Dural Arterio-Venous Fistula

15.15-15.30 10’ Role of 3D Angiography in Spinal Dural Arteriovenous Fistula
  P. Lo, D.C. Suh

15.30-15.45 10’ Endovascular Treatment of Cervical Giant Perimedullary Arteriovenous Fistulas: Transarterial Approach, Transvenous Approach and Direct Percutaneous Puncture of the Venous Pouch

15.45-16.00 10’ Endovascular Embolization of Spinal Dural Fistulae: Preliminary Experience with Novel Successful Application of Onyx
  N. Chaudhary, A.S. Pandey, B.G. Thompson, S.A. Ansari, J.J. Gemmete

16.00-17.30  Spinal Cord AVFs 2
  Chairs: G. Rodesch, L. Biscoito

16.00-16.15 10’ Neurological Improvement Pattern after Embolization and/or Surgery of Spinal Dural Arteriovenous Fistula
  D.C. Suh, Jw Park, C-S Lee, J-Y Yoo, K-K Kim, SR Jeon, SW Roh, SC Rhim

16.15-16.30 10’ Diagnosis and Endovascular Treatment of Spinal Arteriovenous Malformations Supplied by Intercostal and Lumbar Arteries
  T. Tissen, S. Yakovlev, E. Bukharin, A. Bocharov, S. Arustamyan, E. Vinogradov, B. Tissen
16.30-16.45  10’ Benefits of Balanced Action and Watchful Waiting during Coiling of a Fistulous Perimedullary AVM  
J. Zajaczek, H. Hartmann, E.J. Hermann, J.K. Krauss, H. Lanfermann, B. Haubitz

16.45-17.00  10’ Endovascular Occlusion of Spinal Cord Arteriovenous Malformations with Blood Supplied by  
Branches of the Subclavian Arteries  
T. Tissen, S. Yakovlev, E. Bukhart, A Bocharov, S Arustamyan, B Tissen

17.00-17.15  10’ Embolization of Spinal Cord Arteriovenous Malformations through the Anterior Spinal Artery  
S. Kominami, M Suzuki, S Kobayashi, A Teramoto

17.15-17.30  10’ Multiple Hole Fistula of Spinal Cord in a Male Child  
A. Karapurkar, N. Aditya, R. Singh, I Vishwanathan

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14.30-17.30  Tuesday, 5 October 2010  
GREEN HALL

14.30-16.15  fMRI 1  
Chairs: M. Sasaki, D. Seixas

14.30-15.00  25’ New Perspectives in Contrast Enhanced MRI and MRA of the Brain  
M. Essig (disclosure: Lecture sponsored by a Grant of Bayer Schering Pharma)

15.00-15.15  10’ Diffusion Tensor Imaging in Movement Disorders: Review of Major Patterns and Correlation with  
Normal Brainstem/Cerebellar White Matter  
S. Reimão, C. Morgado, L. Neto, J. Campos

15.15-15.30  10’ Functional Organization of the Primary Motor Cortex in Congenital Paraplegia  
C. Stippich, J. Reinhardt, M. Akbar

15.30-15.45  10’ Cortical Adaptation to Visual Blurring: A 3T Functional MRI Comparison between Corrected Myopia  
and Emmetropia  
T. Nguyen, J.L. Stevenart, C. Habas, A. Abanou

15.45-16.00  10’ Challenges for Non-Invasive Brain Perfusion Quantification Using ASL  
I. Sousa, J. Sanches, M. Pimentel, P. Vilela, P. Figueiredo

16.00-16.15  10’ Quantification of Perfusion Changes during a Motor Task Using ASL  
P. Vilela, M. Pimentel, I. Sousa, P. Figueiredo

16.15-17.30  fMRI 2  
Chairs: G. Pellicanò, V. Peterová

16.15-16.30  10’ Distinct Cerebellar Contributions to Intrinsic Connectivity Networks  

16.30-16.45  10’ Functional Connectivity and Coactivation of the Nucleus Accumbens: A Combined Functional  
Connectivity and Structure-Based Meta-Analysis  
F. Cauda, F. D’Agata, A.E. Apanna, K. Sacco, G.C. Geminiani, S. Duca

16.45-17.00  10’ Neuronal Basis of Hedonic Appraisal in Early Onset Schizophrenia: fMRI Investigation  
A. Catalucci, M. Mazza, E. Ciutti, M. Caulo, R. Pollice, R. Roncone, M. Casacchia, P. Di Salle,  
M. Gallucci

17.00-17.15  10’ Neuropsychiatric Lupus Patients and Advanced MR Sequences  
V. Minarech, K. Peterová, J. Krášenský, Z. Masín, L. Podrazilová, M. Olejárová, M. Klembárová,  
A. Navrátilová, J. Závada, Z. Potysová, S.S. Pesicková, M. Kron, V. Bercová, V. Peterová

17.15-17.30  10’ Magnetic Resonance Imaging in Young Patients with Neuropsychiatric Systemic Lupus  
Erythamatosus: A Case Series  
V. Gupta, H.A. Mumtaaz, P. Singh, S. Verma, S. Singh, N. Khandelwal

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14.30-17.30  Tuesday, 5 October 2010  
MAGENTA HALL

14.30-15.15  Encephalopathies 1  
Chairs: J. Valk, F. Pizzini

14.30-15.00  25’ Noninvasive Measuring Brain pH and Biomarker of Brain Tissue Using Mr Technology  
R.H. Wu, Z.W. Shen, Q.C. Qiu

15.00-15.15  14’ Stem Cell Imaging in Neuroradiology: Relevance for Translational Medicine  
L. S. Politi
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<td>15.45-16.00</td>
<td>Encephalopathies 2</td>
<td>10’ The Anatomy of the Medial Lemniscus within the Brainstem Demonstrated at 3 Tesla with High Resolution Fat Suppressed T1-Weighted Images and Diffusion Tensor Imaging</td>
<td>C. Romanowski, M. Hutton, J. Rove, J. Yianni, D. Warren, J. Bigley, I.D. Wilkinson</td>
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<td>16.00-16.15</td>
<td>Malformations 1</td>
<td>10’ Anomalies of Major Brainstem White Matter Tracts by Diffusion Tensor Imaging</td>
<td>N. Rollins, M. Morris, T. Booth, D. Veltkamp, K. Koral, Z. Wang</td>
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<tr>
<td>14.30-15.30</td>
<td>Malformations 1</td>
<td>25’ The Encephalopathic Child</td>
<td>O. Abeyakoon, D. Connolly</td>
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<td>15.00-15.15</td>
<td>Metabolic Pathology 1</td>
<td>10’ Congenital Cystic Eye with Corpus Callosum Hypoplasia</td>
<td>P. Soares Pinto, V. Ribeiro, B. Moreira</td>
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<tr>
<td>15.15-17.15</td>
<td>Metabolic Pathology 1</td>
<td>10’ Evaluation of Middle Interhemispheric Variant of Holoprosencephaly (Syntelencephaly) by Diffusion Tensor Imaging and Fiber Tractography</td>
<td>E. Zan, E. Pasagul, N. Bulakbasi</td>
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<td>15.30-17.15</td>
<td>Metabolic Pathology 1</td>
<td>10’ Differentiation of Acute and Chronic Demyelinating Plaques in Patients with Multiple Sclerosis (MS): Diffusion Tensor Imaging (DTI) Study</td>
<td>T. Nehrych, Z. Rozhkova, A. Khoma, O. Dolia</td>
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<td>14.30-15.30</td>
<td>Malformations 1</td>
<td>10’ Malformations</td>
<td>C.Y.S. Chen, C. Carollo</td>
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VIOLET HALL

Tuesday, 5 October 2010
16.30-16.45 10' Diffuse Periventricular Leukomalacia in Preterm Children: Assessment of Grey Matter Changes by MRI
L. Tzarouchi, A. Zikou, A. Drougia, L. Astrakas, M. Papastefanaki, V. Xydis, S. Andronikou, M. Argyropoulou

16.45-17.00 10' Our Experience with the MR Diagnostics of Late Infantile Form of Neuronal Ceroid Lipofuscinosis
I. Zsigmond, A. Tegzes, P. Barsi

17.00-17.15 10' Infantile Neuroaxonal Dystrophy (INAD): Contribute of MRI Patterns Correlate to Clinical Findings in Differential Diagnosis

14.30-17.30 Tuesday, 5 October 2010

14.30-17.45 Tuesday, 5 October 2010

14.30-16.00 Brain Tumors 1
Chairs: D. Montanaro, M. Uusvåli

14.30-15.00 25' Advances in MR Imaging and New Analysing Methods to Assess Treatment Response in Brain Tumour

15.00-15.15 10' Correlation of MRI and Various Perfusion Parameters with Histopathological Grading of Tumours
S. Soneji, R. Bhaude, R. Gandhi, R. Kakkar, S.B. Desai

15.15-15.30 10' Impairment of Default-Mode Network Connectivity in Patients with Cerebral Glioma
R. Esposito, D. Mantini, G.L. Romani, A. Tartaro, M. Caulo

15.30-15.45 10' Reorganization of Functional Connectivity MRI in Patients with Brain Tumors
C. Briganti, E. Pravata, D. Mantini, C. Sestieri, A. Tartaro, M. Caulo

15.45-16.00 10' Role of Diffusion Tensor MR Tractography in Predicting Supratentorial Gliomas Resectability
A. Castellano, C. Michelozzi, L. Bello, A. Iadanza, G. Scotti, A. Falini

16.00-17.30 Brain Tumors 2
Chairs: D. Yousem, Y. Özsunar Dayanır

16.00-16.15 14' Multimodal MRI and Overall Diagnostic Accuracy in Non-Enhancing Brain Gliomas
S Gaudino, V.S Lorusso, M. Caulo, A. Tartaro, T. Tartaglione, G. Di Lella, C. Colosimo

16.15-16.30 10' Contribution of Diffusion Weighted MRI in the Differentiation of Intracranial Meningiomas and Correlation with Immunohistochemistry
L. Castelletti, M. Bendini, L. Saitta, L. Bonzano, F. Di Paola, L. Castellan

16.30-16.45 10' Intratumoral Topography of CNS Gliomas Revealed by Diffusion Tensor Imaging: Correlations with Tumor Volume and Grade
A. Jakab, P. Molnár, M. Emri, E. Berényi

16.45-17.00 10' Analysis of Brain Tumors and Metastases by Quantitative MT Imaging with bSSFP: Initial Experiences
M. Garcia, M. Gloo, O. Bieri, F. Jax, K. Scheffler, CH. Stippich

17.00-17.15 10' New Distant Tumors in Patients Successfully Treated for Glioblastoma Multiformis: 10 Years Experience
G. Di Lella, C. Falcone, E. Pravatà, S. Gaudino, A.M. Costantini, C. Colosimo

17.15-17.30 10' Comparison of 1.5 and 3.0 T Diffusion-Weighted MR Imaging for Brain Tumors

14.30-17.45 Tuesday, 5 October 2010

14.30-16.30 Management 1
Chairs: B. Gomez Anson, D. Goettmann

14.30-14.45 14' Teleradiology in Neuroradiology: Present and Future

14.45-15.00 10' Teleradiology in Neuroradiology - Considerations about and Implications for Quality of Service
D. Goettmann
15.00-15.10 10’ Exam Portability in Europe: First Steps of a Global Project  
A. Fernandes, T. Baptista

A. Jakab, L. Lánczi, L. Csiba, I. Széll, E. Berényi

15.30-15.45 10’ Comparison of Magnetic Resonance Imaging Findings with Complaints and Physical Examinations of the Patients  
A. Arslanoglu, H. Celik

15.45-16.00 10’ Patient Records, Data Mining and Best Practice - How Much Information Is Enough, and How Do We Get It?  
P. Summers, P. Bijlenga, J. Byrne, J. Macho, S. Coley, T. Sola, T. Doczi, J. Van Der Lei, D. Rufenacht

16.00-16.15 10’ Japanese Society of Neuro-Endovascular Therapy (JSNET) Specialist Qualification System. Eight Years Examination Experience  
T. Hyogo, W. Taki, Jsnet Sqc Board Members

L. Lemme-Plaghos, W. Casagrande, S. Garbugino, D. Avattaneo

16.30-17.45 Contrast Media 1  
Chairs: E.M. Larsson, B.G. Ziedses des Plantes

16.30-16.45 10’ Preliminary Experience with Gadobenate Dimeglumine for High-Resolution Steady State MR Angiography of the Carotid Arteries  

16.45-17.00 10’ Pharmacokinetics and Safety of Gadobenate Dimeglumine (Multihance®) in Patients from 2 to 5 years of Age undergoing Clinically Indicated MRI of the CNS  
G. Pirovano, M. Pasowicz, M.A. Kirchin, N. Shen, J. Parker, A. Spinazzi

17.00-17.15 10’ Contrast-Enhanced Carotid MRA in the NSF Era: Possible Contrast Dose Reduction with a High Relaxivity Contrast Agent  
m. Kuhn, B. Young, A. Kuhn

17.15-17.30 10’ Impact of Contrast Media Concentration and kVp Settings on Image Quality in CT Angiography of the Intracranial Vessels  
B. Ramgren, R. Siemund

17.30-17.45 10’ Superficial Siderosis of the Central Nervous System  
J. Nunes, B.C. Gomes, R. Veiga, R.P. Pais, M.T. Garcia

14.30-17.30 Tuesday, 5 October 2010  
YELLOW HALL

14.30-16.30 Spine 1  
Chairs: R. Cartolari, A. Stafa

14.30-14.45 14’ The Dehydrated or Dark Disk: Imaging Features and Morphological, Biochemical and Biomechanical Features  
V. Haughton

14.45-15.00 10’ MR Myelography in Patients with Lumbosacral Radicular Pain: Diagnostic Value and Technique  
J. Wilmink, J.T. Wilmink

15.00-15.15 10’ The Axial Loaded Imaging of the Lumbar Spine 18 Years After. Is It Still a Valuable Examination?  
R. Cartolari

C. Mollica, F. Ferrando, R. Spagnuolo, L. Satragno, M. Salvatore, A. Brunetti

15.30-15.45 10’ Magnetic Resonance Imaging of Spondylolysis and Spondylolisthesis  
P. Niggemann, J. Kuecha, H.K. Beyer, D. Grosskurth, K.S. Delank

15.45-16.00 10’ Evaluating Marrow Signal Intensity: Comparison of T1 Flair and T1 FSE Images  
S. Destian, A. Allmendinger

16.00-16.15 10’ MR Findings of Seronegative Spondyloarthitis. Fat Saturation Sequences and Contrast Medium  
P. D’Aprile, A. Tarantino, C. Dell’Atti
I. Cravo, G. Zuccoli, T. Palma, S. Costa, R. Simões, F. Coelho, C. Romero, J. Cabral

16.30-17.30  Spine 2  
Chairs: V. Haughton, K. Murphy

16.30-16.45  10’ Clinico-Radiological Profile of Spinal Cord Multiple Sclerosis  
G. Roberson, A. Bag, B. Patel

16.45-17.00  10’ Spinal Cord MR in Multiple Sclerosis and Other Idiopathic Demyelinating Diseases  
A. Rovira, C. Auger

17.00-17.15  10’ The Study of the Spinal Cord White Matter with a 3-Tesla Device  
L. Albini Riccioli, A.F. Marliani, F. Toni, M. Leonardi

17.15-17.30  10’ Diffusion Tensor Tractography of the Spinal Cord; Preliminary Results in a Serie of 18 Patients at 1.5 T  
F. Gelbert, A. Henon, J.B. Gayet, N. Bouzar, M. Perrin, L. Balabaud, C. Mazel, R. Palau

WEDNESDAY, 6 OCTOBER 2010

Plenary Hall Sessions

09.15-13.00  EUROPA AUDITORIUM

09.15-10.55  Never without Anatomy!  
Chairs: T. Tali, S. Kollias

09.15-09.55  Never without Anatomy! The Three Original Features of Carotid and Vertebral System  
P. Rabischong, H. Duvernoy

09.55-10.15  Imaging Anatomy of the Basal Perforating Arteries of the Brain: Microangiography and MR Imaging  
S. Takahashi

10.15-10.35  Neuroanatomy of Visual Pathway and Brain Stem: Demonstration with Modern MR Technology  
Y. Korogi, S. Kakeda, T. Yoneda

10.35-10.55  Cranial Nerves: Neuroanatomy and Pathologies  
K. Karoali

11.00-12.20  And Physiology!  
Chairs: J. Ruscallada Nadal, R. Agati

11.00-11.20  Imaging of Behaviour  
E. Gonzalez-Toledo

11.20-11.40  Functional Magnetic Resonance Imaging (fMRI) of the Olfactory System  
D. Montanaro, F. Frijia, C. Anselmi, N. Vanello, H. Hlavata, F. Vanni, A. Bonocore, C. Maremmani,  
S. De Cori, F. Lombardo, R. Canapicchi

11.40-12.00  Imaging Contribution to Psychiatry  
E. Gonzalez-Toledo

12.00-12.20  fMRI of Emotion: Some Clinical Applications at 3 Tesla  
D. Cevolani

12.20-13.00  Chair: J. Walecki  
The virtual Atlas of Brain Vascular Anatomy  
W.L. Nowinski

PARALLEL SESSIONS

14.30-17.00  Wednesday, 6 October 2010  EUROPA AUDITORIUM

14.30-16.00  Stroke 3  
Chairs: V. Gupta, J. Wilmink

C. Strother, E. Oberstar, B. Davis, K. Pulfer, C. Mistretta
15.00-15.30 25' Quantitative Analysis of Brain Metabolite Concentrations Using MRS in Acute Hypoxia Ischemic Encephalopathy  
R. Wu, Y. Xiao

15.30-15.45 10' Comparing b 1000 and b 2000 Diffusion Imaging in Acute Stroke at 3T MRI  
A. David, C. Billon-Grand, B. Ibanez, C. Cattin, J.F. Bonneville

15.45-16.00 10' Ischemic Penumbra in Acute MCA Stroke: Comparison of the PWI-DWI Mismatch and the ADC-based Neurinfarct Methods  

16.00-17.00 Stroke 4  
Chairs: S. Gaikwad

14.30-17.30 Wednesday, 6 October 2010  
ITALY HALL

14.30-15.45 Aneurysms 3  
Chairs: A. Tournade, M. Muto

Z. Wu

X. Ding

15.00-15.15 10' Endovascular Treatment of Ruptured and Unruptured Fusiform Vertebral Artery Aneurysms  
Y. Li

15.15-15.30 10' True Posterior Communicating Artery Aneurysms  
A. Taylor, D. Lefeuvre

15.30-15.45 10' Onyx HD 500 in the Treatment of 184 Large Necked Intracranial Aneurysms - Long Term Results  
R.I. Piske, E. Paschoal, C.E. Baccin, B.M. Chaves

15.45-17.30 Aneurysms 4  
Chairs: E. Houdart, R. Piske

15.45-16.00 10' Y-Stenting Assisted Embolization of Wide Neck Aneurysms Using Fully Retrieveable and Detachable Intracranial Stents  
S. Muda, R. Rakib, R. Zakaria, Y. Yaakob, A. Abu Bakar

16.00-16.15 10' Treatment of Wide-Necked Basilar Tip Aneurysms Using Kissing-Stent Placement plus Coiling  
T. Li, L Li, J Xue, Z Wang, W Bai, Z Li

16.15-16.30 10' Stent Reconstruction for Bifurcation & Terminal Geometry Intracranial Aneurysms in over 70 Cases: Clinical Applications in Evolution  
J. Chaloupka, M. Hayakawa, A. Keller, R.C. Callison, C. Mertens

16.30-16.45 10' Multicenter Prospective Study on the Safety and Efficacy of the Neuroform3TM Stent for Aneurysm Treatment (Senat Study): Preliminary Clinical Results  
A. Biondi, A. Bonafe

16.45-17.00 10' Wide Neck Aneurysms Treated Using Stent Solitaire  
L. Guimaraens, T. Sola, E. Vivas, A. Casasco, C. Diaz

17.00-17.15 10' Intracranial Aneurysms: Endovascular Reconstruction with Stents; Medellin Experience  
B. Pabon, S. Vargas, P. Urena

17.15-17.30 10' Endovascular Treatment of Blood Blister-like Aneurysms: Initial Experience with Stent-assisted Coil Embolization  
S. Meckel, M. Cronqvist, T.P. Singh, C.C. Phatouros, W. Mcauliffe
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<th>Time</th>
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<tr>
<td>14.30-16.30</td>
<td>Research 4</td>
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<tr>
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<td>Chairs: JE Gonzalez Toledo, C. Bortolotti</td>
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<td>14.30-16.30</td>
<td>Helps Trial: Angiographic Primary Trial Results</td>
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<td>P. White, R. Sellar</td>
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<td>14.30-14.45</td>
<td>10’ MR Clean - Multicenter Randomized Clinical Trial of Endovascular</td>
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<td>Treatment for Acute Ischemic Stroke in The Netherlands (NTR1804)</td>
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<td>C. Majouie, Y.B. Roos, A. Van Der Lugt, W. Van Zwam, R. Van Oostenbrugge, D. Dippel</td>
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<td>15.00-15.15</td>
<td>10’ Meta-Analysis of Clinical Outcome &amp; Procedural Complications in</td>
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<td>Patients with Unruptured Cerebral Aneurysms in the Helps and Cerecyte</td>
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<td>Trials P. White, A. Molyneux, C. Williams, L. Forrester, M. Sneade</td>
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<td>15.15-15.30</td>
<td>10’ Analysis of Risk Factors During Endovascular Treatment of</td>
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<td>Intracranial Ruptured Aneurysms: Results of Clarity Study</td>
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<td>C. Cognard, L. Pierot, R. Anxionnat, F. Ricolfi</td>
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<td>16.00-16.15</td>
<td>10’ @neufuse-A Tool for Investigating Haemodynamics in Intracranial</td>
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<td>Aneurysms P. Summers, P. Watton, J. Byrne, A. Chiariri</td>
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<td>16.15-16.30</td>
<td>10’ PRET. A Randomized Trial Comparing Platinum and Hydrogel-Coated</td>
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<td>Coils in Patients Prone to Recurrence after Endovascular Treatment</td>
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<td>J. Raymond, D. Roy, Pret Collaborative Group</td>
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<td>14.30-17.30</td>
<td>AVFs 1</td>
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<td>Chairs: S. Kominami, R. Anxionnat</td>
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<td>14.30-14.45</td>
<td>10’ Spinal Vascular Malformations - AVMs Experience</td>
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<td>N. Mishra, S.B. Gaikwad, A. Garg, Subhash Kumar</td>
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<td>14.45-15.00</td>
<td>10’ Mechanism of the Formation of Dural Arteriovenous Fistula - The</td>
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<td>Role of Emissary Vein</td>
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<td>15.00-15.15</td>
<td>10’ Parallel Dura Sinus Dural Arteriovenous Fistula: Diagnosis and</td>
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<td>Treatment H. Liu, C. Li, Y. Wang, T. Chen</td>
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<td>15.15-15.30</td>
<td>10’ Imaging of a Reversible Cause of Dementia: Bithalamic Venous</td>
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<td>Congestion Secondary to Tentorial Arteriovenous Fistulae</td>
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<td>F. Signorelli, P. Khouefir, F. Scholtes, N. Mc Laughlin, D. Roy, M.W.</td>
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<td>Bojanowski</td>
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<td>16.30-16.45</td>
<td>10’ Complex Cerebral Arteriovenous Fistula; Endovascular Treatment</td>
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<td>Using Trans Venous and Trans Arterial Approach</td>
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<td>B. Pabon, S. Vargas, P. Urena</td>
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16.45-17.00 10’ Embolization of Carotid Cavernous Fistulae by Transvenous Approach through the Facial Vein  
C. Luo, M. Teng, F. Chang, W. Guo

17.00-17.15 10’ Unusual Carotid Cavernous Sinus Fistula  
A. Karapurkar

17.15-17.30 10’ Unusual Acute Complication of Carotid Cavernous Fistula: Therapeutic Options  
F. Tsai

14.30-17.45 Wednesday, 6 October 2010  
GREEN HALL

14.30-16.00  
fMRI 3  
Chairs: P. Vilela, A. Bacci

14.30-14.45 10’ N-Acetylaspartate (NAA) a Biomarker for Disease Activity in NPSLE Patients  
P. Wang, R.E. Harris, P. Cagnoli, J. Perry, D. Frechtling, G. Bekris, S. Gehrke, J. McCune,  
P.C. Sundgren, A. Hegde

14.45-15.00 10’ Metabolic Changes on MR Spectroscopy of the Hippocampus in SLE  

15.00-15.15 10’ Hippocampal Activation Associated with Successful External Source Monitoring  

15.15-15.30 10’ Plasma Levels of 3-Methoxy-4-Hydroxyphenylglycol Are Associated with Microstructural Changes within  
the Cerebellum in Early Stage of First-Episode Schizophrenia - A Longitudinal Voxel-Based Study  
K. Ohkoto, J. Nakamura, Y. Korogi

15.30-15.45 10’ fMRI Study of Body Image Distortion in Anorexia Nervosa  
G. Pellicanò, G. Castellini, A. D’argenio, E. Bolognesi, V. Ricca, A. Ginestroni, L. Mazzoni, N. Villari

15.45-16.00 10’ Cortical Representation of Taste in the Human Brain: A fMRI and DTI Study  

16.00-17.45  
fMRI 4  
Chairs: S.K. Lee, Watts

16.00-16.15 10’ MRI Aspects in 100 Focal Cortical Dysplasias of Palmini Type II Proven by Neuropathology  
N. Colombo, L. Tassi, A. Citterio, F. Cardinale, G. Lorusso, R. Spreafico

16.15-16.30 10’ 3T MR Spectroscopy in Drug-Resistant Temporal Lobe Epilepsy with Hippocampal Abnormalities  
S. Battaglia, A.F. Mariani, L. Albini Riccioli, V. Clementi, G. Rubboli, P. Agati, R. Agati

16.30-16.45 10’ Radiological Assessment of White Matter Pathway Involvement after Temporal Lobe Epilepsy Surgery  
FA Maps versus Tractography  

16.45-17.00 10’ Sulcal Abnormalities Associated with Focal Cortical Dysplasia  
C. Mellerio, C. Oppenheim, C. Rodriguez, R. Souillard, O. Nagara, S. Rodrigo, B. Devaux,  
F. Chassoux, Jf. Meder

17.00-17.15 10’ Does Electroconvulsive Therapy (ECT) Affect White Matter Integrity? A Longitudinal Diffusion  
Tensor Imaging Study of Patients with Depression  
E. Larsson, E. Steffen, P. Nordanskog, U. Dahlstrand, M. Larsson, L. Knutsson, A. Johanson

17.15-17.30 10’ Seconder Corpus Callosum Abnormalities Associated with Antiepileptic Drugs in Temporal Lobe  
Epileps; Evaluation by Diffusion Tensor Imaging  
H. Gunbey, K. Ercan, A. Findikoglu

17.30-17.45 10’ MRI Changes in Status Epilepticus: A Systematic Review in a Tertiary Center  
N. Bargallò Alabart, T. Lema, M. Carreño, A. Donaire, X. Aparicio, I. Maestro

14.30-17.30 Wednesday, 6 October 2010  
MAGENTA HALL

14.30-16.15 Dementia 1  
Chairs: M. Sasiadek, K. Slavin

14.30-14.45 12’ Alzheimer’s Disease - New Approach to Pathogenesis and Therapy  
J. Leszek, G. Aliev

14.45-15.00 12’ Genetic Aspects of Alzheimer Disease  
K. Pesz, B. Misiak, M.M. Sasiadek
15.00-15.15 12' Proton MR Spectroscopy (1h MRS) in Patients with Mild Cognitive Impairment (MCI)
J. Walecki

15.15-15.30 12' Multimodality Approach to Imaging in Dementia-Role of MR and CT Perfusion and DTI
M. Sasiedek, A. Zimny, P. Szweczyk

15.30-15.45 10' Cerebral Amyloid Angiopathy-Related Inflammation: An Emerging Disease
M. Savoiardo, A. Erbetta, J.C. Difrancesco, M. Brioschi, V. Silani, A. Falini, G. Storchi, L. Brighina,
C. Ferrarese, N. Ticozzi, S. Messina, F. Girotti

15.45-16.00 10' Individual Classification of Stable Versus Progressive MCI Based on DTI Neuroimaging

16.00-16.15 10' Multi-Voxel MR Spectroscopic Study of Cingulate Gyrus in Patients with Mild Cognitive Impairment
R. Wu, Z. Yang

14.30-17.30 Wednesday, 6 October 2010

VIOLET HALL

14.30-16.15 Epilepsy 1
Chairs: F.M. Triulzi, F. Menetti

14.30-15.00 25' Radiological Aspects of Genetic Disorders with Adult-Onset CNS Symptoms
R. Raininko, A. Melberg

15.00-15.15 10' Hippocampal MR Volumetric Studies in Paediatric Control and Epilepsy Group
Salmah J. Win Mar, A. Noorfizura, A. Mohd Shafie, A.H. Ahmad Helmy, A.R. Salmi

15.15-15.30 10' Cerebral MR-Volumetric Examinations in Juvenile Myoclonic Epilepsy
I. Gyuricza, L.R. Kozak, J. Jerney, G. Rudas, P. Barsi

15.30-15.45 10' On the Feasibility of Passive Range-of-Motion Functional MRI Paradigms in the Diagnostic Workup of Childhood Epilepsies
L. Kozak, M. Hegyi, P. Barsi, G. Rudas

15.45-16.00 10' Focal Leptomeningeal Enhancement and Corticopial Calcifications Underlying a Parietal Convexity Lipoma: A Rare Spectrum of MRI Findings in Two Pediatric Epileptic Patients
G. Morana, M.M. Mancardi, M.G. Baglietto, A. Rossi

16.00-16.15 10' ADC Values and Glutamate/Creatine Ratios in the Brain inNormally Developing Children and in Children with Seizure Disorders: DWI and 1H In-Vivo MRS Study
Z. Rozhkova, O. Orla

16.15-17.30 Round Table: Epilepsy and Malformations of the Cerebrum
Chair: A.J. Barkovich

16.15-16.40 25' Epilepsy and Malformations of the Cerebrum
A.J. Barkovich, R. Guerrini, R. Spreafico

16.40-17.05 25' Neuropathology and Pathophysiology of Malformations of Cortical Development (MCDs) and Related Epilepsies
R. Spreafico, A.J. Barkovich, R. Guerrini
17.05-17.30  25’  Elettroclinical Findings and Genetic Basis  
*R. Guerrini*

14.30-16.30  **Brain Tumors 3**  
*Chairs: C. Romanowski, D. Khurjekar*

14.30-15.00  25’  Tisaut Characteristics and Reorganization of Peri-Lesional Components in the Brain on MRI  
*W. Guo*

15.00-15.15  10’  Consecutive Acquisition of Time-Resolved Contrast-Enhanced MRA and Perfusion MR Imaging of Brain Tumors with a Contrast Dose of 16 ml  
*K. Tsuchiya, M. Imai, M. Yoshida, H. Tateishi, T. Nitatori*

15.15-15.30  10’  Metabolic Mapping of Human Gliomas: Assessment with Simultaneous PET/MR Imaging for Preoperative “Hot-Spot” Imaging of Suspected Anaplastic Gliomas  
*S. Biswas, T. Naegele, R. Ritz, A. Boss, A. Kolb, B. Pichler, U. Ernemann*

15.30-15.45  10’  Differentiation between Primary Central Nervous System Lymphoma and Glioblastoma on 3-T MR Imaging: Multivariate Analysis  
*M. Kitajima, T. Hirai, Y. Shigematsu, A. Sasao, S. Nishimura, K. Iwashita, K. Makino, H. Nakamura, Y. Yamashita*

15.45-16.00  10’  Perifocal MR Perfusion and Diffusion Values in Gliomas  
*Z. Rumboldt, P. Morgan, J. Baker, C. Rorden, G. Goldsberry, J. Fridriksson*

16.00-16.15  10’  Glioblastoma Multiform: MRI Findings of the Brain and DWI Analysis  
*S. Benakis, K. Tavernarakis, A. Sykara, E. Tsatalou, K. Stefanidis, C. Kolofousi, V. Ouranos, D. Chondros*

16.15-16.30  10’  Brain Surface Motion Imaging for Prediction of Adhesions between Meningiomas and the Brain Surface  
*T. Taoka, T. Akashi, T. Emura, T. Miyasaka, A. Iwamura, H. Wada, K. Sakamoto, H. Nakagawa, K. Kichikawa*

16.30-17.30  **Brain Tumors 4**  
*Chairs: M. Essig, F. Briganti*

16.30-16.45  10’  Preoperative Embolization of Meningioma with Dural Branch of Internal Carotid Artery  
*M. Hirohata, S. Yamashita, Y. Takeuchi, K. Orito, T. Abe, M. Shigemori*

16.45-17.00  10’  Preoperative Embolisation of the Intra-Cranial Meningiomas via the Ophthalmic Artery  
*M. Manisor, R. Riva, L. Tigan, M. Al-Khawaldeh, F. Trivelato-Padovani, C. Mounayer*

17.00-17.15  10’  Therapeutic Embolization of Meningiomas with Glue: A Potential Alternative to Surgery?  
*G. Rodesch, P. Guedin, S. Gaillard, S. Aldea, O. Coskun, A. Boulin, S. Condette-Auliac*

17.15-17.30  10’  Embolization of Vascularized Vertebral Tumours Using Particles and Glue. Injection Technique, Advantages and Limits of Each of These Materials. Our Experience  
*A. Stafa, C. Barbara, S. Boriani, L. Simonetti, M. Leonardo*

09.15-11.30  **Wednesday, 6 October 2010**  
**WHITE HALL 2**

09.15-10.30  **Head & Neck 1**  
*Chairs: W.Y. Guo, G. Meli*

09.15-09.30  10’  Dural Branches of Proximal Anterior Cerebral Artery: Radiological and Intraoperative Description of a Rare Anatomic Variant  
*F. Signorelli, F. Scholtes, N. Mclaughlin, M.W. Bojanowski*

09.30-09.45  10’  Compressed Print of the Cranial Nerves Observed on Multislice Motion-Sensitized Driven-Equilibrium (MSDE) in Patients with Neurovascular Compression  
*M. Kanoto, A. Oda, T. Hosoya, Y. Toyoguchi, N. Ohki, N. Hasegawa, M. Kuchiki, T. Honma, Y. Sugai*

09.45-10.00  10’  Quantification of the Facial Nerve Motion during Cardiac Cycle Using Phase Contrast MRI. Preliminary Results for a Better Understanding of Neurovascular Conflicts  
*M. Braun, M. Labrousse, G. Calmon, G. Hossu, J. Oster, A. Chays, J. Felblinger*

10.00-10.15  10’  MDCT Assessment of the Cochlear-Carotid Interval  
*H. Gunbey, H. Aydin, H. Cetin, E. Gunbey, A. Alhan*
10.15-10.30  10’ Imaging of the Ear. Particular Findings
F. Calzolari, A. Martini

10.30-11.30  Head & Neck 2
Chairs: D. Goldsher, F. Calzolari

10.30-10.45  10’ TMJ Pain and Neuropathic Pain in Patients with Temporomandibular Joint Disorders
G. Meli, A. Garufi, E. Pedulla’, M. Mandala’, A. Blandino, P. Cascone

10.45-11.00  10’ Diagnostic Value of MRI Performed after Intratympanic Gadolinium Administration in Patients with Ménière Disease
F. Pizzini, A. Beltramello, F. Barbieri, F. Fiorino

11.00-11.15  10’ The Large Vestibular Aqueduct Syndrome in Adults - An Almost Underestimated Realm
D. Goettmann

11.15-11.30  10’ Real-Time fMRI Feedback Training May Improve Chronic Tinnitus
S. Haller, R. Veit

14.30-17.30 Wednesday, 6 October 2010
WHITE HALL 2

14.30-15.30 Advanced CT Studies 1
Chairs: T. Mori, J. Shankar

14.30-14.45  10’ Analysis of CT Perfusion Parameters in Normal Control Patients to Assess the Normal Variations of Major Vascular Territories and the Effects of Using Different Arterial Input Functions
A. Cherney, B. Smoller, S. Mangla, A. Bluestone, A. Dubey, S. Zhabin

14.45-15.00  10’ The Effect of Using 80 kVp versus 120 kVp on Temporal Resolution and Parametric MAP Generation in Perfusion CT
A. Dubey, S. Mangla, A. Bluestone, B. Smoller, A. Cherney, S. Zhabin

15.00-15.15  10’ CTA-SI Are Flow Not Volume Weighted
A.J. Fox, M. Sharma, A. Jairath, S. Symons, L.Y. Zhang, R.I. Aviv

15.15-15.30  10’ Intracranial Masses with Perilesional Edema: Differential Diagnosis with Perfusion-CT
D. Gadda, P. Simonelli, G. Villa, V. Scardigli, D. Petacchi, C. Pandolfo, M. Moretti, S. Chiti, G.P. Giordano

15.30-17.30 Advanced MR Techniques 1
Chairs: E. Cabanis, M.T. Iba-Zizen

15.30-15.45  10’ Lehrmitte-Duclos Disease: Advanced Imaging With 3T MR Scanner

15.45-16.00  10’ Diffusion Tensor Imaging Atlas of Deep White Matter Tracts
L. Hermoye, G. Cosnard, S. Mori, J. Lemaire

16.00-16.15  10’ Improved Image Quality and Detection of Acute Cerebral Infarction with Diffusion Tensor MR Imaging
J. Jang, C. Sohn, S. Choi, J. Kim, T. Yoon, K. Chang

16.15-16.30  10’ Brain Lesions: CAN 3D FLAIR Imaging Replace 2D Flair at 3T?
S. Kakeda, Y. Hiato, J. Nishimura, N. Ohnari, T. Sato, Y. Korogi

A. Maciak, C. Vilchez, W. Mueller-Forell, H. Speckter, P. Stoeter

16.45-17.00  10’ Voxel Based Techniques and fMRI Activation during Pronounced Period of Symptoms of Early Onset Restless Legs Syndrome Patients
P. Margariti, L. Atrakas, S. Konitsiotis, L. Tzarouchi, S. Tsoulis, M.I. Argyropoulu

17.00-17.15  10’ Magnetic Resonance Spectroscopy (MRS) of the Hippocampus
A. Marton, L. Buis, V. Juhas, G. Rudas, P. Barsi

17.15-17.30  10’ Utilization of Cine MRI Technique in Central Nervous System, Head and Neck and beyond in Fetuses and Children
L. Nagae, T. Peygin, R. Zimmerman, L. Bilaniuk
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<td>Ozone Session</td>
<td>M. Bonetti, C. Andreula</td>
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<td>09.15-09.45</td>
<td>Decade Review of Ozone Therapy in China</td>
<td>X. He</td>
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<td>09.45-10.15</td>
<td>The Evolution in the Treatment of Spinal Degenerative Pathologies: from Demolitive, to Conservative or Regenerative Procedures</td>
<td>A. Alexandre, G. Caloprisco, L. Corò, A. Borean, A.M. Alexandre</td>
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<td>10.15-10.30</td>
<td>The Significance of Choosing Ozone Therapy for Lumbar Disc Annular Tear or Annular Disruption</td>
<td>X. He</td>
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<td>10.30-10.45</td>
<td>Transforaminal Decompressive Neuroplasty with Ozolysis for Failed Back Syndrome</td>
<td>V. Kumar</td>
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<td>Spine 3</td>
<td>B. Georgy, M. Braun</td>
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<td>14.50-15.10</td>
<td>CSF Flow in Syringomyelia and Chiari Malformations</td>
<td>K. Stoverud, K. Mardal, H. P. Langtangen, V. Haughton</td>
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<td>15.10-15.30</td>
<td>Leucocyte-Platelet Haemocomponents for Topical Use: Regenerative Potentiality</td>
<td>A. Alexandre, A.M. Alexandre, G. Caloprisco, A. Borean</td>
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<td>15.30-17.30</td>
<td>Spine 4</td>
<td>M. Braun, B. Georgy</td>
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<td>16.00-16.15</td>
<td>Less Studied non Osseous Signs in Painful Lumbar Pathology</td>
<td>J. Théron, T. Sola, L. Guimaraens, A. Casasco, P. Courtheoux</td>
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<td>16.45-17.00</td>
<td>Herniated Disk: Treatment Percutaneous Using Discogel</td>
<td>T. Sola, J. Theron, C. Diaz, E. Vivas, L. Guimaraens</td>
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<td>17.00-17.15</td>
<td>Percutaneous Treatment of Lumbar Intervertebral Disk Hernias with Discogel</td>
<td>K. Pardatscher, G. Volpentina, C. Bombardieri, A. Giaquinta</td>
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<td>17.15-17.30</td>
<td>Percutaneous Nucleoplasty for Discoradicular Conflict</td>
<td>A. Alexandre, A.M. Alexandre, L. Corò</td>
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THURSDAY, 7 OCTOBER 2010
Plenary Hall Sessions

09.15-12.50  
09.15-10.35  Brain Tumors I  
Chairs: P. Parizel, Y. Ono  

09.15-09.35  Brain Tumors and MR-Perfusion Imaging: Clinical Applications  
P. Due-Tønnessen  

09.35-09.55  Recent Advent in DTI and Tractography for Neuro-Oncology  
K. Yamada  

09.55-10.15  Cerebral Brain Tumors: Role and Limits of Imaging and Comparison with Pathology  
D. Tampieri  

10.15-10.35  Brain Tumors: Medical Therapy  
A. Brandes  

10.40-12.50  Brain Tumors II  
Chairs: E. De Divitiis, G. Wilms  

10.40-11.00  The Neurosurgical Approach to Brain Tumors  
F. Calbucci  

11.00-11.20  Pre-Operative and Intra-Operative Imaging of Brain Tumors  
S. Kollias  

11.20-11.40  Intraoperative MRI for Precise Resection of the Gliomas Maintaining the Motor and Verbal Function  
Y. Ono, T. Maruyama, Y. Muragaki, Y. Konishi, K. Abe, T. Hayano, M. Kohno, T. Kawamata, H. Iseki, Y. Okada, S. Sakai  

11.40-12.00  Boron Neutron Capture Therapy in the Treatment of Brain Tumours  
L. Pellettieri  

12.00-12.20  Nanoparticles for Medical and Surgical Tumor Therapy  
J. Provenzale  

12.20-12.50  Conclusive Lecture  

PARALLEL SESSIONS

14.30-17.30 Thursday, 7 October 2010  
EUROPA AUDITORIUM  

14.30-16.00  Stroke 5  
Chairs: A. Bozzao, R. Jäger  

14.30-14.45  10' Vertebral Artery Orifice Stenosis: Reporting of 43 Cases Stenting and Percutaneous Transluminal Angioplasty  
R. Mohammadian, R. Mansourizadeh, M. A. Arami, M. Farhoudi, S. Haririan  

14.45-15.00  10' Intracranial Angioplasty and Stenting for Crebral Atherosclerosis: Results of 92 Consecutive Patients  
D. Huang, Y. Ko, K. Kim, I. Kang, S. Bae, I. Kim, C. Hur  

15.00-15.15  10' Endovascular Treatment of Atherosclerotic Intracranial Arterial Stenoses Using Undersized Balloon Dilatation and Oversized Enterprise Stent Deployment  
Z. Vajda, E. Miloslavski, S. Fischer, T. Güthe, A. Albes, W. Bettolo, H. Bätzner, H. Henkes  

15.15-15.30  10' Stenting of Distal Intracranial Vessels in Stroke  
A. Musacchio, R. Langhi, L. Langhi, M. Musacchio  

15.30-15.45  10' Stent Treatment of Intracranial Atherosclerotic Stenoses - Update of the European Intrastent Registry  
W. Kurre, J. Berkefeld  

15.45-16.00  10' Stent-Assisted Thrombo-Embolic Revascularization (SATER) for Acute Ischemic Stroke Intervention of large Artery Occlusion utilizing Self-Expanding Micro-Stents: A Series of over 30 Consecutive Patients  
16.00-17.30  Stroke 6  
**Chairs**: I. Szikora, S. Bakke

16.00-16.15  10'  Morphological and Clinical Results of Invasive Intra-Arterial Recanalization in Acute Stroke  
I. Gubucz, ZS. Berentei, M. Marosfoi, CS. Orave, D. Varga, I. Szikora

16.15-16.30  10'  Postdilation of the Wingspan-Stent Instead of Predilation is Feasible and Safe  
A. Ragoschke-Schumm, S. Schindhelm, P. Schmidt, S. Schiffler, A. Hansch, R. Drescher,  
M. Bokemeyer, A. Günther, J. Weise, T.E. Mayer

16.30-16.45  10'  Treatment of Neurovascular In-Stent Re-Stenoses Using a Coronary Paclitaxel Eluting Balloon  

16.45-17.00  10'  Long-term Clinical Outcome Following Emergency MR Imaging and Reperfusion Therapy for Acute  
Middle Cerebral Artery Occlusion  
T. Mori, H. Tajiri, T. Icata, T. Uesugi, M. Nakazaki

17.00-17.15  10'  Long-Term Clinical Outcome after Emergency Reperfusion Therapy for Acute Basilar Artery  
Occlusion Based on MR Imaging  
H. Tajiri, T. Mori, T. Icata, T. Uesugi, M. Nakazaki, N. Soga

17.15-17.30  10'  Endovascular Recanalization for the Internal Carotid Artery or Middle Cerebral Artery Occlusion in a  
Subacute Stroke Stage in Deteriorating Patients with Internal Border Zone Infarctions  
T. Iwata, T. Mori, H. Tajiri, T. Uesugi, M. Nakazaki

09.15-12.45  Thursday, 7 October 2010  
ITALY HALL

09.15-10.15  Aneurysms 5  
**Chairs**: P. Purdy, R. Gasparotti

09.15-09.30  14'  Clinical Predictors of Delayed Cerebral Ischemia after Subarachnoid Hemorrhage: First Experience  
with Coil Embolization as the First-Line Treatment in the Management of Ruptured Cerebral  
Aneurysms  
Y. Kawabata, H. Miyake, F. Horikawa, Y. Ueno

09.30-09.45  10'  A Novel Force Sensor with an Optical System for Coil Embolization of Intracranial Aneurysms  
N. Matsubara, S. Miyachi, Y. Nagano, T. Ohshima, O. Hososhima, T. Izumi, A. Tsurumi,  
T. Wakabayashi, M. Sakaguchi, A. Sano, H. Fujimoto

09.45-10.00  10'  Mechanism of Catheter Kickback in the Final Stage of Coil Embolization for Aneurysms -  
Straightening Phenomenon  
S. Miyachi, T. Izumi, N. Matsubara, T. Naito, K. Haraguchi, T. Ichikawa, T. Wakabayashi

10.00-10.15  10'  Use of 3-D Angiograms for Prediction of Coils Needed to Embolize Small Intracranial Aneurysms  

10.15-11.30  Aneurysms 6  
**Chairs**: P. Lylyk, N.K. Mishra

10.15-10.30  10'  Endovascular Treatment of Intracranial Baby Aneurysms  
C. Barbier, S Saleme, P Lacerda, P Courtbeaux

10.30-10.45  10'  Technical Aspects of Single Coil Embolization of Broad Based, Small Intracranial Aneurysms.  
Low Case Flow Center Experience  
L. Borota, P. Jonasson

10.45-11.00  10'  Endovascular Treatment of 55 Posterior Communicating Artery Aneurysms. Overall, Perioperative  
Results  
E. Cotroneo, R. Gigli, F. Puccinelli, G. Guglielmi

11.00-11.15  10'  Follow-Up Study of Intracranial Aneurysms Treatment with Coils  
H. Ghanati, K. Firooznia, M. Motaveilei, H. Ara, H. Ebrahimi, M. Mohammadi Far, M. Abedini,  
M. Shakiba, A. Jalali

11.15-11.30  10'  Unruptured Middle Cerebral Artery Aneurysms Coiling, Feasibility and Outcome. Single Center  
Experience  
O. Mansour, J. Weber, M. Schumacher

11.30-12.45  Aneurysms 7  
**Chairs**: T. Hyogo, R. Riva

11.30-11.45  10'  Intracranial Aneurysms Treatment with Hydrocoils: 6 Years Follow-Up in a Single Center Experience  
A. Tournade, M. Musacchio, A. Lebedinsky, N. Hirota, A. Uemura, T. Tajahmady
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<td>11.45-12.00</td>
<td>10' Endovascular Management of Ruptured Posterior Circulation Aneurysms- Review of 10 Years Experience</td>
<td>N. Khandelwal, K. Priyamvadha, V. Gupta, A. Pathak, S.N. Mathuria</td>
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<td>12.00-12.15</td>
<td>10' The Technique of Double Catheterization of the Sac in the Treatment of Intra-Cranial Aneurysms</td>
<td>F. Trivelato-Padovani, M. Manisor, M. Al-Khawaldeh, R. Riva, C. Mounayer</td>
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<td>12.15-12.30</td>
<td>10' Aneurysmal Rupture during Embolization with Guglielmi Detachable Coils: Causes, Management and Outcome</td>
<td>D. Hwang, Y. Ko, K. Kim, I. Kang, S. Bae, S. Park, I. Kim, C. Hur</td>
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<td>14.30-16.30</td>
<td>Aneurysms 8 Chairs: J. Moret, K. Irie</td>
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<td>14.45-15.00</td>
<td>10' Safety and Efficacy of the Remodelling Technique in the Treatment of Ruptured and Unruptured Intracranial Aneurysms</td>
<td>L. Pierot, C. Cognard, L. Spelle</td>
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<td>15.00-15.15</td>
<td>10' Stent-Jail Technique in Endovascular Treatment of Wide-Necked Aneurysms</td>
<td>Z. Wu</td>
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<td>15.30-15.45</td>
<td>10' Local Intra-Arterial Tirofiban for Intraoperative Vessel Thrombosis during Aneurysm Coiling</td>
<td>J. Rosales, H. Cardenas, Y. Pernia, Y. Matos, O. Rosales</td>
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<td>15.45-16.00</td>
<td>10' Iatrogenic CCF Following Attempted Endovascular Treatment of Intracranial Aneurysm</td>
<td>A. Karapurkar</td>
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<td>16.00-16.15</td>
<td>10' Intravenous Thrombolysis for Acute Cerebral Ischemia Following Endovascular Treatment of Intracranial Aneurysms Using Eptifibatide</td>
<td>M. Musacchio, A. Lebiedensky, L. Armanet, J-F. Cerfon, A. Tournade</td>
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<td>16.45-17.00</td>
<td>10' Very Long Term MRA Follow-Up of Intracranial Aneurysms Adequately Occluded at 6 Months after Coiling: Lotus Study Results</td>
<td>S. Forns, M.E. Sprengers, W. Van Zwan, W.J. Van Rooij, B.K. Velthuis, G.A. De Kort, M. Sluzewski, R. Van Den Berg, G.J. Rinkel, C.B. Majoie</td>
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<td>17.00-17.15</td>
<td>10' Follow-Up of Brain Aneurysms Treated with Bare GDC Coils after 6 Years</td>
<td>S. Finitis, R. Anzionnat, A-L. Durelle, L. Picard, S. Bracard</td>
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<td>17.15-17.30</td>
<td>10' Diagnosis and Treatment of Delayed Compressive Syndrome Associated To Implant of Silk Flowdiverter</td>
<td>J. Berge, X. Barreau, P. Menegon, S. Molinier, T. Tourdias, J. Bocquet, V. Dousset</td>
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<td>17.30-17.45</td>
<td>10' Eight-Year-Plus Follow-Up of Aneurysms after Embolotherapy</td>
<td>V. Kahara, M. Pyysalo, L. Kesi-Nisula, T. Niskakangas, J. Ohman</td>
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<td>10’ 4D CTA Imaging and Treatment of Moya-Moya Associated Intraventricular Hemorrhage</td>
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<td>P. Brouwer, D. Tampieri</td>
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<td>14.45-15.00</td>
<td>10’ Unilateral Moyamoya Disease vs. Asymmetric Manifestations of Definite Moyamoya Disease: Angiographic Pattern Analysis with its Pathognomonic Findings</td>
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<td>J. Chung, Y.C. Weon</td>
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<td>10’ Comparison between Quantification Methods of Carotid Artery Stenosis with CT Angiography</td>
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<td>L. Saba, R. Sanfilippo, R. Montisci, G. Mallarini</td>
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<td>10’ Hemodynamics at the Carotid Terminus and Surrounding Segments Assessed Using Highly Accelerated High-Resolution Phase Contrast MR Velocimetry and Automated Spline Interpolation</td>
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<td>W. Chang, R. Landgraf, A. Frydrychowicz, S. Kecskemeti, K. Johnson, Y. Wu, O. Wieben, C. Mistretta, P. Turski</td>
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<td>10’ Evaluation of Balloon Occlusion Test for Giant Brain Aneurysms under Local Anesthesia</td>
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<td>A. Sultan, T. Hassan, M. Olwany</td>
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<td>10’ Developmental Venous Anomaly (DVA): What Are They Really?</td>
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<td>Small Vessel Ischemic Disease: Pathophysiology, Diagnosis, and Clinical Impact</td>
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<td>N. Bryan, M. Bilelo</td>
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<td>Carotids 1</td>
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<td>Chairs: A. Karapurkar, D. Pelz</td>
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<td>10’ Utilization of 3D-RA Cone Beam CTA for CAS Procedure</td>
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<td>10’ Evaluation of Soft Plaques by Magnetic Resonance Imaging Can Improve the Outcomes of Carotid Artery Stenting and Carotid Endarterectomy</td>
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<td>K. Yamada, S. Yoshimura, M. Kawasaki, Y. Enomoto, T. Asano, S. Minatoguchi, T. Iwama</td>
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<td>09.45-10.00</td>
<td>10’ Quantitative Analysis of Intracranial Arterial Stenosis using CAAS QCA 2D and 3D Compared with Wasid Measurement</td>
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<td>E-S. Lee, O.K. Lim, T.I. Kim, D.C. Suh</td>
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<td>10.00-10.15</td>
<td>10’ Accuracy of Preoperative Carotid Artery Stenosis Measurement - Comparison of Magnetic Resonance Angiography (MRA), Digital Subtraction Angiography (DSA) and Histological Specimens</td>
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<td>T. Belson, F. Charvat, D. Netuka, V. Mandys, J. Vrana</td>
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<td>10.15-10.30</td>
<td>10’ Clinical Application of Optical Coherence Tomography for Carotid Artery Stenosis</td>
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<td>S. Yoshimura, K. Yamada, M. Kawasaki, S. Minatoguchi, T. Iwama</td>
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<td>10.30-13.00</td>
<td>Carotids 2</td>
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<td>Chairs: G. Bonaldi, S. Miyachi</td>
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<td>10.30-10.45</td>
<td>10’ Selection of a Protective Device Following Carotid Artery Stenting in Preparation for the Evaluation of Plaque Distribution by High-Resolution Black-Blood MR Imaging</td>
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<td>K. Irie, M. Negoro, T. Tanaka, M. Hayakawa, A. Sadatou, Y. Hirose</td>
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<td>10.45-11.00</td>
<td>10’ Comparison of the Balloon Versus Filter Protection in Carotid Artery Stenting</td>
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<td>K. Sigita, T. Tokunaga, Y. Takasugi, Y. Okhuma, T. Hishikawa, I. Date</td>
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<td>11.00-11.15</td>
<td>10’ Safety &amp; Effectiveness of Carotid Artery Stenting with Protection</td>
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<td>M. Negoro, M. Hayakawa, K. Irie, T. Ikeda, A. Sadatou, S. Maeda, Y. Hirose</td>
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<td>11.15-11.30</td>
<td>10’ Prospective Analysis of Carotid Stenting in High Risk Patients in a Larger Referal Single Korean Center Study</td>
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<td>11.30-11.45</td>
<td>10’ Endovascular Revascularization of Complete or Near Occlusion of the Carotid Artery</td>
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<td>S. Nemoto</td>
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11.45-12.00 10’ Primary Carotid Stenting for Severe, Symptomatic Stenosis: a Less-invasive Approach
D. Pelz, S Lownie, M Bussiere, D Lee, I Gulka, A Leung

12.00-12.15 10’ Carotid MM-Stenosis: What Is the Threshold That Determines Cerebrovascular Symptoms?
L. Saba, R. Sanfilippo, R. Montisci, G. Malarini

12.15-12.30 10’ Endovascular Repair of In-Tandem Carotid Stenosis
H. Desal, H. Loubriere, L. Azema, A. Costargent, P. Chaillou, P. Patra, Y. Goueffic

12.30-12.45 10’ Carotid Artery Stenting Pitfall
A. Karapurkar

12.45-13.00 10’ Transient and Prolonged Sinus Reaction after Carotid Stenting - Prospective Analysis

14.30-17.30 Thursday, 7 October 2010

14.30-15.45 Dissections 1
Chairs: S. Nemoto, B. Wassermann

14.30-15.15 10’ Intracranial Dissections and Dissecting Aneurysms
A. Biondi


15.30-15.45 10’ Diagnosis, Natural History and Treatment of the Carotid Dissections. Our Experience
A. Stafa, C. Barbara, L. Simonetti, M. Leonardi

15.45-17.00 Dissections 2
Chairs: A. Biondi, O. Mansour

16.00-16.15 10’ Stent Placement for Intracranial Internal Carotid Artery Dissection Presenting with Ischemic Stroke
R. Kondo, Y. Matsumoto, Y. Matsumori, K. Sato, S. Fujiwara, A. Takahashi, T. Tominaga

A Tournade, M. Musacchio, A. Lebedinsky, N. Hirota, A. Uemuera, T. Tajahmady

16.30-16.45 10’ Endovascular Treatment of Extra- and Intracranial Dissections Using Self-Expanding Microstents

16.45-17.00 10’ Treatment of Spontaneous Intradural Vertebral Artery Dissections
T. Nakazawa, Y. Takeichi, Y. Yoko, T. Fukami, J. Jito, N. Nitta, K. Takagi, K. Nozaki

17.00-17.15 10’ Endovascular Surgery for Ruptured Vertebral Artery Dissection

17.15 -17.30 10’ Spontaneous Dissection of Intradural Vertebral and Basilar Arteries. Review of 55 Cases (28 Hemorrhagic and 27 Ischemic). Regarding Multimodality Endovascular Approaches
R.L. Piske, J.L. Silva, C.E. Baccin

14.30-17.30 Thursday, 7 October 2010

14.30-16.00 fMRI 5
Chairs: S. Aoki, C. Stippich

14.30-14.45 10’ Normal CSF Flow Measurements at the Aqueduct Performed at 3T
E. Kapsalaki, I. Tsougos, P. Svolou, E. Dardiotis, G Hadjigeorgiou, I. Fezoulidis, K.N. Fountas

14.45-15.00 10’ Balanced Steady-State Free Precession Sequence in the Study of CSF Dynamic Alterations
G. Pellicanò, S. Meli, I. Del Seppia, I. Samih

15.00-15.15 10’ Phase-Contrast MR as Non-Invasive Tool in the Diagnosis of Benign Intracranial Hypertension
L. Nocetti, A. Mantovani, S. Vallone, T. Costi, P. Carpeggiani, G. Pinna
15.15-15.30  10’ Normal Pressure Hydrocephalus (NPH): Is It Time for MRI CSF Dynamics Studies for the Diagnosis?  
D.M. Peltz, U. Godano

15.30-15.45  10’ White Matter Changes in Normal Pressure Hydrocephalus, a Possible Marker for the White Matter Damage  
J. Vrana, D. Horinek, V. Sule, P. Rejchrt, D. Hoza, T. Belsan, F. Charvat

15.45-16.00  10’ Abnormalities of the Dura Mater: Are Multiple Clinical Syndromes with Dural Lesions Associated to Abnormal Connective Tissue?  
D. Quiñones, J. Viaño

16.00-17.30  MRI 6  
Chairs: D. Tampieri, E. Piovan

16.00-16.15  10’ Automated Versus Human In Vivo Segmentation of Carotid Plaque MRI  
C. Oppenheim, R. Van’t Klooster, R. Marsico, O. Ngagana, O. Eker, R.J. Van Der Geest, I.M. Adame, E. Touze, J.F. Meder

16.15-16.30  10’ Idiopathic Intracranial Hypertension: Assessment of the Endovascular Techniques for Treatment  
A. Mironov

16.30-16.45  10’ Endovascular Stenting of Unilateral Transverse Sinus Stenosis for Treatment of Benign Intracranial Hypertension  
W. Mustafa, K. Kadziolka, A. Leautaud, L. Pierot

16.45-17.00  10’ Interest of Endovascular Techniques in the Pseudotumor Cerebri Syndrome  
P. Courthéoux, S. Saleme, C. Barbier, P. Lacerda

17.00-17.15  10’ Diagnosis and Non-Invasive Follow-Up of Cerebro-Vascular Pathologies (10 Years of CT, DWI and Angio-MR without Contrast Medium)  
L. Sabattini

17.15-17.30  10’ Clinical Application of Balanced Steady-State Free Precession Technique in Neuroradiology  
Y. Lu, S. Wu, J. Lirng, W. Guo, C. Chang

09.15-10.30  Infectious Diseases 1  
Chairs: L. Lucato, F. Resta

09.15-09.30  14’ The Different Faces of Central Nervous System Tuberculosis: A Pictorial Review  

09.30-09.45  10’ Miliary TB Meningitis: MRI Findings in Three Patients  
A. Karthikasalwah, M. Nazri Mn, S. Muda

09.45-10.00  10’ Revisiting the CNS Tuberculosis with Emphasis on Giant Tuberculomas and Introducing the Outer Rim Excrescence Sign  
D. Kumar, R.K. Sheoran, S.K. Bansal, O.P. Arora

10.00-10.15  10’ Tuberculosis Simulating Tumour in Brain  
U. Rashid Chaudhry

10.15-10.30  14’ Infectious Diseases of the CNS: the Importance of Local Singularities in an Increasingly Interconnected World. The Latin America Experience  
L. Lucato

10.30-11.30  Encephalopathies 4  
Chairs: M. Brant-Zawadzki, M. Papathanasiou

10.30-10.45  10’ The Role of Magnetic Resonance Perfusion Imaging in the Assessment of Limbic Encephalitis with Neuronal Potassium Channel Antibody. A Case of Rapidly Progressive Dementia  
C. Nunes, M. Cordeiro, F. Silva, I. Santana, C. Moura, F. Alves

10.45-11.00  10’ MRI Imaging in Nonneoplastic Limbic Encephalitis  
M. Scharitzer, C. Baumgartner, A. Muehlebner, D. Prayer

11.00-11.15  10’ Missense PANK2-mutation without the Tiger’s Eye - MR Findings in a Large Group of Patients with Pantothenate Kinase-Associated Neurodegeneration (PKAN)  
11.15-11.30  10’ Rhombencephalitis by Listeria SPP. in Immunocompetent Patient  
J. Nunes, B.C. Gomes, M. Shamasna, R.P. Pais, M.T. Garcia

11.30-12.30  10’ Neuroimaging of Immune Reconstitution Inflammatory Syndrome (IRIS) during HIV Infection  
V. Cuvicnic, G. Martin-Blondel, H. Dumas, C. Cognard, B. Marchou, F. Bonneville

11.45-12.00  10’ Brain Metabolism and Cognitive Impairment in HIV Infection: A 3 Tesla Magnetic Resonance Spectroscopy Study  
M. Mohamed, P. Barber, R. Skolasky, O. Selnes, R. Maxley, M. Pomper, N. Sacktor

12.00-12.15  10’ MRI Spectrum of HIV Related Neurological Disorders and Evaluation of the Different MRI Techniques in Diagnosis and Prognostication of Them  
R. Badhe, R. Kakkar, R. Gandhi, S. Soneji, S. Desai

12.15-12.30  10’ Glaucoma and Blindness, an Early Axonal Diagnosis and Prevention by MRI  
M.-T. Iba-Zizen, E.A. Cabanis, A. Istoc, M. Yoshida

14.30-16.30 Thursday, 7 October 2010 MAGENTA HALL

14.30-16.30  Parkinson 1  
Chairs: Y. Korogi, K. Sartor

14.30-14.45  10’ Ultrasonography and RM Imaging in Progressive Supranuclear Palsy (PSP)  
W. Liboni, E. Salzedo, P. Pignatta, F. Molinari, S. Giordano

14.45-15.00  10’ A Simple Method to Assess Accuracy of Deep Brain Stimulation Electrode Placement: Pre-Operative MRI and Postoperative CT Image Fusion  
M. Metello, J. Silva, P. Linhares, C. Reis; M. Gago; M.J. Rosas, R. Vaz, M. Ayres Basto

15.00-15.15  10’ High Resolution 3T Diffusion Tensor Imaging-Based Tractography for Differential Diagnosis of Parkinsonism  
J. Furtner, G. Kasprisian, S. Seidel, W. Pirker, D. Prayer

15.15-15.30  10’ Correlation of Magnetization Transfer Ratios and Clinical Parameters in Late Parkinson’s Disease  
M. Gavra, M Papathanasiou, E Boviatis, D Sakas, A Gouliaos

15.30-15.45  10’ DBS Targeting of Subthalamic Nucleus by Means of 3 Tesla MR Unit: Comparison with Conventional Targeting  

15.45-16.00  10’ Diffusion Tensor Imaging and MR-Tractography for Characteristic of Microstructural Integrity of White Matter in Patients with Parkinson’s Disease (PD)  
Z. Rozhkova, I. Karaban’, N. Karaban’, M. Shkliar

16.00-16.15  10’ Neuromelanin MR Imaging in Dementia with Lewy Bodies (DLB) at 3T: Comparison with Parkinson’s Disease and Alzheimer Disease  
S. Sugawara, M Ida, M Ishizuka, N Torozu, K Hino, Y Kubo, Y Kawaguchi, T Suzuki, S Ikuta

16.15-16.30  10’ High Field MR Findings in Lower Body Parkinsonism  
J.S.P. Tan, L.L. Chan, K.M. Ng, H. Bumpel, E.K. Tan, A. Hegde

09.15-11.45 Thursday, 7 October 2010 VIOLET HALL

09.15-10.15  Paediatrics Vascular 1  
Chairs: K. Yamada, P. Soares Pinto

09.15-09.45  25’ Angioarchitectures, Clinical Manifestations and Endovascular Remodelings of the 24 Galenic Malformations  

09.45-10.00  10’ Collateral Pathways from the Galenic System in Cerebral AV Shunts  
M. Komiyama, T. Ishiguro, T. Morooka

10.00-10.15  10’ Cerebral Medullary Veins: Normal Anatomy and Pathologic Pattern in Fetal and Paediatric Patients  
T. Feygin, L.T. Bilaniuk, M. Epelman, R.A. Zimmerman
### Paediatrics Vascular 2
**Chairs:** K. Ter Brugge, Y. Iizuka

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<td>10.15-12.00</td>
<td>Endovascular Management of Pediatric Aneurysms</td>
<td>R. Dawson, E. Saleh</td>
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<td>10.45-11.00</td>
<td>Brain Artery Stenosis in Neurofibromatosis Type 1 (NF1)</td>
<td>A. D’Amico, F. D’Arco, F. Caranci, D. Melis, R. Taursisco, E. Del Giudice, G. Lama, A. Scuotto, R. Conforti, M. Melone, N. Di Paolo, A. Brunetti</td>
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<td>11.15-11.45</td>
<td>Differential Consideration of Bilateral Basal Ganglia Lesions in Children</td>
<td>G. Zuccoli, L. Flom, V. Sperling, A. Panigrady, C. Fitz</td>
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### Paediatrics Brain Tumors 1
**Chairs:** E. De Luis, A. Righini

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<td>14.30-16.05</td>
<td>Pediatric Brain Tumors</td>
<td>R. Zimmerman</td>
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<td>15.05-15.20</td>
<td>Medulloblastoma: Atypical CT &amp; MRI Findings in Children</td>
<td>A. Eran, A. Oztuk, N. Aygun, I. Izbudak</td>
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<td>15.50-16.05</td>
<td>Unusual Giant Spinal Teratoma in an Infant</td>
<td>Y. Lu, F. Chang, W. Guo, C Chang</td>
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### Paediatrics Brain Tumors 2
**Chairs:** L. van den Hauwe, B. Goraj

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<td>16.25-17.00</td>
<td>Pituicytoma Presenting with Spontaneous Hemorrhage</td>
<td>P. Soares Pinto, B. Moreira, M. Melo Pires, J. Xavier</td>
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### Paediatrics Brain Tumors 3
**Chairs:** M.A. Weber, A. Falini

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<tr>
<td>17.00-17.30</td>
<td>Cerebellar fMRI Lateralization of Language in Children after Pilocytic Astrocytoma Resection: Comparison with Healty Children</td>
<td>F. Ghielmetti, A. Erbetta, S. Bulgheroni, P. Vitali, D. Riva, M.G. Bruzzone</td>
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### Paediatrics Vascular 2
**Chairs:** K. Ter Brugge, Y. Iizuka

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<td>17.00-17.30</td>
<td>Characterization of Glioblastoma and Metastatic Tumor Tissue by Proton Spectroscopy and Diffusional Kurtosis Imaging</td>
<td>P. Raab, E. Bültmann, A. Tabesh, U. Pilatus, E. Hattingen, F.E. Zanella, H. Lanfermann</td>
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<td>15.00-15.15</td>
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<td>MR Characterization of Gliomas Using Arterial Spin Labeling in Combination with Multivoxel MR-Spectroscopy</td>
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<td>15.30-15.45</td>
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<td>Single Voxel Spectroscopy in the Follow-Up of Low Grade Glioma</td>
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<td>15.45-16.00</td>
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<td>Conventional MRI and MR Spectroscopy in Primary Central Nervous System Lymphoma</td>
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<td>16.00-16.45</td>
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<td>Proton Magnetic Resonance Spectroscopy Provides Relevant Prognostic Information in High Grade Astrocytomas</td>
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<td>16.45-17.00</td>
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<td>5 Year Longitudinal MRI and 1h Single Voxel MRS Follow-Up in 14 Patients with Gliomatisis Treated with Temodal, Radiotherapy and Antiangiogenic Therapy</td>
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<td>16.30-16.45</td>
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<td>Recurrence of High Grade Gliomas Treated with Bevacizumab (Anti Vascular Endothelial Growth Factor) and Irinotecan: How to Diagnose Tumour Progression on MRI?</td>
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<td>17.15-17.30</td>
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<td>Intracranial Extramedullary Hematopoiesis and Concurrent Cystic Astrocytoma in a Patient with Thalassemia Major</td>
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<td>09.15-10.15</td>
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<td>Head &amp; Neck 3</td>
<td>W. Dillon, A. Goulimos</td>
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<td>09.30-09.45</td>
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<td>Meningoencephalocele and Other Septoaplasty Complications - In the Context of a Clinical Case</td>
<td>J. Baptista, A. Fernandes, A. Bráz, M. Patricio, R. Montemor</td>
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<td>09.45-10.00</td>
<td>10'</td>
<td>Characteristic Dynamic Enhancement Pattern of MR Imaging for Malignant Thyroid Tumor</td>
<td>H. Hwang, Y.N. Park, Y.S. Shim, S.S. Byun, H.S. Kim</td>
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<td>10.00-10.15</td>
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<td>Liquid-Based Cytology for Thyroid Fine-Needle Aspiration: Comparison with Conventional Smear Cytology</td>
<td>H. Seo, J. Lee, Y.H. Lee</td>
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<td>Head &amp; Neck 4</td>
<td>S. Kan, G.K. Ricciardi</td>
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<td>10.15-10.30</td>
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<td>Computer Tomography-Guided Biopsy of the Deep-Seated Lesions in Deep facial and Skull Base Areas</td>
<td>E. Wu, S.H. Ng, Y.L. Chen, Y.M. Wu</td>
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<td>10.30-10.45</td>
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<td>Radiological Appearances of Oropharyngeal Soft Tissue Reduction with Bipolar Radio-Frequency Treatment in Sleep Disordered Breathing: A Pilot Study</td>
<td>S. Ghosh-Ray, B. Kotecha, S. Chawda</td>
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| 10.45-11.00 | 10’ Duel Acquisition Extracranial CTA/ Enhanced Neck CT for Pre-transoral Laser Microsurgery Evaluation of Head & Neck Cancer Patients  
S. Weindling, J. Salassa, J. Casler, D. Chellini |
| 11.00-11.15 | 10’ Bilateral Temporal Muscles Hypertrophy - Case Report and Review of the Literature  
A. Couceiro, A.P. Antunes, R. Sousa, L. Pereira, G. Sá |

**Thursday, 7 October 2010 - WHITE HALL 2**

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| 14.30-16.15 | Advanced CT Studies 2  
Chairs: P. Maly Sundgren, C. Strother |
| 14.30-14.45 | 10’ Iterative Reconstruction Algorithm for Head CT  
Z. Rumboldt, V. Tipnis, V. Spampinato, W. Huda, G. Goldsberry, A. Cianfoni |
| 14.45-15.00 | 10’ Evaluation of Neuro Best Contrast Filter for Head CT  
Z. Rumboldt, V. Spampinato, W. Huda, S. Tipnis |
| 15.00-15.15 | 10’ Radiation Dose Reduction in CT of the Brain: Can Advanced Noise Filtering Compensate for It?  
R. Siemund, A. Löve, D. Van Westen, L. Stenberg, C. Petersen |
| 15.15-15.30 | 10’ Impact of Varying Arterial Input Functions in CT Perfusion Studies of the Brain in Pathologic Ischemic Studies  
B. Smoller, A. Cherney, S. Mangla, A. Dubey, A. Bluestone, S. Zhabin |
| 15.30-15.45 | 10’ Whole Brain CT Perfusion of Arteriovenous Shunting in Arteriovenous Malformation  
J. Shankar, C. Lam |
| 15.45-16.00 | 10’ Study of Computed Tomography Perfusion on Traumatic Cerebral Contusion  
A. Abdul Karim, W. Jalaaluddin, A. Ghani, J. Abdullah |
| 16.00-16.15 | 10’ CT, CTA, Perfusion CT Guidance of Acute Stroke Intervention Using the Penumbra Device  
| 16.15-17.30 | Advanced MR Techniques 2  
Chairs: R. Zimmerman, A. Bjørnerud |
| 16.15-16.30 | 10’ T2 Flair Hyperintense Signal Intensity at the Posterior Limb of the Internal Capsule: Clinical Significance in ALS Patients  
G. Proogerou, S. Ralli, I. Tsougos, I. Patramani, G.M. Hadjigeorgiou, I. Fezoulidis, E. Kapsalaki |
| 16.30-16.45 | 10’ The Technique Methods and Progress of MR pH Imaging  
Z. Shen, L. Ning, R. Wu, K. Brindle |
| 16.45-17.00 | 10’ The Comparison among Three Different Reprocessing Technologies for Quantitation and the Influence of Steam and Press Sequence on Metabolic Concentration  
R. Wu, X. Guo |
| 17.00-17.15 | 10’ Comparative Lateralizing Ability of Multimodality MRI in Temporal Lobe Epilepsy  
K. Ercan, H. Gunbey, E. Bilir, E. Zan, A. Alban |
| 17.15-17.30 | 10’ DTI in Familiar Tuberous Sclerosis - Comparison of Fractional Anistropy and Apparent Diffusion Coefficient with Normal Subjects  
A. Varga, L. Szidonya, M. Kasay, G. Rudas, P. Barsi |

**Thursday, 7 October 2010 - YELLOW HALL**

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| 14.30-15.15 | Spine 5  
Chairs: T. Sola, J. Théron |
| 14.30-14.45 | 10’ The Tangled Cauda Equina Sign: Indicator of Significant Spinal Stenosis  
R. Sattenberg, R.K. Downs, J.O. Heidenreich |
| 14.45-15.00 | 10’ Minimally Invasive Lumbar Decompression to Treat Lumbar Spinal Stenosis  
D. Schomer, M. Solberg, W. Wong, D. Fourny, B. Chopko |
| 15.00-15.15 | 10’ Posterior Vertebreal Arch Cement Augmentation to Prevent Fracture of Spinous Processes after Interspinous Spacer Implant  
G. Bonaldi, A. Cianfoni |
| 15.15-15.30 | 10’ Revision Surgery of Internal Fixation. Role of Neuroradiology in 88 Patients Operated  
M. Bortoluzzi |
15.30-15.45 10’ Tumours with Intraspinal Component

15.45-17.15 Spine 6
Chairs: P. Courthéoux, R. Izzo

15.45-16.00 14’ Neurmodulation, a New Frontier for Neuroradiologists
B. Georgy

16.00-16.15 10’ Spinal Cord Stimulators: Normal Positioning and Postsurgical Complications
E. Zan, K.N. Kurt, R.B. North, D.M. Yousem

V. Kumar

16.30-16.45 10’ Percutaneous Radiofrequency Neurotomy Is Effective in the Treatment of Lumbar Facet Joint Syndrome
S. Marcia, A. Cauli, S. Marini, M. Marras, E. Piras, G. Mallarini

16.45-17.00 14’ “Regional” Concept of Back Pain and Therapeutic New Proposal
J. Théron, T. Sola, L. Guimaraens, A. Casasco, P. Courtheoux

17.00-17.15 14’ Current Experience and New Indications of Liposuction in Spinal Pathology
J. Théron, T. Sola, L. Guimaraens, A. Casasco

FRIDAY, 8 OCTOBER 2010
Plenary Hall Sessions

09.15-12.30 EUROPA AUDITORIUM

09.15-10.15 Interventional Neuroradiology
Chairs: S. Bracard, M. Gallucci

09.15-09.45 Interventional Neuroradiology Is Not Only a Sum of Technicalities, It Is a Medical Work Needing Special Human Approach
J. Moret

09.45-10.15 Facing the Emotional Truths of Grief Caused by Complications of Interventional Neuroradiology
K. Goto

10.30-12.30 Stroke: The Brain Is Not the Heart!
Chairs: E. Jacobsen, G. Scotti

10.30-10.50 Neuroradiological Approach to Brain Stroke
G. Schroth

10.50-11.10 Advanced Contrast-Enhanced MRI for Stroke Risk Assessment
B.A. Wasserman

11.10-11.30 DTI for Stroke Imaging
K. Yamada

11.30-11.50 Imaging of Spinal Stroke
S. Kolllias

11.50-12.10 Endovascular Stroke Treatment: from Fibrinolysis and Aspiration to Thrombectomy and Stenting
H. Henkes

12.10-12.30 Penumbra and Extra Corporal Ozone Therapy
G. Wasser

PARALLEL SESSIONS

14.30-17.15 Friday, 8 October 2010 EUROPA AUDITORIUM

14.30-16.00 Stroke 7
Chairs: L. Lemme-Plaghos, M. Negoro

14.30-14.45 10’ Bridging Therapy in Acute Ischemic Stroke Patients: An Endovascular Multimodal Step-Up Approach
S. Vallone, L. Verganti, C. Moratti, M. Malagoli, P. Carpeggiani
14.45-15.00 10’ Mechanical Thrombectomy with the Penumbra Recanalization Device in Acute Ischemic Stroke. A Matched Pair Analysis in Comparison with Intra-Arterial Thrombolysis

15.00-15.15 10’ Aggressive Mechanical Clot Disruption for Acute Ischemic Stroke with Low dose Intra-Arterial Urokinase after Failure of IV Thrombolysis
S. Kim, H. Kim

15.15-15.30 10’ Early Clinical Experiences with a New Generation Flow-Enabler and Clot Retriever (Phenox Bonnetr)
S. Felber, Z. Vajda, H. Henkes

15.30-15.45 10’ The Potential of Stent-Triever: Experience in 180 Acute Ischemic Stroke Treatments
T. Liebig, H. Lockau, S. Stehle, D. Dorn, S. Prothmann, A. Foerschler, H. Henkes

15.45-16.00 10’ In Vivo Evaluation of the First Dedicated Combined Flow Restoration and Mechanical Thrombectomy Device (Solitaire FR) in a Swine Model of Acute Vessel Occlusion
P. Mordasini, J. Grailla, G. Schroth, U. Fischer, M. Arnold, C. Brekenfeld

16.00-17.30 Stroke 8

16.00-16.15 10’ Temporary Bypass Using Enterprise Stent for Treatment of Acute Proximal Middle Cerebral Artery Thrombosis
W. Mustafa, K. Kadziolka, A. Leautaud, L. Pierot

16.15-16.30 10’ Acute Stroke Treatment with a Self-Expandable, Fully Retrievable Intracranial Stent
C. Roth, P. Papanagiotou, S. Behnke, S. Walter, A. Haass, W. Reith

16.30-16.45 10’ Carotid Stent Placement in Acute Stroke
C. Roth, P. Papanagiotou, S. Behnke, S. Walter, A. Haass, W. Reith

16.45-17.00 10’ Asymptomatic Occlusion of Both Common Carotid Arteries Missed on MRA
A. Karapurkar, N Aditya

17.00-17.30 25’ Cerebral Hyperperfusion Syndrome Following Intracranial Revascularization: Anatomic and Pathophysiologic Considerations
J. Chung

14.30-17.30 Friday, 8 October 2010

14.30-16.00 Aneurysms 10
Chairs: R. De Blasi, M. Longo

14.30-14.45 14’ Microporous Membrane Covered Flow Diverting Stent for Cerebral Aneurysm Occlusion: Initial European Experience and Mid Term Follow-Up

14.45-15.00 10’ Mid term Experiences with the Silk Stent - Report of 51 Cases
G. Gal, J. Nepper-Rasmussen

15.00-15.15 10’ Silk Arterial Reconstruction for Intracranial Aneurysms. Multicentric French Study on 51 Consecutive Patients
J. Berge, A. Bonafé, H. Brunel, E. Chabert, J. Gabrillargues, K. Kadziolka, X. Barreau, L. Pierot, V. Douisset

15.15-15.30 10’ Aneurysms Treatment Using Intracranial Stent (Large Wide-Necked and Giant Aneurysms)
L. Guimaraens, T. Sola, E. Vivas, A. Casasco, C. Diaz

15.30-15.45 10’ Silk Versus Pipeline for Reconstructive Endovascular Treatment of Intracranial Aneurysms. Technical Differences, Difficulties, Advantages and Disadvantages of Two Types of Flow Diverters
K. Kadziolka, L. Estrade, A. Leautaud, W. Pathi, L. Pierot

15.45-16.00 10’ Can Flow Divert Stent Devices Prevent Aneurysmal Rupture? Direct CCF Following Intracavernous Carotid Aneurysm Treatment with Silk Stent
K. Kadziolka, W. Mustafa, L. Estrade, L. Pierot

16.00-17.30 Aneurysms 11
Chairs: G. Wilms, G. Gal

16.00-16.15 10’ Silk Stent in the Treatment of Intracranial Aneurysms-Short and Mid-Term Experience
M. Moura Guedes, L. Neto, P. Sequeira, J. Guedes Campos
16.15-16.30 10’ Effect of Flow Modification on Aneurysm Induced Mass Effect
I. Szikora, ZS. Berentei, ZS. Kulesar, M. Marosfoi, I. Gubucz, PK. Nelson, A. Berez

16.30-16.45 10’ Endovascular Procedure Evaluation using 3 Tesla Diffusion-Weighted MR Imaging in Patients with Intracranial Aneurysms Treated by Flow Diverter Stents
A. Biondi, A. Drier, N. Sourour, F. Di Maria, B. Jean, D. Dormont

16.45-17.00 10’ Preliminary Results of Flow Divergence Device (Silk Stent) in the Treatment of Intracranial Aneurysms: 1 Year Follow-Up
D. Tampieri, M. Cortes

17.00-17.15 10’ 3T MRI in the Evaluation of Brain Aneurysms Treated with Flow-Diverting Stent
F. Toni, L. Cirillo, Af. Marliani, F. De Santis, C. Princiotto, M. Dall’olio, L. Simonetti, M. Leonardi

14.30-17.15 Friday, 8 October 2010  

14.30-16.15  
**Research 6**  
*Chairs*: J. Krejza, K. Katada

14.30-15.00 25’ Towards New Paradigms for Three-Dimensional Analysis of Neuroradiological Images
D. Steinmann, L Antiga

15.00-15.15 10’ 3-Tesla High-Spatial-Resolution Contrast-Enhanced MR Angiography with Parallel Imaging in Cerebral Venous and Sinus Thrombosis
M. Lettau, R.J. Barrows, S. Heiland, M. Laible, M. Bendszus, S. Hähnel

15.15-15.30 10’ Time Resolved Angiography: Can It Be Used as a Venous Triggering Technique for Magnetic Resonance Venography ? Faisability, Usefullness in Cerebral Venous Pathology Imaging
B. Daumas-Duport, N. David, R. Bourcier, E. Calvier, F. Toulgoat, A. Gaultier, H.A. Desal

15.30-15.45 10’ Cerebral Venous Thrombosis: Diagnostic Accuracy of Combined, Dynamic and Static, Contrast-Enhanced 4D MR Venography

15.45-16.00 10’ Dissection of Cranial Cervical Arteries and Dural Sinus Thrombosis
L. Divano, T. Studnik, C. Mabiglia

16.00-16.15 10’ Susceptibility Weighted Imaging (SWI) and Cerebrovascular Disorders
F. Tsai

16.15-17.15  
**Research 7**  
*Chairs*: H. Ghanaati, L. Saba

16.15-16.30 10’ Comparison between 4D Phase Contrast MRI and Computational Fluid Dynamics with Patient specific Inflow Boundaries in Unruptured Intracranial Aneurysms
J. Schneiders, P. Van Ooij, J. Van Den Berg, E. Van Bavel, R. Van Den Berg, A. Nederveen, C. Majoie

16.30-16.45 10’ Intracranial Aneurysms: Magnetic Resonance Imaging and Magnetic Resonance Angiography vs. Digital Subtraction Angiography

16.45-17.00 10’ Comparison of 3D TOF-MRA and 3D CE-MRA at 3T for Imaging Intracranial Aneurysms
M. Cirillo, F. Sciomazzoni, A. Iadanza, M. Cadioli, N. Anzalone

17.00-17.15 10’ Vascular Malformation of the Brain
R.S. Pakbaz, C.V. Kerber

14.30-17.15 Friday, 8 October 2010  

14.30-15.45  
**AVMs 1**  
*Chairs*: A. Takahashi, L. Simonetti

14.30-14.45 10’ Cavernous Malformations of the Central Nervous System: A Pictorial Essay
A. Hegde, T. Lim, S. Mohan, W. Lim

14.45-15.00 10’ Embolization of Brain Arteriovenous Malformations with Onyx: Results and Complications
N. Limbuucci, A. Consoli, S. Nappini, F. Ricciardi, S. Mangiafico
15.00-15.15 10' Double Arterial Catheterization in the Endovascular Treatment of Brain Arteriovenous Malformation with Onyx®
G.S. Nakiri, R. Riva, D.G. Abub, F. Padovani, M. Khawaldeh, C. Mounayer

15.15-15.30 10' Intraoperative Neurophysiological Monitoring and Provocative Test during Endovascular Treatment of AVMs
B. Pabon, S. Vargas, A. Franco, J.F. Arias

15.30-15.45 10' Use of Cervical Spinal Cord Stimulation to Treat and Prevent Arterial Vasospasm after Aneurysmal Subarachnoid Hemorrhage

15.45-17.15 AVMs 2
Chairs: B. Pabon, S. Kim

15.45-16.00 10' Transvenous Balloon-Assisted Technique in Transarterial Embolisation by Onyx-18 Injection of Intracranial dural Arteriovenous Fistulas
N. Sourour, A. Biondi, F. Clarenccon, F. Di Maria, Y. Guermazi, J. Chiras

16.00-16.15 10' EVT of an Arterio-Venous Malformation and Dural Arterio-Venous Fistulae with Onyx. A Single Centre Experience
A Tournade, M Musacchio, A. Lebedinsky, N. Sourour, T. Tajahmady

16.15-16.30 10' Venous Approach in the Treatment of Cerebral Arteriovenous Malformations: About 5 Consecutive Cases
R. Riva, M. Manisor, M. Ruggiero, M. Al-Khawaldeh, F. Trivelato-Padovani, C. Mounayer

16.30-16.45 10' A Late Haemorrhagic Complication in a Cured Arterio-Venous Malformation
D. Le Feuvre, A. Taylor

14.30-17.30 Friday, 8 October 2010

14.30-16.15 fMRI 7
Chairs: M. Thurnher, G. Polonara

14.30-15.00 25' A Possible Role of Brodmann’s Area 8 in Pre-Surgical fMRI
J. Valk, N. Van Vucht, P.H. Pevenage

15.00-15.15 14' Pitfalls in fMRI
S. Haller, A. Bartsch

15.15-15.30 10' The Shape of Motor Resonance: Right- or Left-Handed?
M. Cabinio, V. Blasi, P. Borroni, A. Iadanza, G. Cerri, G. Scotti, A. Falini

15.30-15.45 10' Functional Connectivity. MRI of Language Network in Patients with Drug-Resistant Epilepsy
E. Pravatà, C. Briganti, C. Colosimo, D. Mantini, C. Sestieri, A. Tartaro, M. Caulo

15.45-16.00 10' The Effects of Paradigm Selection and Post-Processing on fMRI Language Lateralization: Threshold-Independent Methods, I
V. Tóth, G. Rudas, L.R. Kozák

16.00-16.15 10' The effects of Paradigm Selection and Post-Processing on fMRI Language Lateralization: Threshold-Dependent Methods, II
L. Kozuk, V. Toth, G. Rudas

16.15-17.30 fMRI 8
Chairs: G. Dal Pozzo, F. Caranci

16.15-16.45 25' Neuromarketing: Is fMRI Unveiling Consumer’s Unconscious Behaviors?
L. Hermoye

16.45-17.00 10' Functional MR Imaging of Patients with Mild Aphasia after Stroke: Activation of Language Network from Acute to Chronic Phase and Preliminary Results of Early Rehabilitation Effect
C. Ambrosi, F. Mattioli, L. Mascaro, L. Biagi, M. Tosetti, R. Gasparotti
17.00-17.30 15' The Prognostic Value of fMRI and H1-MRS spectroscopy in the Study of Patients in Vegetative State
D. Cevolani, M. Maffei, R. Agati, A. Battistini, R. Piperno, M. Leonardi

14.30-16.15 14.30-16.30 Encephalopathies 5
Chairs: M. Savoiardo, Z. Rumboldt

14.30-14.45 10' Acute Toxic and Auto-Immune Mediated Encephalopathies
P. Demaerel

14.45-15.00 10' Posterior Reversible Encephalopathy Syndrome - Type of Edema Depends on Serum Albumin Levels
A. Pirker, B. Voller, L. Kramer, E. Auff, D. Prayer

15.00-15.15 10' Posterior Reversible Encephalopathy Syndrome with Obstructive Hydrocephalus
C. Wirojtanawanugoon, J. Laohamutua

15.15-15.30 10' Neuroimaging Findings in Osmotic Demyelination Syndrome. A Review of Typical and Atypical Findings
N. Siddiqui, LCH. Cruz Jr, I. Cravo, G. Zucoli

15.30-15.45 10' Diffusion Tensor Imaging and T2 Relaxometry in Primary Sjogren’s Syndrome
L. Tzarouchi, N. Tsifetaki, S. Konissiotis, A. Zikou, L. Astrakas, V. Botzoris, A. Drosos, M. Argyropoulou

15.45-16.00 10' Revised Classification Criteria of Wernicke Encephalopathy
G. Zucoli, N. Siddiqui, R. Nardone, Y. Saito, I. Cravo, LCH. Cruz Jr., R. Sechi

16.00-16.15 10' Wernicke's Encephalopathy: The Best Way to Make Early Diagnosis
D. Machado, A. Bocchio, A.M. Rosano’, M. Oggero, N. Milloz, G. Doveri, T. Meloni

14.30-17.00 14.30-16.15 Foetal MRI - Round Table
Chairs: A. Rossi, N. Girard, M. Resta

14.30-14.45 15' Normal Fetal Brain
P. Griffiths

14.45-15.00 15' Fetal Brain Injury
A. Righini

15.00-15.15 15' Fetal Supratentorial Malformations
O. Glenn

15.15-15.30 15' Anomalies of the Posterior Fossa and the Spinal Ord. Fetal MRI
C. Hoffmann

15.30-15.45 15' Advanced Techniques for Fetal Brain in Utero
E. Grant

15.45-16.15 30' Discussion

16.15-17.00 Foetal MRI 2
Chairs: A. Rossi, N. Girard, M. Resta

16.15-16.30 10' Imaging Findings and Utility of Fetal Central Nervous System MRI
G. Papaioannou, D. Loggitsi, I. Kampas

16.30-16.45 10' Development of the Hippocampal Region Demonstrated by Fetal MRI
D. Bajic, N. Canto Moreira, J. Wikström, R. Raininko

16.45-17.00 10' In Utero Tractography of Callosal Agenesis

14.30-17.30 14.30-15.45 Brain Tumors 7
Chairs: L. Albini Riccioli, I. Pronin

14.30-15.00 25' Clinical fMRI and DTI. Preoperative Functional Neuroimaging
C. Stippich
15.00-15.15 10’ Role of Magnetic Resonance Tractography in the Preoperative Planning and Intraoperative Assessment of Patients with Intra-Axial Brain Tumors
A. Romano, L.F. Calabria, V. Coppola, L. Figa Talamanca, V. Cipriani, S. Pugliese, L.M. Fantozzi, A. Bozzao

15.15-15.30 10’ Integration of Functional MRI and Intra-Operative MRI Provides a High Degree of Precision and Confidence at Surgical Brain Tumor Resection
N. Chepuri

15.30-15.45 10’ Exploring Functional Connections in the Living Human Brain with MR Tractography and Intraoperative Subcortical Mapping
A. Castellano, L. Bello, A. Iadanza, E. Fava, A. Casarotti, C. Papagno, G. Scotti, A. Falini

15.45-17.30 Brain Tumors 8
Chairs: W.Y. Guo, A. Ramos, C.O. Ortiz Vasquez

14.30-17.30 Friday, 8 October 2010
WHITE HALL 2

14.30-15.30
Brain Heart 1
Chairs: A. Beltramello, S. Roosendaal

14.30-14.45 10’ Early CT Signs in Out-of-Hospital Cardiac Arrest Survivors: Temporal Profile and Prognostic Significance
J. Inamasu, S. Miyatake, M. Nakatsukasa, K. Kobayashi, M. Honda

14.45-15.00 10’ Global Change of Cerebral Hemodynamics in Patients with Chronic Heart Failure

15.00-15.15 10’ The Relationship between Leukoaraiosis and Heart Function
H. Seo, S.H. Kim, Y.H. Lee

15.15-15.30 10’ Neuroimaging Findings after Pediatric Cardiac Arrest
G. Zuccoli, A. Panigrahy, C.R. Fitz, D. Willaman, E.L. Fink

15.30-17.30
Trauma 1
Chairs: A. Taylor, D. Zimatore

15.30-15.45 10’ Importance to Forensic Aims of Virtual Autopsy Obtained Using Tridimensional Multi-Slice Computed Tomography (3D-MSCT) in the Study of Fatal Single Gun-Shots Wounds to the Head
T. Tartaglione, L. Filograna, S. Gaudino, M. Sciandra, R. Calandrini, C. Colosimo

15.45-16.00 10’ Non-Accidental Pediatric Central Nervous System Trauma
R. Zimmerman

16.00-16.15 10’ Neuroimaging Findings in Abusive Head Trauma
G. Zuccoli, A. Panigrahy, R. Berger

16.15-16.30 10’ Long-Term Consequences of “Minimal” Traumatic Brain Injury: The Role of MRI and 99mTc-SPECT
G. Bommarito, R. Manara, D. Cecchin, N. Jelic, M. Dam
16.30-16.45 10’ Change of Regional Cerebral Function in Subjects with Post-Traumatic Stress Disorder (PTSD) Survived the Earthquake of April 6, 2009 in L’Aquila: Preliminary Reports
A. Catalucci, M. Mazza, F. Pasano, E. Ciutti, M. Anselmi, F. Di Salle, M. Gallucci

16.45-17.00 10’ Quantitative DTI Tractography of the Uncinate Fascicle: Differentiation between Traumatic Injury and Abnormalities in Vascular Disease and Alcoholism
T. Kurki, J. Laalo, J. Karhu

17.00-17.15 10’ Diffusion Tensor Imaging and Tractography of Traumatic Brachial Plexus Palsies. Preliminary Experience
R. Gasparotti, G. Lodoli, M. Frigerio, C. Ambrosi

17.15-17.30 10’ CT Angiography in Brain Death Diagnosis: Clinical Experience in 184 Patients
M. Musacchio, A. Meyer, I. Manoila, A. Lebidensky, J-C. Zinek, H. Oesterle, N. Stahl, A. Bianchi, T. Tajahmady, A. Tournade

14.30-17.30 Friday, 8 October 2010

14.30-16.30 Spine 7
Chairs: I.S. Choi, J. van Goethem

14.30-14.45 10’ Efficacy of Percutaneous Vertebroplasty with Calcium Sulfate: A Preliminary Experience
S. Marcia, S. Marini, E. Piras, M. Marras, C. Boi, G. Mallarini

14.45-15.00 10’ X-Press BKP: A Preliminary Experience
S. Marini, S. Marcia, C. Boi, E. Piras, M. Marras, G. Mallarini

15.00-15.15 10’ Preliminary Experience with New Synthetic Ceramic Bone Substitute Cerament™ Spine Support in Vertebral Compression Fracture (VCF): Short Term Follow-Up at 9 Months about 15 Cases
F. Zeccolini, G. Ambrosanio, P. Vassallo, A. Lavanga, G. Guarnieri, M. Muto

15.15-15.30 10’ Safety and Clinical Efficiency of Percutaneous Vertebroplasty in the Elderly (>\approx 80 year-old)
Y. Guermazi, F. Clarencan, E. Cormier, B. Jean, M. Rose, J. Chiras

15.30-15.45 10’ Percutaneous Vertebroplasty for Osteoporotic Fractures: Experience with High Viscosity Cement Using a Hydraulic Injection Device, the “Confidence” System
B. Georgy

15.45-16.00 10’ “Primary Care” Vertebroplasty Clinic in a Free-Standing, Radiologist Owned Diagnostic Imaging Center. Diagnosis, Treatment, Prevention, and Follow-Up of VCFS
H. Hatten, Jr.

16.00-16.15 10’ One Session Multi-Level Vertebroplasty: Indications and Results of 55 Patients
G. Guarnieri, R. Izzo, P. Vassallo, A. Lavanga, G. Ambrosanio, A. Di Gaeta, M. Muto

16.15-16.30 10’ Risk of Secondary Vertebral Fracture Following a Vertebroplasty and Predisposing Clinical Factors
E. Piovan, M. Rossini, L. Idolazzi, S. Adami, A. Beltramello

16.30-16.45 10’ Preliminary Experience with Vertebral Body Stenting System VBS Synthes for the Treatment of Osteoporotic Vertebral Compression Fracture (VCF): a Follow-Up at 12 Months About 20 Cases
G. Ambrosanio, F. Zeccolini, E. Capobianco, G. Guarnieri, M. Muto

16.45-17.00 10’ Technical Approach of Spinal Fracture with Osseofix

17.00-17.15 10’ Radiofrequency (RF) Kyphoplasty in Comparison to (BKP) Balloon Kyphoplasty: A Prospective Evaluation
R. Pflugmacher, R. Bornemann, K. Kabir, D.C. Wirtz, T. Randau

17.15-17.30 10’ Percutaneous Anterior Column Stabilization of Focal Metastatic Lesions of the Spine: The Value of Plasma-Mediated Radiofrequency Ablation before Cement Injection
B. Georgy
### SATURDAY, 9 OCTOBER 2010

**Plenary Hall Sessions**

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| 09.15-10.15 | Neuroradiology of Trauma  
*Chairs: R. Zimmerman, A. Beltramello*                     |
| 09.15-09.35 | Minor Brain Trauma: Pathology, Imaging and Clinical Aspects  
*D. Chakeres*                                      |
| 09.35-09.55 | Vascular Trauma  
*U. Limaye*                                             |
| 09.55-10.15 | Traumatic Intradural Arterial Aneurysm(s): Etiologies, Clinical Manifestation and Treatment Strategies: Experiences in Thailand (and Some SE Asian Countries)  
*S. Pongpech*                                      |
| 10.15-12.00 | Cases Discussion  
*A. Osborn with M. Thurnher*                                |
| 12.00-13.00 | Closing Ceremony  
Welcome to Istanbul 2014  
*Kamil Karaali*                                           
Farewell  
*Marco Leonardi*                                          |

### MEET THE EXPERT

**TUESDAY, 5 OCTOBER 2010**

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| 14.30-15.30 | Education, Training and Credentialing of Neuroradiologists Around The World  
*Anton Hasso*                                      |
| 15.30-16.30 | A Life in Neuroradiology  
*Michael Huckman*                                    |

**WEDNESDAY, 6 OCTOBER 2010**

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| 14.30-15.30 | Reflections on Therapeutical Approaches  
*Luc Picard*                                       |
| 15.30-16.30 | A Personal Approach to Interventional Neuroradiology  
*Anton Valavanis*                                   |
| 16.30-17.30 | Conversation with Bill Dillon: Diagnosis and CT-Guided Treatment of Spinal Pain, Including Spontaneous Intracranial Hypotension  
*William Dillon*                                    |

**THURSDAY, 7 OCTOBER 2010**

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<th>Time</th>
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| 14.30-15.30 | A Life in Neuroradiology  
*Ugo Salvolini*                                      |
| 15.30-16.30 | Conversation with Anne Osborn  
*Anne Osborn*                                         |

### HOW I DO IT SESSION

**BLUE HALL**

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<th>Time</th>
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| 16.00-17.30 | Small Vessel Ischemic Disease: Pathophysiology, Diagnosis, and Clinical Impact  
*Nick Bryan, Michel Bilelo*                           |

### FRIDAY, 8 OCTOBER 2010

<table>
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<th>Time</th>
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| 14.30-15.30 | Conversation with Katsuya Goto  
*Katsuya Goto*                                      |
POSTER SESSION 1ST GROUP

from Monday, 4 October to Wednesday, 6 October

Poster Set-Up/Dismantle Times: Set Up: Monday, 4 October (12:00-15:00) - Dismantle: Wednesday, 6 October (17:30-18:30)

Advanced Imaging Modalities

P001 Semi-Automatic Dynamic Causal Modeling: A Further Step Towards Clinical Translation of Neuroscience
C. Kiefer, R. Wiest

P002 Evaluation of Cerebral Disconnections in Prolonged Consciousness Disorders by Steady State Functional MRI: Preliminary Results

P003 Interscanner Variability of Normal Fractional Anisotropy Values

P004 Oculomotor Nerve Palsy-High Resolution MR Imaging
K. Sethi, C.J. Das, S. Dhawan

Cerebrovascular Disease-imaging and Intervention

P006 Branching Pattern of Lenticulostriate Arteries Observed by MR Angiography on 3.0T
T. Akashi, T. Taoka, T. Emura, M. Sakamoto, T. Wada, H. Nakagawa, K. Kichikawa

P007 Relation between Chronic Subcortical Encephalopathy and Onset of Haemorrhagic Complications in Patients Submitted to Intravenous Thrombolysis
C. Babara, A. Stafa, G. Procaccianti, L. Simonetti, M. Leonardi

P008 Combined Intra-Arterial Thrombolysis and Mechanical Desobstruction in Acute Ischemic Stroke

P009 Clinical Applications of Whole Brain CT Perfusion & CT Angiography with 320 Detector CT Scanner
W. Chong, T. Plan, M. Holt, J. Ly, V. Srikanth, M. Crosset

P010 Incidence of New Brain Lesions on Diffusion Sequences after Intravascular Treatment of Carotid Stenosis without Distal Protection System

P011 Eco-Color-Doppler, CT Angiography, High Resolution MRI and PET/CT Findings of Idiopathic Inflammatory Pseudotumor of the Carotid Bifurcation
D. Giancristofaro, A. Tartaro, M. Caulo, G. Esposito

P012 Meta-Analyses on the Mortality Rate Following Stent-Assisted Coil Embolization of Intracranial Aneurysms
H. Weng, Y. Yang, H. Wong, C. Yang

P013 Surgical and Endovascular Treatment of Basilar Artery Trunk Saccular Aneurysms
T. Higa, H. Ujiie, K. Kato, T. Hori, Y. Okada

P014 Analysis of Atherosclerotic Basilar Artery in Patients with Isolated Pontine Infarction Using MR Voxel Based Histogram
H. Jang, H. Lee, H. Chang, H. Kim, C. Won

P015 The Effect of Self-Expanding Carotid Stents on Plaque Thickness and Overall Vessel Diameter: An Ultrasonographic Study
G. Marchuk, D.H. Lee, S.P. Lownie
P016 Factors Associated with MR-Imaging Depicted Intraplaque Hemorrhage in Patients with Carotid Stenosis

P017 Fibromuscular Dysplasia of Middle Cerebral Artery in an Adolescent: Case Report
S. Rosa

P018 Brainstem Compression and Hemorrhage in Direct Carotid-Cavernous Fistula

P019 Congenital Vascular Variations Masquerading as Intracranial Aneurysm on 3D Time-of-Flight Cerebral Magnetic Resonance Angiography in Correlation with Cathether 3D Rotational Angiography
C.Y. Shen, M.C. Wu, D.F. Tsao, Y.S. Tyan

P020 Ischemic Stroke Imaging with DWI and ADC Maps beyond Hyperacute Stage
S. Benakis, A. Sykara, V. Ouranos, K. Stefanidis, C. Kolofousi, E. Tsatalou, D. Exarchos, D. Chondros

P021 Stent-In-Stent for Acute In-Stent Thrombosis after Carotid Artery Stenting. Case Report
Y. Takasugi, K. Sugiu, K. Tokunaga, Y. Okkuma, T. Hishikawa, I. Date

P022 Turn-Back Embolization Technique for Effective Transvenous Embolization of the Dural Arteriovenous Fistulas
S. Tanoue, H. Kiyosue, Y. Horii, M. Okahara, Y. Sagara, J. Kashiwagi, Y. Kondo, R. Shimada, H. Mori

P023 Persistent Hypoglossal Artery Arising from the External Carotid Artery
A. Uchino, N. Saito

P024 Persistent Primitive Olfactory Artery: MR Angiographic Diagnosis
A. Uchino, E. Kazawa, W. Mizukoshi, N. Saito, J. Tanaka, Y. Sato, K. Inoue

Free topics

P025 Outcome Prediction in Head Injury Based on Computed Tomography Abnormalities
G.K. Matis, E. Vafiadis, D. Voultsinou, C. Tsikas, O.I. Chrysou, T.A. Birbilis

P026 MRI Findings of Dorsalgia
A. Inugami, K. Okane

P027 An Early MRI Change Following Reversible Hypoxic Brain Injury: A Case Report

P028 Raising Diagnostic Accuracy in Detection of Brain Metastasis: High Field MRI or High Molar Gadolinium Contrast?
E. Kim, S. Lee, J. Kim, H. Choi

P029 Basketball Training Increases the Volume of Left Putamen
N. Lee, I. Park, K. Lee, J. Han, W. Lee, K Park, I. Ryu

P030 Normal Anatomy of the Limbic System. An MRI Memento
M. Musacchio, I. Manoilo, A. Lebedinsky, H. Oesterle, T. Tjahmady, A. Tournade

P031 Superficial Siderosis Following Braquial Plexus Avulsion Injury
L. Neto, C. Santos, L. Bisceito, J. Campos

P032 Central Pontine Myelinolysis (CPM)-Like MR Images on Six Cases of Pathologically Proved Intravascular Lymphoma

P033 3D-Fiesta Imaging in Defining Morphology of Ventricular System in Children and Adults
M. Peltz, U. Godano

P034 The “VA Approaching ICA Sign”: the Finding to Predict the Persistent Hypoglossal Artery in MIP Image of Cranial MRA

P035 Intentional and Unintentional Injuries in Shkodra District, Albania
Z. Shabani, G. Qirjako
Head and Neck Imaging and Intervention

P036 Imaging Study of Oral Cancer

P037 Osteoma or Meningioma?
C. Chrissiopoulos, S. Mourgela, A. Sakellaropoulos, N. Ampertos, K. Kirkgiannis, K. Petritsis, A. Spanos

P038 Characteristic Dynamic Enhancement Pattern of MR Imaging for Malignant Thyroid Tumor
H. Hwang, YN. Park, YS. Shim, SS. Byun, HS. Kim

P039 The Utilization of Covered Stent for the Treatment of Recurrent Vein Graft Aneurysm
K. Kitazawa, Y. Ito, K. Nishino, J. Shinbo, Y. Jinbo, Y. Fujii

P040 Usefulness of Multidetector Computed Tomography (MDCT) Images with Soft Tissue Algorism Reconstruction and with Bone Algorism Reconstruction for Head and Facial Trauma

P041 Do You Remember the Branches of the External Carotid Artery? A CT Scan Review of the Arterial Anatomy of the Face
M. Musacchio, A. Lebidensky, I. Manoila, K. Pelsy, F. Villarejo, M. Antoniu, H. Oesterle, T. Tajahmady, A. Tournade

Imaging in Epilepsy

P042 Neuroimaging in Seizures Patient Associated with Nonketotic Hyperglycemia (NKH)
C. Chen, WS. Chen, CH. Wu, HC. Huang, SK. Lee

P043 Phosphorus Magnetic Resonance Spectroscopy (31P MRS) in Patients with Mesial Temporal Lobe Epilepsy: Preliminary Results
E. Park, K. Lyra, M. Otaduy, L. Lucato, C. Leite

P044 Bilateral Symmetric Amygdaloid Calcifications: A Pathognomonic Brain Anomaly of Lipoid Proteinosis
I. Manoila, M. Musacchio, H. Oesterle, A. Tournade

Imaging of Brain Tumors - Multimodality Approach

P045 Tumor Recurrence and Radiation Brain Necrosis: Differentiation Using Newer MRI Techniques
E. Vafiadis, T. Gerukis, D. Voultsinou, A. Cheva, G. Mpalampanis, V. Kalpakidis, P. Palladas

P046 3D MR Spectroscopy in Differentiation between Brain Tumor Recurrence and Radiation Necrosis
S. Cirkovic

P047 Preoperative Evaluation of Consistency of Pituitary Adenomas with T2 Map and Propeller DWI
M. Enokizono, M. Morihawa, R. Ideguchi, M. Uetani, T. Matsuo, I. Nagata, T. Hayashi, S. Honda

P048 MRI and MR-Spectroscopy of Intraventricular Anaplastic Oligodendrogloma
V. Katsaros, G. Stranjalis, T. Flaskas, D. Sakas

P049 Relationship between FDG Uptake and Apparent Diffusion Coefficients in Solitary Brain Tumor
M. Maeda, N. Matsushima, K. Takeda

P050 White Matter Integrity and Cognition in Familial Cerebral Cavernous Malformations: A Diffusion Tensor Imaging Study
N. Menjot De Champfleur, M. Leroy, E. Le Bars, H. Duffau, P. Labauge, A. Bonafe

P051 Differences in Peritumoral Architecture Organization Evaluated with Diffusion-Tensor Imaging (DTI) and MR Spectroscopy (MRS) in Patients with Low and High Grade Gliomas
J. Seok, K. Ahn, J. Kim, S. Jung, B. Kim

P052 Orbital Tumors: Using CT Perfusion in Differential Diagnosis
I. Shchurova, I. Pronin, L. Fadeeva, V. Kornienko

P053 Neurocysticercosis Mimicking Brain Tumor Case Report
V. Vasiljevic Vuckovic, S. Milosevic Medenica, D. Grujicic

P054 Fractional Anisotropy of Corticospinal and Thalamofrontal Pathway in Parkinson’s Disease
D. Voultsinou, E. Vafiadis, S. Mpostanjopoulou, Z. Katsarou, P. Palladas, V. Kalpakidis, A. Petridis

P055 Are Decreased ADC and CBV Values Diagnostic for Central Nervous System Lymphomas?
T. Gerukis, D. Voultsinou, E. Vafiadis, A. Cheva, I. Moralis, P. Palladas, P. Prasopoulos
Imaging of the Spine and Spinal Cord

P056 Sparganosis of upper Cervical Cord
D. Park, W. Jung, J. Ryu, J. Heo, Y. Kim, C. Park, C. Hahn, J. Kim, Y. Lee, S. Lee

P057 Evaluation of Cervical Cord Decompression Surgery by using Diffusion Tensor Analysis at 3T MRI

P058 Lumbosacral Radiculography by 3D MR Rendering for Diagnosis of Symptomatic Extraforaminal with or without Foraminal Disc Herniation
W.M. Byun

P059 MR Imaging Findings of Intramedullary Spinal Cord Metastasis
S. Kan, K. Hayakawa

P060 Spinal Subdural Tuberculous Abscess
W. Kim, O. Kim, H. Kim, S. Oh

P061 Evaluation of Spinal Vascular Malformations Using 64-Slice CT-Angiography. A Propos 3 Cases
S. Milosevic Medenica, B. Prstojevic, V. Vuckovic Vasiljevic

Inflammatory, Demyelinating and Degenerative Diseases of the Brain

P063 Diffusion Tensor Imaging of Amyotrophic Lateral Sclerosis: How to Analyze and Recent Results

P064 Creutzfeldt-Jakob Disease (CJD). A Diagnostic Challenge for MRI
B. Walter

P065 The Factors Associated with Atrophy of Parahippocampus

P066 Characteristic MR Imaging Findings of Acute, and Chronic Progressive Neuro-Behcet Disease
K. Kutomi, O. Kyo, A. Yamamoto, H. Kido

P067 Striatal Distribution of Dopamine Transporters and Dopamine D2 Receptors at Different Stages of Parkinson's Disease - A CFT and RAC PET Study

P068 Immune Restoration Inflammatory Syndrome (IRIS) in an AIDS Patient with Infratentorial Progressive Multifocal Leukoencephalopathy (PML)
S. Kaur, N. Mohd Ramli, K. Rahmat

Interventional Neuroradiology

P073 Matrix2 Coils for Endosaccular Occlusion of Intracranial Aneurysms: Comparison of One-Year Outcomes with Bare Platinum Coil Cohort
S. Youn, H. Kim, M. Han

P074 Progressive Myelophaty in Spinal Epidural Arteriovenous Fistula. Case Treated by Endovascular Approach
R. Schizzi, R. Padolecchia, V. Valsania, R. Sergi, C. Bonfanti, M. Boccardo
P075 Unprotected Stenting in Symptomatic Patients with Severe Carotid Artery Stenosis. 30 Days Results

P076 Usefulness of Distal Subtraction Angiography for Preoperative Tumor Embolization in Meningiomas Originating from the Central Skull Base

P077 Direct Puncture Casting of Scalp Arteriovenous Fistulae with N-Butyl-2-Cyanoacrylate: Usefulness of Modified Circular Compression Device
N. Lee, S. Youn, H. Seol, S. Suh, H. Suh

P078 Endovascular Treatment for Unruptured Asymptomatic Aneurysms
Y. Matsumaru, W. Tsuruta, M. Hayakawa, O. Kamiya

P079 Endovascular Treatment (EVT) of Anterior Communicating Artery Aneurysm Associated with Unilateral Moyamoya Disease
S. Muda, N. Abdullah, R. Ralib, Z. Mohamad, S. Bee Hung, A. Abu Bakar

P080 Large Vertebral Artery Arteriovenous Fistula with Epidural Varix Treated via Endovascular Hybrid Technique: Two Cases Report
C. Ou, H. Wong, T. Yang

P081 Endovascular Treatment of Distal Cerebral Aneurysms
B. Prstojevic, M. Samardzic, I. Vukasinovic

P082 Endovascular Treatment of a Giant Cranio-Cervical Aneurysm with a New Self Expandable Stents Leo and Leo Plus
A. Tournade, M. Musacchio, A. Lebedinsky, N. Hirota, A. Uemuera, T. Tajahmady

P083 Carotid Artery Stenting for Asymptomatic Cervical ICA Stenosis

P084 Intracranial Mycotic Aneurysms, Experience from Ramathibodi Hospital
J. Pakorn, P. Sirintara, C. Ekkachat, L. Ekkasit

P085 Staged Stenting Procedure for Carotid Stenosis in High Risk Patient
S. Ishihara

Molecular Imaging

P086 Clinically Different Stages of Alzheimer’s Disease associated with Amyloid Deposition by [11C] PIB PET Imaging
S. Hatashita, H. Yamasaki

Pediatric Neuroradiology

P087 Synaptic Plasticity. Detectable by Diffusion Tensor Imaging (DTI)?
B. Walter

P088 Susceptibility-Weighted Imaging in Pediatric Epilepsy
M. Ida, S. Sugwara, Y. Kubo, N. Yorozu, K. Hino, Y. Kawaguchi

P089 Multi-National Evaluation of the Safety and Efficacy of Gadobenate Dimeglumine for Neurologic MR Imaging in Children
M. Kuhn, B. Young, A. Kuhn

P091 MRI Findings in Moebius Syndrome-Clinical Case
M. Metello Lourenco, A. Maia, A. F. Almeida, M. Ayres Basto

P092 Neuroimaging of Acute Encephalopathy in Neonates
A. Patton, G. Miller

P093 Leigh Syndrome in a 20 Month Old Child. Case Report

P094 Gemella Morbilorum Subdural Empyema and Hematoma Complicating Acute Sinusitis
D. Rodrigues, C. Santos, A. Geraldo, L. Neto, A. Campos, J. Campos

P095 Possible Clinical Applications of the MR-NOVA Software in Cerebrovascular Diseases
E. Ciceti, Ghielmetti, L. Caputi 1, F. Longaret, P. Ferroli 2, M.R. Carriero 1, E. Parati 1, M.G. Bruzzone
POSTER SESSION 2nd GROUP

from Thursday, 7 October to Saturday, 9 October

*Poster Set-Up/Dismantle Times: Set Up: Thursday, 7 October (07.30-08.30) - Dismantle: Saturday, 9 October (13.30-14.30)*

**Advanced Imaging Modalities**

**P001** Clinical Utility of DTI Sequence in Brain: Fraction Anisotropy (FA) ADD New Information to Conventional Imaging in Some Pathologies
J. Calvar, Y. Bergamo, P. Yañez

**P002** The Usefulness of Susceptibility Imaging in Clinical Practice
O. Chawalparit, S. Tritrakarn, P. Pornpupoyawut, P. Charochaovanich

**P003** Feasibility of Fine Anatomical Mapping for Evaluation of the Substantia Nigra Pars Reticulata and Subthalamic Nuclei Using Susceptibility-Weighted Phase Images at 3T
M. Ida, S. Sugawara, Y. Kubo, N. Yorozu, K. Hino, Y. Kawaguchi

**P004** Diffusion Anisotropy Analysis of Association Fiber Tracts in Heroin Abuser

**P005** SPECT in neuroimaging: A pictorial Review
S. Nair, A. Neelakantan, J. Patterson, R. Jampana

**Cerebrovascular disease-imaging and intervention**

**P006** Usefulness of three-dimensional Digital Subtraction Angiography in Endovascular Treatment of a Spinal Dural Arteriovenous Fistula

**P007** Comparison of Multidetector Computed Tomography Venogram (MDCTV) and Magnetic Resonance Venogram (MRV) in Suspected Cerebral Venous Sinus Thrombosis
H. Joo Siong, N. Mohd Ramli, K. Rahmat, K. A. Abdul Kadir

**P008** EEG and MR Findings in Neuropsychiatric Lupus Patients with Epilepsy

**P010** High Resolution MRI in Diagnosis of Intracranial Arterial Dissection

**P012** Multimodal Neuroimaging Approach to Patients with Carotid Artery Occlusive Disease
F. Mamedov, N. Arutunov, D. Usachev, L. Fadeeva, V. Kornienko

**P014** Quantitative Evaluation of the Penumbra in Acute Cerebral Infarction using whole-Brain CT Perfusion
K. Murayama, K. Katada, M. Nakane, M. Hayakawa, H. Toyama

**P015** Flow Dynamics of Cerebral Aneurysms using Time resolved 3D Phase-Contrast MRI (4D-Flow). Comparison with Computer Fluid Dynamics

**P016** Investigation of Neuropsychiatric Lupus Patients with Stroke

**P017** CT Perfusion and CT Angiography in Acute Ischemic Stroke

**P018** Pregnancy and Postpartum Period Related Central Nervous System (CNS) Disorders: Magnetic Resonance Imaging (MRI) Findings and Pathophysiologic Features
D. Loggitsi, G. Papaioannou, I. Kambas

**P019** MR Imaging and MR Angiography in Migrainous Patients
P020  Stenosis Asymmetry Index between Symptomatic and Symptomatic Patients in the Analysis of Carotid Arteries
L. Saba, R. Montisci, R. Sanfilippo, R. Bura, G. Mallarini

P021  Rupture of an Intracranial Aneurysm during Angio-CT
F. Scholtes, F. Signorelli, M.W. Bojanowski

P022  How to Distinguish between Venous and Arterial Strokes and What for?
S. Semenov, I. Moldavskaya, A. Semenov, L. Barbarash

P023  Pre- and Post-Angioplasty Perfusion Study with Perfusion CT in Patient with Cerebrovascular Stenotic Disease
S. You, S. Yim, J. Lee, K. Jo

P024  Bloomingly Hypointense Middle Cerebral Artery of Acute Stroke on T2*-Weighted Gradient Echo Imaging: Association with the Response to Intra-Arterial Thrombolysis
S. Youn, H Kim, M Han

P025  Carotid Cave Aneurysms Causing Subarachnoid Hemorrhage
S. Nair, M. Behbahi, S. Jenkins, J.J. Bhattacharya

P026  Moya Moya Phenomenon as a Delayed Complication of Aneurysm Clipping
S. Nair, S. Jenkins

Free Topics

P027  MS Plaque Annotations and Volum Assessment
E. Ada, C. Karagoz, D Kaya, W. Hamza, E. Kislal, E. Idiman

P028  Petrous Apex Cephaloceles
M. Arantes, I. Rego, D. Vieira, R Garcia, J.R. Pereira, L Mascarenhas

P029  Imaging Artifacts in MRI Simulators
S. Carrasco, I. Huete, R. Zunino

P030  Diagnostic Power of Diffusion Weighted Image on Hypoglycemic Encephalopathy?: Single Center Experience
H. Chang, M. Kim, H. Lee, H. Jang, H. Kim, C Sohn, S. Lee, S. Lee, J. Kwon

P031  Metabolic and Hydroelectrolytic Acquired Disorders and CNS Injury: Pictorial Review of Neuroimaging Findings
C. Conceicao, T. Palma, I. Cravo, C. Gonçalves

P032  Role of Imaging in the Evaluation of Visual Pathway
C. Das, K. Sekhri, S. Dhawan

P033  Neurological Manifestations and MRI Findings in a Novel GJA1 Missense Mutation in a Family with ODDD
S. De Cori, R. Battini, F. Moro, F. Lombardo, H. Hlavata, F. Frizja, R. Canapicchi, D. Montanaro

P034  Resected Meningiomas: Diagnostic Performance of Fluid-Attenuated Inversion Recovery MR Imaging for Detection of Remnant or Recurrence

P035  Imaging Features of the Various Cavernous Sinus Lesions and Review of the Literature

Head and Neck Imaging and Intervention

P036  Diagnosis, Incidence and Prognosis of Vascular Intra and Extra-Cranial Lesions in the Moderate-To-Heavy Head Trauma
C. Barbara, A. Staşa, L. Simonetti, M. Leonardi

P037  CT and MRI Correlation in Patients with Suspected Cholesteatoma after Surgery
J. Blanco, S. Osuaba, I. Alba, E. Soler, J. Gálvez

P038  Carotid Blowout Syndrome. Emergent Endovascular Management by Stenting
M. DesChamplain, J. Tisnado, J. Tisnado, M. Amendola, C. Amendola

P039  CT-Angiography in the Follow-Up of Carotid Thromboendoarterectomy
A. Staşa, C. Barbara, L. Pedrini, L. Simonetti, M. Leonardi

P040  Magnetic Resonance Imaging of Acute Optic Neuritis: Optic and Periopiotic Conditions
K. Toyoda, K. Kutomi, H Oba, H Kido, A Yamamoto, S Furui

Imaging in Epilepsy

P041  Epilepsy: Comparative Analyses in 1.5 Tesla and 3 Tesla MRI
N. Hatamleh, P. Yañez, M.T. Figueroa, M. Perez Rovira, Y. Bergamo
P042 Epilepsy: RMI Comparative Analyses in 1.5T and 3T
N. Hatamleh, M.T. Figueroa, Y. Bergamo

P043 Focal Cortical Dysplasia (FCD): Pictorial Review
S. Carrasco, P. Riquelme

Imaging of Brain Tumors - Multimodality Approach

P044 Brain Metastasis of Melanoma in a Child: A Rare Case Report
A. Brochado, D. Ferreira, A. Marques, C. Reis

P045 The Role of MRI Spectroscopy in Evaluating Malignant Brain Tumors
C. Chrissicopoulos, S. Mourgela, N. Ampertos, A. Sakellaropoulos, K. Kirgiannis, K. Petritsios, A. Spanos

P046 The Limitations of Magnetic Resonance Spectroscopy in the Diagnosis of Brain Tumors
C. Chrissicopoulos, S. Mourgela, N. Ampertos, A. Sakellaropoulos, K. Kirgiannis, Ch. Iliadis, K. Petritsios, A. Spanos

P047 A Multicentric Glioblastoma Multiforme after a Breast Carcinoma
C. Chrissicopoulos, S. Mourgela, K. Kirgiannis, N. Ampertos, A. Sakellaropoulos, P. Riganellis, K. Petritsios, A. Spanos

P048 Intracerebral Capillary Hemangioma: A Case Report
J. Kim, J. Byun

P049 Application of Hierarchical and K-Means Clustering in Analysis of ADC and Kurtosis Values of Brain Tumors
T. Stotic-Opinical, J. Mihaiović, M. Mavvanshi, M. Dakovic

P050 Diffusion Weighted MR Imaging and Proton MR Spectroscopy Findings of Intraventricular Central Neurocytoma

P051 Solitary Brain Metastasis: Diffusion Weighted Imaging and MR Spectroscopy Features

P052 Evaluation of Dynamic Changes of Brain Perirumoral Oedema before and after Operation by DTI and MRS
A. Turkin, M. Dolgushin, F. Podoprigora, D. Pitzkhelauri, S. Takush, L. Fadeeva, V. Kornienko

P053 Unusual Rare Pituitary Lesions Masquerating Pituitary Adenoma: MR and Pathologic Features and Review of the Literature

P054 Unusual Meningeal Masses: MR and Pathologic Correlation and Review of the Literature

Imaging of the Spine and Spinal Cord

P055 Spinal Subdural Hygroma Concomitant with Spontaneous Intracranial Hypotension. Is It a Cause of Intracranial Hypotension or a Consequence of Hypotension?
I. Anno, T. Isobe, E. Sato

P056 MR Findings in Subacute Combined Degeneration of the Spinal Cord
A. Brochado, A. Marques, C. José Dias

P057 Indentation of the Dorsal Root Ganglia in Patients with Extraforaminal Disc Herniation with or without Foraminal Disc Herniation on Contrast Enhanced MR Imaging
W. Byun, S. Lee, H Jang

P058 The Unknown Guilty: Spinal Arachnoid Cyst as an Infrequent Cause of Spinal Cord Compression
E. Gomez Rosello, A. Quiles Granado, E. Balliu Collgros, G. Laguillo Sala, J. Puig Alcantara, S. Pedriza Gutierrez

P059 Primary Spinal Glioblastoma Multiforme WHO Grade IV in a Child - Imaging Findings

P060 Late-Onset Autosomal Dominant Limb Girdle Muscular Dystrophy and Paget’s Disease of Bone Unlinked to the VCP Gene Locus
O. Moske-Eick, M. Kottlors, V. Haug, R. Schwarzwald, J. Kirschner, M. Schumacher

P061 Imaging Techniques in the Paraspinous Harmonization Method
J. Théron, T. Solà, L. Guimaraes, A. Casasos, J.M. Constans, P. Courtheoux

P062 Comparison of Axial T2 Mapping with CT Discography in Assessment of Lumbar Intervertebral Disk Degeneration
T. Okubo, A. Watanabe, H. Yamada, S. Inou, R. Ono, T. Ozawa, T. Toyone, Y. Wada
Inflammatory, Demyelinating and Degenerative Diseases of the Brain

P063  Brain MR Imaging in Patients with Infectious Endocarditis  

P064  Neurosarcoïdosis: The Radiologic Features in 5 Cases  
H. Aburano, N. Hashimoto, F. Ueda, M. Suzuki, T. Gabata, O. Matsu

P065  Acute Disseminated Encephalomyelitis: Atypical Radiological Presentation  

P066  Morphological Change and Diffusion Tensor Parameters in the Superior and Middle Cerebellar Peduncle in Cases of Spinocerebellar Degenerative Disease  

P067  Contrast-Enhanced High-Resolution Susceptibility-Weighted Imaging in Patients with Pyogenic Brain Abscesses: Comparison with Post-Contrast-Enhanced T1-Weighted Imaging  

P068  Comparative Analysis of MR Imaging Sequences in Diagnosis and Monitoring Progression of Creutzfeldt-Jakob Disease  
M. Conti, A. Achene, A. Salis, S. Costantino, M. Seu, G. Sechi, I. Magnano, M.I. Pirasaut

P069  Diffusion-Weighted MRI in Creutzfeldt-Jakob Disease: Focus on the Cerebral Cortex and Chronologic Change  
C. Song, J. Lee, I. Lee, I. Yu, S. Choi

P070  Brain MRI and CT Characteristics of Patients with Antiphospholipid Antibody Syndrome (APS)  

P071  Ring-Enhancing Lesions in a Patient with AIDS: A Diagnostic Challenge  
D. Ferreira, V. Mendes, A. Vide, C. Reis

Interventional Neuroradiology

P072  Protocol of Radiation Dose Measurement with Newly Developed Head Phantom and Network with Internet for Interventional Neuroradiology  
T. Abe, Y. Uchiyama, N. Tanaka, M. Hirohata, N. Hayabuchi

P073  Intravenous Glycoprotein IIb/IIIA Inhibitor (Tirofiban) Followed by Low-Dose Intra-Arterial Urokinase and Mechanical Thrombolysis in Stroke  
Y. Ihn, B.S. Kim, Y. Won, S. Jung

P074  Intra-Arterial Thrombolysis of Central Retinal Artery Occlusion  
S. Jeon, S. Choi, D. Kim

P075  Is Plasma Oxidized LDLs or Oxidized LDLs Antibodies Correlate with Acute Stage of Clinical Outcome of Acute Ruptured Intra-Cranial Saccular Aneurysms?  
K. Lee, W. Chen, C. Liu

P076  Diagnostic and Interventional Management of 14 Patients with Vein of Galen Aneurysmal Malformation (VGAM)  
M. Piano, M. Rollo, A. Pedicelli, G.M. Di Lella, T. Tufo, M. Caldarelli, C. Colosino

P077  Embolization of a Wide Neck Giant Basilar Tip Aneurysm By Using Two Coils. A Case Report  
S. Rosa

P078  Migration of a Detached Coil That Assisted the Deployed Stent to Migrate, during Stent Assisted Coiling of a Recurrent Aneurysm  
S. Rosa

P079  Comparison of Cone-Beam CT Images between Xper CT and Dyna CT in Interventional Neuroradiology  
H. Suzuki, S. Ishihara, D. Kawahara, M. Ostomo, R. Kanazawa, S. Kohyama, F. Yamane

P080  Embolization of an Ruptured Lenticulostriate Artery Aneurysm: A Case Report  
Y. Tsai, H.F. Wong, H.H. Weng

P081  Chemo-Immunotherapy with Osmotic Blood-Brain Barrier Disruption Using Selective Catheterization for Recurrent or Refractory Primary CNS Lymphoma  
N. Uemiya, S. Ishihara, F. Yamane, S. Kohyama, R. Kanazawa, T. Yoshihara, I. Ochiai, K. Mishima, R. Nishikawa

P083 Combined Endovascular Deconstructive and Reconstructive Technique for Ruptured Vertebral Artery Dissection (VAD)
W. Mustafa, K. Kadziolka, L. Esrtade, L. Pierot

Pediatric Neuroradiology

P084 Venous Sinus Thrombosis an Underestimated Problem in Neonates?
M. Bekiesinska-Figatowska, J. Madzik, I. Terczynska, E. Szczepanik

P085 Congenital CNS Tumors Diagnosed on Prenatal MRI
M. Bekiesinska-Figatowska, E. Jurkiewicz, M. Duczkowski, A Duczkowska, A. Romaniuk-Doroszewska, H. Bragoszewska, A. Ceron

P086 A Pediatric Case of Brainstem and Spinal Cord Ganglioglioma
C. Cankurtaran, G. Zuecoli

P087 MELAS with Multiple T2 High-Intensity Lesions in Bilateral Cerebellar Hemisphere: A Case Report
M. Enokizono, M. Morikawa, R. Ideguchi, M. Uetani, T. Sato, H. Moriiuchi

P088 Osteopetrosis: A Case with Internal Carotid Arteries Stenoses and Collateral Circulation
D. Ferreira, V. Mendes, J.M. Dias Costa, M.L. Silva

P089 Primary Brain Abnormalities in Syndromic Craniosynostoses
V. Castro Mendes, D. Ferreira, J. Pereira, M.L. Ribeiro-Silva

P090 Neuroimaging Features of Angiocentric Glioma
V. Mendes, D. Ferreira, M.J. Costa, M.L. Ribeiro-Silva

P091 Unusual Complications of Subarachnoid Cysts: Subdural Hematoma and Hygroma
M. Ferreira, C. Concejão, T. Baptista, J. Reis

P092 The Method of Choice for Pre-Surgical Brain Mapping in Infancy is fMRI: A Paradigmatic Case

P093 Proton Spectroscopy in Patients with Leigh Syndrome. Own Material
S. Chelstowska, E. Jurkiewicz, I. Pakula-Koscielska, K. Nowak, K. Malczyk, J. Sykut-Cegielska, E. Pronicka, M. Bekiesinska-Figatowska

P094 MRI Appearances of Primary Intracranial Arachnoid Cysts in Infants and Children
G. Papaioannou, D. Loggitsi, I. Kampas

Spinal Interventions

P095 Percutaneous Aspiration and Ozolysis of Symptomatic Synovial Cysts of Lumbar Spine, a Least Invasive Option
V. Kumar, H. Gupta

Posters, Neuroradiology Department; Bologna

P 096 Lumbar Disk Hernias: Percutaneous Treatment with DiscoGel® in Patients Who Did Not Respond to Oxygen-Ozone Chemonucleolysis.
F. de Santis, L. Cirillo, M. Dall’Olio, C. Princiotta, L. Simonetti, M. Leonardi

P 097 Spinal Dural Arterio-Venous Fistulae Lacking Spinal Cord Signal Abnormalities: Cases Reports and Literature Review.
L. Cirillo, F. Toni, A.F. Marliani, L. Alibini Riccioli, F. Bartiromo, M. Leonardi

P 098 Cervical Spinal Cord 1H-Magnetic Resonance Spectroscopy in Amyotrophic Lateral Sclerosis: Preliminary Results

P 099 Retreatment Apex Basilar Aneurysm with Intra-Extra Aneurysm Stent Implantation: A “Waffle Cone” Tehnique
L. Cirillo, M. Dall’Olio, C. Princiotta, L. Simonetti, A. Stafa, M. Leonardi

P 100 Treatment of a «Blister Like» Aneurysm with Coils and Stent in Stent: Neuroform and Silk
C. Princiotta, L. Cirillo, M. Dall’Olio, L. Simonetti, M. Leonardi

P 101 The Treatment of Intracranial Aneurysms with the Stent Silk Analysis of a Single Centre Experience
M. Leonardi, L. Cirillo, M. Dall’Olio, C. Princiotta, L. Simonetti, A. Stafa
SATELLITE SYMPOSIA

TUESDAY, 5 OCTOBER, 2010

12.45-13.30  BALT INTERNATIONAL  INDIGO HALL
The Silk Route Through Bologna
Chairman: J. Moret
Packing the Flowdiverter Idea: Was a Good Thing to Do? - J. Moret
Travel Stories: The French Multicentric Serie - J. Berge
Travel Stories: An Argentinian Story - W. Casagrande
Newly Discovered Territories: What Happens Inside the Aneurysm? - D. Rüfenacht

13.30-14.30  PHILIPS HEALTHCARE  BLUE HALL
Advances in MR Neuro Imaging
Introduction - I.N. Gipp
From Structure to Functional Imaging - J. Walecki
Applications of Arterial Spin Labeling in Neuroradiology: What Can this Method Bring to the Clinician? - X. Golay

WEDNESDAY, 6 OCTOBER, 2010

12.45-13.30  CODMAN NEUROVASCULAR - A JOHNSON & JOHNSON COMPANY  BLUE HALL
The CODMAN ENTERPRISE Experience: Coiling with the Vascular Reconstruction Device
A Personal Experience - N. Kocer
A Personal Experience - F. Turjman
A Personal Experience - S. Mangiafico

13.30-14.30  MICRUS ENDOVASCULAR  INDIGO HALL
Chairs: E. Cotroneo, M. Leonardi
A Stable Status-Quo? The Liberties of New Technologies
Modern advances on standard practices - M. Bendszus
Remodeling and the Conglomerate Mass Technique - P. Brouwer

13.00-14.30  GUERBET  MAGENTA HALL
Efficacy of Innovative Approaches in Brain Lesions Assessment
Introduction by the Chairman
Original Use of 3D-TRICKS in Cranial Arterio-Venous Malformations - Speaker To Be Announced
Dynamic CE-MRI, a Reliable Diagnostic Tool for Head and Neck Tumors - Speaker To Be Announced
High Field Brain MRI: No Limit? - Speaker To Be Announced
Q&A and Conclusion by the Chairman
THURSDAY, 7 OCTOBER, 2010

13.30-14.30 AB MEDICA INDIGO ALL
A new Percutaneous Approach to the Treatment of Discal Hernias
Chair: Giuseppe Bonaldi
My Own Experience - Jacques Théron
My Own Experience - Teresa Sola
My Own Experience - Stefano Marcia
Discussion

13.00-14.30 GE HEALTHCARE MAGENTA HALL
Advanced Imaging Techniques for Stroke Management
Chair: Marc Barlow
Opening Talk: What are the Challenges and Future of Stroke Management? - M. Barlow
Interest of CT Perfusion for Stroke Management: Volume Helical Shuttle and Gemstone Spectral Imaging - S. Halpin
Clinical Interest of Multimodality Software “Integrated Registration” - Radiosurgery of Brain AVM using CyberKnife - R. Anxionnat
MR for Rehabilitation after Stroke - S. Williams

FRIDAY, 8 OCTOBER, 2010

12.45-13.45 BRACCO IMAGING WHITE HALL 1
Brain Tumors
Solutions in Contrast Imaging: How to Optimize Contrast Use in Brain Imaging

13.45-14.30 BOSTON SCIENTIFIC ITALY HALL
Intracranial Stenting: Review of the Evidence
Chair: Donatella Tampieri
Vascular Wall Response and Interactions with the Neuroform Stent Delivery System - Adel Malek
Lessons Learned about Intracranial Stenting Over the Years and Most Recent Clinical Experience with the Neuroform EZ Stent System - Lucio Castellan
Monday, 4 October
Opening Ceremony
Palazzo della Cultura e dei Congressi - Europa Auditorium
Monday, 4 October - 17.00-19.10

OPENING CEREMONY

17.00-17.30

Welcome to Bologna

Paolo Ambrosetto  Master of Ceremonies
Ivano Dionigi  Rector of the University of Bologna
Sergio Stefoni  President of the Medical Faculty of Bologna
Francesco Ripa di Meana  Chairman, City Hospitals of Bologna
Cosma F. Andreula  AINR President
Luc Picard  WFNRS President
Turgut Tali  XX Symposium President
Marco Leonardi  XIX Symposium President

Opening Session

Chairs: M. Leonardi, O. Flodmark

17.30-18.10  40'

Thoughts on the Architectonic Organization of the Brain Applied to Diagnostic and Interventional Neuroradiology

Anton Valavanis, Switzerland
Universitätsspital, Institut für Neuroradiologie; Zürich; Switzerland

18.10-18.40  30'

Time is Brain. Still a Valid Concept for the Treatment of Acute Stroke Patients?

Rüdiger von Kummer
Technische Universität; Dresden, Germany

Since Hippokrates (460 to 370 BC), we did not change the nosologic concept of "stroke" that groups together intracranial hemorrhage and brain ischemia, caused by a large variety of vascular and hematologic conditions and diseases. After computed tomography had allowed excluding "hemorrhagic stroke", the treatment of "ischemic stroke" was investigated disregarding the individual causes of stroke. The pivotal study (part 2) of the NINDS rt-PA stroke study group showed excellent clinical outcome in 39 out of 168 patients (23%) after I.V. rt-PA vs. 26 out of 165 patients (16%) after treatment with placebo within 3 hours of stroke onset. Since the publication of this study in 1995 and approval of the treatment by the FDA, it was widely believed that all types of ischemic stroke could be treated with I.V. thrombolytics if treatment was initiated within 3 hours. Treatment beyond this time-limit was regarded as risky. The second positive trial with rt-PA, ECASS III, showed, however, no increased risk of brain hemorrhage for patients being treated between 3 hours and 4.5 hours. In ECASS III, 219 out of 418 patients (52%) had an excellent clinical outcome after rt-PA treatment vs. 182 out of 403 patients (45%) after placebo. This suggests that both studies showed the same net effect of 7% - and no effect in 93% - of the patients and more patients with spontaneous excellent clinical outcome when randomized later. A combined analysis of all randomized trials on rt-PA in acute ischemic stroke showed excellent clinical outcome in 41% of rt-PA treated patients when treated within 90 minutes and in 37% when treated between 271 and 360 minutes. During this time period, the proportion of patients with spontaneous excellent outcome increased from 29% to 36%. It is questionable then, whether the rt-PA effect is really declining or just changing because patients with more severe strokes appear early and have another stroke pathology than patients being admitted late. Nevertheless, the clinical benefit after I.V. thrombolytics is relatively small compared to patients with proven arterial recanalization. We have the means and it is time to differentiate among patients with acute brain ischemia according to their individual vascular and brain tissue pathology in order to achieve better treatment results. Time is a surrogate for pathologic processes and a weak argument for identifying the appropriate treatment for the individual patient.

18.40-19.10  30'

Discovering Bologna, the Secret Charm of a City

Anna Ottani Cavina
Bologna University, Federico Zeri Foundation; Bologna, Italy

19.15-20.30

Welcome Cocktail Buffet

Exibition Hall Level 1 & 2
Cape Town
International Convention Center

11th congress
WFITN
World Federation of Interventional and Therapeutic Neuroradiology

8th to 11th November 2011
SOUTH AFRICA

Local organizing committee:
Allan TAYLOR, David LE FEUVRE
H53 OMB, Groote Schuur Hospital
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Website: www.wfitn2011.org
Morning Seminars
Morning Seminars
Tuesday, 5 October - 08.30-09.00

Europa Auditorium
Advances with Flat Detector Imaging in the Angiography Suite
M. Mawad
Baylor College of Medicine, Department of Radiology, Houston TX; USA

Italy Hall
Suspected Abusive Head Trauma in Small Children - The Role of Neuroradiology and the Neuroradiologist
O. Flodmark
1 Karolinska Institutet; Stockholm, Sweden; 2 Department of Neuroradiology, Karolinska University Hospital; Stockholm, Sweden

To the radiologist, neuroradiologist in particular, physical abuse of infants and babies are of greatest interest since neuroradiology is often the only means by which the diagnosis of abuse can be suspected and subsequently proven. Small infants are most often shaken while larger infants are more often submitted to shaken/impact injury. The resulting brain damage is devastating. The infant presents with most non-specific symptoms, making the clinical diagnosis of abuse extremely difficult.

The repeated accelerations and decelerations and rotations associated with repeated shaking of a small baby will cause venous haemorrhage into the subdural space, a very important marker indicating that the baby has been shaken. Repeated instances of abuse will cause haemorrhages of different ages. Same treatment will also cause tearing injuries seen in the white/grey matter interface, often with small haemorrhages as well as retinal haemorrhages. Hypoxic/ischaemic brain injury added upon the tearing injuries aggravates brain oedema. With the findings of sub-dural haemorrhages, brain oedema and retinal bleeds in combination, child abuse is the only clinically reasonable diagnosis.

The most important method used to diagnose abuse of infants is CT-scanning of the brain. It is an effective way of showing subdural haemorrhage and can give an indication of the age of the haemorrhage. MR imaging has a superior sensitivity in detecting collections of haemorrhage in the subdural space. It has a superior ability to demonstrate brain injury. The only but most important weakness of MRI is its inability to accurately indicate the age of a subdural haemorrhage.

The purpose of this presentation is to stress the fact that physical abuse of infants and small children is a radiological diagnosis. The clinical diagnosis is always difficult and in most cases impossible. Objective imaging documentation of internal injuries, fractures, intracranial haemorrhages and brain injuries is in the domain of radiology and is often the only possibility to make the correct diagnosis and confirm the presence of child abuse!

Blue Hall
Living Matter Simulation, from Gene to Body
K. Fukasaku
Computational Biomechanics; Riken, Japan

At each level of molecular, cell, organ and body, we already have various knowledge. However, description of larger level using smaller level is not established very well. For example, cell biology is not described by molecular biochemistry. Although we know biochemical reactions and structure of cells, such reactions are driven in spatially separated membranous organelle. We are reconstruction cells having organelle and biochemical reactions in computers. We also reconstructing organs having such virtual cells. Then, virtual organs to human body. Our next generation living matter simulator is designed to have metabolizing myocardium, beating heart and blood stream. One of the purpose is, of course, medical use, simulation for diseases and treatments. We are planning to show over view of our living matter simulation and its trial for high energy focused ultra sound (HIFU) and particle radiation. Our real human vessel simulation model for training and trial of endovascular procedure will be shown, too.

Indigo Hall
Causes and Imaging of Non-Hypertensive, Non-Traumatic Intracranial Hemorrhages
M. Schumacher
Clinic for Neuroradiology, Neurocenter University Hospital; Freiburg, Germany

Intracranial hemorrhages are a serious illness with a high mortality rate. They require rapid diagnosis and classification and, whenever possible, clarification of the etiology. The patient’s outcome depends on early diagnosis and initiation of appropriate relieving operations or drainage. In the past, CT was the method of choice. However, over the past years especially after the introduction of FLAIR and the blood-sensitive Gradient Echo Sequences (GRE), it has been found that MRI can also depict all types of hemorrhage and even has greater sensitivity for smaller and certain special types of bleeding. In addition to the classification of hemorrhage, it is important to know the pattern of changes during the course of hemorrhage resorption via biological degradation, and thus to be able to retrospectively estimate the age of the hemorrhage with at least a reasonable degree of certainty.

Close knowledge of the evolution of hematomas in the CT and MRI is imperative for adequate interpretation of findings. They progress differently in the CT and MRI due to the different physical principles. For progressive examinations with both methods, various bleeding stages are differentiated from per- or hyperacute stage to the chronic stage. In ICH schemata for MR-diagnostics, the subacute phase, lasting from four days to one month, is subdivided in early subacute (days 3 to 7) and late subacute (day 7 to 1 month).

The image characteristic in the CT shows these degradation processes of the blood products in parallel with
increasing loss of density, corresponding to the lower weakening of the X-ray. In the MRI, the characteristic changes in the breakdown of the hemoglobin follow the various paramagnetic effects in the breakdown of the haemoglobin products. These differ by field strength and the sequence used.

The various magnetic properties in the degradation process are the result of different oxidation states of iron in the haemoglobin degradation substances. The various oxidation states in the degradation of haemoglobin are decisive for the MR signal characteristics, but they are additionally influenced by the protein concentration in the hemotema, the hydration, the composition of the erythrocyte content, the hematocrit and the internal structure of the hemotema.

The resorption stages and their image characteristics in CT and MRI are presented exemplary for different diseases such as Amyloidangiopathy, Neoplasia/herniation syndromes, Sinus/ cortical venous thrombosis, Arteriovenous malformation, Post treatment hemorrhage (p-surgical, radiation), Hemorrhagic infarction, Aneuerysm.

Green Hall
Neuroradiology of Emergency
L. Simonetti
Neuroradiology Department, Maggiore Hospital; Bologna, Italy

Magenta Hall
DTI of Brachial Plexus
G. Pellicanò, L. Mazzoni, P. Zanobini, N. Villari
Radiology Dept. Careggi University Hospital; Florence, Italy

Purpose: To evaluate the feasibility of DTI of the brachial plexus, using a standard 1.5T MR scanner and a standard receiver coil.

Introduction: DTI allows to estimate the degree of anisotropy of water diffusion, applying diffusion gradients in many directions. Using the informations provided by DTI acquisition, it is possible to reconstruct neurons patterns: in fact water molecules contained in these cells have a strongly anisotropic diffusion behaviour, due to the shape of neurons cell membrane. This technique has a wide application in intracranial MR studies, providing useful informations about white matter (presurgical MR applications, degenerative diseases, etc.), but interest is growing about DTI application on periferal nervous system. In particular, DTI application on brachial plexus is challenging, considering the wide spectrum of effects that can affect the measurement (presence of many tissue-tissue and air-tissue interfaces, breathing, blood flow artifacts, heart motion and so on). In this work we describe a preliminary experience about DTI study of the brachial plexus using a 1.5T MR scanner and a standard cardico-coil as receiver. In particular it is reported an acquisition and reconstruction protocol that tries to minimize the influence of the artifacts. Our goal was to check if it is possible and useful to introduce DTI in MR of the brachial plexus in clinical practice. The study has been performed mainly on healthy subjects and only few applications on patients are reported.

Materials and Methods: 20 healthy subjects and 10 with post-traumatic paralysis have been scanned, with the receiver coil placed on the brachial plexus. The scanner was a 1.5T Philips Intera (release 12, Best, The Netherlands). The standard imaging protocol was composed of: SE T1w (sagittal orientation), TSE T2w (coronal orientation), TSE T2w with and without fat suppression (axial orientation, following the medial plexus fibers path), all with a thickness of 3mm and gap = 0. The total scanning time was ~15 minutes. Using these acquisitions as reference, a DTI w sequence (thickness = 3mm, gap = 0, TE = 80ms, TR = 6600ms, 18-22 slices, b = 0-800 s/mm², FOV = 320x250 mm², respectively RL and AP directions, pixel size ~2x2 mm², 10 averages, 32 diffusion gradient directions, scanning time ~20-25 minutes) was localized in the axial plane.

One healthy subject was preliminary scanned many times in different days, varying the acquisition plane (coronal-axial), the number of diffusion gradient directions (16-32) and the sensitizing factor b (800-1000 s/mm²), to test the basic DTI protocol.

After the acquisition and automatic FA calculation, fibers were reconstructed using a remote console (Viewforum, Philips, Best, The Netherlands). The reconstruction algorithm implemented on this console is deterministic; default threshold parameters for FA and angles were used. Brachial plexus was divided in three regions, that were reconstructed independently: from proximal to distal to spinal cord. Finally, to assess the reliability of the reconstructed fibers, they were superimposed on anatomical images, in order to verify the degree of matching of 3D reconstructions and anatomical imaging.

Results: A good matching between 3D fibers reconstructions and anatomical images was recorded in all the examinations. The middle part was always properly reconstructed. The reconstruction of proximal and distal part was possible only in the 30% of the examined subjects, probably due to low SNR and breathing depending artifacts.

In the five patients with post-traumatic paralysis 3 of 5 showed fibers interruption corresponding to roots avulsion on standard images.

Conclusions: DTI of Brachial Plexus can be applied in patients with post-traumatic lesions of this district, even if it shows some difficulties to identify all roots course, especially at C7-D1 levels.

Violet Hall
External and Middle Ear Imaging and Pathology
D. Yousen
Johns Hopkins Medical Institution; Baltimore, MD, USA

Congenital lesions of the external and middle ear require an understanding of the branchial system as well as the indications and contraindications for surgical correction. EAC atresia will be emphasized with imaging findings that increase surgical risk of repair. The intracranial complications of otomastoiditis will also be reviewed as well as the main complication of development of cholesteatoma. Finally, the differential diagnosis of the white versus the red retrotympanic mass will be reviewed with implications for surgery.

White Hall I
Functional Spine Imaging
V. Haughton
University of Wisconsin; Madison, WI, USA

As it does for the brain, Functional imaging provides additional clinically valuable information on the spine, especially in the problem of back and neck pain.
While conventional anatomic spine imaging demonstrates many abnormalities, such as herniation of the intervertebral disk, with nearly perfect accuracy, it does not effectively distinguish incidental degenerative changes in the disk from those that result in pain production. Functional imaging of the spine, still under development and evaluation, will facilitate the identification of painful disks and the selection of patients for innovative treatments that are presently under development. Functional imaging of the spine includes: MR spectroscopy, fMRI of the spinal cord, diffusion imaging, T2 relaxation time, T1 rho measurement and dynamic imaging. The purpose of this presentation is to review the status of these functional MR techniques.

**MRS:** MR spectroscopy demonstrates tissue constituents that have characteristic resonant frequencies. For the disk, the substances that can be recognized in MR spectra and quantified include lactic acid and glycosaminoglycans. Lactic acid has been documented by direct sampling of the disk in painful degenerating disks. With MRS, the concentration of lactic acid is measured non-invasively. In pilot studies, lactic acid concentration effectively distinguishes asymptomatic degenerating disks.

**FMRI:** Functional MRI detects regions of brain or of spinal cord in which activation, that is increased blood flow, occurs with the performance of a specific task. fMRI has been used experimentally to detect activations in the spinal cord secondary to sensory and motor tasks.

**Diffusion imaging:** Diffusion imaging, based on the diffusion of protons in tissue, has been used to detect infarction in the spinal cord, as it has in the brain. Used to measure diffusion tensors, it has shown the structure of spinal cord tracts various spinal cord diseases. In the intervertebral disk, diffusion changes with the degree of disk degeneration. Diffusion in the intervertebral disk has been studied by measuring changes in signal intensity over time after intravenous injection of contrast medium. Degeneration in the disk slows the rate of diffusion into the disk.

**T2 relaxation time measurement and T1 rho measurement:** The T2 relaxation time and the T1rho in the disk correlate with the water content, which changes with aging and degeneration. Both techniques have been validated by means of conventional measures of water content. With these techniques, changes in water content due to normal aging and due to degeneration can be measured. The techniques provide a quantitative, non-invasive measure method to distinguish early degeneration from aging and to monitor the effects of aging, degeneration and experimental treatment on the intervertebral disk.

**Dynamic imaging:** Dynamic imaging shows changes in spinal alignment due to changes in loads and torques on the spine. The clinical utility of the technique has not been proven. Dynamic imaging also allows the measurement of the changes in alignment as a torque is applied to the spine. Normal disks permit less than one degree of rotation secondary to a normal physiologic axial rotary torque while degenerating disks permit up to 6 degrees of rotation. Dynamic imaging provides a crude approximation of the biomechanical function of the spine.

**Conclusions:** Techniques for functional imaging of the spine have been developed and validated. These will assist in the detection of patients with early degenerative changes that may be treatable with genetic, biomechanical, or biochemical manipulation of disk tissue. Functional techniques allow the sampling of metabolites in the disk, water content, biomechanical function. Spine imaging specialists have the opportunities to apply these techniques in research and in clinical practice.
Morning Seminars
Wednesday, 6 October - 08.30-09.00

Europa Auditorium

Ophthalmic Artery: Its Variations and Dangerous Anastomosis

L.S. Choi
Lahey Clinic Medical Center,
Interventional Neuroradiology;
Burlington, MA, USA

Italy Hall

Cerebrovascular Pathologies in North Africa

N. Boukhrissi, N. Boukhrissi, M. Jiddane, K. Tlili, B. Mansouri, M. Beddi
1Hôpital des Spécialités Morocco; 1 Tunisia; 2 Algeria; 3 Centre Hospitalier National Nouakchott; Mauritania

Cerebrovascular pathologies in their stroke pattern part are the most important public healthcare priorities in the world. The knowledge of validated epidemiological data, which were got in USA, Europe have taken aware of the great scale of this medical problem at the same level of cancers and cardiovascular pathologies. Management of stroke give a key role to medical imaging for diagnosis, prognosis and therapeutic approach. The aim of the lecture is to give an overview on the status of this subject in North Africa.

International radiologists density standard; 70

Pathologies profile: There has been a decline of the incidence of most infectious/parasitic diseases and malnutrition; with the modernization and improving in living standards cardiovascular diseases, obesity and hypercholesterolemia, tabagism are on the rise incidence. We’ll see the changes occured in the etiological and epidemiological data from the first series on the 1990’s to the 2000’s as well risk factors. Medical imaging contribution: Before the 1980’s angiography were the one tool, then CT became the rule while MRI has been sparsely introduced.

Echo doppler is currently used in general clinics and departments while interventional diagnostic and therapeutic are pushed in institutes dedicated to head & neck and nervous system.

Neurosurgery & interventional neuroradiology: As reference of the historical background and trends in this matter, we’ll present a national survey of aneurysms conducted in Morocco for the International Congress of Neurosurgery-2005.

Conclusion: Future. Vital prognosis factors at the acute stage of stroke in North African studies were similar to the reported data. They are very important to predict the outcome and to undertake the most adequate therapeutic strategy. Nowadays, it is clearly demonstrated that stroke units are beneficial in terms of both mortality and morbidity. The relative poor prognosis observed in these studies, must be a good incitement for policy maker to create not only more stroke units with plants dedicated to neurorehabilitation but also to improve management of neurovascular malformations in North Africa. Multidisciplinary staffs of Neuro Surgeons, NeuroRadiologists and Neuroradiologists are pushed in institutes while interventional diagnostic and therapy were the one tool, then CT became the rule while MRI has been sparsely introduced.

The power of neuroimaging in revealing the cause of Cerebral Palsy (CP) is now well accepted. Imaging using various imaging modalities shows pathology in 77% when Computed tomography (CT) is used and in 89% when magnetic resonance imaging (MRI) is employed. Neuroradiology is capable of defining brain pathology including various congenital malformations and different destructive lesions in white and grey matter. By definition, CP always includes some kind of motor deficit. However, some of the lesions found to be responsible for the motor deficit in CP may also cause other functional deficits such as visual, cognitive defects. The additional symptoms may also occur isolated without concurrent motor deficit. Thus, knowledge about the underlying brain injury may define individuals with a certain kind of destructive brain lesion with associated handicap but without CP. The traditional way to define the timing of an insult and subsequent brain injury responsible for CP is to define an injury as being either pre-, peri- or postnatal in origin. However, neuroradiology has demonstrated that the morphology of a certain lesion is dictated by the maturation of the brain at the time of the insult. Selective vulnerability in different parts of the brain during different stages of brain development is of greater importance to determine the brain pathology than the type of insult. Thus it is more logical to relate a certain type of brain injury to the known time window during which this particular lesion is known to occur than to relate the injury to the time of birth. Hence it is possible that neuroradiological definition of a specific lesion and the time window during this lesion is known to occur, contradicts the clinical impression of cause and effect in CP. This may have important medical legal implications as well as being of importance in the treatment and reha-
bilitation of a child with CP. Although timing of an insult is the most important factor in determining the pattern of pathology, the duration and severity of the insult are other important factors. Thus profound asphyxia causes lesions different from those due to partial hypoxia in the mature brain but also in the immature brain before 34 gestational weeks. The purpose of this presentation is to demonstrate that CP most often is caused by a brain lesion that can be both identified and classified by neuroimaging. Thus neuroimaging mergers as the most important tool to be used when investigating the causes of cerebral palsy. To know the cause of a child’s handicap is important for the individual child and its family, for purposes of genetic counseling, rehabilitation and has significant medico-legal implications.

Indigo Hall
Brain AVMs Understanding and Management
A. Valavanis
Universitätsklinikum, Institut für Neuroradiologie; Zürich; Switzerland

Green Hall
The Stroke Unit: Angio-CT
L. Simonetti
Neuroradiology Department, Maggiore Hospital, Bologna; Italy

Magenta Hall
Possibilities of Magnetic Resonance Imaging in Systemic Lupus Patients
V. Peterová
MR Department, Radiodiagnostic Clinic, First Faculty of Medicine, Charles University in Prague; Czech Republic

Systemic lupus erythematosus (SLE) is an autoimmune disease characterized by production of autoantibodies against own cell nuclei with cytotoxic tissue damage. Neuropsychiatric lupus (NP-SLE) occurs in 50-75% of SLE cases. Process mainly affects women of childbearing age and leads to chronic vasculitic and vasculopathic impairment of various organs - joints, skin, brain, kidneys and cardiovascular system. SLE is accompanied by accelerated atherosclerosis with high risk of stroke, which is considered a major cause of death. Effective method to monitor the cerebral affection in SLE patients is magnetic resonance (MR) imaging, which answers the question if there are any lesions, about their localization, about extent of the edema, the blood-brain barrier or metabolic activity, together with evaluation of cervical spine during one investigation. Pathological lesions in NP-SLE patients, but also in SLE with clinically silent NP-SLE are mostly distributed in supratentorial gray and white matter in frontal and parietal lobes and lesions up to 3mm prevail. But in NP-SLE patients suffering from stroke great wedge-shaped lesions are present. Infratentorial lesions, callosal and cervical spinal lesions are quite rare. White matter as a whole is perfectly displayed using flow attenuation inversion recovery (FLAIR) sequence. Long FLAIR is usually favorable, but needs a longer acquisition time. Inversion recovery in T1 weighted images (T1WI) can depict better the morphology of the lesions, but lesions are most often isosignal in T1WI. Fast field echo sequences due to shorter time can improve the imaging, usually in MR angiography (MRA). MRA can better distinguish the slight changes on the smaller cerebral arteries caused by vasculitic or vasculopathic process. Aneurysms on magistral arteries are rare, but can be found, in typical locations at Willis circle branching. If we monitor patients over the years very thin slices from 1 to 3 mm are used, usually in the mode FLAIR and T1WI, which allow volumetric measurements (lesion load, brain - parenchyma fraction) and evaluation of atrophy of brain compartments, as well as an increase of lesions in time. Volumetric studies are performed by semiautomatic methods in special software, using manual contoured rims of some particular parts of brain or fully automatic methods. Amygdalae, hippocampi and other specialized regions can be thus been traced and their size evaluated. In hyperacute or acute patients, if the lesions are not visualized by MR imaging diffusion imaging (DWI) is very advantageous by showing localized diffusion reduction. Diffusion tensor imaging (DTI) may be illustrative supplement, showing in various colors the direction of individual fibers. MR spectroscopy is particularly useful when MR imaging is negative. It for instance shows the reduction of N-acetyl aspartate or choline changes in places of vasculopathic process and can further vary other characteristics of the lesions. Metabolic activity of lesions can be distinguished by use of magnetization transfer suppression of bound-water signal in T1WI in lesions. We are able to evaluate functioning or disorder of blood-brain barrier after contrast administration of complex-bound gadolinium, manganese or iron particles by assessment of postcontrast enhancement. T2-weighted images with fat signal suppression, i.e. spectral presaturation with inversion recovery (SPIR), short time inversion recovery (STIR) or water selective excitation MR imaging (WATIS) can in some lesions improve the resolution of tissues previously covered by fatty components and better differentiate structures. Those techniques can be also used during MR angiographic sequences. In general, white matter lesions in SLE and NP-SLE patients are non-specific and therefore represent the differential diagnosis of other white matter diseases: multiple sclerosis, encephalitis, other vascular events, other autoimmune rheumatic diseases, hypertensive encephalopathy. MR imaging is only a very sensitive method, able to distinguish the lesion by an excellent way, with perfect localization possibility, further determine their nature, even though the resolution of non-inflammatory and inflammatory lesions is not possible.

References
White Hall 2

Imaging of White Matter Diseases

Y. Miki
Department of Radiology; Osaka City University, Japan

Multiple sclerosis (MS) is the most important white matter disease, but leukoaraiosis (age-related white matter lesion) is the most frequently encountered white matter lesion. In this talk, multiple sclerosis, leukoaraiosis, and other white matter diseases are reviewed. MS is an autoimmune, inflammatory demyelinating disease of the central nervous system. MS shows multiple lesions in both space and time. The revised McDonald criteria are the most widely used diagnostic criteria for MS in Western countries, although some modifications of the diagnostic criteria are needed in Asian countries, as Asian patients show fewer lesions and differences in lesion distributions. Wide variations exist in MS lesions, including ovoid lesions, callosal-septal interface lesions, isolated U-fiber lesions (juxtacortical lesions), tumefactive lesions and Baló's concentric lesions. MR imaging is important not only as a diagnostic tool of MS, but also as a biomarker of this disease. Neuromyelitis optica (NMO) is an idiopathic, severe, demyelinating disease of the central nervous system that preferentially affects the optic nerve and spinal cord. NMO is more frequent in Asia and was formerly thought to be a variant of MS by researchers in Asian countries. However, this disease is now considered to be a distinct entity, since a specific antibody for this disease (NMO-immunoglobulin G or aquaporin 4 antibody) has been identified. Some differences in brain and spinal cord lesions are seen between MS and NMO. Acute demyelinating encephalomyelitis (ADEM) is a severe inflammatory demyelinating disease that frequently develops secondary to infection or vaccinations. ADEM is usually monophasic, but may recur or evolve to MS. Diagnostic criteria for differentiation between ADEM and MS have been proposed. Leukoaraiosis is an age-related degeneration of deep cerebral white matter, characterized by hyperintensity on T2-weighted or FLAIR imaging. Leukoaraiosis does not always represent infarction. Several risk factors for leukoaraiosis have been reported, including aging, hypertension, diabetes mellitus, metabolic syndrome, atherosclerosis, genes and cutout plaques. A variety of pathological changes has also been reported to correspond to leukoaraiosis. Fazekas classification is widely used to visually classify leukoaraiosis, and computer-assisted quantification of leukoaraiosis has also been reported. Questions for CME

1. Which of the following criteria is currently regarded as the gold standard for multiple sclerosis diagnosis?
   a. Poser criteria
   b. Schumacher criteria
   c. McDonald criteria
   d. Wendy's criteria

Answer: c (McDonald criteria)

2. Which of the followings is the target of NMO-immunoglobulin G?
   a. Aquamarine-3 water channel
   b. Aquamarine-4 water channel
   c. Aquaporin-3 water channel
   d. Aquaporin-4 water channel

Answer: d (Aquaporin-4 water channel)

Yellow Hall

Biomechanics of the Spine

R. Izzo
Cardarelli Hospital; Naples, Italy

The spine is a multarticulare complex structure controlled by the muscles which supports the head and trunk during the posture and movements and which encloses and protects the spinal cord. The normal function of the spine presupposes its stability. Apart from protecting the neural elements the spine's stability is the basic requirement for the transfer of power forces between the upper and lower limbs, for the active generation of forces, to prevent the early biomechanical deterioration of its own components and to minimize the energy expenditure during the action of the muscles. According to the American Academy of Orthopedic Surgeons the stability is the "capacity of the vertebrae to remain cohesive and to preserve the normal deplacements in all the body physiological movements". The instability is an important case often unknown of low back and neck pain. Back pain is an important societal problem with highly significant costs experienced by up to 75-80% of the people in the industrialised societies at least once in its lifetime. While most of classical definitions of instability refer to a global increase of the movement or the"normal limits" associated with back and/or radicular pain, the concept of normality remains still debated also owing to absence of standard references. According to Panjabi the stability is controlled by a stabilising system consisting of three subsystems: spinal column, spinal muscles and a neuromuscular control unit working in strict connection to each other. The spinal column has two function: structural and transducer. The former provides the intrinsic stiffness with the contribute of the muscular work, the latter answers with abnormal inputs to the muscles fired without the normal coordination. A feedback mechanism creates ending with increased stresses on both the muscles and spinal components with inflammation and eventually chronic pain. Degenerative instability can be defined as an alternation of the vector forces between the FSUs with creation of abnormal, paradoxes movements. A degenerative primus movens triggers disorders of movements which, in turn, increase the initial osteo-articular and biomechanical abnormalities extending them to the adjacent joint. The degeneration involves generally the disc from which spreads centrifugally to the facet joints of the same level and then to adjacent segments transforming a segmental disease in a regional one. In many cases of chronic pain, while the instability is accounted for, the pain is generated by the posture or by a strong muscle action more than the movements. Furthermore when the disc, with the degeneration, loses the capacity of transmitting uniformly loads, just as the knee and ankle joints, the irregular transmission of loads can provoke pain: the instability could be in some cases at least a myth, as suggested by the unpredictable results of the surgical fusions.
3. The diagnosis of a malformative syndrome is still growing and appears to be unavoidable in the evaluation of a malformation syndrome. More specifically in relation to the final diagnosis (and prognosis) the role of neuroradiology and above all of Magnetic Resonance (MR) can be divided in four different steps:

1. Make the diagnosis of a malformative syndrome. In these cases MR (and/or Computerized Tomography - CT) features can be pathognomonic. Some examples can be: Aicardi syndrome, De Morsier Syndrome or Walker-Warburg syndrome in which the malformations’ features are so typical than can suggest the diagnosis with a very high degree of probability.

2. Suggest the diagnosis of malformative syndrome. In this case MR (and/or CT) reveals one or more aspects that are necessary to make the diagnosis but still remain not specific. Typical examples can be the totally or partial absence of corpus callosum, or the presence of polymicrogyria that can be part of a number of different syndromes but are not specific for anyone.

3. The diagnosis of a malformative syndrome cannot be excluded. This negative definition means that MR (very rarely CT) discloses some very slight signs that can still be considered at the border between normal and abnormal development, but should be highlighted considering the clinical suspicion of a malformative syndrome. These aspects are more frequently observed in midbrain-hindbrain region or in corpus callosum. They usually refer to minor dysmorphological aspects that can not be categorized in one major malformation, but can be suggestive of some at least minor derangement in normal brain development.

4. Negative exam. A normal examination cannot be considered as an examination without any information. Many neurological syndromes can have a complete normal MR study even the number of supposed normal MR exams is progressively reducing and the systematic use of new quantitative techniques such as voxel based morphometry have shown as qualitatively apparent normal brain can become abnormal if quantitatively scrutinized.

In conclusion the diagnostic role of neuroradiological techniques in malformation syndromes has been significantly changed in the last years and is still in evolution due to more quantitative approach to assess dysmorphological aspects in developing brain. Thus the study of phenotypic aspects of the brain in malformative syndromes could increase progressively its importance as well as the genotypic one.

In the recent years the advances in neuroradiology, developmental biology and molecular genetics have greatly increase our understanding of developmental disorders affecting the central nervous system both as isolated anomalies and as a part of larger malformation syndromes. The contribute of neuroradiology in assessing abnormal brain development from the early fetal life to the first steps of postnatal development is still growing and appears to be unavoidable in the evaluation of a malformation syndrome. More specifically in relation to the final diagnosis (and prognosis) the role of neuroradiology and above all of Magnetic Resonance (MR) can be divided in four different steps:

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Europa Auditorium

Current Status of Carotid Stenting: The North American vs the European Perspective

M. Mawad
Baylor College of Medicine, Department of Radiology, Houston, TX, USA

Blue Hall

Phenotypic Identification of Neurological Malformations: Neuroradiology of Syndromes

F. Triulzi
Children’s Hospital “V. Buzzi”, Milan, Italy

In the recent years the advances in neuroradiology, developmental biology and molecular genetics have greatly increase our understanding of developmental disorders affecting the central nervous system both as isolated anomalies and as a part of larger malformation syndromes. The contribute of neuroradiology in assessing abnormal brain development from the early fetal life to the first steps of postnatal development is still growing and appears to be unavoidable in the evaluation of a malformation syndrome. More specifically in relation to the final diagnosis (and prognosis) the role of neuroradiology and above all of Magnetic Resonance (MR) can be divided in four different steps:

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Indigo Hall

Arterial Wall Understanding and Therapeutic Consequences

K. Ter Brugge
Toronto Western Hospital, Diagnostic and Therapeutic Neuroradiology; Toronto Ontario; Canada

Green Hall

Stroke Imaging Standardization

M. Sasaki
Advanced Medical Research Center, Iwate Medical University; Morioka, Japan

Stroke imaging is widely used to assess patients with acute ischemic stroke, including candidates for thrombolytic therapies. However, the procedures and interpretations of stroke imaging remarkably vary among institutions and vendors; this may deteriorate the quality and accuracy of stroke imaging, particularly perfusion imaging. Perfusion imaging, which is performed using either CT or MRI, is used to evaluate the extent of the area with ischemic penumbra by applying a mismatch concept and is expected to contribute to the prolongation of the therapeutic time window of reperfusion therapies. However, recent clinical trials on thrombolytic therapies were unable to fully establish the efficacy of this technique. One of the reasons for this can be the significant inter-institutional variability in the sizes of perfusion abnormalities; these differences can be attributed to differences in the parameters and algorithms among software packages or institutions. To resolve this issue, some university-industry cooperative research groups such as Acute Stroke Imaging Standardization Group (ASIST) - Japan (http://assist.umin.jp) and Stroke Imaging Repository (STIR) (http://stir.ninds.nih.gov) are attempting to standardize and cross-validate perfusion imaging. These activities have elucidated the potential advantages of delay-insensitive algorithms and have yielded novel digital phantoms, which can accelerate the validation and evolution of commercial and academic software for perfusion analysis. Further studies using standardized protocols and sophisticated software packages or institutions. To resolve this issue, some university-industry cooperative research groups such as Acute Stroke Imaging Standardization Group (ASIST) - Japan (http://assist.umin.jp) and Stroke Imaging Repository (STIR) (http://stir.ninds.nih.gov) are attempting to standardize and cross-validate perfusion imaging. These activities have elucidated the potential advantages of delay-insensitive algorithms and have yielded novel digital phantoms, which can accelerate the validation and evolution of commercial and academic software for perfusion analysis. Further studies using standardized protocols and sophisticated software packages or institutions. To resolve this issue, some university-industry cooperative research groups such as Acute Stroke Imaging Standardization Group (ASIST) - Japan (http://assist.umin.jp) and Stroke Imaging Repository (STIR) (http://stir.ninds.nih.gov) are attempting to standardize and cross-validate perfusion imaging. These activities have elucidated the potential advantages of delay-insensitive algorithms and have yielded novel digital phantoms, which can accelerate the validation and evolution of commercial and academic software for perfusion analysis. Further studies using standardized protocols and sophisticated software packages or institutions.
presentation of lesions that are disseminated in time and space, but a variety of laboratory and imaging tests can contribute to the diagnosis. MRI can provide supporting evidence for the diagnosis of MS by demonstrating multifocal white matter lesions, it can exclude other central nervous system lesions that might mimic the clinical findings of MS and it can substantially reduce the time required to establish a diagnosis. Any part of the CNS can be affected by MS, including the optic nerves and spinal cord. Indeed, the most frequent presenting complaints are related to the optic nerves and/or the spinal cord. In the latter group, MRI of the brain will demonstrate multifocal white matter lesions in 40-70% of individuals, even in the absence of any clinically detectable brain lesion. This fact has led to the popular practice of doing brain MRI in all patients with suspected MS, even if all the symptoms are outside the brain. The brain lesions themselves have a predilection to the peryventricular white matter (particularly the peritrigonal region) and the corpus callosum, however, any part of the brain can be affected. Lesions can also be detected in the spinal cord and optic nerves, but not as reliably as in the brain. The morphology of plaques varies on MRI. The most common are ovoid in shape with the long axis oriented perpendicular to the corpus callosum or periventricular surface.

Figure 1 Typical MS lesions in the brain and spinal cord.

Small lesions are the rule but the lesions can be 5-6 cm or larger in size, resembling tumor. Later in the disease, confluent lesions become more prevalent. Gadolinium enhancement occurs during the active inflammatory stage of the disease and usually lasts 2-3 months. This phase of the plaque is often accompanied by edema and mass effect. Treatment with high dose steroids can suppress contrast enhancement but only for as long as the individual remains on steroids. Later the mass effect resolves and the intensity of the plaque begins to look more fluid-like, notable by relative hypointensity on T1-weighted images. Plaques may occur even in the clinically asymptomatic patients. Some of these plaques have been shown to be transient in nature. This observation has led to some therapeutic research protocols using MRI to monitor the effectiveness of experimental therapy, rather than clinical assessment. Many normal adults have small hyperintensities on T2-weighted MRI. Thus MRI must be interpreted with caution so that a diagnosis of “MS” or “consistent with MS” is not erroneously assigned to a healthy individual.

Novel MR Imaging Techniques: Conventional MR imaging is associated with shortcomings including a low capacity to predict clinical status, low sensitivity to diffuse white matter involvement and to gray matter lesions. Newer emerging techniques offer opportunities for improved specificity and sensitivity in diagnosing and monitoring MS, enhancing our ability to detect and characterize the disease burden, including occult microscopic disease invisible when using conventional MR techniques.

Volumetric MR imaging Lesion quantification and brain atrophy: Volumetric MR imaging provides quantification of disease burden by assessing the lesion load on T2 and T1 images (hyperintensities on T2 weighting), and is used in monitoring the natural history of the disease and in clinical trials. Quantification of diffuse atrophy reflects the adverse outcome of pathology and is seen even in the early stages of disease, including CIS. There are a number of computer-assisted manual, semi, or automated techniques for quantification which are mainly based on programs developed locally. A standardized, reliable, quick and operator friendly technique needs to be developed and tested before it can be used in the clinical setting.

Magnetization transfer imaging (MTI): MTI offers greater pathologic specificity for macromolecules such as myelin and is quantified by calculating the magnetization transfer ratio (MTR), which provides an imaging marker for myelin disorder. MTR is reduced in MS lesions, in the perilesional area, in dirty spots, in the corpus callosum, and in the periventricular white matter. Histopathologic studies have shown that a substantial portion of the total cerebral lesion load is located within the cerebral neocortex but also in the thalamus, basal ganglia, hypotalamus, hippocampus, cerebellum, and spinal cord. With a double inversion (DIR) MR sequence, inversion times can be selected to suppress the signals from both the CSF and the white matter. The images show superior delineation of gray matter and detection of cortical lesions is improved.

Figure 2 DIR image showing superior de-
lineation of gray matter and detection of cortical lesions.

Appreciating gray matter pathology by imaging, might, therefore, provide new insight, improving our understanding of MS pathobiology, and providing additional markers to monitor disease evolution, and treatment response. f-MRI: Despite the sensitivity of MR derived quantitative parameters to disease changes and tissue integrity, their correlation to clinical scales of impairment and disability are still scanty. f-MRI studies in MS patients have shown that there are adaptive mechanisms of brain plasticity which might contribute to limiting clinical consequences of tissue injury. Studies have investigated the patterns of cortical activation in patients with MS during the performance of motor, visual and cognitive paradigms and have shown that brain activation patterns are altered compared to controls, indicating that there is cortical reorganization in patients affected by this condition. Failure or exhaustion of such mechanisms with increasing disease duration or burden might be among the factors contributing to irreversible clinical disability. High field strength MRI presents a new set of advantages to disease detection and burden might be among the factors contributing to irreversible clinical disability. High field strength MR imaging (3.0 T and higher), high signal-to-noise ratio (SNR) can be achieved, allowing for thinner sections and higher-resolution matrices which can increase the number of detectable lesions, providing better appreciation of lesion heterogeneity and better detection of cortical lesions. High-field strength MRI presents a new set of challenges that require extensive refinement during the next few years. In the past 2 decades, MR imaging has brought about dramatic changes in the evaluation of MS, including diagnosis, natural history, and therapeutic monitoring. Using novel imaging techniques, several new imaging concepts have been developed during the study of MS—including “lesion load,” “NAWM,” “MTR,” and “WBNA.” Combining different MR modalities, which are sensitive to different aspects of MS pathology, is a promising way to increase further our understanding of the mechanisms involved in the pathophysiology of this disease. Nevertheless, there are many remaining challenges in front of us. New techniques need to be refined and validated before they can be integrated properly into clinical research and practice. New acquisition schemes and analysis procedures require standardization and optimization so that they can be used in multi-site settings. According to current knowledge, T2 and gadolinium-enhanced T1 MR imaging remain mainstay approaches in practice. MS is a challenging disease in all aspects ranging from etiology to diagnosis and treatment. It is also a disease that has greater heterogeneity in terms of clinical forms, imaging appearance, and treatment response. With the ever-advancing technology, MR imaging will certainly further improve our understanding of this disease and continue to play an extremely important role going forward.

References

Violet Hall
Magnetic Resonance Diffusion Tensor Tractography in the Brain: Its Application and Limitation
S. Aoki1, Y. Masutani2, O. Abe1
1Department of Radiology, Juntendo University, Tokyo, Japan. 2Department of Radiology, Graduate School of Medicine, University of Tokyo; Japan

Diffusion tractography of magnetic resonance imaging (MRI), such as diffusion tensor tractography, allows us to visualize white matter tracts in vivo and to study white matter integrity quantitatively. Virtual dissection of the living human brain can be performed in the first time. We developed tracking software, dTV and VOL-UME-ONE, in 2001, as a freeware (http://www.ut-radiology.umin.jp/people/masutani/dTV.htm), and we used it to visualize eloquent white matter bundles with relationship to brain tumors, cerebral infarctions and other lesions. We also used it for quantitative measurement of the specific tracts segmented by diffusion tensor tractography (tract-specific analysis) to reveal the pathologies in so-called normal appearing white matter.

Three dimensional visualization of the white matter fibers such as corticospinal (pyramidal) tract, optic radiation and arcuate fasciculus with relationship to brain tumors such as gliomas was extremely helpful for preoperative evaluation and intraoperative navigation.

We correlated tracking with intraoperative electric fiber stimulation to validate fiber tracking, in patients with small lacunar infarctions near the corticospinal tracts, relationship between the tract and fresh infarction correlated well with final (2 weeks later) motor function. Quantitative measurement of the tract is a very sensitive tool.

We analyzed the corticospinal and corticobulbar tracts in patients with amyotrophic lateral sclerosis (ALS). Changes of the diffusion parameters (fractional anisotropy and ADC) of the tracts were observed not only between normal controls but also between subtypes of ALS (limb- and bulbar-onset). Tract-specific analysis can also apply for the limbic-related tracts such as fornix, cingulum, uncinate fasciculus and etc.

We observed differences in some of the fibers in neurocognitive/psychiatric patients such as schizophrenia and Alzheimer disease. Using fiber tracking, we can now develop white matter mapping.

We visualized components of the pyramidal tract (fibers from foot, hand, face motor areas separately) and made a probabilistic map. Diffusion tractography is a unique tool to visualize and segment the white matter pathways and one can evaluate the segmented tract quantitatively. Importance of this tool will become more significant in clinical and neuroscience fields in the future.

White Hall
Cervical Disc Herniation and the Decompenstate Cervical Spine
M. Bortoluzi
Divisione di Neurochirurgia, Spedali Civili, Brescia, Italy

Background: in the last decades the interest of neurosurgeons and neuroradiologists has been mainly focused on the question of the “hard or soft disc” herniation. Little attention was paid to the crucial question of the unbalanced cervical spine despite the fact that malalignment favours the degeneration of adjacent disc and late myelopathy.

Material and Method . Retrospective analysis of microdiscectomy and carbon cage replacement (Brantigan*) in A) 80 patients operated on at one single level from January 1996 to January 2003 with a neurological symptomatic cervical disc degeneration (mean age 47 years, 66 patients with pure radicular symptoms and 14 patients with combined myelo-radiculo-pathy and B) 36 patients operated on at two adjacent levels (33 cases) and three adjacent levels (3 cases) from January 2004 to January 2009 (all with radicular symptoms with combined “mild” medullary symptoms in 8 cases).

Objectives. Updating the role of Neuroradiology, on the basis of the surgical treatment’s results with special attention to the causes impeding or favouring the restore of a balanced regional cervical lordosis. Apart from the disc herniation which caused the neurological dysfunction, the attention ought to be focused on the degenerated disc(s), centre(s) of the abnormal alignment, in fact, in order to restore a more effective cervical balance the surgical treatment of the “centres of malalignment” is crucial. Surgical Technique. Anterior approach and microsurgical technique. The disc is removed. A proper carbon cage with a seven degree wedge angle, filled with bone is introduced. No plate and screws have been used.

Results. The follow up in the first group (A) varies from 6 to 13 years, in the second group (B) from 1 to 6 years. in the group A (80 cases at one single level operated) the clinical radicular symptoms (66 cases) in all cases resolved. The “mild” medullary symptoms (14 cases) improved significantly in 8 cases (57%) and were unchanged in the remaining 6 cases. in the group B (36 cases at 2 or 3 levels operated) the radicular symptoms in all cases resolved and the medullary symptoms (10 cases) improved significantly in 6 cases (75%) and were unchanged in the other 2. in both groups no cases of pseudoarthrosis, subsidence or migration of the cage has been shown. in all cases the correction of the segmental deformity and the restoration of the segmental lordosis has been obtained. No patient has been reoperated at the same or at adjacent levels to the fused segments. All patients returned to preoperative activities.

Spontaneous Improvement of the Regional Cervical Lordosis, in the group A, after the surgical treatment of a single segment, this finding was observed in 61% (49 cases) and not in the remaining 39% (31 cases). Neck pain (Odom criteria) was unchanged only in 16% with spontaneous restoring of regional lordosis but not fewer than 42% of patients without regional lordosis. In the group B in all cases the spontaneous improvement of the regional cervical lordosis was observed and modest neck pain in only 2 cases (5%).

Discussion. Our findings support the conclusion that the timely and proper correction of a “patho-mechanic” dysfunction of a single level promotes a spontaneous process of restoration of the normal regional lordosis. On the contrary the persistence of a single pathological level maintains and favours an improper cervical curvature with an abnormal balance of the entire cervical region. The reasons of failing of spontaneous lordotic regional realignment are the same of the unbalanced cervical spine. So the attention should be paid to the “centre(s) of unbalance” impeding the restoring of a balanced cervical regional lordosis.

Our experience indicates that the surgical treatment of a single disc is adequate and correct only if the same disc, causing neurological complaints,
is as well the centre of abnormal alignment. If the centre of unbalance is not only the “neurological symptomatic” single disc, but also the adjacent discs or a kyphotic deformity of the vertebral body which cause pathomechanical dysfunctions and both prevent a correct realignment, the treatment have to include also these segments. In fact, in these cases, the correction of the single neurological symptomatic disc alone, favours the worsening of the adjacent segments and impedes the correction of the unbalance. So the correct option is the surgical management of the “decompensate cervical spine”, which requires a proper comprehensive treatment.

Conclusion. The task of Neuroradiology should be the realizing the concept of the “decompensate cervical spine” and recognizing the anatomical centre(s) of abnormal alignment aiding the neurosurgeon in the proper surgical strategy.
Friday, 8 October - 08.30-09.00

Morning Seminars

Europa Auditorium

Aneurysms Embolization, Selection of Technical Approaches

J. Moret
Chairman, Department of Interventional Neuroradiology; Beaujon University Hospital, Clichy, France

Italy Hall

What Should a Clinical Neuroradiologist Know about Anisotropy and Optical Imaging?

Y. Ozsunar
Adnan Menderes University School of Medicine Radiology Department; Aydin, Turkey

Both anisotropic and optical imaging methods are non-invasive new diagnostic techniques that have already moved from research to hospital. Both methods hold promise to be widely used in routine neuroradiological work-up. Diffusion weighted imaging is a magnetic resonance imaging (MRI) method that is able to reveal both isotropic and anisotropic imaging of water molecules. Specifically, anisotropic imaging is depicting the water diffusion in restricted tissue that is hindered by the cell membranes, such as neural fibres. The technique provides anatomic and quantitative information in normal and pathologic white matter, especially in multiple sclerosis or leukodystrophies. As various applications of anisotropic imaging, fractional anisotropy, tractography or diffusion tensor imaging can be mentioned, most notably in investigation of stroke, normal aging and neurodegenerative diseases. However, the problems with availability and complexity of MRI have led the researchers to seek for a simpler, more practical, inexpensive and non-invasive neuroimaging technique. Hence, optical imaging has attracted considerable interest. In optical imaging, visible light or near infrared light are used to obtain physiological information from viable tissues. A light probe is positioned on the scalp to measure the absorption and scattering of the light, which is related to concentration of oxy-deoxyhemoglobin and pathophysiological changes of neuronal tissue. Diffuse optical imaging can be used as 2D or 3D optical tomography using continuous wave, frequency domain and time domain methods. The aim of this lecture is to summarize the basic fundamentals, current and potential application of these techniques.

Blue Hall

Diffusion Tensor Imaging with Fiber Tractography: Assessment of Developing Brain and Aberrant Fiber Connections in CNS Anomalies

S. Lee
Yonsei University School of Medicine, Department of Radiology; Seoul, South Korea

Diffusion tensor imaging (DTI) is a novel method that can visualize white matter microanatomy and integrity in vivo. Recent advances of high-end MR technology and more robust algorithms provide higher quality DTI and more reliable tractography results. Development of parallel imaging techniques, introduction of high field MR system, generation of better algorithms and user friendly post-processing software enable us to use DTI and fiber tracking (FT) as clinical tools rather than research modality. Brain development is a complicated process with delicate fiber connections and crossings with maturation of white matter, i.e. myelination. Diffusion tensor imaging is capable of describing fiber integrity and connectivity, therefore, it is the best tool for the evaluation of developing brain and CNS anomalies. Modified fiber connection is usually seen in developmental disorders. With development of brain and maturation of myelination, increased fractional anisotropy (FA) of most hemispheric white matter fibers are observed. Previous study with multicenter, multiracial trial showed DTI-FT demonstrates abnormal hemispheric fiber connection in the cases of callosal agenesis or acquired pathology of corpus callosum. Corpus callosum is a special fiber bundle connecting both hemispheres. In early development of brain, there comes a callosal precursor and releases chemotaxants inducing fiber development and connections between both hemispheres. In complete agenesis of corpus callosum, partly developed callosum connects all fibers from frontal, temporal and parietal lobes. Homotopic connection was found by previous DTI studies. Cortical dysplasia (CD) is a kind of migration anomaly and characterized by cortical thickening, gray-white matter interface blurring and subcortical white matter signal change. Decreased FA around gray-white matter junction is seen in CD and FT describes decreased subcortical fiber connections in the affected cortex. FT is more sensitive than other conventional anatomic images. In the case of heterotopic gray matter in the white matter, the arrested neurons exist in the white matter bundles and might have some degree of directivity like the normal white matter tracts and show increased anisotropy. Gray matter in the white matter, that is, nodular or band heterotopia, showed a higher anisotropic value compared to the normal white matter tracts and showed increased FA. In CD, fiber tracts are abnormal and periventricular leukomalacia (PVL) in premature births. Before the era of DTI, an impairment of the corticospinal tract was believed to be responsible for the motor dysfunction. Previous study by Hoon et al reported that sensory fibers were the problem in PVL, and they showed a normal descending corticospinal tract at DTI and FT. In PVL, with either spastic quadriplegia or diplegia, severe atrophy of the periventricular fibers is demonstrated at DTI and FT due to previous germinal matrix hemorrhage. The corticospinal tract is usually normal, and sensory fibers are decreased in comparison with those of age-matched control subjects. The connecting fibers between the thalamic and parietal cortex, the posterior thalamic radiations, are also absent. Thinning of the corpus callosum due to volume loss of periventricular white matter (PWM) can be observed. In hemiplegic cerebral palsy, the motor
dysfunction is well correlated with the DTI and FT findings. The atrophied lenticular side corticospinal tract is clearly depicted at FT. Joubert syndrome is a subtype of posterior fossa malformation and consists of vermian hypoplasia and derangement of the cerebellar-brainstem connections or cerebellocortical connections. At MR imaging, the typical molar tooth appearance of the superior cerebellar peduncle (SCP) is diagnostic, and partial or complete absence of the vermis is demonstrated. At DTI and FT, a thickened and elongated SCP with a horizontal configuration can be seen. On DTI & FT, Joubert syndrome showed a thickened SCP and a connection to the pre-motor and motor cortex. In age-matched control subjects, a visual inspection showed that the SCP was smaller than in Joubert syndrome and there were few fibers to the cortex. This suggests that there is some modified connection from the cerebellum to the cerebral cortex in Joubert syndrome. DTI is the only method that can depict aberrant fiber connections in vivo. More robust post-processing techniques, better resolution DTI and multitemporal, higher angular DTI will be used for future studies of developmental brain disease and will lighten the new era of pediatric brain imaging.

Indigo Hall

Dural Fistulas: Clinico-Anatomical Study and Therapeutical Strategies

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Groupe Hospitalier Pitié-Salpêtrière, Service de Neuroradiologie; Paris, France

Green Hall

Stroke Endovascular Therapy

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Early recanalization reduces mortality and improves outcome in acute ischemic stroke patients.1 Endovascular therapy yields higher recanalization rates than IVT, which is still the first-line evidence-based treatment for most acute ischemic stroke patients. In recent years, interest in endovascular revascularization has markedly increased and numerous devices have been advocated for endovascular stroke treatment.2 At our department endovascular stroke treatment is performed since 1992 and more than 700 patients have been treated using thrombectomy, local intraarterial thrombolysis with Urokinase, mechanical thrombectomy by MERCI, Phoenix and Catch devices as well as PTA, and stent placement.1 In our experience as well as in animal experiments placement of an intracranial stent that compresses the occluding thrombus at the arterial wall is feasible and can result in fast and efficient recanalization.11 However, permanent stent placement necessitates the additional application of antiplatelet agents, i.e. aspirin and clopidogrel. To avoid the risk of hemorrhage,9 after antiplatelet therapy and the risk of in-stent stenosis, the concept of a retrievable stent has been introduced, which combines the fast and efficient recanalization effect of an intracranial stent and the capability of extracting the thromboembolus comparable to mechanical devices.10 We use retrievable stents in addition to the established techniques since January 2010 and we compared this technique during a five-month period with patients that were treated with another endovascular approach, e.g. thrombectomy or local thrombolysis. NIHSS score on admission of overall 40 patients, treated by endovascular approach, during this period of 5 months was 15.5 (IQR 12-29). Time to recanalization was significantly shorter in the group A (N=20), treated with retrieval stents (median 52.5 min.; IQR 37.5-61.0 min.) compared to Group B treated by multimodal endovascular approach (median 90.0 min.; IQR 66.0-12.5 min.; p = 0.001). Moreover, sufficient recanalization (TIMI 2/3) was achieved in Group A in 94.1% of patients compared to 78.3% in Group B (p = 0.179). The introduction of retrieval stents broadens the spectrum of endovascular stroke treatment, improves the recanalization rate and, more importantly, significantly reduces the time needed for recanalization which is expected to result in less infarct growth.

References

Magenta Hall

Cerebral Microbleeds, Associated Conditions and Clinical Relevance

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With the more widespread use of T2* weighted and susceptibility-weighted imaging (SWI), cerebral microbleeds (CMB) have become an important neuroradiological finding. Haemosiderin deposits around small vessels indicate extravasation of blood and cause magnetic susceptibility artefacts which appear as small areas of signal loss on T2* images and SWI. The magnitude of the susceptibility artefact caused by CMBs depends on a number of technical factors, including magnetic field strength, slice thickness and echo time (TE). CMBs occur in a number of conditions. They are present in 6% of the general elderly population, in 30% of patients with ischemic stroke and 60% of patients with primary intracerebral haemorrhage, depending on pulse-sequences and field-strength. The two commonest pathological con...
Cerebral Microbleeds are also associated with a number of less common conditions such as cerebral autosomal dominant arteriopathy with subcortical infarcts and leukoencephalopathy (CADASIL), haemorrhagic complications (coagulopa-thies such as idiopathic thrombocyto-penic purpura), familial cavernomas, bacterial endocarditis, cerebral SLE, diffuse axonal injury, and metastatic disease. These rare conditions will be shown. An association of CMB with Alzheimer’s disease (AD) has also been recognised, and link parenchymal amyloid pathology with vascular amyloid. CMB mimics include flow voids in leptomeningeal vessels, cavernomas, and susceptibility artefacts close to the skull base. Accurate documentation of number and location of CMB is important for clinical studies. We have developed a microbleed rating scale which shows an excellent intrarater and interrater reliability for the number and location of microbleeds. Future work includes automated and semi automated detection of microbleeds. Cerebral microbleeds are not a static condition. We performed a longitudinal study in stroke clinic patients over 5 years. Of patients with microbleeds at baseline, 50% had new microbleeds at follow-up compared with 8% of those without baseline microbleeds. The percentage of new microbleeds at baseline predicted new microbleeds as did mean systolic blood pressure. A recent report showed that new microbleeds can develop within 7 days of an acute ischemic stroke. This led to the hypothesis that acute ischaemia could trigger a widespread small vessel angiopathic process. With respect to the clinical relevance of microbleeds, three main topics will be discussed: cerebral microbleeds as an explanation of an acute stroke in the presence of negative diffusion weighted imaging; the risk of cerebral haemorrhage in the presence of microbleeds and its implication for anticoagulation; the impact of CMB on cognitive performance. CMB are found in an increased percentage (60%) of patients with a haemorrhagic stroke and there is a debate about the risk and benefits of antithrombotic treatment in patients who are found to have CMBs. We showed in a case-control study that lobar CMBs (suggesting possible cerebral amyloid angiopathy) are a risk factor for aspirin-related intracranial haemorrhage. A recent systematic review of case-case comparisons showed that CMBs are more common in warfarin-related ICH than “spontaneous” ICH and another study reported MBs in 87% of patients with ICH following warfarin treatment of AF. There is increasing evidence that CAA carries a particularly high risk of warfarin-related ICH. We are currently studying the risk of CMBs and anticoagulation treatment in a multi-center prospective study. CMB have also an impact on cognitive function. We studied 25 patients with and 30 patients without microbleeds matched for age, gender and IQ and found a striking difference in the prevalence of executive dysfunction, which was present in 60% of microbleed patients compared with 30% of non-microbleed patients. Microbleeds were an independent predictor of executive impairment. A large scale study of patients attending a memory clinic demonstrated CMBs in 65% of patients with vascular dementia and 18% with Alzheimer’s disease, which is well above the expected incidence in the general population. In Alzheimer’s disease, patients with >8 CMBs had worse cognition and more abnormal CSF amyloid-beta levels. This provides evidence for the role of CMB in AD. Furthermore, CMBs are an independent risk factor for death in a memory clinic population. Conclusions: In our experience, the employment of fMRI in so disparate pathologies has shown an undoubted added value in the study of emotions. Nevertheless, this “advanced technique” in Magnetic Resonance is not devoid of bias and difficulties in its setting up, especially when high magnetic fields (e.g. 3 Tesla) come into play: the higher signal to noise ratio and the higher acquisition rate have to face susceptibility artefacts and many other problems. However, the possibility of seeing the changes in the brain activity, although indirectly, has opened up new horizons in the understanding of “what happens into our black box.”

Violet Hall

Probing Cerebral Hemodynamic Parameters with MRI: Basic Principles and Applications in Brain Tumor Diagnosis

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Magnetic resonance imaging has, over the last decade become an important diagnostic tool for assessment of a variety of functional parameters in the brain. Functional MRI using blood oxygen level dependent contrast enables indirect measurement of focal brain activation in response to sensory-motor-, language- or cognitive tasks and has become an important tool in pre-surgical mapping of eloquent brain areas. A range of novel methods are now available which have shown to have significant role in both tumor characterization and grading as well as in the assessment of response to therapy. Capillary permeability and extracellular volume fraction can be quantified by kinetic modeling of the dynamic effect of an injected intravenous contrast agent. A range of hemodynamic parameters can also be estimated with modern MRI techniques, including large vessel flow, capillary flow (CBF, tissue perfusion), tissue blood volume (CBV) and mean transit time (MTT). Recent technical developments have opened up for using new parameters like the distribution of vessel sizes at the capillary level (vessel size imaging) as well as assessment of tissue oxygen extraction. Some of these techniques require the injection of an intravenous contrast agent but there is also a rapid development of completely non-invasive alternatives like arterial spin labeling (ASL) for quantitative measurement of CBF. This talk will give and introduction to the different methods, now available through advanced MRI techniques and used to probe the various functional and hemodynamic parameters relevant in brain tumor diagnosis.

White Hall I

Spinal Instability

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1. Definition and classification

Although “Spinal instability” is a popular term with 79,600 hits in Google and over 400 hits in PubMed, the first return in Google “Back.com - FAQs - What is lumbar instability” “hits” the nail on the head. When reading the opinion of more than ten specialists, one gets almost as many different definitions, ranging from the simple and elegant such as “Lumbar instability involves the abnormal movement of two vertebrae on each other”, over the simple and maybe not so elegant such as “Means that...
the spine is not stable and usually needs surgery.” to the more complex definitions. Merriam-Webster defines instability as the quality or state of being unstable, where unstable is lacking steadiness: apt to move, sway, or fall (an unstable tower), not being in or able to maintain a state of balance. Britannica defines an unstable equilibrium as one in which the least departures produce forces tending to increase the displacement, e.g. a brick lying on the floor is in stable equilibrium, while a ball bearing balanced on a knife-edge is in unstable equilibrium. Frymoyer defines spinal instability as the loss of spinal motion segment stiffness such that force application to that motion segment produces greater displacements than would be seen in a normal structure, resulting in a painful condition, the potential for progressive deformity and neurotoxic structures at risk. For some this defines “macro-instability”. It can be classified as axial rotational, translational, retrolisthetic, and postsurgical instability syndromes. Micro-instability on the other hand does not involve gross abnormal motion. For some it equals degenerative disc disease.

2. Imaging

2.1. Macro-instability: Imaging in instability can either be anatomic or functional and/or dynamic. Dynamic examinations involve either flexion/extension or any other movement that produces the patients pain. This is usually performed with X-rays but can also be done on CT or MR either with an axial-loading device or on a stand-up MR machine. Anatomic (static) examinations can also be performed with plain film, CT or MR depending on the underlying pathology. Rotational and retrolisthetic instability result from facet joint hypermobility usually due to degenerative disease. Anterolisthesis is the typical example of translational instability. Finally, postsurgical instability is due to excessive ligament, disc or bone removal.

2.2. Micro-instability:

According to some surgeons microinstability is equal to degenerative disc disease, internal disc disruption, and/or internal disc derangement. Imaging can be done accordingly.

White Hall 2

Spinal Biopsy: How and When

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CT-guided percutaneous core needle biopsy is a fast, cheap, and safe procedure.

The most common approach is the posterolateral or the transpedicular using a 11 to 13 G needle under CT guidance. CT allows the percutaneous axial approach, high spatial resolution. With CT we can reach “critical” anatomical regions with perfect needle control. Biopsies of lesions in the spine are often challenging procedures with significant risk of complications. CT-guided needle biopsies could lower these risks but uncertainties still exist about the diagnostic accuracy. Highest accuracy rates were obtained in primary and secondary malignant lesions. Most false negative results were found in cervical lesions and in benign, pseudotumoral, inflammatory, and systemic pathologies. Overall, the results on the literature show that percutaneous CT-guided core needle biopsy has a high accuracy rate.

If the diagnosis after a percutaneous CT-guided needle biopsy is negative or the result is not consistent with the clinical suspect and/or radiological imaging, it is mandatory to repeat the needle biopsy or to carry out an open biopsy.

Many studies show that the diagnostic rate is not affected by the variables such as age, gender, type and diameter of the biopsy needle, diagnosis as well as lesion localization and level.
Morning Seminars
Saturday, 9 October - 08.30-09.00

Europa Auditorium
How to Prepare a Lecture or Communication, How to Keep the Audience’s Attention, How to Have a Message Received

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Italy Hall
MRI Studies for Patients with Neurological Disorders and Implantable Cardiac Electronic Devices: Not What We Can Do, What We Should Do

D. Goldsher
MRI Inst. Neurorad. Unit, Rambam Health Care Campus and B. Rappaport Faculty of Med, Technion-Israel Inst. Technology; Haifa, Israel

Blue Hall
New View on the CSF Circulation: CSF Is Produced and Absorbed by Brain Capillaries

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is safe. All published studies were performed at centers with expertise in MRI and device monitoring, and were limited to patients with neurological symptoms and true clinical needs for MRI, the best or the only modality for diagnosis.

Recently, a pacing system [The Medtronic EnRhythm-MRI SureScan] was designed, tested and approved for use with MRI under specified scanning conditions. It is considered to be the first MR-conditional pacemaker and has a European CE-mark. The current consensus is that MR imaging in PM and ICD patients can be done, but it is an off-label procedure, requiring very good justification and safety precautions. It should be done only when clinically indicated and only in selected centers with the proper expertise, resources and experience. Individuals with certain PM and ICDs may now benefit from the advantages of this imaging modality. The guidelines and recommendations will be elaborated.

After being formed in the choroid plexus of the lateral ventricle, the cerebrospinal fluid (CSF) passes through the ventricular system, circulates in the subarachnoid spaces, and is reabsorbed through the arachnoid villi into the superior sagittal sinus. Has this textbook description of the CSF circulation a firm foundation? A definite answer cannot be given without investigating the total fluid transport between the blood and the brain.

Since the human brain lacks a lymphatic system, the only existing pathways between the blood and the central nervous system are through the CSF circulation or through the brain capillaries. The two pathways have the common and vital function of transporting fluid into and out of the brain and cannot act independently because the fluid transport between the brain interstitial fluid and the CSF is unrestricted. Is it really likely that the main transport of fluid between blood and brain takes place outside the brain, in an indirect and ineffective fashion via the CSF circulation? In all other tissues and organs, there is a direct transport of fluid within the organ, via the capillaries. The classical theory of the CSF circulation is based on four major assumptions: 1) the exchange of fluid across the brain capillaries is insignificant; 2) the choroid plexus produces the major part of the intracranial fluid; 3) the arachnoid villi absorb the major part of the intracranial fluid including all water-soluble macromolecules; and 4) the intracranial pressure is dependent on the balance between CSF production and CSF absorption, in the choroid plexus and arachnoid vili, respectively. Production of the CSF

The total CSF formation amounts to about 500 ml per day. How much of this fluid is produced by the choroid plexus? After total removal of the choroid plexus in experimentally isolated ventricular system, the reduction of CSF formation is only 30 percent. This indicated that the rest of the ventricular CSF formation, 70 percent of the ventricular formation, originates from the brain capillaries via the walls of the ventricular system. There is also a substantial extraventricular CSF formation in the subarachnoid space. When adding the ventricular CSF formation to the extraventricular CSF formation, about 10-20% of the total CSF formation originates from the choroid plexus and 80-90% originates from the brain capillaries.

As mentioned, the classical theory of the CSF circulation is based on the assumption (2) that the choroid plexus is the main supplier of the intracranial fluid. However, treatment of obstructive hydrocephalus by shunting or choroid plexectomy is based on total removal of this supply. Fluid supply is vital for brain function and without maintained fluid supply brain function would rapidly
The blood-brain barrier acts as the kidney of the brain by active removal of water-soluble molecules from the brain.

Of all water-soluble molecules, the blood-brain barrier significantly restricts the transport into the brain for 98% of the smaller molecules and 100% of the larger molecules. With the exception of actively transported molecules into the brain, all these molecules have a very low concentration in the brain and the CSF in comparison to the blood concentration. Since the blood brain barrier is not perfectly semipermeable, there is indeed a minor leakage into the brain even of a large macromolecule like albumin. The albumin concentration in CSF is 0.5% of that in the blood. Irrespectively of the magnitude of the leakage in a non-perfect semipermeable membrane, even a minute leakage is not compatible with preserved concentration gradients across the membrane. To maintain the concentration gradient, active transport across the membrane, from the low concentration compartment to the high concentration compartment, is mandatory. The CSF tracer studies convincingly demonstrate that brain capillaries have the capacity of active transport of water-soluble molecules, from the brain and the CSF to the blood, i.e. against the concentration gradient at the blood-brain barrier.

Conclusions
1) The brain capillaries produce the major part of the CSF. 2) The choroid plexus only produces a minor part of the CSF. 3) The CSF is absorbed by the brain capillaries - not by the arachnoid villi. 4) Intracranial pressure is dependent on the balance between fluid production and fluid absorption in the brain capillaries. 5) Most water-soluble molecules are actively absorbed by the brain capillaries. The driving force of the CSF circulation is the pulsating cerebral arteries, which cause an intense mixing of the CSF with a rapid bi-directional transport in the subarachnoid space.

The intracranial pulsations also enable rapid bi-directional transport of fluid and molecules between the brain and the CSF and vice versa. This transport takes place in the paravascular spaces and interstitial spaces of the brain. There is a small net flow of ventricular CSF, mainly derived from the brain capillaries, that helps to wash out the ventricles and the nearby subarachnoid spaces with final CSF absorption in the brain.

Like in all other capillary beds, the Starling principle governs the fluid homeostasis also in the central nervous system. The blood-brain barrier restricts the transcapillary transport of fluid and ions. Therefore, fluid absorption is dependent on the crystalloid osmotic gradient across the capillary wall. The main osmolyte in CSF and blood is the crystalloid NaCl. The fluid moves passively across the capillary wall by the two opposing Starling forces in the capillary, i.e. the hydrostatic pressure gradient causing filtration and the crystalloid osmotic gradient causing absorption. A new principle of active transport is proposed for maintaining fluid and solute homeostasis in the brain. The principle includes the preservation of concentration gradients and osmotic gradients across the capillary wall. Thus, in addition to the passive transport of water and solutes by diffusion or filtration, active transport of water-soluble solutes across the blood-brain barrier is mandatory to maintain brain homeostasis.
Ultrasound in Neuroradiology

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Ultrasound has expanded our ability to detect, localize, and quantify cerebral vascular disease and to evaluate physiological and pathophysiologic hemodynamic responses to various stimuli. Transcranial Doppler ultrasound (TCD) with imaging capabilities is the only noninvasive modality that enables a neurosonologist to investigate cerebral hemodynamics and image intracranial structures simultaneously. TCD has been rapidly evolving from a simple diagnostic tool to an imaging modality with a broad spectrum of clinical applications. TCD can provide rapid information about presence of vascular stenosis and occlusion in patients with acute stroke, the hemodynamic status of the cerebral circulation, and real-time monitoring of recanalization. TCD can image the collateral flow in patients with unilateral, high-grade stenosis or occlusion of the extracranial internal carotid artery, without using potentially dangerous compression tests. Extended applications such as vasomotor reactivity testing, emboli monitoring, and right-to-left shunt detection help clinicians ascertain stroke mechanisms at the bedside, plan and monitor treatment, and determine prognosis. In the neurointensive care unit, TCD is useful for detecting and monitoring vasospasm after subarachnoid hemorrhage, increased intracranial pressure and confirming cerebral circulatory arrest. Large and medium-sized arteriovenous malformations can also be detected. TCD is of established value for screening children with sickle cell disease. Ultrasound accelerated thrombolysis has emerged as a new approach to treat ischemic stroke, while transcranial magnetic reperfusion imaging-guided focused ultrasound surgery offers a new potential noninvasive alternative to surgical resection of brain tumors.

Violet Hall

Considerations on Advanced MRI Techniques in Studying Brain Gliomas

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Introduction: Advanced 3 Tesla Magnetic Resonance Imaging (MRI) techniques such as diffusion and perfusion imaging and MR Spectroscopy (MRS) allow a more accurate diagnosis of central nervous system tumours. The clinical benefits of high field strength MRI techniques has modified the diagnostic work up of brain tumours. The higher signal/noise ratio of 3T MRI systems gives a better spatio-temporal image resolution, yielding greater morphological detail, than images produced by lower field magnets. In addition, dynamic sequences can be performed to disclose tumoral signal changes over time during administration of contrast medium. Advanced MRI techniques such as diffusion and perfusion imaging and MRS, that required long examination sessions, can now be performed at the same time as morphological scans session. These MRI techniques provide informations on the amount of cellularity, neoangiogenesis and on the tumour metabolism, thereby classifying the grade of tumour malignancy according to the World Health Organization classification.

This study analyses the MRI scans of the consecutive patients with a diagnosis of glial brain tumours, who underwent surgery or stereotactic biopsy at our hospital between 2004 and 2010, and whose histological reports were available. Our aim is to establish how advanced MRI techniques have enhanced the diagnostic accuracy with respect to morphological examination alone and to find which are the parameters with more statistical accuracy. We know, as is reported in the literature, very high rCBV and Cho/Cr values reflect a high grade of malignancy, especially when associated with a rise in lipids indicating cell necrosis. Another feature is the inhomogeneous ADC values in the diffusion maps. Areas of reduced diffusion reflecting increased cellularity, and areas of enhanced diffusion such as those caused by necrosis are predictive of a high grade of malignancy, especially when associated with increased Cho/Cr values and the presence of lipids. An other important aspect is that advanced MRI techniques will disclose the most malignant areas of a tumour. Diffusion and perfusion imaging with MRS give an overview of the tumour as a whole and allow multiple measurements of the different tumour components. Also, histological analysis is based on infor-
mation obtained from the surgical or biopsy specimen reflecting only part of the tumour which is often more extensive and infiltrating than the specimen alone. Although biopsy remains the gold standard to define the histopathological nature of a tumour that cannot be resected due to its location or that remains undefined, sampling errors and failure to remove tissue from the most malignant portion of the lesion may alter diagnosis.

Our analysis of the contribution of advanced MR techniques to the neuroradiological diagnosis of brain tumours shows that the combined information yielded by diffusion and perfusion imaging and MR spectroscopy will improve the accuracy of diagnosis. These techniques served to identify tumour grade and, when possible, tumour type, in most patients by the histological diagnosis. This stems from the fact that neuroradiological examination of the tumour assesses the lesion as a whole using the functional techniques to sample the most malignant areas of the lesion which is not always possible by biopsy.

White Hall

Spontaneous Intracranial Hypotension: Diagnosis and Percutaneous Therapy

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Introduction: Intracranial hypotension is a condition which may be spontaneous or secondary to trauma, lumbar puncture or CSF overdrainage. When spontaneous, it is rare and potentially self-limiting thought to be caused by leakage from the arachnoid or perineural cysts; it can be less benign determined subdural hematomas, and no underlying cause can be detected. Diagnosis can be based on history, physical examinations, brain and spine MRI and, eventually, by measuring CSF pressure and injecting contrast to obtain X-Ray and CTmyelography. The depletion of CSF volume and pressure, leads to neurological manifestations, the most common of which is typical orthostatic headache, due to brain vertical displacement and traction on pain-sensitive intracranial and meningeal structures. It may be associated to nausea, vomiting, diplopia or visual field defect, probably due to traction or compression cranial nerves in up-right position. Rarely, it can result in coma by dienecephalic compression, as occurred in one case out of 39 of ours.

Diagnostic findings: Brain MRI MRI main finding is diffuse pachymeningeal thickening and contrast enhancement, with sparing of leptomeninges, secondary to CSF volume depletion, according to the Monro-Kelly theory, as defined by Cushing: with an intact skull, the sum of the brain volume plus the CSF volume plus the intracranial blood volume is constant; therefore, an increase in one should cause a reduction in one or both of the remaining two. A decrease in CSF volume must be, therefore, compensated by an increase in extracellular fluid and blood volume, resulting in intravascular dilatation. This must be correctly differentiated by other pathologies such as pachymeningitis, carcinomatosis, arachnoiditis and sinus thrombosis. Subdural fluid collections (hygromas), which we observed in our group of patients with a prevalence of 58.46%, is also to be considered a secondary phenomenon compensating for the CSF depletion.

A true subdural haematoma, which we observed in 3/39 cases, should be considered a complication. Other common findings are:
1. increased volume of pituitary gland and venous dural sinuses (VDS) (prevalence of 96.43% and 92.31% respectively). VDS sign is represented by a characteristic convex bulging in the dominant transverse sinus;
2. downward brain displacement (96.15%): descent of the infundibular recess of the third ventricle, is more sensitive than the downward position of the cerebellar tonsils;
3. Deep brain swelling (50%) always associated with brain sagging; the same patients had a reduction of the angle formed by the vein of Galen (vG) and the straight sinus (SS); the phenomenon depends on the enlargement of intracerebral venules and capillaries;
4. IAC sign: bilateral enhancement of the dura that casts the internal acoustic canal (87.3% of our case material).

Diagnostic findings: leakage site identification

The diagnosis is usually followed by a first tentative of conservative therapy: the patient is suggested to stay in bed, highly hydrated. In case there is no clinical improvement the identification of the fistula is needed to establish a therapeutic approach. MR myelography and CT myelography are considered equivalent (sensitivity 74-84%) (6).

Therefore, the first exam to be proposed is a conventional MRI study of the entire spine, including myelographic techniques. In case MRI is negative, a conventional X-Ray and CT myelography is recommended. The relatively high percentage of false negatives of both techniques is easily understood if one considers that CSF pressure is reduced, and, consequently, the leakage is minimal and very slow. In our experience, we obtained a significant rising in sensitivity after increasing CSF pressure, by injecting, together with contrast, 15-20 cc of saline solution. Once the fistula is identified, under CT guidance a needle is put in its correspondence and 15 cc of fresh autologous blood mixed with 3 cc of contrast is inject. The blood clot will determine a targeted subdural patch.

References
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Technology Development in Neuroradiology

S.W. Atlas
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Neuroradiology is at yet another critical time point in the history of clinical imaging, particularly with MRI and CT, as we enter an unprecedented era in medical diagnosis and therapy. Imaging has come to occupy an increasingly central role in medical care. The appropriate utilization of emerging clinical applications of molecular biology, advanced medical technologies, and minimally invasive treatments depend more than ever on delivery of the long held promise of medical imaging. Along with the advances in medical imaging have come striking changes in demographics of populations and diseases. The world’s population is aging, and soon the elderly will dominate the health care system resources of many nations. Globalization of disease profiles is also underway; the chronic diseases of developed nations, with their reliance on imaging for diagnosis and treatment, are projected to overtake the traditionally dominating infectious and nutritional diseases of developing countries. Early detection has become paramount, and no field will be more important in this pursuit than diagnostic imaging. More than a decade after seemingly achieving its status as a mature imaging modality by most clinical standards, MRI for neurologic disease has maintained an accelerating path of innovation and expansion of applications. The specifics of its current clinical utilization are also somewhat unexpected, because many had anticipated that non-CNS MRI would continue at a remarkable pace, it must be noted that CT scanning has re-emerged in neuroradiology as a highly important modality for diagnosis and patient management, particularly in cerebrovascular disease. In that light, it should be remembered that the diagnosis of neurologic disease must be based on neuropathology and sound evidence. Patients cannot afford to have their care misdirected and their time wasted by implementing new techniques solely because new techniques exist. This is the time where the importance of guidance based on genuine expertise and the appropriate utilization of technology is at an unprecedented level, when the need for focused and relevant clinical research is at an all time high. This presentation will focus on the use of emerging newer MRI methods in the context of contributing significantly to diagnosis and guiding therapy in disorders of the brain. Novel imaging methodology, most notably high field MR scanning using the new gradient technology, as well as tissue characterization methods depicted by novel software tools such as 3DT2 and 3DT1 pulse sequences, are explained and explored in a variety of clinical settings, particularly where they may have the most impact; emerging applications in newer areas, including psychiatric disorders and fetal anomalies, are discussed; recent trends in CNS diseases themselves are updated and related to imaging findings; and limitations of imaging are noted where appropriate. Clinical caveats are noted alongside exciting new findings in an effort to at least suggest rationale for optimal utilization of these new techniques.
- Congenital variant
- Congenital Variant with suspicion of (silent?) thrombosis
- Abnormal venous drainage by interfering causes (a.o. thrombosis of internal jugular vein)
- Thrombosis of superior sagittal, straight, transverse or sigmoid sinus
- Other causes of abnormal venous drainage (AV dural fistulas)

Examples of these conditions will be shown.

Results: The distribution of normal, normal variants and abnormal findings will be given and discussed. The findings will be illustrated and where applicable compared with the clinical data. A few cases are illustrated here below.

Conclusions: The different techniques of venography will be presented and the results of the analysis as described above in patients with subacute or chronic complaints will be presented in detail. This study of a large population may help to evaluate different manifestations of cerebral venous drainage and their relationship to clinical conditions. Special attention will be given to the present day possibilities to diagnose treatable venous obstructions by MR venography.

Figure 1 Female patient 79 years of age with pulsatile tinnitus on the left TOF venography without and with contrast shows absence of left jugular internal vein; the image with contrast shows extensive collateral circulation on the left side, possibly the cause of the tinnitus. Clinical note: pressure on the neck on the left side made the tinnitus disappear; a classic but rarely performed clinical maneuver.

Figure 2 Male patient with subacute persisting left sided headache, TOF venography shows the predominant right sided venous drainage; on the left side no internal jugular vein is visible and there are irregularities in the sigmoid sinus. In cerebro there were no abnormalities.

Figure 3 Female patient, 32 years, dizziness complaints since 6 months. TOF venography shows a congenital variant with persisting occipital sinus on the right side, collateral circulation, no visualization of the internal jugular vein on the right side. Patient uses (oral) contraceptive pills and is a moderate smoker.

10.30-11.00

A Plea for New Regulations on Randomized Clinical Trials in Surgical Treatments

E. Houdart
Department of Neuroradiology, Lariboisière Hospital, Paris, France

Amongst the methodologies used to assess the value of a medical intervention, the randomized clinical trial provides the most reliable results. My concern is studies that compare the outcome of preventive surgical treatment to the natural history of a lesion. Taking the example of two failures in the neurinterventional field (TEAM and ARUBA), my intention is to show that without regulations mandating active participation of all planned study sites, randomized studies conducted in this setting are bound to fail. Many neuroradiological teams have refused upfront to participate in both studies because of various arguments, none of which hold up to elementary analysis. The real reasons for this refusal to participation (or what may be worse, for the presence of participation that most centers have been displaying) are of a different nature. It is easy to understand that such studies by definition lead to a decrease in the interventional activity (a minimum of 50% of patients does not undergo the procedure). This decreased activity has several consequences, none of which provides an incentive towards active participation. For the medical community, the choices are simple. We should either stop setting up such studies or change the rules of participation.

If the choice is to stop, this has to be signified clearly, to the medical community, the patients and the health authorities, so that time and money are not spent in setting up future studies that are bound to fail. If the choice is to pursue this line of clinical research, then new rules must be set up and agreed upon. When the benefit of an intervention is clearly questioned by the medical community, every surgical center should be required to submit the protocol to its Ethics Committee. If the majority of these Ethics Committees approves the protocol, then this decision would render participation of all the relevant sites mandatory.

Enforcement would be simple: reimbursement of the procedure would be linked to the patient’s inclusion into the study.

11.00-11.30

7 Tesla Brain Imaging

M. Forsting
Klinikum der Universität, Direktor, Inst Radiol u Neurorad; Essen, Germany

Molecular Imaging and Nano-Technologies

11.30-11.50

Molecular Imaging in Neuroradiology

C. Zimmer
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11.50-12.10

Use of Nanoparticles for CNS Imaging and Therapy

J. Provenzale 1,2
1 Duke University Medical Center; Durham, USA; 2 Emory University School of Medicine; Atlanta, USA

In the past decade, rapid advances have been seen in applications of nanotechnology for medical uses with the emergence of a field termed nanomedicine. Nanotechnology refers to the development of materials and devices on the nanometer scale (i.e., 1-100 nanometers) for manipulation of physical, chemical or biological processes. There can be little question that nanotechnology research will lead to advances in imaging. This presentation is designed to introduce neuroradiologists to fundamental concepts in nanotechnology with the intention of stimulating their interest in wish in promoting, and guiding, the progress of nanomedicine as applied to Neuroradiology. The presentation will be organized along the following topics:

1. General Principles of Nanoparticles
2. Molecular Imaging and Therapy
3. Surgical Treatments
MRI can potentially monitor the temporary repair of tissue damage, in their incorporation into tissue and to track the movement of transplants, be identified on MRI offers the ability means for CNS tissue regeneration. The various uses of nanoparticles in CNS disease will be explained. These uses include imaging of brain tumors, use as neuroprotection devices and as a means for CNS tissue regeneration.

Cell Tracking and Future Implications to Neuroimaging

J. Frank
National Institutes of Health; Bethesda, MD, USA

Cellular therapy for repair of a wide range of disease and injury is an area of considerable interest and research of the ways in which nanoparticles can be used as imaging agents alone, drug-delivery vehicles or both. Stem cell research is ongoing in a presentation will be made

12.10-12.30

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Tuesday, 5 October - 14.30-17.15

COMMUNICATIONS

Stroke 1

Chairs: A. Fox, M. Bergui
14.00 -14.30

Introductory Lecture

Continuous Aspiration Thrombectomy (CAT) in Acute Ischemic Stroke Treatment and the New Penumbra System 054

R. von Kummer
Technische Universität; Dresden, Germany

14.30-14.45 10’

Stroke in Young People: The Increasing Role of Advanced Images

D. Santa Cruz, A. Ojeda, M. Nallino, A. Uriarte
Diagnostico Medico Oroño, Rosario, Argentina

Stroke in young people (15-45 years) is an infrequent pathology whose causes are more proteiform than in the older population. The role of images in this disease had had a great development in the last decade. The aim of this pictorial essay is to highlight the importance of MSCT and conventional and advanced MR techniques in the diagnostic work-up of young patients with a stroke. Neuroimages allow us to confirm the vascular origin of the lesion, to determine the precise localization and extension of the abnormality, to evaluate intra and extracranial circulation and sometimes suggest the appropriate therapy. In conclusion, imag-
ing plays a crucial role in the diagnostic evaluation and management of stroke in young population.

14.45-15.00

Superficial Temporal Artery Calcification in Patients with End-Stage Renal Disease: Association with Vascular Risk Factors and Ischemic Cerebrovascular Disease

Z. Anwar 1,2, E. Zan 1,3, M. Carone 1, A. Ozurt 1, S.M. Sozio 1, D.M. Yousem 1
1 Aga Khan University School of Medicine, Karachi, Pakistan, 2 Johns Hopkins Hospital Dept of Radiology, Baltimore, MD, USA, 3 Ataturk Education and Research Hospital-Dept of Radiology, Ankara, Turkey, 4 Johns Hopkins School of Public Health-Dept of Biostatistics, Baltimore, MD, USA

Background and Purpose: Extracranial STA calcification is an unusual finding seen in patients with chronic kidney disease that has unknown ramifications with respect to intracranial ischemic disease and etiology. We sought to determine the risk factors associated with this rare phenomenon and to assess the coexistence of cerebral ischemia.

Materials and Methods: Medical records and laboratory data on risk factors for vascular calcification were retrospectively retrieved for 453 patients with a discharge diagnosis of ESRD. CT-Head examinations were reviewed to identify and associate STA calcification with 1) risk factors for the vascular calcification, 2) intracranial artery calcification, and 3) cerebral ischemia (white matter and/or cortical ischemic changes).

Results: STA calcification was present in 9.9% (45/453) of the studied cohort. The prevalence of cerebral ischemia was 24.4% (114/453) in patients with STA calcification and 9.5% (38/408) in patients without it. Diabetes mellitus (OR 2.56, p = 0.037, 95% CI, 1.059-6.208) and vertebral artery calcification (OR 4.02, p = 0.001, 95% CI, 1.235-12.857) were independently associated with the risk of STA calcification. The risk of cerebral ischemia, however, was not related to the coexistence STA calcification (p = 0.221).

Conclusion: The presence of diabetic mellitus is important in describing the risk of STA calcification in patients with ESRD, whereas age, gender, hypertension, serum calcium, serum phosphate, or serum hemoglobin levels are not. The risk of cerebral ischemia is not related to the coexistence STA calcification but has the strongest association with diabetes mellitus and vertebral artery calcification.

15.00-15.15

Improved Detection of Hyperdense Middle Cerebral Artery Sign by Sagittal Reformations

M. Kurosuchi 1, H. Terada 1, N. Kitamura 1, T. Nakatsuka 1, H. Kudo 1, S. Kasuya 2, R. Kasai 1, H. Morita 2, T. Hasebe 1, T. Nagao 1, R. Sakakibara 1, N. Kitamura 1, T. Nakatsuka 1, H. Kudo 1, T. Hasebe 1, T. Nagao 1, R. Sakakibara 1
1 Toho University Sakura Medical Center, Department of Radiology, Sakura, Japan, 2 Toho University Sakura Medical Center, Department of Neurosurgery, Sakura, Japan

New computed tomography (CT) technology, including multidetector scanners and more powerful workstations, allows faster and easier performance of multidetector reformations. We evaluated the possibility of improving the detection of a hyperdense MCA sign on CT in acute stroke by multidetector reformations.

Materials and Methods: We retrospectively reviewed the records of 266 consecutive patients who were admitted to our institute because of clinical suspicion of ischemic brain infarction from January 1, 2007, to August 31, 2009. Records were compiled from our hospital database. Next, we obtained the presence, conspicuity and location of the hyperdense MCA sign. Consensus was always achieved. The presence, conspicuity and location of hyperdense MCA sign was analyzed in a secondary review by two independent staff radiologists. Both of the two readers were blinded to the result of the first review. In case of disagreement, a third observer was consulted. Consensus was always achieved.

Results: Within our population of 251 patients with nonenhanced CT, 92 patients had two inclusion criteria in their history. Nine of 92 patients showed a hyperdense MCA sign. This group of nine patients consisted of 4 men and 5 females (mean age, 74.3 years; age range, 45-88 years). All 9 patients had atrial fibrillation. Six of 9 patients had a MRA examination within 24 hours following first CT scan. MRA confirmed MCA occlusion in 3 cases and ICA occlusion in one case corresponding to hyperdense MCA sign. Two of 9 patients had a conventional angiography within 3 hours following first CT scan. Conventional angiography confirmed MCA occlusion in one case and ICA occlusion in one case corresponding to hyperdense MCA sign. Another case had no MRA or angiography.

On blinded secondary review, axial images and coronal images suggested the presence of hyperdense MCA sign in 7 and 6 patients. While all of the nine patients sagittal images detected the presence of hyperdense MCA sign. In three of seven patients, the hyperdense MCA sign was more con-
spicuous on sagittal images than on axial images. Hyperdense MCA signs were detected solely on sagittal images in two of 9 patients.

Conclusion: Multplanar reformations, especially sagittal images, improved the detection of a hyperdense middle cerebral artery sign on CT scan using multidetector scanner in acute stroke.

15.15-15.30

ROJ Measurement of Middle Cerebral Artery: Is It a Primary Sign of Infarction?

G. Panagi1, M. Kastania2, I. Markaki1, N. Stroumbakis1, S. Foudara1, E. Sgora1, E. Panourgiakis1
1 Gen. Hospital Skilission; Chios, Greece; 2 Univ. Hospital Areteion; Athens, Greece; 3 National Institute of Statistics; Athens, Greece

Introduction: The purpose of this project was to calculate the ROI of the Middle Cerebral Artery in patients with stroke, in order to define if this measurement could be used as another primary sign of infarction even if other primary signs of infarction were absent.

Materials and Methods: We studied retrospectively the brain CT scans of one hundred patients who presented in the emergency room during one year, the first 6 hours after the onset of symptoms.

Two polygonal ROI were drawn on the M1 segments of both middle cerebral arteries and three parameters were calculated automatically: the HU density, the volume and the surface of the corresponding artery segment. We also reported the age and sex for each patient. CT findings (including the hyperdense appearance of MCA and the ribbon sign) and the neurological findings.

Results: The range of calculated ROIs was between 43 HU and 999HU. Higher densities of MCA were reported in the hemisphere that was suspected according to the clinical presentation of the symptoms. This was reported in cases that no other primary signs of infarction on CT were apparent, but also in cases that primary signs were also obvious. On T. Test there was statistically significant difference in ROI measurement of the right MCA between patients with hyperdense appearance of the R MCA and normal appearance of the R MCA. On Wilcoxon there was statistically significant difference between the ROI of the right and left MCA in patients with acute ischemic stroke in the region of the brain supplied by the left MCA.

Conclusion: The measurement of ROI of MCA might serve as an additional primary sign of infarction in large series of studies.

Stroke 2

Chairs: H.H. Henkes, L. Castellan

15.30-15.45

12'

Incremental Benefit of CT Perfusion for Certainty of Stroke Diagnosis over Unenhanced CT and CT Angiographic Source Images

A.J. Fox1, J. Hogyan2, A. Ciarallo3, D. Dowlatshahi1, P. Howard1, V. John1, R. Yeung1, L. Zhang1, J. Kim1, G. Macfarlane1, Ty Lee2, Ri Aivi1
1 Sunnybrook Health Sciences Centre, Dept of Neuroradiology; Toronto, Canada; 2 Sunnybrook Health Sciences Centre, Dept of Neurology; Toronto, Canada; 3 Robarts Research Institute, Dept of Medical Biophysics; London, Canada

Purpose: To evaluate the diagnostic benefit of an incremental CT protocol, including incremental review of Non-contrast CT (NC-CT), CT angiographic-source images (CTA-SI) and CT Perfusion (CTP), for confirmation of clinically suspected stroke. We hypothesize detection is significantly improved with an incremental protocol.

Materials and Methods: The study was institutional review board approved and participants gave informed consent. 191 patients (105 male, 67±16yrs) with stroke-like symptoms <= 3 hours were recruited. Blinded review was performed by 4 readers with limited stroke imaging experience. Diagnostic confidence was recorded on a 5 point scale. Logistic regression calculated real from observed diagnostic adjusting for confidence. Predictive effects of observed diagnostic performance and confidence score was quantified by entropy r2. Accounting for multiple reader assessments sensitivity, specificity and confidence intervals were calculated. Receiver operating characteristic (ROC) analyses including area under the curve (AUC) were conducted for 3 different modalities in combination with confidence score. Inter- and intra-rater agreement was established with Cohen’s Kappa.

Results: Final diagnosis was infarct 64% (123/191), TIA (18%) and stroke-mimic (17%). Large vessel occlusion occurred in 70% (86/123) of infarct patients. Sensitivity for stroke determination using NC-CT/CTA-SI/CTP increased by 12.4%-18.5% over NC-CT/CTA-SI and NC-CT respectively for confidence level (> =4). The incremental protocol was more likely to confirm clinical stroke diagnosis (OR 13.5), compared to NC-CT/CTA-SI (OR 6.4) and NC-CT (OR 3.3); AUC was 0.67 for the combination of NC-CT and confidence score, 0.72 for the combination of CTA-SI and confidence score, and 0.81 for the combination of CTP and confidence score. Inter- and intra rater agreement increased with progressive sequence use.

Conclusion: An incremental stroke protocol including CTP increases diagnostic performance for stroke diagnosis and inter- and intra observer agreement.

15.45-16.00

12'

Hemorrhagic Transformation of Ischemic Stroke: Perfusion CT-Based Prediction

A.J. Fox1, R.I. Aviv1, C.D. D’Esterre2, B.D. Murphy3, J.J. Hopyan4, B. Buck2, V. Li1, L. Zhang1, S.P. Symons1, T.Y. Lee1
1 Sunnybrook Health Sciences Centre, Dept of Neuroradiology; Toronto, Canada; 2 Sunnybrook Health Sciences Centre, Dept of Neurology; Toronto, Canada; 3 Robarts Research Institute, Dept of Medical Biophysics; London, Canada

Purpose: To determine whether admission perfusion computed tomography (CT)-derived perfusion/hyperintensities were directly associated with hemorrhagic transformation (HT) or death. Using a combination of CTP and confidence score, we attempted to predict hemorrhagic transformation.

Materials and Methods: This prospective study was institutional review board approved, and all participants gave written informed consent. Forty-one patients who presented with acute stroke within 3 hours after stroke symptom onset underwent two-phase perfusion CT, which enabled PS measurement. Patients were assigned to one of two groups according to whether they had hemorrhage transformation (HT) at follow-up magnetic resonance imaging (MRI) and/or whether they received tissue plasminogen activator (TPA) treatment. Clinical, demographic, perfusion CT, and/or imaging characteristics were compared. Association between PS and HT was assessed with logistic regression and receiver operating characteristic (ROC) analysis.

Results: HT developed in 23 (56%) patients. Patients with HT had higher National Institutes of Health Stroke Scale (NIHSS) scores (p = 0.005), poorer outcomes (p = 0.001), and a higher likelihood of having received TPA (p = 0.005)
Comparison of patients with and without HT. Baseline blood flow (P = .17) and blood volume (P = .11) defects and extent of flow reduction (P = .27) were comparable between the two groups. The mean PS for the HT group, 0.49 mL·1 min⁻¹ 100 g⁻¹ was significantly higher than that for the non-HT group, 0.09 mL·1 min⁻¹ 100 g⁻¹ (P < .0001). The PS odds ratio, 5.5; 95% confidence interval [CI]; 1.69; 7.06; P = .0007 and size of hypoattenuating area at nonenhanced admission CT (odds ratio 0.4; 95% CI: 0.2, 0.7; P = .002) were the only independent variables associated with HT at stepwise multivariate analysis.

The mean area under the ROC curve in patients with with CTA spot sign was as risk factor for hematoma expansion increased sensitivity from 0.78 (95% CI: 0.52-0.94) to 0.94 (95% CI: 0.72-1.00) and NPV from 0.90 (95% CI: 0.76-0.97) to 0.97 (95% CI: 0.85-1.00). The mean area under the ROC curve was 0.918 (95% CI: 0.828, 1.00). The PS threshold of 0.23 mL·1 min⁻¹ 100 g⁻¹ had 77% sensitivity and 94% specificity for detection of HT.

Conclusion: Admission PS measurement appears promising for distinguishing patients with acute stroke who are likely from those who are not likely to develop HT.

CT Perfusion and CT Angiography in Thrombolite Therapy

K. Puszar, G. Szilagyi, G. Forrai, Állami Egészségügyi Központ, Budapest, Hungary

Purpose: Clinical treatment decision in stroke depends on accurately assessing damaged tissue versus tissue at risk. CT perfusion (CTP) and CT angiography (CTA) can be obtained rapidly, it is useful in busy emergency departments, such as National Health Center. The CT technology helps physicians to identify patients who are suitable for treatment and shows probable efficiency of thrombolytic therapy.

Methods and Materials: In our study we have shown the results of 30 patients who had undergone CTP and CTA within 3 hours after onset of symptoms. We calculated MTT, CBF and CBV in two groups depending on the location of occlusion (occlusion of main branch of MCA and occlusion of secondary branch of MCA). After thrombolysis (intravenous) the perfusion images were compared to the follow up CT examination. These results were also divided into two groups: occlusion of main branch and secondary branches of MCA.

Results: There was an association between the different clinical outcomes and the results of CTP and CTA. There were different results in the two examined groups in terms of the saveable tissue and follow up CT examination. We have also demonstrated some interesting cases which warrant unusual outcome.

Conclusion: In most of the cases the CTP and CTA can be used and evaluated in the diagnosis of stroke and in predicting the final tissue damage. There is a good correlation between the results of the CTP and the probable efficiency of the therapy.
Materials and Methods: We longitudinally investigated 30 patients (14 male and 16 female; mean age = 66.8±13.1) with acute supratentorial SICH at admission CT having a National Institutes of Health Stroke Scale at entry ranging from 6 to 29. Perfusion studies were performed by using a single-section CT scanner equipped for CT perfusion imaging. CT perfusion protocol consisted of a series of 45 CT scans acquired in a single slice located at hematoma level containing the largest volume of blood. CBF, cerebral blood volume (CBV) and mean transit time (MTT) perfusion maps were generated for each patient with a deconvolution-based algorithm. Regional CBF (rCBF), CBV (rCBV) and MTT (rMTT) levels were measured in four different regions of interest (ROIs) drawn freehand on the baseline single slice CT scan: 1) the hemorrhagic core; 2) the perihematomal low density area; 3) 1 cm rim of normal appearing brain tissue surrounding the perilesional low density rim; 4) an area mirroring the region including the clot and perihematomal low density area planimetrically defined. CBF, CBV and MTT values were expressed in ml/100g/min, ml/100g and seconds, respectively. rCBF values lower than 10 ml/100g/min, ranging from 10 to 20 ml/100g/min, included in the perihematomal low density area; and perihematomal low density area; normal or high in the remaining areas studied. In comparison to values at admission, rCBF and rCBV showed a temporal pattern characterized by an increase of rCBF and rCBV with a decrease of rMTT mean levels at 48 hours, a return toward initial values at 5 days and a decline of rCBF and rCBV with a proliferation of rMTT mean levels at 7 days after SICH. Absolute rCBF values measured at 7 days after SICH were ischemic in hemorrhagic core, oligemic in perihematomal low density area, normal or high in the remaining areas studied. In comparison to values at admission, absolute rCBF levels were low in hemorrhagic core and in perihematomal low density area, normal or high in the remaining areas studied. In comparison to values at admission, absolute rCBF levels were low in hemorrhagic core and in perihematomal low density area, normal or high in the remaining 16 patients. After checking data for normality, statistical analysis was performed by using a single-section CT scanner equipped for CT perfusion imaging. CT perfusion protocol consisted of a series of 45 CT scans acquired in a single slice located at hematoma level containing the largest volume of blood. CBF, cerebral blood volume (CBV) and mean transit time (MTT) perfusion maps were generated for each patient with a deconvolution-based algorithm. Regional CBF (rCBF), CBV (rCBV) and MTT (rMTT) levels were measured in four different regions of interest (ROIs) drawn freehand on the baseline single slice CT scan: 1) the hemorrhagic core; 2) the perihematomal low density area; 3) 1 cm rim of normal appearing brain tissue surrounding the perilesional low density rim; 4) an area mirroring the region including the clot and perihematomal low density area planimetrically defined. CBF, CBV and MTT values were expressed in ml/100g/min, ml/100g and seconds, respectively. rCBF values lower than 10 ml/100g/min, ranging from 10 to 20 ml/100g/min, included in the perihematomal low density area; and perihematomal low density area; normal or high in the remaining areas studied. In comparison to values at admission, absolute rCBF levels were low in hemorrhagic core and in perihematomal low density area, normal or high in the remaining areas studied. In comparison to values at admission, absolute rCBF levels were low in hemorrhagic core and in perihematomal low density area, normal or high in the remaining areas studied. In comparison to values at admission, absolute rCBF levels were low in hemorrhagic core and in perihematomal low density area, normal or high in the remaining areas studied. In comparison to values at admission, absolute rCBF levels were low in hemorrhagic core and in perihematomal low density area, normal or high in the remaining areas studied.

Results: The timing of CTP parameters in the transition from acute to subacute phase of SICH seems to be represented by a centrifugal gradient with an improvement from the core to the periphery, which persists over time associated to a three-phasic perfusion pattern in each ROI studied after the initial values detected at 24 hours from bleeding. At 7 days after bleeding, no ischemic values were identified in perihematomal area where, however, rCBF levels were strongly reduced with values indicative of oligemic tissue not at risk for infarction. More precisely, the concomitant decrease of rCBF and rCBV we detected in this area seems to suggest the development of brain edema. These results suggest that CTP is a promising method for the evaluation of perfusion changes related to the temporal evolution of SICH.

Conclusions: The cerebral pCT study at our hospital within 6 hours after onset of a stroke during a period of 18 months. We excluded patients with aneurysms, neoplasias, and the ones without control CT after 24 hours of the acute event or clinical evolution registry (NIHSS scale and modified Rankin scale(mR)). We characterized the chosen 21 patients by the SITS MOST defined criteria and additionally add CTP results. We then correlated the clinical and imaging data obtained in the acute phase with the difference between the initial and final values for the NIHSS and NIHSSi scales and with the control CT observed complications (namely haemorrhagic transformation and cerebral edema) using the Pearson coefficient.

Results: Our population was previously autonomous (previous mR of 0.8±0.4) and with moderately serious stroke (entrance NIHSSi-f < 5). Two patients suffered haemorrhagic transformation, the greater one was related with the increase of the pHEB but wasn’t associated with the elevated mismatch volume. The deceased patient equally presented an increase of the pHEB. The development of the cerebral edema strongly correlated with the increase of the pHEB (r = 0.8).

Conclusions: The cerebral pCT study is a prognosis marker for stroke. The isolated parameter which better correlated with the variation of the severity and the incapacity was the pHEB.
Aneurysms

Chair: A. Mironov, N. Koer

14.30-14.45

Introductory Lecture

Usefulness of 320-Row Area Detector CT, Focusing on the Detection of Aneurysmal Pulsation

K. Katada, M. Hayakawa, K. Murayama
Department of Radiology and Neurosurgery, Fujita Health University, School of Medicine; Toyoake, Japan

Purpose: To detect pulsation of ruptured and unruptured cerebral aneurysms by employing the ECG-gated reconstruction method with a 320-row area detector CT scanner.

Subjects: The subjects in this study were 54 patients with a total of 68 cerebral aneurysms who underwent ECG-gated CT scanning with an area detector CT scanner in the previous 3 years. The aneurysms included 56 unruptured aneurysms and 12 ruptured aneurysms.

Methods: A 320-row area detector CT scanner (Toshiba Medical Systems Corporation, Tochigi, Japan) was used. Scanning was performed over two cardiac cycles with a tube voltage of 120 kV, a tube current of 220 mA, and a scan speed of 0.35 s/rot. Non-ionic contrast medium (370 mgI/mL) was injected at a rate of 5 mL/s via an antecubital vein, followed by a 30-mL saline flush, also injected at 5 mL/s.

Results: Good dynamic images were obtained in all patients. Pulsation of a part of the aneurysm was observed in 15 of the 56 unruptured aneurysms and in 9 of the 12 ruptured aneurysms. The percentage of aneurysms showing pulsation was significantly higher in the ruptured aneurysm group (p = 0.0012).

Discussion: Unlike conventional CT systems, a 320-row area detector CT scanner (which allows examinations to be performed without the use of helical scanning) permits the entire aneurysm to be observed dynamically. In the present study, pulsation of a part of the aneurysm was observed in a significantly higher percentage of lesions in the ruptured aneurysm group. To date, none of the patients have experienced aneurysmal rupture during the follow-up period. Further research is needed to assess long-term outcomes.

Conclusion: It is expected that the detection of aneurysmal pulsation using an area detector CT scanner will prove to be a useful index for assessing the risk of aneurysmal rupture.

14.45-15.00

Intracranial Vascular Fenestrations and Their Association with Aneurysms

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University of Louisville Medical Center, Dept of Radiology, Louisville, KY, USA

Purpose: The purpose of this work is to assess the nature of intracranial vascular fenestrations, both from a morphologic/anatomic perspective as well as from a histologic perspective. This will then be elaborated on and a discussion of the changes in fluid dynamics/flow dynamics with fenestrations will be endeavored upon. Ultimately, aneurysm association with fenestrations will be discussed.

Materials and Methods: The materials and methods will include selected examples of intracranial vascular fenestrations, including those associated with aneurysms. Also, a thorough review of the pathologic literature, as well as neurosurgical literature, and radiologic literature will be performed.

Discussion Conclusions: Intracranial vascular fenestrations are a well known phenomenon. However, their association with aneurysms, whether this be related to changes in flow dynamics as a consequence of the fenestration versus related to inherent histologic alterations in the vessel wall, are not as well described. It is the goal of this work to give a better understanding of the relationship of intracranial vascular fenestrations and associated aneurysms. While definite conclusions regarding this association are not expected to be reached, the phenomenon is an important one, and one which should be kept in mind when interpreting studies.

15.00-15.15

Assessing the Severity of Vasospasm after SAH Using DyNA-CT to Measure Cerebral Blood Volume: A Feasible Method for the Neuro-ITU Patient

M. Kamran1, Y. Deuerling-Zheng1, I. Grunwald1, J. Yarnold1, J.V. Byrne2
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Key words: Flat-detector CT, Vasospasm, CBV

Purpose: Developments in the flat detector technology and high frame rotational angiography can be exploited to estimate cerebral blood volume (CBV). The speed and ease of measurements in patients with altered cerebral haemodynamics in the angiography room has the potential to provide a single investigation to select patients for angioplasty. To assess the feasibility of this approach, accuracy of CBV estimates was compared with magnetic resonance perfusion weighted imaging (MR-PWI).

Materials and Methods: Patients from the neuro-intensive treatment unit (ITU) with suspected vasospasm following aneurysmal subarachnoid haemorrhage (SAH) were scanned using biplane angiography system (Axiom Artis dBA; Siemens Healthcare, Germany). The imaging protocol included two 8-seconds rotational acquisitions: the mask and the contrast enhanced runs, each comprising approximately 400 projection images at 0.5 degree steps. CBV maps were constructed after registration of the two volumes, voxel-by-voxel subtraction, and normalisation with an automatically estimated input function. The reconstruction was done on a dedicated prototype software (Siemens AG, Healthcare). Contemporaneously, an MR-PWI scan was performed to obtain CBV values for comparison. Clinical and imaging parameters were recorded for all patients. To explore the statistical agreement between the imaging techniques, relative CBV values (rCBV) calculated for the grey and the white matter re-
gions of interest (ROIs) were analysed using Pearson correlation and Bland-Altman tests. Correct identification or exclusion of haemodynamically significant vasospasm were used as clinical endpoints to evaluate utility of Dyna-CT in the diagnosis and management of vasospasm. Research ethics committee approval was obtained for the study that included the examination of unconscious patients.

**Results:** Two patients underwent MR-PWI and Dyna-CT examinations, performed within 12 to 18 hours of each other. At the time of the studies, both patients were unconscious i.e. on mechanical ventilation. One of the patients had angiographic vasospasm but not haemodynamic abnormalities on the MR-PWI examination (criterion standard). On visual comparison, the parametric maps for the two techniques showed a similar distribution of CBV and CBF differences. Quantitative analysis of the rCBV values measured for the grey and the white matter ROIs showed good correlation (Pearson correlation coefficient for grey matter 0.73, white matter 0.96, and overall 0.84). The two modalities were in excellent statistical agreement as shown by the Bland-Altman analysis (95% limits of agreement range for grey matter ROIs, -0.0715 to 0.0615; and combined grey and white matter ROIs, -0.165 to 0.171). Bias in measurements was minimal (grey matter ROIs, 0.011; white matter ROIs, -0.005; combined grey and white matter ROIs, 0.0029) and the limits of agreement included clinically significant rCBV discrepancies.

**Conclusion:** The preliminary results demonstrate the feasibility and the accuracy of CBV measurement using C-arm angiography apparatus in the neuro-ITU patients with altered cerebral haemodynamics that would assist decision making in patients with suspected delayed neurological deficits after SAH. The technique allows a comprehensive non-invasive assessment of the vasospasm and its haemodynamic significance. It manipulates imaging data from a single scan using different post-processing methods and provides soft tissue images, angiographic images, and CBV maps. Examination time, radiation exposure, and radiographic contrast dose to the patient are therefore, reduced. A single scan evaluation in an optimal interventional environment improves workflow by avoiding patient transfer between the diagnostic and the interventional set-ups. We intend to study a cohort of 25 patients with vasospasm following SAH to explore the true potential of the technique in this specific clinical setting. In addition, the ability to study physiological parameters known to be of prognostic significance in patients with acute stroke, inside the neuro-interventional room has implications for the management of patients with other causes of cerebral ischemia. A combination of this capability with the existing Dyna-CT facilities of generating angiographic and parenchymal soft tissue images could help in the triage of patients with acute stroke to reduce time delays between the diagnosis and the treatment stages.

**References:**

**Effect of Perianeurysmal Environment on Intraaneurysmal Flow**

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1. National Institute of Neurosciences; Budapest, Hungary; 2. University of Techniques and Economics; Budapest, Hungary

**Background and Purpose:** The natural history of unruptured aneurysms is poorly understood. The effect of aneurysm size on the risk of rupture has been shown in multiple studies (ISUIA). In clinical practice irregular aneurysm morphology is considered as an independent contributing factor to rupture risk. The purpose of this study is to analyze perianeurysmal anatomy and its effect on aneurysm morphology, as well as the impact of morphology on flow conditions that may affect rupture risk.

**Methods and Materials:** Aneurysms of the supraclinoid carotid artery were studied using 2 and 3 dimensional DSA, TOF MRA and heavily T2 weighted MR cisternography. In addition, computerized flow simulation studies were obtained using finite element modeling and applying ANSYS flow simulation software.

**Results:** A total of six supraclinoid aneurysms were studied. DSA demonstrated significant impressions on the aneurysm wall resulting irregular morphology in 5 out of the 6 lesions. On MR cisternograms, the anatomical structure causing the impression was identified as the optic nerve (3), the posterior communicating artery (1) and the skull base (1). In the one case with regular morphology, flow simulation demonstrated homogenous distribution of both pressure and wall shear stress. Uneven systolic pressure distribution was related to outside wall impressions in two out of the 5 irregularly shaped aneurysms. In all of these cases, there was an area of increased wall shear stress around the impressions caused by the above anatomical structures.

**Conclusion:** Anatomical structures in the perianeurysmal environment does have an impact on the shape of the aneurysm. The resulting irregular morphology causes uneven distribution of hemodynamic load, such as pressure and wall shear stress. Areas of increased hemodynamic stress may present an increased risk of rupture.

**Comparison of CT Angiography with Digital Subtraction Angiography in Small Cerebral Aneurysms**

N. Khandelwal 1, S. Dhana Rekha 1, V. Gupta 1, S.K. Gupta 1, P. Singh 1, S.N. Mathuria 1
1. Pignor-Department of Radiodiagnosis; Chandigarh, India; 2. Pignor-Department of Neurosurgery; Chandigarh, India

**Purpose:** To compare the accuracy of CT Angiography (CTA) with that of Digital Subtraction Angiography (DSA) and surgical findings (if operated) in detection and characterization of small (less than 5mm) cerebral aneurysms.

**Materials and Methods:** Prospective study done over period of two years in which all patients presenting with non-traumatic subarachnoid hemorrhage (SAH) underwent CTA and DSA within 24 hours of each other, after getting informed consent from the patients. Of these, 18 patients with aneurysms less than 5mm were included in the study. The CTA and DSA data was compared with surgical and angiographic findings (if operated) in patients presenting with non-traumatic subarachnoid hemorrhage (SAH) underwent CTA and DSA within 24 hours of each other. At the time of the studies, both patients were unconscious i.e. on mechanical ventilation. One of the patients had angiographic vasospasm but not haemodynamic abnormalities on the MR-PWI examination (criterion standard). On visual comparison, the parametric maps for the two techniques showed a similar distribution of CBV and CBF differences. Quantitative analysis of the rCBV values measured for the grey and the white matter ROIs showed good correlation (Pearson correlation coefficient for grey matter 0.73, white matter 0.96, and overall 0.84). The two modalities were in excellent statistical agreement as shown by the Bland-Altman analysis (95% limits of agreement range for grey matter ROIs, -0.0715 to 0.0615; and combined grey and white matter ROIs, -0.165 to 0.171). Bias in measurements was minimal (grey matter ROIs, 0.011; white matter ROIs, -0.005; combined grey and white matter ROIs, 0.0029) and the limits of agreement included clinically significant rCBV discrepancies.

**Conclusion:** The preliminary results demonstrate the feasibility and the accuracy of CBV measurement using C-arm angiography apparatus in the neuro-ITU patients with altered cerebral haemodynamics that would assist decision making in patients with suspected delayed neurological deficits after SAH. The technique allows a comprehensive non-invasive assessment of the vasospasm and its haemodynamic significance. It manipulates imaging data from a single scan using different post-processing methods and provides soft tissue images, angiographic images, and CBV maps. Examination time, radiation exposure, and radiographic contrast dose to the patient are therefore, reduced. A single scan evaluation in an optimal interventional environment improves workflow by avoiding patient transfer between the diagnostic and the interventional set-ups. We intend to study a cohort of 25 patients with vasospasm following SAH to explore the true potential of the technique in this specific clinical setting. In addition, the ability to study physiological parameters known to be of prognostic significance in patients with acute stroke, inside the neuro-interventional room has implications for the management of patients with other causes of cerebral ischemia. A combination of this capability with the existing Dyna-CT facilities of generating angiographic and parenchymal soft tissue images could help in the triage of patients with acute stroke to reduce time delays between the diagnosis and the treatment stages.
modality for non traumatic SAH with DSA being reserved for cases where endovascular management is warranted.

Tuesday, 5 October 10' - 11'

'De Novo' Aneurysms: Radiologic and Clinical Analysis of Our Ten Years Experience

G. Di Lella 1, P. Colelli 1, M. Rollo 1, B. Tirpakova 2, C. Colosimo 1
1. Institute of Radiology, Catholic University of Sacred Heart; Rome, Italy;
2. Institute of Neurosurgery, Catholic University of Sacred Heart; Rome, Italy

Purpose: Recent clinical evidence suggests that patients successfully treated for aneurysmal rupture should be considered at risk to develop new lesions adjacent to the former aneurysm in a new site (de novo), where no pathology was found in previous neuroradiologic studies. The real incidence of new aneurysms is unknown because of inhomogeneity in literature data, being comprised between 0.8-2.2% for 'de novo', while the 'regrowth' occurs in 0.5%. These data may be underestimated because Pts are partially lost at the follow up. Anyway de novo lesions represent the most common cause of recurrent post-clipping subarachnoid haemorrhage (SAH). Familiarity, female sex, smoke, age at first bleeding and hypertension are considered risk factors. Moreover results are in accordance with literature, suggesting that SH and 'additional'! All Pts had favourable outcome, except a transitory language impairment in a Pt treated for a de novo lesion in the L MCA. Probably, the good outcome was related to Hunt-Hess grade (8 Pts were 0 on Hunt-Hess scale; 2 Pts had SAH, but they were 1 and 2 on Hunt-Hess scale). Our results are in accordance with literature, regarding higher female prevalence, younger age of discovery of the first aneurysm and incidence of risk factors in de novo lesions, while hypertension was found only in three cases.

Conclusion: Our data, in accordance with the literature, suggest that SH from brain aneurysms may not be a 'one time' event. Patients treated have a higher risk to develop a new lesion and, if 45 years or younger at the time of first treatment, should be evaluated by CT or MR angiography, depending on the surgical or endovascular procedure, one year after the surgery and subsequently every two years. The type and the incidence of risk factors suggest a genetic influence: dedicated genetic studies, in our institution, are trying to find patients with higher risk of aneurysm development and those, between them, with higher rupture risk.

Aneurysms 2

Chairs: D.H. Hwang, E. Cotroneo

16.00-16.15

MR Angiography Follow-Up 5 Years after Coiling: Formation of De Novo Aneurysms and Growth of Untreated Aneurysms

S. Fers 1, M.E. Sprengers 1, G.A. De Kort 1, B.K. Velthuis 1, M. Blaser 1, W. Van Zwam 1, W.J.J. Van Rooij 1, C.B. Majoie 1
1. Department of Radiology, Academic Medical Center; Amsterdam, The Netherlands; 2. Department of Radiology, University Medical Center Utrecht, The Netherlands; 3. Department of Radiology, St. Elizabeth ziekenhuis Tilburg, The Netherlands; 4. Department of Neurology, Rudolph Magnus Institute of Neuroscience, University Medical Center; Utrecht, The Netherlands

On behalf of the LOTUS study group

Introduction: In patients presenting with intracranial aneurysms, additional aneurysms are frequently found or may develop with time. Additional aneurysms can be treated, but if small or with unfavourable geometry, are often left untreated. The frequency of de novo aneurysm formation and rate of growth of untreated additional aneurysms is unknown. Our group has previously reported on the incidence of de novo aneurysm formation and growth in a group of 65 patients with a fixed follow-up period, but the study had relatively small sample size. This makes it difficult to assess clinical relevance of periodic screening. Our group has previously reported on additional aneurysm formation and growth in a group of 65 patients with a fixed follow-up period, but the study had relatively small sample size. The purpose of this study was to assess the incidence of de novo aneurysm formation and pace of growth of additional untreated aneurysms with an elaborated sample of 247 patients with 288 coiled intracranial aneurysms after a fixed follow-up period of 5 years.

Methods: From 7 medical centres in the Netherlands, all patients with coiled intracranial aneurysms between January 1995 and June 2005 were identified. Medical ethics committees of all participating centres approved the study protocol and written informed consent was obtained from all participants. If patients had simultaneous aneurysm occlusion (complete occlusion or small neck remnant) at 6 month angiographic follow-up, were <70 years of age and had no contra-indication for Magnetic Resonance Imaging (MRI), they were invited to undergo long-term follow-up Magnetic Resonance Angiography (MRA) at 3Telsa. MRA images were analysed to assess long-term stability of coiled aneurysms. For the purpose of this study, we selected only the patients with a fixed follow-up duration of 5 years: 0.5 years. Location and size of additional aneurysms were recorded by two experienced neuroradiologists, compared with imaging at the time of coiling and classified as unchanged, grown, de novo or incomparable with previous imaging. Frequency of treatment of additional aneurysms or supplementary follow-up imaging was assessed.

Results: In the selected period, 1808 intracranial aneurysms were treated
in 1675 patients by endovascular coiling. 702 patients were invited for long-term follow-up MRA, 973 did not meet inclusion criteria for participation. 128 patients gave no informed consent, 174 patients could not be traced and 400 patients (57%) with 436 coiled aneurysms were included in the study, of whom 334 patients with 363 aneurysms were included in the study, of whom 334 patients with 363 aneurysms were included in the study.

There were 168 women and 79 men (32%) with a mean age of 54 years (median 55, range 23-70). Of 268 coiled aneurysms, 215 were ruptured and 53 were unruptured.

In 54 of 247 patients (21.9%), 77 additional aneurysms were found. The comparison of MRA images to previous imaging of 17 patients with additional aneurysms is still in process and 6 additional aneurysms were classified as incomparable. The remaining 54 additional aneurysms could be compared with previous imaging: 46 of 54 were unchanged, 4 had grown and 2 were de novo aneurysms. Five years after coiling, a de novo aneurysm was found in 2 of 247 patients (0.8%, 95%CI 0-2%). In the first 45% of patients we observed some cases of subarachnoid hemorrhages in acromegalic patients. Although a higher prevalence of ischaemic heart disease and mortality has been shown, no data are available on cerebrovascular involvement in acromegalic patients.

Purpose: To investigate acromegalic patients by means of brain MR angiography in order to evaluate the prevalence of intracranial aneurysms.

Material and Methods: Patients followed in our centre because of proven acromegalic underwent brain MRI (Philips Achiva 1.5T). MR angiography was used for evaluating the prevalence of intracranial aneurysms.

Conclusions: Aneurysm prevalence of 0.8% is comparable with previous studies.

Introduction: Aneurysms are classified as small aneurysms, aneurysms of medium size, and large aneurysms. The largest group includes the so-called giant aneurysms, which are defined as having a diameter of more than 25 mm. However, some patients developed atypical infarcts without proof of hemodynamically relevant spasm. The purpose of this study was to perform a pattern analysis of these ischemic lesions with the aim to generate hypotheses concerning etiology and risk factors.

Methods: We retrospectively included 262 consecutive patients from 2007 onwards with ‘ruptural’ aneurysms after SAH proven by CT and/or MRI. Vasospasm was assessed by means of CT- or MR-Angiography and Perfusion measurement or Digital Subtraction Angiography (DSA). Fisher grade of SAH was correlated with extent and patterns of atypical infarcts and clinical outcome.

Results: Of all patients, 58 (22%) showed cerebral ischemic lesions in the absence of vasospasm on conventional imaging. 55% of these were classified as embolic most likely caused by complications of cerebral DSA, endovascular or neurological aneurysm treatment.

In the other 45% of patients with infarction, the cause of the cerebral ischemia remained unknown. In this group, patterns of cerebral hypoxia and territorial infarcts with cortical necroses were seen. Neurological symptoms caused by interventional complications were usu-

Atypical Ischemic Lesions in Patients with SAH Apart from Vasospasm

M. Wagner1, F. Steinbiss1, E. Güresir1, S. Weidauer2, J. Berkofeld1
1 Department of Neuroradiology, Goethe University; Frankfurt, Germany; 2 Department of Neurology, Katharinenkrankenhaus; Frankfurt, Germany

Introduction: Delayed cerebral ischemia in patients with subarachnoid hemorrhage (SAH) is commonly associated with vasospasm. However, the various risk factors for the rupture of intracranial aneurysm have been addressed extensively in the literature. Very few studies, if any, have investigated the role of venous hypertension in the fate of these aneurysms. From our previous experience of venous pressure measurement in the treatment of acute dural sinus thrombosis, we have discovered some discrepancy of venous pressure in asymmetry of dural sinus.

Therefore, we propose that dural sinus asymmetry is associated with aneurysm rupture.

Material and Result: We have reviewed cerebral angiograms from...
January 2000 to April of 2008. Two hundred nineteen cases met with our inclusion criteria, but only 173 had sufficient data. This group consisted of 131 females and 42 males. Age ranged from 15 to 90 in females and 26 to 81 in males. Of the entire group, 140 had ruptured aneurysm. 87 of these 140 patients showed venous asymmetry. In females, there were 91 cases of aneurysm rupture, of which 60 had venous asymmetry. In males, 49 had a history of ruptured aneurysm, and of these, 27 had venous asymmetry. Chi-squared analysis showed significant ($p<0.05$) between aneurysm rupture and venous asymmetry in the entire group and in females, but not in males.

**Conclusion**: Our analysis demonstrates a correlation between aneurysm rupture and dural sinus asymmetry in females, not in males. Perhaps, our analysis of males is limited to relative small sample size. However, our result indicates that aneurysm rupture and asymmetry of dural sinus are not completely independent.

We theorized that dural sinus asymmetry reflects underlying venous hypertension and that in turn predisposed to aneurysm rupture from increased venous back pressure.
Palazzo della Cultura e dei Congressi - Blue Hall  
Tuesday, 5 October - 14.30-17.30

COMMUNICATIONS

Research 1

Chairs: Z. Kulcsar, A. Norbash  
14.30-14.45

Introductory Lecture  
Paradigm Shift for the Management of Brain Aneurysms  
A. Takahashi  
Department of Neuroendovascular Therapy, School of Biomedical Engineering, Tohoku University; Sendai, Japan

For the development of management system for all types of existing brain aneurysm, we have developed the system to comprehensive research. One of the system consists of animal experiment and the other consists of evaluation system including computer fluid dynamics (CFD) using micro CT and/or 3D DSA. This system enables us to develop new concept for the paradigm shift from simple neurosurgical and/or neuroendovascular therapy approach to more comprehensive management option including both of invasive therapy with more non-invasive therapy including drug management. Among those effort to make this happen, I will cover the recent achievement using animal models.

Using rat and possibly rabbit model, we could research on real intracranial brain aneurysms which may present with SAH. Several drug is tested to show the possibilities using conjunction with invasive management and/or sole treatment. Rho-kinase inhibitor and statin and/or ARB has different effect on several different phases of aneurysm development and positive effects were identified for future management option. CFD research is promising, but consistent research using real follow-up of unruptured and/or ruptured brain aneurysm is still challenging. Using those animal models, we could achieve much reliable and reproducible results which may contribute to the more universal type of devices. Those topics will be reviewed based on the efforts which is taking place in our laboratories.

14.45-15.00

Introductory Lecture

Reflections on Therapeutic Approaches  
K. Murphy  
Medical Imaging, University of Toronto; Canada

Every field in medicine undergoes a phase of creativity, and inventive-ness. Frances Crick termed this the phase when a society is incandescent. This stage is critical because that’s when we can recruit talent and inspire young minds. Most great ideas do not arise from a series of well thought out moves. Clinical pressure is what drives our field. We are carbon based life form and but remember that it only takes pressure to turn carbon into diamonds.

It’s important to attend society meeting as often our new ideas arise after the chance interaction with an incandescent mind and that moment that lights for us another way to solve a problem. Our role here is called in MBA speak “the innovation of the user” and its essential to commercial success. It’s a fundamental talent we have that comes from our complex training in imaging physics and patient responsibility. This is one of our skills that we will celebrate at meeting like this Symposium and at SIR. Some of us file patents, some share the knowledge and teach. Inventing is about wealth, its how you can be involved some how in treating thousands of patients a day instead of 10.

The key to therapeutic advancement is that someone thought of them. Some one synapsed differently and will start making bad decisions about the money you have lost the plot from and the self respect, if it becomes a fun life. But the anchor is the clinical environment that allows you to do take short cuts, to ignore complications, to do early human work in third world countries. You must never bend on your principles. You must never allow patients to be treated like guinea pigs. If a company doesn’t listen to your warnings you don’t want to be involved with them.

15.00-15.15

Reflections on Therapeutic Approaches  
K. Murphy  
Medical Imaging, University of Toronto; Canada

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The key to therapeutic advancement is that someone thought of them. Some one synapsed differently and thought of the new approach. Some minds seem to do this more than others some are wired that way, almost like an intellectually and professionally acceptable form of Tourettes syndrome. Indeed inventiveness and humor are close in nature I think the unexpected associations of things to create the non obviousness inventive step. That’s almost the definition of what is patentable. The key elements in invention and innovation would therefore be clinical need and pressure thought association dissatisfac-

tion with the status quo, a supportive clinical environment that allows you try something new out and a regulatory system that is not restrictive. To develop and nuance the idea the ability to perform clinical research in a collaborative way is necessary.

The path from the idea in the middle of the night while sleeplessly rehearsing the next day’s big procedure, to a device is long. On average its 5-7 years. Most great inventions are made by clinicians not PhDs. Only 2% of doctors determine the practice of the other 98%, very few clinicians become serial inventors. Ideas are in some way like a crop cycle. By the time you have your first one you are 35-40, you get it squared away and in production by 45, that leaves you with time for about 1-2 more if you’re lucky. Once you have one idea you have street cred so the next one is easier for you to navigate. You make a better deal for your self. The more innovative the idea the harder it will be for you to get it established. Device development research is very different from scientific research. In a small company the only research that gets done is that which supports approval and re-imbursement. Anything else is a loss of focus. It’s an interesting rigor, and a fascinating world. You develop a team of buddies who will become as close as very friends from internship who you still trust 20 years later because you know what they are made off. It’s a fun life. But the anchor is the clinical work, that’s where the ideas come from and the self respect, if it becomes about the money you have lost the plot and will start making bad decisions.

The last skill needed and ultimately the most important one is tenacity, for that is what determines who wins and loses. Handling this in an ethical way while not falling foul of conflict of interest guidelines is a real challenge. As an inventor you will be pressured to bend the rules. As a board member you will be pressured to do take short cuts, to ignore complications, to do early human work in third world countries. You must never bend on your principles. You must never allow patients to be treated like guinea pigs. If a company doesn’t listen to your warnings you don’t want to be involved with them.
Background: Advancements in stem cell research have created a potential for regenerative treatment strategy to a wide spectrum of diseases tested both in experimental animal systems and in humans, e.g. diabetes mellitus, Parkinson, ischemic heart disease, traumatic brain injury (TBI) and stroke. Preferably, minimally invasive techniques for reaching a desired target organ should be used. Endovascular technique has benefits via-a-via percutaneous access to organs with less accessible anatomical locations such as the CNS, the pancreas and the heart. To minimize surgical risk we propose a novel endovascular technique, named Extroducer, to create parenchymal access through endovascular methods.

Materials/Methods and Results
We have developed, manufactured and tested a microendovascular catheter system with a distal depth limiting collar and a penetrating tip that is used to perforate vessels, thereby creating a working channel to the extravascular space. To prevent hemorrhage during termination of the procedure, a hollow electrolysis detachment-zone leaves the distal tip in the vessels after the intervention. Consol multiphysics software simulations showed that in the dimensions used, the detached distal end of the Extroducer system is auto-sealing at physiological blood-pressure. This was also verified in vivo by simultaneous angiography and microsurgical exposure. Interventions have been performed ex vivo (n=15) and in vivo in both rats (n=13) and rabbits (n=12) by testing Extroducer prototypes. All tests demonstrate absolute extravascular hemostasis and absence of thrombo-embolic complications when exiting the vessels from the inside to the extra-vascular space. We deposited prototypes after intervention in vascular walls over a period of 14 days in rats and 30 days in rabbits, with no impairment on blood flow or signs of thrombo-embolic complications upon re-angiography and/or re-exploration. The Extroducer system was incorporated with standard clinical microcatheter-systems both in an ex vivo simulator setting and in a full scale clinical angiographical setting in rabbits. For verifying the functionality of the Extroducer system, a contrastagent or methylene blue was administered via the system to the extravascular space and visualized by angiography or microsurgery, respectively. Passage of mesenchymal stem cells was tested ex vivo through a 1700 mm long Extroducer system showing that 90% of the cells survived and were possible to re-seed in vitro.

Conclusion: In conclusion, the novel design of the Extroducer prototypes has sustained all testing so far. We consider the Extroducer, in the clinical setting, a tool for creating direct access to all organs of the body with microendovascular technique for parenchymal access to perform stem cell transplantations, cytostatics-or contrastagent-injections or sampling procedures. The benefit should be greatest in organs such as the CNS, the pancreas and the heart which are difficult or high risk to access with other techniques.

Research 2

Chairs: W. Taki, A. Norbash, D. Prosetti
15:15-15:30

Introductory Lecture
A Live Swine Model for Development of Techniques Using Percutaneous Intraspinal Navigation
P. Purdy1, B. Welch1, R. Novakovic2, S. Miller2, T. Fujimoto2
1 UT Southwestern Medical Center-Departments of Radiology & Neurosurgery; Dallas, TX, USA;
2 UT Southwestern Medical Center-Departments of Radiology & Neurology; Dallas, TX, USA;
3 UT Southwestern Medical Center-Department of Orthopaedic Surgery; Akashi, Japan

Background: Percutaneous Intraspinal Navigation (PIN) involves placement of a catheter, endoscope, or other instrument into the spinal subarachnoid space and the use of that space as a conduit for navigation within the spinal canal and into the cerebral subarachnoid space. We described this technique using a lumbar puncture approach and angioplasty balloons for creation of spinal cord injury in a canine model. We also described the technique for multiple applications in human cadavers.

Development of the technique as a clinical tool requires refinement of instrumentation, documentation of applications, and establishment of safety. These also depend on understanding anatomy. Our work originally utilized human cadaveric materials for technical elaboration; recently we have developed a live animal model using Sinclair swine to explore potential risks and their avoidance. This presentation will review the instrumentation used and the results obtained with survival studies involving endoscopic navigation along the spinal cord.

Materials and Methods: At 9 months Sinclair swine (Sinclair Bio Resources, Columbia, Missouri) weigh approximately 30-40 kg. Their spinal canal size, while smaller than that of humans, is large enough to introduce some commercially available endoscopes. A total of 4 Sinclair swine were studied following a UT Southwestern approved protocol to document basic procedural safety in which PIN endoscopy was performed using a 2.5 mm diameter 65 cm length urologic endoscope with a 1 mm working channel (Karl Storz, Inc.-Germany). The technique was advanced via the sheath and cephalad within the spinal canal to the limit of its length (generally near the cervicothoracic junction) and withdrawn, utilizing tip deflections to examine the spinal column and nerve roots. Video recordings were obtained throughout the procedures. Endoscopic images were captured via recording onto DVD, played back via a Canopus TwinPact 100 digitizer into an Apple Mac Pro computer and edited using Apple iMovie software. Also, video recordings of each animal were obtained postoperatively for documentation of neurologic function using a Sony HDR-UXT HD DVD camcorder and edited using iMovie software. Localization of the endoscope was documented using radiographic image capture and progression of endoscopy was monitored via fluoroscopy.

Results: Endoscopic anatomy of the live swine spinal cord and spinal roots was seen and postoperative video demonstrating intact neurologic function following spinal cord endoscopy was obtained. One animal suffered a lumbar nerve root consequence foot drop that cleared by 72
hours, but none suffered clinically apparent spinal cord impairment.

Conclusions: While Sinclair swine functioned well in this study, the occurrence of nerve root injury in 1 animal was disconcerting. A larger species (Yucatan swine) that weighs 40-50 kg at 9 months is available from the same vendor and might be preferable for translational comparisons. However, this study shows that PIN is feasible using steerable fiberoptic endoscopes of commercially available sizes and with working channels of 1 mm or slightly larger. Visualization of spinal cord and multiple spinal nerve roots enable potential diagnostic as well as interventional use of this technique. Rigidity of sheaths available for arterial catheterizations increases the trauma during spinal access. Newer access technology is under development and specialized endoscopic technology, as well as instrumentation to be used with the endoscope, is needed.

References

Effect of Olmesartan and Pravastatin on Experimental Cerebral Aneurysms in Rats

N. Kimura 1, H. Shimizu 1, H. Eldawoody 1, T. Nakayama 1, A. Saito 1, A. Takahashi 1
1. Department of Neuroendovascular Therapy, Tohoku University Graduate School of Medicine; Sendai, Japan;
2. Department of Reconstructive Endovascular Therapy, Tohoku University Graduate School of Medicine; Sendai, Japan;
3. Department of Neuroendovascular Therapy, Tohoku University Graduate School of Biomedical Engineering; Sendai, Japan;
4. Department of Neuroendosurgery, Tohoku University Graduate School of Medicine; Sendai, Japan;

The major initiation process of intracranial aneurysms is thought to involve endothelial dysfunction due to hemodynamic stress. Angiotensin II type 1 receptor blockers and statins improve vascular endothelium function. The effects of olmesartan and pravastatin were investigated on the development of experimental aneurysms in rats. Eighty-three rats underwent aneurysm induction. Seven groups of 10-E4 rats were treated with low or high dose olmesartan, low or high dose pravastatin, low doses of olmesartan and pravastatin, hydralazine, or no drug (control) for 12 weeks, when rats were sacrificed for vascular corrosion casting and scanning electron microscopy. Aneurysmal changes were observed in 100% and stage III in 50% of rats. However, this study shows that PIN is feasible using steerable fiberoptic endoscopes of commercially available sizes and with working channels of 1 mm or slightly larger. Visualization of spinal cord and multiple spinal nerve roots enable potential diagnostic as well as interventional use of this technique. Rigidity of sheaths available for arterial catheterizations increases the trauma during spinal access. Newer access technology is under development and specialized endoscopic technology, as well as instrumentation to be used with the endoscope, is needed.

References
The stent systems under investigation were implanted 2-3 weeks after aneurysm construction. Angiographic controls were made after 2 (n=4), 4 (n=4) and 6 (n=6) months, and finally preparations of the stent-bearing vessels were harvested for histological examination.

Results, Discussion and Conclusion: In vitro, the stents showed high flexibility and could be positioned even through curves without creasing. The radial strength was comparable to current standard products despite the fine-mesh structure. The in-vivo trials in mini-pigs showed reliable initial placement, navigability and curve flexibility. Moreover, there was significant flow canalization in the carrier vessel and clearly reduced flow into the aneurismal sack. Secondary coiling with probing of a microcatheter through the stent mesh could be performed without problems. The angiographic long-term results, histological analyses and resultant conclusions of the study, which is still running will be presented in October 2010.

Increased positive SWSSG in the adjacent proximal region. The WSS has reached values of more than five times the temporal average values of the parent vessel, whereas the WSSG approximated or exceeded peaks of 40 Pa/mm in all three cases. All patients developed an aneurysm in a period of two years, one of which had ruptured.

Conclusions: The results of this hemodynamic study, in accordance with the clinical follow up suggests that the combination of high WSS and high positive SWSSG focused on a small segment of the arterial wall may have a role in the initiation process of aneurysm formation.

Research 3

Chairs: M. Mawad, L. Pierot
16:30-16:45

Introductory Lecture

“How Healthy Is Interventional Neuroradiology?” The Heart Rate of a Neuro-Interventionalist during Procedures

P. Brouwer
Leiden University Medical Center,
Neurovascular Network Northsea;
Leiden, The Netherlands

Neurointerventional procedures can be time consuming and stressful. In an attempt to assess the stress level of these procedures we measured the heart rate of the neurointerventionalist in real time. The impact of outpatient clinic, coiling, stenting, NBCA-embolization and Onyx-embolization were compared and will be presented.

Introduction Lecture

Computational Simulation of Flow at Bleed of Aneurysms and Confirmation by Clinical Angiogram

K. Fukasaku1, M. Negoro2, Y. Konishi2, S. Noda3, R. Himeno3, H. Yokota3, I. Nara4, K. Fukui5, Y. Shikokawa6
1 Computational Biomechanics, Riken; Wako, Japan; 2 Department of Neurosurgery, Fujita Health University; Toyoake, Japan; 3 Department of Neurosurgery, Kyorin University; Mitaka, Japan; 4 Department of Neurosurgery, Himonya Hospital; Tokyo, Japan; 5 Department of Neurosurgery, Fujita Neurosurgical Clinic; Toyohashi, Japan

1 Fujita Health University Hospital; Toyohave-Nagoya, Japan; 2 Nagoya University School of Engineering; Nagoya, Japan

Traditional training paradigms in medical field meet the challenge as the result of changes in health care. Recent evolution of minimally invasive technologies requires the quality of care and patient safety. It means that young generation of neurointerventionalist has reduced the procedural experience during training period. As these young doctors training issue has evolving, there has been evolving a training method as simulation.

Here we propose an in vitro patient-specific anatomical model of cerebral blood vessels as the simulator of neurointervention.

Rapid production technique of an in vitro model of human cerebral arteries based on CT scan or MRI is invented. This arterial model is transparent to visible light, and gives human-like elasticity by using silicone elastomer as model material. It can be used for pre-procedural simulation for any neurointerventional procedures.

Combined with the simulator, we have invented the catheter control system which is able to manipulate a catheter without direct touching by human hands. There are two basic mechanisms consisting of catheter driving device and regulating device. For driving linear stepping method (LSM) is applied, for regulating magnetic motion capture sensors (MMCS) are used.

This catheter controlling robotic system has abilities to perform endovascular procedures from the distant places. It may help to reduce the radiation exposures to the neurointerventionists and also to help train young doctors.
Preface: Rupture of cerebral aneurysms is caused by various physical factors. Fluid dynamics should play some important roles in the factors. We have developed computational fluid dynamics (CFD) system which is affinitive with clinical imaging. It is well known that blebs are high risk structure of aneurysm. By our CFD analysis, blebs have poor flow. Using specially set clinical angio-equipment, the flow pattern can also be visualised. We report validation of CFD result. Also, detection of risky flow pattern by clinically available equipment should valuable for our clinical work.

Materials and Methods: Three dimensional (3D) structures of aneurysms and parent arteries were obtained by 3D modalities. Any modalities, rotation 3D digital angiography, 3D time of flight MR angiography and 3D CT angiography, were acceptable. The C arm was given to our home brew voxel based CFD system, which did not need manual segmentation nor mesh generation. Imaging data was obtained minimamising noise. The calculation model had solid wall, at present, and flow pattern was pulsatile, whose pattern was gotten by Dopper wire. The calculation was achieved by both of a personal computer and our super computer. The results achieved by both of a personal computer and our super computer were visualised by our home brew voxcel based CFD system, which did not need manual segmentation nor mesh generation. Experimental particle image velocimetry was In-tegris Allura DSA unit (Philips Medical Systems, The Netherlands, B.V.). The C arm was set to clearly show the bleb and sac. DSA were obtained injection 10 or 15 ml contrast media at 2 or 3 ml/sec at 7.5 frames per second. Anterior communicating aneurysm was said to have high risk, so calculated, too.

Results: Flow at blebs was poor rather than fast or rich on CFD. Stream lines could not enter blebs easily. This result could be also visualized by DSA. Routine 3 fr/sec DSA could not show the difference very well. Some of anterior communicating aneurysms were also had poor flow, too.

Calculation time for CFD was extremely variable. In case of low spatial resolution, to calculate 128 x 128 voxel model, it took about 24 hours for one cycles using Xeon 5160 quad core personal computer system. If high spatial resolution, it took 120 hours for the same number of voxcel model. To build calculation models from clinical images, it took only a few hours as no need of mesh generation. When clinical images could be obtained by satisfactory resolution without significant noise, the data was directory converted to CFD models. In cases of noise images, it took about an hour to remove noise.

Discussion: Observation of flow through operating microscope while clipping, blood flow in the bleb could be looked through. So, flow at the bleb was thought to increase. However, our result showed the flow at bleb might decrease. Decreased flow at bleb should degenerate aneurysm wall and let us look the flow inside. Behavior of aneurysm wall at low flow could be evaluated from biological points of view. Validation of CFD must not be ignored. Experimental particle image velocimetry has been one possible solution. However, clinically familiar CDF could be much easier method. Moreover, simulating calculation, it took very long time and computers were not always available. Finding poor flow at bleb by DSA meant high risk of rupture. This was an easy way to evaluate risk of rupture.

Well known high risk anterior communicating aneurysm had poor flow in some occasions. By balanced perfusion from both A1 segments of anterior cerebral arteries, flow in the ACom aneurysm should be decreased so have higher risk of rupture. In case of hypoplasia or aplasia of unilateral A1, ACom became terminal type so might have high risk again.

Conclusion: CFD for aneurysm with bleb showed decreased flow at bleb. Relatively slow flow was thought to a possible risk factor of rupture, also slow flow might have high risk again. CFD for aneurysm with bleb showed decreased flow at bleb. Relatively slow flow was thought to a possible risk factor of rupture, also slow flow might have high risk again.

Using C-Arm CT

Intra-Arterial Contrast Injections for Measurement of Regional CBV Using C-Arm CT

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Recent work by our group has demonstrated that following an intra-venous injection of contrast medium measurement of CBV values obtained using C-arm CT are comparable with those made with conventional perfusion CT techniques both in normal canines and in ones with an acute ischemic stroke. Others have also demonstrated the feasibility of using C-arm CT to measure CBV in humans with acute ischemic strokes. The aim of our recent work was to test the ability to use selective intra-arterial injections of contrast medium to obtain local (regional) rather than global measurements of CBV. The motivation of this work was to determine whether or not it might be possible to perform multiple assessments of CBV in parenchyma down-stream from a major arterial occlusion such that, using this parameters, viability of ischemic tissue could be assessed during prolonged attempts at revascularization without a need for either an intravenous injection of contrast medium or a change in the catheter position from that being used for revascularization.

Under an institutional approved protocol 4 normal animals and 9 animals with an acute ischemic stroke were studied. All studies were done on a single plane angiographic flat detector system (Zeoego, Siemens Healthcare, AX, Forchheim, Germany) and a 64 slice CT scanner (Sensation Care, MW., WI). Conventional PCT values were processed using commercially available software. C-arm CT measurements were processed using prototype software. The 4 normal animals were studied first with conventional PCT using an intravenous injection of contrast medium. They were then immediately brought to the angiographic suite where a CBV measurement was performed after: a) an intravenous injection; b) an aortic arch injection; c) an injection into the left common carotid artery; d) an injection into the right carotid artery; and finally; e) an injection into one of the vertebral arteries. In the other 9 animals an acute ischemic stroke was created by selective catheterization and embolisation of one of the middle cerebral arteries. Then, after a 4 hour interval standard PCT measurement of CBV was performed as already described. This was followed by measurement of CBV using C-arm CT, again using the same injection sequences and protocols as for the normal animals. CBV maps from the standard PCT were matched with those from the C-arm CT and a qualitative assessment of CBV levels was performed.

In all instances, CBV maps from the standard PCT acquisitions matched well with those from the C-arm CT assessments done in conjunction with either an aortic arch injection or an intravenous injection of contrast medium. There was not agreement, however, between the PCT maps and the C-arm CT maps done in conjunction with the carotid or vertebral injections. Injection into a carotid artery contra-lateral to the side of a middle cerebral artery occlusion did not result in contrast filling of the territory of the occluded middle cerebral artery. Likewise, injection into a vertebral artery did not
result in reliable and homogeneous reflux of contrast into the territory of an occluded middle cerebral artery throughout an acquisition.

In Conclusion and, perhaps not surprisingly, because of an inability to account for all inputs into the parenchymal territory of an occluded artery (an thus not having certainty that there was a steady state of contrast opacification in the parenchyma of interest), we found it impossible to obtain reasonable CBV measurements using selective intraarterial i.e. carotid or vertebral injections aimed at filling by collaterals the territory distal to a middle cerebral occlusion. For assessment of CBV in subjects with a proximal large artery occlusion either an intravenous or an aortic arch injection seems to be required for meaningful assessment of CBV. The ability to measure perfusion parameters in other organs having less complex arterial supply than the brain requires further investigation.
Spinal Cord AVFs

Chairs: A. Thron, F. Causin

14.30-15.00

Introductory Lecture

Spinal Cord Arteriovenous Shunts: Anatomical, Clinical and Therapeutic Considerations

G. Redeschi, S. Kominami, A. Krajinà, R. Sellar, M. Soderman, R. Vandenberg, S. Condette Auliac
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Nippon Medical School-Department of Radiology; Tokyo, Japan;
Faculty of Medicine in Hradec Králové-Department of Radiology; Prague, Czech Republic;
University of Edinburgh-Department of Neuroradiology; Edinburgh, United Kingdom;
Karolinska Institute-Department of Neuroradiology, Stockholm, Sweden; 6 University of Amsterdam-Department of Neuroradiology; Amsterdam, The Netherlands

Introduction: Spinal cord arteriovenous shunts (SCAVSs) are rare and challenging diseases. They are considered as devastating malformations because of the high natural history and of the eloquence of the spinal cord (SC), particularly when invading the anterior structures of the SC. The anterior spinal axis (ASA) is the most important artery vascularizing the SC from both morphological and functional points of view. It has therefore for a long time been considered as a “forbidden artery” that could not be emboledized. Micronanatomical studies have however clarified the vascular disposition and distribution of the ASA and have allowed to precise the branches of the ASA that could be catheterized and embolized safely, even with liquid emboli. We report our experience of a specific group of SCAVSs, vascularized by the ASA, and located exclusively in the anterior spinal sulcus thus not invading the cord tissue.

Material and Methods: Among a series of 61 intradural SCAVSs registered in our databank and for managed in our institution and in our network since 2002, 8 were considered to be exclusively embedded in the anterior sulcus of the SC, respecting the cord parenchyma. The clinical and radiological files of these patients have been reviewed, as the management proposed.

Results: The intrasulcal localisation of the shunt was precised by angiography as MRI was not able to depict in each circumstance the place and type of the shunt. Only short or long sulco-commissural arteries projecting angiographically on the midline behind the continuity of the ASA vascularized the shunt. The venous drainage of the lesion was always exclusively through the anterior spinal vein. The invasion of the cord tissue itself was excluded as no pial, coronal or perforating branch of radiculo-medullary or radiculo-pial feeders could be seen. These radiological data correlate with the microanatomy of the ventral sulcus that represents a compartment constituted by a groove covered by a thick layer of pia mater, containing the ASA and its sulco-commissural branches, and the anterior spinal vein, the latter lying below the ASA, in the depth of the ventral sulcus. Five of the 8 patients were males, 2 were females. The mean age of presentation was 29 years, the median age of consultation was 30.5 years. Two lesions were nidus-type AVMs and 6 were arterio-venous fistulae (AVFs) (3 micro AVFs [mAVFs] and 3 macro AVFs [MAVF]). Three were located in the cervical cord, 4 in the thoracic cord, and 1 at the level of the conus. Six patients presented with progressive neurological symptoms, two with acute symptoms related to haemorrhage (one AVM and one mAVF). Pain venous reflux via the anterior spinal vein was seen in all patients. Venous ectasias were seen in MAVFs. False aneurysms (arterial or venous) were seen only in haemorrhagic AVFs. Seven patients were emboledized with acrylic glue after transarterial superselective catheterization of the sulco-commissural feeders. One patient has not been treated because of the impossibility to reach a safe stability of the microcatheter inside the sulcal artery with the risk of erratic embolus in the SC itself. Embolization was then withdrawn, the patient being moderately disabled, and he is currently followed up. Cure of the malformation could be achieved in 4 patients at this stage (2 mAVFs, 2 MAVFs). Both AVMs are treated at more than 75%. One 10 year old child with cervical multiple monomycelomorphic AVFs is currently still under treatment, her initially symptomatic MAVF being cured. All treated patients are improved or asymptomatic at this stage. No morbidity or mortality occurred in our series.

Conclusion: SCAVSs of the anterior sulcus of the cord are a group of lesions that, although giving rise to non specific symptoms, should be considered as particular lesions because they remain strictly in the subpial space and do not invade the spinal cord tissue. Their management remains challenging because they are vascularized exclusively by sulco-commissural branches of the ASA. Embolization is a valid therapeutic option for these lesions if superselective catheterization of the feeders can be achieved. Proper deposition of glue, that represents in this anatomical disposition the best embolic material to be used, allows anatomical and clinical controls of these lesions.

Role of Contrast-Enhanced MR Angiography in Spinal Dural Arterio-Venous Fistula

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Aim: to assess the reliability of spinal contrast-enhancement MR angiography (CE-MRA) using TRICKS sequences in localizing spinal dural arterio-venous fistula (SDAVF) before selective DSA exam and possible subsequent treatment.

Materials and Methods: From January 2007 to December 2009 we investigated 16 consecutive patients suspected of harbouring vascular spinal cord malformation. All MR examinations were performed on a 3T system (SIGNA EXCITE, GE Healthcare). The MR protocol was composed of a conventional morphological MRI study, subsequently completed with CE-MRA. TRICKS sequences were acquired on the coronal plane with the following technical parameters: TETR 1.5/ 3.8
Role of 3D Angiogram in Embolization of Spinal Dural Arteriovenous Fistula

P. Lv 1, D. C. Suh 2
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Purpose: Recently 3D angiography has been used for many cerebrovascular diseases. However, it’s application to spinal vascular disease is limited despite highly difficulties especially in selection of feeder of spinal dural arteriovenous fistula (SDAVF). We present our experience in patients with SDAVF and specify the role of 3D angiogram.

Materials and Methods: Among 29 SDAVF in our neurointerventional database, 3D angiogram was obtained in recent 9 consecutive patients. The patient age ranged 38-76 (M:F = 2:3). The fistula was 8 thoracic, 1 lumbar and 1 cervical level. We obtained 3D angiogram by injection of 1cc contrast agent for 6 sec. Postprocessing and reviewing of images were done in independent workstation. We evaluated image quality regarding the course evaluation and separation of feeder from other branches, and useful view angle for demonstration of feeder.

Results: Between the 12 patients with DSA or post-operative findings validations, in 9 patients CE-MRA correctly depicted the origin of the fistula; in particular 2 patients were treated surgically only on the MRA results, because conventional angiography failed. In 3 cases MRA and DSA disagreed; in the first one DSA didn’t identify AV shunt visualized on CE-MRA, in the second patient CE-MRA didn’t depict SDAVF; in the third patient CE-MRA localized the arterial feeder at a totally different vertebral level form SDAVF described in DSA. Lastly CE- MRA localized the feeder from other branches. Overlapping images with bone provided real anatomical insights for the complex imaging feature in SDAVF. Advantages of 3D DSA included direction and angle analysis of feeder, decision of working side, and identification of fistular point.

Conclusion: 3D angiogram provided essential anatomical and 3 dimensional information regarding the complex course of feeder in SDAVF. Obtaining 3D angiogram at the time of diagnosis is mandatory to make a plan of further possibility of embolization.
Cervical GPMAVF's with complex angiographic architecture can be treated with transvenous embolization or direct puncture of the venous pouch with very good clinical results.

### Endovascular Embolization of Spinal Dural Fistulae: Preliminary Experience with Novel Successful Application of Onyx

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1 University of Michigan Hospital - Department of Endovascular Neuroradiology; Ann Arbor, MI, USA; 2 University of Chicago Medical Center - Department of Neuroradiology/Neurosurgery; Chicago, IL, USA

**Introduction:** Surgical excision has been the traditional method for treatment of spinal dural fistulae. Currently, the natural history of spinal dural fistulae is not clearly understood. There is a case series reported in the literature documenting successful endovascular treatment of spinal dural fistula with n-BCA liquid embolic material. A relatively new liquid embolic agent, Onyx has been used extensively in the endovascular treatment of cerebral arteriovenous malformation and arteriovenous fistula. The first application of Onyx in the endovascular treatment of spinal dural fistulae has been reported in literature in 2003. An additional 3 cases of spinal dural fistulae have been treated successfully with Onyx reported in 2009. We present our experience of endovascular treatment of spinal dural fistula with mainly n-BCA but also including some cases successfully treated with Onyx.

**Materials and Methods:** A systematic retrospective review of all the cases of spinal dural fistulae was identified that were referred to our institute and were treated there. We looked at patients with angiographic evidence of spinal dural fistulae and other spinal vascular malformation that underwent either surgical or endovascular treatment at our institute from February 2004 to February 2010. Patient chart review, outpatient clinic follow up letters and imaging review formed the retrospective analysis for the identified group of patients.

**Results:** Fourteen patients were identified to have been diagnosed with spinal vascular malformation. There were 9 males and 5 females in the cohort. The age ranged from 16 - 81 years (mean 57 years). Thirteen were confirmed on digital subtraction spinal angiography (DSA) and 1 was negative on DSA. Two of these 13 cases were medullary arterio-venous malformation (one cervical and other upper thoracic). So, of the 11 cases of spinal dural fistulae 3 cases had to undergo surgical excision due to the proximity of the anterior spinal artery supplement to the arterial feeder to the fistula. All these cases were marked with coils in the anterior division of the intercostal artery to facilitate level identification during microsurgical excursion. Eight patients treated by endovascular embolization had a total of 12 procedures. Onyx was used as the liquid embolic agent in 4 cases. The other 8 endovascular embolizations were performed utilizing n-BCA and coils. There were no procedure related complications in any of the endovascular treatments. The mean follow up of the cohort was 15 months (range 10 days - 52 months). Seven of the 11 cases treated had symptomatic improvement and 2 were stable after treatment. Two cases had persistent and even worsened spasticity in lower limbs following treatment. All of the cases treated with Onyx had marked improvement in clinical symptoms. Angiographic follow up on the patients treated with Onyx was not available because of the short duration of follow up.

**Discussion:** The role of n-BCA in the endovascular management of spinal dural fistulae is well established in the literature. Interestingly there is a trend towards endovascular treatment if feasible and surgical excision in the cases where endovascular treatment is not safe or technically possible. Durability of endovascular treatment has still not been established in the literature. Onyx might be an alternative to n-BCA in situations of inaccessibility of the arterial feeder due to anatomical tortuosity. We demonstrate the ability of Onyx to be diverted into the arterial feeder even in situations where a distal catheter location is not obtained. The unique properties of Onyx can be utilized to treat spinal dural fistula safely from a relatively proximal location of the microcatheter. Coil embolization of other distal intercostal branches prior to injection of Onyx allows the embolysate to be directed towards the fistula feeder thereby avoiding non-target embolization. Our findings and experience corroborate well with the findings of Nogueira et al.

**Conclusion:** Endovascular embolization of spinal dural fistula is increasingly more safe and feasible due to advanced microcatheter technology. Detailed analysis of the normal arterial and venous drainage of the spinal cord is needed to understand the pathophysiology of spinal dural fistulae. Long term angiographic and clinical follow up data of a large cohort is necessary to establish the durability of endovascular treatment. The use of Onyx as a liquid embolysate to treat spinal dural fistula is technically safe. It can be utilized as an alternative to n-BCA in cases with difficult access from a proximal microcatheter location.

### Neurological Improvement Pattern after Embolization and/or Surgery of Spinal Dural Arteriovenous Fistula

**Spinal Cord AVFs 2**

Chair: G. Rodesch, L. Biscotto

**Materials and Methods:** Among 28 SDAVF in our neurointerventional database, successful embolization (n = 20), surgical resection (n = 6) and no treatment (n = 2) was done. The patient age ranged 34-76, mean 55 (M.F = 24:4). Level of the fistula was 2 cervical, 20 thoracic, 5 lumbar and 1 sacral levels. We evaluated demographic data, pre-procedural neurological status, duration of symptom onset, level of the lesion, MRI finding of spinal cord and compared to post-procedural neurological improvement.

**References:**
Diagnosis and Endovascular Treatment of Spinal Arteriovenous Malformations Supplied by Intercostal and Lumbar Arteries

T. Tissen 1, S. Yakovlev, E. Bukharin, A. Bocharov, S. Arustamyan, E. Vinogradov, B. Tissen
1 Burdenko Neurosurgery Institute; Moscow, Russia; 2 Central Trauma Institute; Moscow, Russia

Background and Purpose: Selective Spinal Angiography (SSA) is considered the preferred method for diagnosis of arteriovenous malformations (AVMs) of the spinal cord in the detection of blood supply sources, blood outflow pathways, localization, haemodynamic characteristics, and the course of the AVM’s vascular conglomerate. The decision for choosing a method of endovascular treatment of spinal AVM depends on these data. We determined the optimal endovascular methods in the treatment of thoracic and lumbar spinal AVMs.

Material and Methods: The authors report over 1000 afferent AVM occlusions performed at the Burdenko Neurosurgery Institute from 1983 to 2009. Patient age ranged 6–76 years. Totally, over 394 patients were operated. There have been worked out methods of AVM embolization, indications for using PVA-emboli (polyvinylacetate), histoacryl glue, microcoils and combined methods. To occlude AVM vessels, we used micro-guided “BALT” catheters devised for superselective afferent vessels catheterization.

Results: The great radicular artery of Adamkiewicz and a variety of small-size radicular branches that arise from intercostal arteries supply the middle thoracic region (from D-14, D-XI segments) of the spinal cord. Lower thoracic and lumbar spinal regions are mainly supplied by the terminal segments of the great radicular artery and in 15-20% by the ascending lumbar artery. The main task of AVM embolization is occlusion of the aneurysm’s vascular conglomerate and preservation of spinal cord-supplying arteries. In patients with simultaneous AVM and spinal cord blood supply we performed partial AVM embolization with an afferent vessel preservation. When including an AVM with histoacryl glue or PVA-embolus it is necessary to consider the character of venous outflow because there is a risk for venous thrombosis or ischemia of the spinal cord due to complicated venous outflow. In cases of afferent vessel hypertrophy and high cerebral blood velocity in AVM we used microcoils and placed them in immediate proximity to the malformation stroma, i.e. before (below) the “artery-vein” conduit formation.

Conclusion: To perform an AVM occlusion one should have detailed information about blood supply of the spinal cord and structure of AVM which can be provided by SSA. Cerebral blood velocity, diameter of afferent and efferent vessels, and symptoms of patient must also be considered. These data permit to choose an appropriate endovascular method of treatment and allows an adequate occlusion of spinal cord AVMs.
other six weeks showed substantial regression of spinal cord edema with residual small-sized myelomalacia at the level of the 9th thoracic body. Diameter of the conus was declining and thrombosis of the venous pouch was progressive. However the diameter of some perimedullary vessels was progressively increasing and another interventional treatment became necessary. Herein the venous pouch was occluded and backward embolisation of the AVM via placement of coils was started. Purposeful physiotherapy was performed and with increasing improvement of clinical status the girl was able to walk with assistance. Repetitive MRI controls showed total regression of spinal cord edema and constant thrombosis of the venous pouch. Another three months later an additional embolisation of the biggest feeder at the 8th thoracic artery on the left side was performed via coil application. This time there was no clinical deterioration following the intervention and postinterventional MRI showed no spinal cord edema whereas reduction of diameter of the dorsolateral spinal vessels could be verified. Latest MRI control nearly one year after onset of clinical symptoms showed constant absence of spinal cord edema and small-sized myelomalacia while clinical improvement was substantial. The girl is able to walk without assistance and she can briefly stand on one foot, she regained bladder and anal continence. The reported case history demonstrates the benefits of a purposeful and balanced equilibrium between intervention and postinterventional MRI. Those data were determined for spinal cord AVM and investigated neurological symptoms in patients before and after treatment.

Material and Methods: Over a period of 25 years (from 1983 till 2009) 78 patients with AVM in the cervical region of the spine cord were treated in the Burdenko Neurosurgery Institute (male-31, female-22, children-25). Endovascular treatment of AVMs was performed above 118 AVM vessels occlusions. All subjects underwent MRI and SSA. The endovascular methods used for occlusion of AVM vessels were balloon-occlusion method by F. Serbinenko, occlusion with PVA-fragments, occlusion with Hystoacryl glue. The combined method was used for AVMs with multi-channel blood supply. AVM vessels occlusion by PVA-emboli was performed in 42 patients; 23 of them required repeated embolization. Occlusion by histoacryl and lipiodol glue compositions was used in 27 cases. For AVM afferent vessels catheterization we used different micro-guided "BALT" microcatheters. Results: AVM gets blood supply mainly from radiculomedullary branches of the vertebral artery and costocervical trunk and thyroid axis. Aneurysm’s twisted vessels which have been reported to be hypointense on preoperative T1 images, were not detected (revealed) by postoperative control MRI. Instead of them a hyperintense signal from thrombosed AVM vessels was marked. The benefit from endovascular surgery and all symptoms of the disease were evaluated for each patient individually. 69 patients showed significant neurological improvement though earlier they revealed severe neurological symptoms: paraparesis, paraplegia, tetraparesis, tetrarispina associated with sensitive disturbances and pelvic organs dys-function. Absence of neurological regression was marked in 6 patients. Conclusion: Thus, having analyzed positive neurological outcome in 90% of patients with AVMs in the cervical region of the spinal cord operated by using endovascular technique we conclude that endovascular method of treatment is considered an adequate method of choice.
he had spastic quadriparesis with greater involvement of the left side and distal more than proximal. There was sensory deficit below C5 with loss of joint sense on the left side and pin prick on the right side.

MRI showed A-V Fistula on the left side at T5 with a large venous varix severely compressing the cord at C6. DSA showed a multiple hole A-V Fistula with a multiple huge venous varices. There were large draining veins extending into the posterior fossa. 2 pedicles were embolized in the same sitting with dramatic clinical improvement. MRI 2 days later though showed massive oedema of the spinal cord extending into the brainstem. MRI 3 weeks later showed resolution of the oedema and thrombosis of the large venous sac.
Communications

fMRI 1
Chairs: M. Sasaki, D. Seixas
14.30-15.00 25'
Introductory Lecture
New Perspectives in Contrast Enhanced MRI and MRA of the Brain
M. Essig
German Cancer Research Center; Heidelberg, Germany
15.00-15.15 10'
Diffusion Tensor Imaging in Movement Disorders: Review of Major Patterns and Correlation with Normal Brainstem/Cerebellar White Matter
S. Reimão, C. Morgado, L. Neto, J. Campos
Neuroimaging Department, Hospital de Santa Maria; Lisbon, Portugal
Purpose: Diffusion tensor imaging (DTI) color mapping and fiber tractography has been used to study the white matter of the brainstem and cerebellum depicting the afferent and efferent tracts between these two structures. This information combined with structural MR imaging has proven useful in the early detection of impaired extra-pyramidal circuits. We review DTI imaging of the normal cerebellar white matter and characteristic patterns in the more frequent movement disorders.
Methods: We reviewed structural MR imaging and DTI color mapping and fiber tractography of the normal brainstem/cerebellar white matter, correlating it with DTI imaging obtained in patients evaluated in our department with different clinically proven movement disorders including Parkinson’s disease (PD), multisystem atrophy (MSA), spinocerebellar ataxia (SCA), and Progressive Supra-nuclear palsy (PSP).
Results: DTI imaging with color mapping and fiber tractography can be used to map the normal anatomy of the brainstem/cerebellum, not only of the white matter and the orientation of the fiber bundles but also allowing the study of gray matter structures. In Parkinson’s Disease we could find fractional anisotropy (FA) reduction in the substantia nigra, with a lateral to medial gradient. In MSA cases the FA was significantly decreased in the transverse pontine fibers and middle cerebellar peduncle. In PSP the decreased FA was more pronounced in the superior cerebellar peduncle decussation and in the superior cerebellar peduncle. The FA change in SCA was variable. The different DTI pattern in movement disorders appears to be complementary to conventional structural MR, and in the future can be a useful tool for specific movement disorders identification in the clinical practice.
Conclusion: DTI imaging is very useful in identifying the normal brainstem and cerebellar white matter fiber bundles. Early white matter water-molecule disturbance in the brainstem and cerebellar fibers in different types of movement disorders can be identified by DTI and provide a functional evaluation of the impaired extra-pyramidal circuits. Our results are concordant with other series demonstrating that DTI is a useful tool in the evaluation of the status of white matter fibers and some gray matter structures, and in combination with structural imaging may have diagnostic value in patients with movement disorders.
15.15-15.30 10'
Functional Organization of the Primary Motor Cortex in Congenital Paraplegia
C. Stippich 1, J. Reinhardt 1, M. Akbar 2
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Introduction: In congenital chronic paraplegic patients with myelomeningocele (MMC) only little is known about the functional organization of the primary motor cortex (M1). The neural tube defect in myelodysplastic patients occurs between the 21st and 28th day of embryonic development and is typically associated with dysplastic changes in the brain and with hydrocephalus. This is the first study to assess the somatotopic organization of M1 in MMC patients using fMRI.
Material & Methods: Ten right-handed MMC patients with complete paraplegia (ASIA-Score grade A) due to thoracic spinal lesions underwent standardized BOLD-fMRI (executed tongue and finger movements, imagined foot movements) at 1.5 T or 3.0 T to study M1-somatotopy. Patient data were processed and evaluated on an individual basis using BrainVoyager® and compared to normative data obtained from healthy volunteers.
Results: Individual anatomico-functional correlations in all MMC patients revealed normal somatotopic organization of M1 for the cortical tongue and finger representations. Foot representations were abnormal with a marked cranio-ventro-lateral shift of 3.1 mm (z-axis), 17.6 mm (y-axis), and 9.2 mm (x-axis) in the right hemisphere and 2.8 mm (z-axis), 11.8 mm (y-axis), and 9.0 mm (x-axis) in the left hemisphere (statistical means). In 50% of the patients unilateral imagined toe movements resulted in bilateral M1 activations.
Conclusions: Patients with congenital paraplegia activate M1 during imagined toe movements. Foot representations are shifted compared normal controls, but the basic principle of somatotopic representations in M1 is preserved. Bilateral M1 activations from unilateral imagined toe movements most likely represent some patients inability to imagine toe movements separately for each side.
15.30-15.45 10'
Cortical Adaptation to Visual Blurring: a 3T Functional MRI Comparison between Corrected Myopia and Emmetropia
T. Nguyen 1, Jl Stievenart 2, C Habas 1, A Abanou 1
1 Department of Neuro Imaging - C.H.N.O. des 15/20; Paris, France; 2 Department of Nuclear Medicine - Hopital Beaujon, Clichy, France
Purpose: To demonstrate a difference of the visual cortex response in corrected myopic patients and normal subjects.
Materials and Methods: We explored 20 corrected myopic patients and 20 emmetropic volunteers in functional MRI (fMRI). The subjects first underwent ophthalmological examination, to evaluate the refraction levels. fMRI included a retinotopic examination, with two sets of visual stimulation where various levels of image clarity were presented to the subjects. Progressive changes in spatial resolutions lead to image blurring or focusing, and the subjects were asked to point out the moment they noticed a change in image resolution. fMRI data of the two groups were analyzed and compared using Brainvoyager® and SPMS®.

Results and Discussion: Visual areas were similarly located in corrected myopic and emmetropic subjects. The extent of cortical response was more extended in myopic patients, and the response time course, shorter to those of volunteers. These results confirmed previous reports concerning a tolerance in myopic patients to blurred images. They also demonstrated the larger extent of recruited visual areas to enhance the cortical perception of visual stimuli, corresponding to a cortical plasticity phenomenon.

Conclusion: Our preliminary fMRI evidences suggests a difference in visual perception in emmetropic and myopic subjects, who could refer to cortical adaptation for a more tolerant perception of images with non optimal spatial resolution.

Challenges for Non-Invasive Brain Perfusion Quantification Using ASL

I. Sousa 1, J. Sanchez 1, M. Pimentel 2, P. Vilela 3, F. Figueiredo 3
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Introduction: Arterial Spin Labeling (ASL) offers a completely non-invasive, potentially quantitative method for measuring brain perfusion, or regional cerebral blood flow (CBF), using Magnetic Resonance Imaging (MRI). Its developments over the last decade have finally earned ASL a place in the clinical setting, but a number of limitations may still hinder the accurate quantification of perfusion using this technique. In particular, the standard application of ASL may lead to measurement errors resulting from different arterial transit times or the presence of vascular artefacts. The ASL techniques consist on magnetically labeling the water molecules in the arterial blood by applying appropriate inversion radiofrequency pulses and then acquiring the image after a certain time interval, the inversion time (TI). The difference in the measured magnetization of the tissues, between the label image and a control image (without label), can be mathematically described by a kinetic model as a function of TI [Buxton, 1998]. In principle, it is sufficient to collect an image at a single TI point to obtain a perfusion measurement, provided that appropriate pulse sequences (QUIPSS II or Q2TIPS) are used and certain assumptions about the model parameters are verified. However, this is not always the case, particularly in pathological conditions such as cerebrovascular disease where arterial transit times may be much longer than in the normal brain. In these cases, it is possible to estimate perfusion, as well as arterial transit times, by collecting images at multiple TI points and then fitting the mathematical ASL model to the data. However, such measurements may be difficult due to the very low intrinsic low signal-to-noise ratio (SNR) of ASL images. An increased number of image repetitions can be used in order to improve the SNR, at the cost of increased scanning time. However, the accuracy of the estimated parameters also strongly depends on the exact values used for TI. In this study, the authors address some of the challenges that arise in the measurement of brain perfusion using ASL, by estimating the errors produced by both single and multiple TI acquisitions and proposing a method for the optimization of multiple TI ASL strategies.

Methods: Three different pulsed ASL acquisition strategies were investigated for obtaining quantitative brain perfusion maps: i) a standard single TI acquisition, using a long TI value of 1800ms (as is used in Q2TIPS); ii) a uniform multiple TI acquisition, covering the interval 0-4000ms in regular steps; and iii) an optimal multiple TI acquisition, determined by our proposed algorithm. We propose a Bayesian optimal sampling strategy algorithm based on the Fisher information matrix criterion for the simultaneous estimation of perfusion and the arterial transit time: it determines the optimal TI values to be used in the ASL acquisition, taking into account the uncertainty of the model parameters (namely, perfusion and transit time) as well as the amount of noise in the data. In order to predict perfusion quantification errors from ASL data acquired with the three different schemes, we performed Monte Carlo simulations based on the mathematical ASL kinetic model and realistic distributions of the relevant physiological parameters, both in health and pathology. A group of 10 healthy volunteers was studied on a Siemens Verio 3.0 T system with a 16-channel head coil, using a pulsed sequence with a GE-EPI readout. ASL images were collected using the three acquisition schemes and the resulting perfusion measurements were compared.

Results: Our results show that the standard single-TI ASL acquisitions may lead to severe perfusion measurement errors in some circumstances. In fact, while they yield relatively good results when arterial transit times are within a limited range, we show that they produce severe perfusion quantification errors when arterial transit times are increased beyond their normal values. In these cases, multiple-TI acquisitions are still able to provide accurate perfusion measurements. Moreover, the measurement errors are significantly reduced when employing the optimal acquisition strategy, when compared to a uniform sampling strategy.

Conclusion: Although single-TI ASL acquisitions present short scanning times and allow simple perfusion quantification (already implemented in clinical workstations), our results indicate that they may produce severe measurement errors. We therefore conclude that multiple TI strategies are generally preferred for perfusion quantification using ASL, not only because they produce smaller perfusion measurement errors, but also because they allow the simultaneous estimation of additional physiological parameters of interest, such as the arterial transit time. Moreover, we suggest that it is possible to use optimized acquisition strategies, which may reduce scanning time as well as measurement errors.

Quantification of Perfusion Changes during a Motor Task Using ASL

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Introduction: Arterial spin labeling (ASL) is a non-invasive MRI technique that allows the quantitative measurement of perfusion, or regional cerebral blood flow (CBF). The ASL techniques use the labeling of the blood, by inverting or saturating the spins of wa-
Methods: The study was conducted on a Siemens Verio 3T system using a 16-channel head coil and a pulsed ASL Q2TIPS-PICORE sequence with a GE-EPI readout was used for the perfusion evaluation. The sequences were driven in 3D PACE mode for projection correction. Fifteen healthy volunteers were studied using a simple motor task consisting in sequential thumb-digit apposition.

I was used two different functional ASL protocols: i) one perfusion scan (TI1 = 700 ms, TI1s = 1600 ms, TI2 = 1800 ms; 91 Interleaved tag and control volumes were acquired; TR/TE = 2500/11 ms and flip angle = 90°; 9 contiguous axial slices of 6 mm thickness acquired in-line with the AC-PC axis, positioned from the vertex of the brain to the top of cerebellum; FOV = 256 x 256 mm²; matrix 64 x 64; gap between the labelling slab and the proximal 18.8 mm) during rest and another one during an equal period of motor task (total scan time ~ 8 min) and ii) a block design alternating five 25sec periods of motor task with five 25sec periods of rest (total scan time ~ 4 min) (TI1 = 700 ms, TI1s = 1600 ms, TI2 = 1800 ms; 101 Interleaved tag and control volumes were acquired; TR/TE = 2500/11 ms and flip angle = 90°; 9 contiguous axial slices of 6 mm thickness acquired in-line with the AC-PC axis, positioned from the vertex of the brain to the top of cerebellum; FOV = 256 x 256 mm²; matrix 64 x 64; gap between the labelling slab and the proximal 18.8 mm). The post-processing was performed using FSL (www.fmrib.ox.ac.uk/fsl). The perfusion CBF quantification was evaluated.

Results: The mean CBF values obtained for protocols #1 / #2 were: CBF-Frest = 61.0 / 69.4 ml/100g/min; CBF-Factivation = 104.8 / 109.9 ml/100g/min; and CBF-Fvariation = CBF-factivation - CBF-frest = 43.7 / 40.5 ml/100g/min (Table 1). The relative perfusion changes during activation [defined as CBF-fvariation / CBF-frest (%)] were 73±6 % and 62±7 % (mean±SE) for protocols #1 and #2, respectively, with no significant difference between them (Table 2).

Conclusions: These results show that both activation vs rest and block design functional protocols were capable to detect consistent variations in perfusion associated with a simple motor task. However, the block design has the advantages of requiring shorter acquisitions, directly comparing rest and activation conditions and allowing the acquisition of simultaneous Blood Oxygenation Level Dependent (BOLD) contrast information, while still providing comparable results with the more conventional activation vs rest protocol. In conclusion, our results indicate that a blocked design ASL-BOLD protocol may be a preferable approach for the evaluation of perfusion changes to endogenous stimuli.

Table 1: Relative perfusion changes during activation

<table>
<thead>
<tr>
<th>Protocol</th>
<th>CBF-Frest (ml/100g/min)</th>
<th>CBF-Factivation (ml/100g/min)</th>
<th>CBF-Fvariation (ml/100g/min)</th>
</tr>
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<tbody>
<tr>
<td>#1</td>
<td>61.0</td>
<td>104.8</td>
<td>43.7</td>
</tr>
<tr>
<td>#2</td>
<td>69.4</td>
<td>109.9</td>
<td>40.5</td>
</tr>
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FMRI 2

Chairs: G. Pellicanò, V. Peterová
16.15-16.30 10'

Distinct Cerebellar Contributions to Intrinsic Connectivity Networks

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Introduction: Convergent data from various modalities strongly implicate cerebellar systems in non-motor functions. The functional anatomy of these systems has been assembled from disparate sources including animal studies, lesion studies in humans, and structural and functional imaging studies in humans. To better define this distinct functional anatomy, we delineated the role of the cerebellum in several non-motor systems simultaneously and in the same subjects using resting state functional connectivity MRI. This method allows for the identification of intrinsic connectivity networks (ICNs) based on temporal correlations in low-frequency oscillations of self-BOLD signal. Independent component analysis (ICA) was applied to resting state data from two independent datasets to identify common cerebellar contributions to several previously identified ICNs involved in cognitive and sensorimotor functions.

Methods: Resting-state data covering the whole encephalon and cerebellum of two populations of healthy volunteers (N = 15 and N = 22) were acquired with a 3T scanner at two different sites. Pre-processing of the T2*-weighted images included motion correction, spatial normalization to MNI space, and temporal filtering. We applied single-subject ICA to these preprocessed data and used an unbiased template-matching procedure to identify the five previously described ICNs (the left and right executive control networks, the salience network (interoceptive and emotional processing), the default mode network (episodic memory and self-reflection) and the sensorimotor network). One-sample t-tests for each ICN in each dataset were generated in SPM5 resulting in 2 maps for each ICN. Lastly, to concentrate on replicable cerebellar contributions to the 5 ICNs we generated intersection maps limited to voxels that were present in both datasets using a joint probability threshold of p < 0.01 (height and extent, corrected at the whole brain level).

Results: We found distinct cerebellar contributions to each of the ICNs. The neocerebellum participates in: 1. the right and left executive control networks (especially crus 1 and 2), 2. the salience network (lobule VI), and 3. the default-mode network (lobules IX-VII). Little to no overlap was detected between these cerebellar regions and the sensorimotor cerebellum (lobules V-VI). Clusters were also located in pontine and dentate nuclei, the main cerebellar input and output channels.

Conclusions: The results suggest that the most phylogenetically recent part of the human cerebellum, particularly crus 1 and 2, make specific contributions to parallel cortico-cerebellar loops involved in non-motor cognitive functions: executive control, salience detection, and episodic memory/self-reflection. The largest portions of the neocerebellum were dedicated to the executive control network which is involved in the selection and maintenance in working memory of relevant multimodal information.
Functional Connectivity and Coactivation of the Nucleus Accumbens: A Combined Functional Connectivity and Structure-Based Meta-Analysis

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The nucleus accumbens (NACC) is increasingly recognized as a pivotal centre within brain systems regulating motivation and reward. The Nacc is located at the conjunction between the head of the caudate and the anterior portion of the putamen, laterally to the septum pellucidum; together with the olfactory tubercle, the Nacc forms the ventral striatum, a critical element of the mesocortico-limbic system. Despite clear-cut clinical relevance, our knowledge of Nacc connectivity is mainly based on experimental studies using tractographic techniques in animals. The literature in humans has flourished only recently, with two diffusion tensor imaging and one meta-analysis of coactivation patterns from IAPs fMRI and PET studies. However the primary goal of these studies was the investigation of basal ganglia functional subdivisions and connectivity patterns; none of them was specifically targeted at the Nacc. Thus, we set out to investigate the connectivity pattern of the Nacc by using a resting state functional connectivity protocol in combination with a structure-based meta-analysis, in order to compare evidences from the two techniques. Both RSfc and MACM allow mapping of functional connectivity: while RSfc is based on correlational techniques applied on data acquired on healthy subjects during a resting state, MACM, using literature data, analyzes coactivation patterns within groups of studies that activated a specific “seed” area. Convergence of the two techniques can strengthen the results of the study. To do so we investigate functional connectivity patterns of the nucleus accumbens (Nacc) in 18 healthy participants by using a resting state functional connectivity (rsFC) protocol. Besides, a meta-analytic connectivity modeling (MACM) was used to characterize patterns of functional coactivations including Nacc: the results of a structure-based meta-analyses of 59 functional magnetic resonance imaging (fMRI) and positron emission tomography (PET) studies were submitted to activation likelihood estimation (ALE) analysis in order to estimate consistent coactivation patterns across the different imaging studies. The results we obtained, combining RSfc and MACM, show that spontaneous activity in the Nacc predicts activity in regions implicated in reward circuits, including orbito-medial pre-frontal cortex, globus pallidus, thalamus, midbrain, amygdala and insula. This confirms the key role of Nacc in the mesocortico-limbic system, which integrates inputs from limbic and cortical regions. Furthermore, activity in brain regions having few or no direct anatomical connections with the Nacc, such as the sensorimotor cortex, cerebellum, medial and posterior parietal cortex and medial/ inferior temporal cortex, was also detected, supporting the view that not all functional connections can be explained by anatomical connections, but can also result from connections mediated by third areas. Our rsFC findings are in line with the results of the structure-based meta-analyses: MACM maps are superimposable with the Nacc rsFC results, and the paradigm class that more frequently generates activations in the Nacc are the reward paradigms. Furthermore, our results overlap considerably with recently proposed schemata of the principal neuron systems in the limbic forebrain and anterior part of the limbic midbrain in rodents and non human primates.

Neuronal Basis of Haedonic Appraisal in Early Onset Schizophrenia: fMRI Investigation

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Introduction: Cognitive deficit are known to be a core feature of schizophrenia and are present before the illness onset. First-episode schizophrenia already affects social cognition areas involved in processing emotions and some studies underline the role of dysfunctional neural networks as the basis of disturbed social interactions in early schizophrenia. Impairments in social cognition showing up in schizophrenic patient are associated with structural deficits and abnormal activity in specific brain regions. Anhedonia, the loss of the capacity to subjectively experience pleasure, is a core clinical feature of schizophrenia, in particular with negative symptoms. These patients show deficits in processing emotional stimuli, ranging from simple sensory experiences to complex social interactions. Social interactions in humans are strongly dependent on hedonic processing. The application of functional neuroimaging to severe mental health has facilitated the investigation of critical questions regarding the disturbances of higher brain function and provides an opportunity to attempt to elucidate the pathophysiological basis of these disorders.

To date the neural basis for emotional abnormalities in schizophrenia has not been explored in depth with neuroimaging techniques. In this fMRI study we examine the biological basis of hedonic appraisal in schizophrenia. The capacity to subjectively experience pleasure, and the role of hedonic processing in the expression of emotional responses, is explored using visual stimuli.

Material & Methods: 15 first episode schizophrenic subjects (age 15-34) participating to the study. All subjects were outpatients of Psychiatric Dept. of the San Salvatore Hospital, L’Aquila, Italy. Clinical assessment of symptoms was performed via a non-structured clinical interview and with Brief Psychiatric Rating Scale (BPRS) version 4.0; 15 healthy control subjects (matched for age and education) were included.

40 color pictures of scenes rated 20 as highly disgusting and 20 highly pleasant stimuli by healthy subjects were obtained from IAPS; 40 pictures of scrambled scenes were also used as control stimuli. Sensitivity to disgust was measured with the Diagust Scale. All subjects participated in a fMRI experiment in which they viewed alternating blocks of disgusting and scrambled and pleasant images. Images will
be acquired using a 1.5T whole-body scanner (GE HD). The BOLD contrast has been obtained using EPI T2*w. The acquisition of 22 transverse slices (TR=2000 ms) has provided coverage of the whole cerebral cortex. A 3D T1 anatomical scan (1×1×1 mm) has been also acquired, covering the whole brain. MRI functional data were analyzed using the BrainVoyager QX software.

Results: A t test revealed a statistically significant difference in the disgust minus scrambled in magnitude of activation between the 2 groups. Data analysis revealed that healthy subjects had significantly greater activation in the right posterior insula and anterior insula. In left hemisphere healthy subjects had significantly greater activation in the right posterior insula and anterior insula. In left hemisphere healthy subjects had significantly greater activity in the inferior frontal gyrus and medial frontal gyrus. Healthy subjects had also a significantly greater activation in the right posterior insula and anterior insula. In left hemisphere healthy subjects had significantly greater activity in the inferior frontal cortex and in the left anterior insula.

Discussion & Conclusion: Disgust is a very basic emotion whose expression has an important survival values for the conspecifics. As expected, we observed specific activation of anterior and posterior insula in right hemisphere and anterior insula in left hemisphere during observing disgust mimicking the response in healthy subjects. In healthy subjects in fact, the crucial role of the insula in emotion feeling strongly suggests that the neural substrate for emotions is not merely sensorial. It is more likely that the activation of the insula representation of the viscera-motor activity is responsible for the first-person feeling of disgust. These results confirm the idea that anhedonia symptom in schizophrenic subjects is related to a deficit in this viscera-motor response that is absent in this patients since the early stage of illness. Another interesting result is the activation of the inferior frontal operculum (IFO), in particular in disgust procedure in healthy subjects. According to some study, IFO reacts to experience of similar emotions and is modulated by empathic tendencies. IFO lesions also disrupt experience and recognition of disgust, suggesting a role for this region in emotional simulation/understanding. From what has been shown in literature, emotional flattening present in schizophrenic patients is due to recruitment failure in areas of the limbic/paralimbic system during the experience of pleasant and unpleasant stimuli. Our preliminary experience seems to provide a functional anatomical substrate, confirming that proposed in literature. It also allows to believe that the identification of neuronal dysfunction using fMRI may be a useful tool in the diagnostic confirmation of severe mental disorders.

17.00-17.15
Neuropsychiatric Lupus Patients and Advanced MR Sequences
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1. MR Department, Radiodiagnostic Clinic, First Faculty of Medicine, Charles University in Prague, Czech Republic; 2. Faculty of Mathematics and Physics, Charles University in Prague; 3. Institute of Rheumatology, First Faculty of Medicine, Charles University in Prague, Czech Republic; 4. Department of Radiodiagnostic, Institute of Rheumatology, First Faculty of Medicine, Charles University in Prague, Czech Republic

The project represents a prospective evaluation of distribution of pathological lesions in cerebral white matter in magnetic resonance imaging (MRI) in patients with neuropsychiatric lupus erythematosus (NP-SLE) in two different MR sequences and compare these results with age and disease activity at the time of MR examination and further details of patients.

Patients and Method: The group I will consist of 30 female NP-SLE patients, which were examined clinically, and using MR imaging. MR examination included thin slices in T1 (spin-echo sequence) and T2-weighted images (turbo spin echo and ultra-turbo spin echo sequence) natively and T2-weighted images with fat suppression on 1.5T device. Their results were compared with findings of healthy subjects and with data of group II patients with systemic lupus erythematosus (SLE) without neuropsychiatric symptoms.

Results: Fat signal suppression method, i.e. spectral presaturation with inversion recovery (SPIR), improved contrast in the brain parenchyma by increasing the signal to noise ratio and by improving detail resolution of tissues previously covered by fatty components and better differentiates anatomical structures. But in our study we observed only nonsignificant differences between both sequences in each patients. Between persons in Group I and Group II significant difference was found.

Conclusion: The project failed to improve the detection of occurrence of pathological white matter lesions by fat saturation sequence as compared with conventional T2 weighted images. But the groups of patients were quite small and in following studies would be enlarged. The study was supported by research project MZO 00064165 and grant GAUK.

17.15-17.30
Magnetic Resonance Imaging in Young Patients with Neuropsychiatric Systemic Lupus Erythematosus: A Case Series
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Key words: Systemic lupus erythematosus; Magnetic resonance imaging; neuro-psychiatric; brain.

Systemic lupus erythematosus (SLE) is a multisystem autoimmune disease with a great variability in disease presentation and course. Neurological involvement is a frequent occurrence in SLE and is associated with increase in morbidity and mortality. About 50% of SLE patients will have neuropsychiatric phenomena at some time during their illness. Despite the high incidence of this complication, NPSLE is extremely difficult to diagnose definitively because of the wide variety of neuropsychiatric symptoms of the disease and neurologic manifestations of on going steroid treatment. To help sort through the diagnostic possibilities, neuro-imaging has become important in the evaluation of SLE patients with neurologic symptoms.

Case Series: We describe MRI findings in 6 young patients of SLE who presented with neuropsychiatric symptoms. Apart from already described findings of infarctions, white matter hyperintensities, cerebral atrophy, we had a case with subarachnoid hemorrhage which has not been described before.

Conclusion: Recognition of MRI findings in neuro psychiatric SLE is very important and can be done reliably by MRI.
Alzheimer disease and neural stem/progenitor cells in animal models. We found that the level of glutamine and glutamate (Glx) in the animals of early Alzheimer disease is lower than the animals of control group. In stem/progenitor cell studies, we found that the 1.28 ppm biomarker was observed in human mesenchymal stem cells (MSCs) without growth-arrested and the mobile lipid droplets formed.

Noninvasive Measuring Brain pH and Biomarker of Brain Tissue Using MR Technology

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In recent years, noninvasive MR methods to measure regional pH have been developed. A diverse set of pH indicators has been described. Some of them show the character of pH-dependent chemical shift and others show the pH-dependent magnetization transfer as well as the pH-dependent relaxation. These methods based on MR imaging or MR spectroscopy are used to measure intra- or extracellular pH either in vitro or in vivo. With technical development, pHe imaging will be a useful tool in the tumor mechanism and tumor imaging as well as the approach of image-guided stroke therapy. It has been known that many pathological states are associated with changes in tissue acid-base balance. For example, acidic extracellular pH (pHe) has been proposed to be a feature of tumours. Compared with normal tissue, extracellular pH (pHe) is normally lower in tumours, and intracellular pH (pHi) is often higher. Many years before, the pHe of tumours in vivo has been measured using microelectrodes. However, this method is invasive and unfavorable to monitor the extracellular pH variables. MR technology is a powerful tool. In addition to protons (1H) and phosphorus (31P), pH measurement approaches has been applied to other NMR nuclei such as fluorine (19F) and carbon (13C). Noninvasive identification of cell and tissue is a great advance over previous invasive methods. Remarkable prospect has been demonstrated because of the efficacy of cellular transplant therapies based on neural stem/progenitor cells (NSPCs) for some central nervous system (CNS) diseases. Currently, we are studying metabolic profiles of early
A Novel Tract Imaging of the Brain Stem Using Phase Difference Enhanced Imaging Technique: Normal Anatomy and Multiple System Atrophy


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**Purpose:** The brain stem, including the midbrain,pons, and medulla, concentrates structures of vital importance in a relatively small area. However, when conventional MR image contrast is used, many internal structures of the brain stem cannot be clearly delineated. The anatomic structures of the brain stem such as superior, middle, and inferior cerebellar peduncles have previously been identified on diffusion tensor images by previous reports. In these reports, however, the distinction between medial lemniscus and central tegmental tract, and between longitudinal fasciculi have not been clearly defined. Even the diffusion tensor images obtained with the highest resolution may not be sufficient to resolve these anatomic structures of the brain stem. Recently, we have developed new phase-weighted MR imaging, 'Phase Difference Enhanced Imaging (PADRE)', in which the phase difference between objective and surrounding tissue is enhanced, and could create various contrasts of tissues using the single (scanned) MR data. Some of PADRE images offered us the new contrast which could not be realized by any preceding phase technique. Our objective is to clarify if the PADRE technique, in which the phase difference between objective and surrounding tissue is selectively enhanced, can reveal the brainstem anatomic microstructures.

**Aim:** The corpus callosum (CC) is the main white matter structure connecting the cerebral hemispheres and providing for the interhemispheric transfer and integration of information. This study investigates the possibility of describing the topographical organization of human CC using functional magnetic resonance imaging (fMRI) and diffusion tensor imaging (DTI) in healthy subjects and in callosotomy patients.

**Material & Methods:** 36 healthy volunteers and 9 callosotomy patients gave their informed consent to participate. Data were collected using a 1.5 Tesla magnet during studies of the cortical representation of gustatory, tactile and visual sensitivity and motor activation. The protocols were approved by the institutional Ethics Committee. Callosal resection, performed to treat severe epilepsy, was total in 5 patients, partial anterior in 3 and partial posterior in 1. Taste stimulation was applied to 12 controls and 5 patients (1 with posterior, 1 with anterior and 3 with total callosotomy). Tactile stimulation was applied in 22 controls and 5 patients (1 with posterior, 1 with anterior and 3 with total callosotomy). Tactile stimulation was applied in 22 controls and 5 patients (1 with posterior, 1 with anterior and 3 with total callosotomy). Seven volunteers were scanned while performing manual motor tasks. All stimuli were presented according to block-design protocols that alternated periods of rest with stimulation. DTI was performed in 16/36 healthy volunteers and in all patients. Regions of interest were selected in cortical regions of the primary gustatory (GI), somatosensory (SI), visual (VI) and motor (MI) areas exhibiting fMRI activation.

**Results:** fMRI Activation foci were detected in the CC and were mainly evident on mid-sagittal images. Healthy volunteers. Foci evoked by taste stimuli were detected in the anterior part of the CC, i.e., the genu, in most subjects. Foci elicited by tactile stimulation of different body regions lay in the central CC region, the foci evoked by foot, leg, trunk, arm, hand, and face stimulation being arranged posterior to anterior; in some subjects, activation evoked by hand stimulation was split into multiple foci, with the main foci occupying the middle body of the CC. Foci evoked by visual stimuli were seen in the splenium. Motor tasks evoked activation in the central part of the CC. Callosotomized patients. One patient with anterior resection, who received both taste and tactile stimulation, had a single activation focus in the posterior part of the body of the CC, evoked by touch stimuli to the hand. Another patient with anterior resection saw a small portion of the splenium, who received both tactile and visual stimuli, had a single focus in the spared splenium, evoked by visual stimulation. The patient with posterior resection, who underwent taste and tactile stimulation, exhibited only foci evoked by taste stimulation, in the genu of the CC.

**Conclusions:** These data indicate that a callosal BOLD effect can be evoked by peripheral sensory stimulation and by motor tasks. Activation foci occupy consistent locations that are related to the sensory or motor stimuli applied. The functional topographical organization of the CC explored with fMRI and DTI is in line with data from previous human lesion studies and monkey neuroanatomical reports.
over routine MR images and can detect the pathological changes of the small internal structures of the brainstem in multiple system atrophy (MSA).

Materials & Methods: High-spatial-resolution PADRE images at 3T MR system were acquired in six healthy volunteers and two patients with MSA-C by applying a 3D-D-SPGR sequence. These images obtained with healthy volunteers were correlated with anatomic specimens to determine the brainstem anatomy. Then, for anatomic appearances of the brainstem, two neuroradiologists compared the PADRE images in patients with MSA-C with those in healthy volunteers.

Results: Various structures in the brainstem, such as the superior and inferior cerebellar peduncles, medial lemniscus, spinothalamic tract, medial longitudinal fasciculus, corticospinal tract, tegmental tract, corticospinal tract, and transverse pontine fibers were identified on PADRE images, which have been difficult to appreciate by conventional MR techniques. The PADRE images in patients with MSA-C demonstrated that the disappearance of transverse pontine fibers and significant atrophy of the inferior cerebellar peduncle, which is mainly corresponding to the superior cerebellar peduncles and corticospinal tracts are normal.

Discussion: Generally, the SWI selects only negative sign of phase difference which is mainly corresponding to vessels-fs phase difference, especially to veins. However, since PADRE is designed so as to select several phase difference and enhance them on the magnitude image, we can have the different contrast image from SWI. In our study, many internal structures of the brainstem, which could not be previously identified on SWI, were assigned by using PADRE technique. In fact, the anatomical detail inside these structures closely parallels the known anatomical subdivisions. A mechanism by which PADRE technique may enhance the visibility of nerve fiber bundles, because the small tracts within the brainstem, including the superior cerebellar peduncle, inferior cerebellar peduncle, and corticospinal tract, were mainly displayed on the PADRE images with superb contrast. Therefore, PADRE image may provide a novel microscopic tract imaging of the brainstem and may have a potential to reinforce the clinical utility of MRI in differentiating MSA from other conditions.

Conclusion: PADRE technique can offer a new microscopic tract imaging of the brainstem and may have a potential to reinforce the clinical utility of MRI in differentiating MSA from other conditions.

Results: In all volunteers the ML was seen as a pair of bands of low signal intensity which is mainly corresponding to the superior cerebellar peduncle, while the superior cerebellar peduncles, medial longitudinal fasciculus, and the medial lemniscus were is recognizable, with normal or near normal. These PADRE findings match those expected on the basis of MSA-C histopathology. In MSA, the input cerebellar fibers, including pontocerebellar fibers (transverse pontine fibers and middle cerebellar peduncle) and olivocerebellar fibers (inferior cerebellar peduncle), are mainly affected. On other hand, there is little pathological alteration in the superior cerebellar peduncle. Moreover, the corticospinal tracts in MSA have been relatively well preserved. In our patients with MSA-C, the corticospinal tracts also became individually demonstrated with normal.

Conclusions: PADRE technique can offer a new microscopic tract imaging of the brainstem and may have a potential to reinforce the clinical utility of MRI in differentiating MSA from other conditions.
pressed T1 weighted images. These bands lie close to midline in a sagittal orientation within the rostral medulla. They rotate to lie in a coronal plane in the pont, dorsal to the transverse pontine fibres (Fig 1b arrow). In the caudal mesencephalon they rotate to lie obliquely, parallel and dorsal to the cerebral peduncle and lie lateral to the decussation of the superior cerebellar peduncle. More rostrally within the mesencephalon they lie lateral and dorsal to the red nucleus. The ML stands out on the fat suppressed images due to its heavy myelination with various surrounding gray matter structures that do not suppress as much. These bands of low signal correlate well with the blue coloured head to foot orientated fibres on the colour FA maps generated from the DTI data (figure 1c arrow).

**Conclusion:** Conventional imaging of the brainstem has previously shown limited detail of the important fibre pathways. In recent years, DTI analysis of the brain has led to a detailed demonstration of fibre pathways in the brainstem. These images have limited resolution and are often significantly distorted. This study of normal volunteers has illustrated the value of high resolution, fat suppressed T1 weighted images of normal volunteers has illustrated the value of high resolution, fat suppressed T1 weighted images. These high resolution images with good spatial accuracy can potentially be used to aid the localisation of other nuclei, such as the PPN. This technique may be of value in assessing the ML in other conditions affecting sensory pathways such as diabetes mellitus.

**Materials & Methods:** At our institution, DTI is routinely performed along with conventional MRI in children with brain malformations. DTI parameters include 25 cm, image matrix: 128 x 128 reconstructed to 256 x 256, slice thickness: 2 mm; voxel 2 mm3 , 80 slices, TR/TE: 9000/100, b value = 1000; parallel imaging (SENSE) factor 2; no signal averaging, 3 acquisitions; 30 direction gradients, 5 x b0 averages, axial plane. Diffusion tensor data in DICOM format is co-registered on the MR operator console and then subjected to correction of motion and eddy current distortion prior to calculation of tensor images derived from clinical data on proprietary software on a PC (Excent Work Space (Philips Healthcare Systems)). Tractography was performed using FACT; FA threshold was set at 0.2 and stopping angle 70 degrees. The brain malformations and the presence, location, and relative size of the SCP, MCP, ICP, TPF, CST, and ML were recorded by an experienced pediatric neuroradiologist with > 20 years experience including 5 years using DTI. Figure 1 is a 3D rendering of the normal brainstem tracts.

**Results:** There were 312 subjects ranging in age 34 weeks estimated gestational age at the time of imaging to 21 years; interpretable DTI were acquired in 268. The most common brain malformations seen were agenesis of the callosal callosum (ACC), Chiari II malformations, Dandy-Walker (DW), holoprosencephaly (HPE), lissencephaly, and molar tooth deformities although numerous other malformations of cortical development were studied. In isolated callosal agenesis or ACC with cortical dysplasia, the brainstem tracts were normal in position with variable hypoplasia of the CST.

The more severe Chiari II malformations were associated with normal position of the tracts but variable hypoplasia to complete absence of the MCP and TPF bundles and absence of the SCP; the CST appeared merged with the ML (Figure 2). In DW malformations, the CST, TPF, and ML were normally positioned while the ICP were laterally displaced. More severe forms of HPE were associated with more severe hypoplasia of the CST and MCP with preservation of expected tract locations. Molar tooth deformities were association with hypoplasia of the MCP and enlargement of the SCP and variable absence of the dorsal TPF. Absence of the dorsal TPF and fusion of the CST and ML were also seen in incomplete lissencephaly.
Conclusions: DTI shows abnormalities of the larger brainstem tracts in complex congenital malformations which are known to affect the brainstem and in the brainstem of complex supra tentorial anomalies not traditionally associated with hindbrain anomalies. Knowledge of the appearance of the normal and aberrant brainstem tracts by DTI may further an understanding of the hindbrain development.

16.15-16.30
Carotid Artery Wall Thickness and Leukoaraiosis. Evaluation Using Multi-Detector Row CT Angiography
L. Saba, G. Mallarini
A.O.U Cagliari; Italy

Purpose: Several studies demonstrated that leukoaraiosis is a clinically relevant condition; in fact patients with leukoaraiosis show, on average, a negative prognosis in terms of death, stroke and myocardial infarction. The purpose of this paper is to determine whether carotid artery wall thickness (CAWT) studied by using multi-detector-row CT angiography (MDCTA) is correlated to leukoaraiosis and its severity. Several studies demonstrated that leukoaraiosis is associated with an increased risk of stroke; for this reason we suggest the use of CAWT as further parameter to stratify the stroke risk.

Results: Measurements of the distal common CAWT ranged from 0.5 to 1.6 mm. A correlation between leukoaraiosis and increase of CAWT was observed (Pearson Correlation 0.373; p < 0.001). By using as threshold 0.9 mm, it was found an important statistical association between thick CAWT and leukoaraiosis: (p< 0.001). By using 0.9 mm as threshold ROC curve analysis indicated a sensitivity of 58% and a specificity 75% for leukoaraiosis.

Conclusions: Results of this study showed a statistically significant correlation between increase of CAWT and leukoaraiosis (and its severity). A correlation between leukoaraiosis and increase of CAWT was observed (Pearson Correlation 0.373; p < 0.001). By using as threshold 0.9 mm, it was found an important statistical association between thick CAWT and leukoaraiosis: (p< 0.001). By using 0.9 mm as threshold ROC curve analysis indicated a sensitivity of 58% and a specificity 75% for leukoaraiosis. A correlation between leukoaraiosis and increase of CAWT was observed (Pearson Correlation 0.373; p < 0.001). By using as threshold 0.9 mm, it was found an important statistical association between thick CAWT and leukoaraiosis: (p< 0.001). By using 0.9 mm as threshold ROC curve analysis indicated a sensitivity of 58% and a specificity 75% for leukoaraiosis.

14’
Introductory Lecture
Is Multiple Sclerosis a Grey Matter Disease?
F. Barkhof, M. Wattjes
VU Medical Center, Amsterdam, The Netherlands

Multiple Sclerosis (MS) is the most common chronic inflammatory demyelinating disease of the central nervous system (CNS) in young adults. MS has been traditionally considered as a disease predominantly affecting the white matter of the central nervous system. This is somehow reflected by the high sensitivity of MRI in the detection of white matter abnormalities in MS patients particularly located in the juxtacortical, periventricular and infratentorial white matter. In order to better discriminate between un-specific vascular white matter changes and acknowledge the importance cortical involvement, juxtacortical lesions involving subcortical U-fibers have been introduced into MRI criteria for MS. Secondary grey matter damage due to axonal damage within the white matter is reflected by focal and global atrophy on MRI. Although cortical atrophy already occurs in early disease stages, it is more prominent in advanced stages with higher disease duration and higher clinical disability scores. There is no doubt that grey matter atrophy is a relevant marker of disease progression, clinically relevant since they are linked to certain clinical manifestations and clinical outcome measures such as physical disability. Cortical manifestation of MS pathology goes beyond neocortical areas and also involves subcortical structures and the hippocampus which is clinically related to cognitive impairment. Histopathologically, grey matter lesions are subdivided into four different types: mixed white matter-grey matter lesions (type I), pure intracortical lesions surrounding a blood vessel (type II), subpial cortical lesions (type III), and cortical lesions which involve the cortical ribbon (type IV). From the radiological point of view, grey matter manifestations in MS have been disregarded for a long time because of the low sensitivity of conventional MRI techniques in the detection of cortical lesions. The underlying reasons are still not completely understood. Probably the low amount of myelin within the cortex and low degree of lymphocyte infiltration in cortical lesions play a key role. It has been recently shown that double inversion recovery (DIR) sequence simultaneously attenuating cerebrospinal fluid and white matter (“grey matter only”) provide a substantially higher sensitivity in the detection of grey matter lesions when compared to standard T2-weighted and fluid attenuated inversion recovery sequences. Additionally, other certain sequences such as 3D magnetization-prepared rapid acquisition with gradient echo (MPRAGE) seem to be able to show higher cortical lesion load. Imaging at higher magnetic field strength (> 1.5T) can further increase the detection rate of cortical lesions. In vivo imaging at 3T using DIR shows an almost 3-fold increase of pure cortical MS lesion compared to 1.5T. First results from post-mortem and in vivo studies using magnetic field strength beyond 3T (ultra-high field MRI) with higher spatial resolution are quite promising that the sensitivity concerning cortical MS lesion might even increase. High resolution in vivo imaging at 7T
was even able to discriminate between different histopathological types of cortical lesions and showed a relationship between certain types of lesion lesions and clinical outcome measures. This will probably lead to a certain paradigm shift that – even from the neuroimaging perspective – MS is at least to a certain and relevant extend a grey matter disease.

16.45-17.00
Magnetic Resonance Imaging Characteristics Associated with Aquaporin 4 Antibodies in Neuromyelitis Optica and Neuromyelitis Optica Spectrum Disorders
J. Downer1, M. Leite2, R. Carter1, W. Küker1, J. Palace1, G. Quaghebeur1
1 Department of Neuroradiology, John Radcliffe Hospital; Oxford, United Kingdom; 2 Department of Clinical Neurology, Oxford University; Oxford, United Kingdom

Purpose: Neuromyelitis optica (NMO) is a severe demyelinating central nervous system disease that preferentially involves spinal cord and optic nerve. It is now recognized that NMO is an immune-mediated disorder associated with antibodies to aquaporin 4 (AQP4), a cell membrane channel found predominantly in the central nervous system. Immunoassays for AQP4 antibodies are now available. One assay, developed in Oxford, has been shown to detect AQP4 antibodies in more than 75% of patients with NMO. Diagnostic criteria for NMO incorporate imaging and antibody status. The typical MRI appearance is of a longitudinally extensive periaqueductal disease, was more often in the antibody positive group (33.3% vs. 68.2% (p=0.0752); 0% vs. 40.9% (p=0.0139)). Periaqueductal brain stem lesions where seen more often in the antibody positive group (33.3% vs. 4.6% (p=0.042)).

Conclusion: Our observation that T1 hypointensity within a spinal cord lesion is more often seen in the presence of AQP4 antibodies is of interest. This characteristic has been proposed as a potential discriminating feature of NMO. Our data confirm that longitudinally extensive central spinal cord lesions are associated with AQP4 antibodies. A minority of patients had normal brain imaging, confirming a finding of AQP4 positive patient brain imaging fulfilling diagnostic criteria for MS. Lesions around the lateral ventricles and within corpus callosum, common sites of disease in MS, were also less common in the antibody positive group. Characteristic brain lesions have been described in NMO. Our results demonstrate that one such pattern of brain involvement, namely periaqueductal disease, was more often, but not exclusively seen in AQP4 antibody positive patients.

17.00-17.15
MR Imaging in Multiple Sclerosis: The Accuracy of Dual Inversion Recovery at 3 Tesla and the Potential for Single Sequence Imaging
M. Khangure, S.R. Khangure
St John of God Hospital, Perth, Australia

Purpose: To compare the accuracy of a three dimensional T2 weighted dual inversion recovery (DIR) sequence versus two dimensional FLAIR and dual echo T2(DET2) sequences at 3T in the detection of intra cranial lesions in patients with known or suspected multiple sclerosis (MS).

Methods: The studies of 53 patients who underwent imaging with DET2, FLAIR and DIR sequences for known or suspected MS were retrospectively reviewed. In 18 cases a diagnosis of MS was clinically suspected. In the remaining 35 cases a diagnosis of MS had been previously established and patients were imaged for follow-up or monitoring. All patients were imaged on a 3 T MRI unit. Conventional and sagittal images were dual echo DET2 and three dimensional DIR turbo spin echo weighted sequences were utilised. The DIR images were displayed in 3 orthogonal planes.

Results: All 18 patients with suspected MS, 12 were normal and 4 had non specific findings. Two demonstrated lesions characteristic of MS. Demyelinating lesions were seen in all of the 35 patients with known MS. In all cases all lesions seen on DET2 or FLAIR sequences were visible and more conspicuous on DIR sequence. In 14 of the 37 patients (38%) with lesions, the DIR sequence showed additional lesions not visible on the other sequences. Additional detected lesions were predominantly intra cortical.

Conclusion: At 3Tesla, a 3 dimensional DIR sequence is as accurate as 2 dimensional FLAIR and DET2 sequences at detecting the presence of intra cranial demyelinating lesions. A great number of lesions were detected with a DIR sequence, and all lesions were more conspicuous. A single DIR sequence may be considered appropriate for monitoring or screening for MS.

17.15-17.30
Differentiation of Acute and Chronic Demyelinating Plaques in Patients with Multiple Sclerosis (MS): Diffusion Tensor Imaging (DTI) Study
T. Nehrchy1, Z. Rozhkovova2, A. Khoma1, O. Doliya1
1 Danylo Galitskii National Medical University, Department of Neurology; Lviv, Ukraine; 2 Medical Clinic Boris; Kiev, Ukraine

Proposal: We propose quantitative approach for differentiation acute and chronic demyelinating plaques in patients with MS using DTI and MR tractography methods.

Materials and Methods: Two groups of patients were studied by conventional MRI and DTI on 1.5T SIGNA EXCITE (GE). The 1-st group (PG) includes 43 patients (36-65y., disease duration from 3-6y.) with relapsing-remitting MS, and the 2nd group (CG) includes 20 healthy subjects (25-60y.). Axial DTI of the brain using a single shot, multi slice spin-echo echo planar diffusion tensor pulse se-
Extracellular water is increased relative to uninvolved white matter. These histopathologic findings would seem to correlate well with intermediate ADC elevations and a tendency toward isotropy.

**Conclusion**: Although the pathological findings in the demyelinating plaques are diverse, the comparison FA with ADC values in the acute and in the chronic plaques (black holes) provides us very useful diagnostic information for differentiation the type of MS. DTI characterizes both of MS-plaques as lesions, presenting higher ADC and lower FA values in comparison with intact brain tissue. Typical acute plaques show a concentric ring pattern on DW images. The center of an acute plaque is characterized by marked T2 hypointensity, high ADC, and marked reduction of anisotropy as compared with the rim, intact WM, and chronic plaques.

**Table 1 Mean ADC, and FA values for acute ring plaques, subacute enhancing lesions, and chronic plaques.**

<table>
<thead>
<tr>
<th></th>
<th>Thalamus</th>
<th>Intact WM</th>
<th>Acute plaque center</th>
<th>Acute plaque rim</th>
<th>Subacute plaques</th>
<th>Chronic plaques</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADC</td>
<td>0.00070</td>
<td>0.00079</td>
<td>0.00159</td>
<td>0.00092</td>
<td>0.00099</td>
<td>0.00108</td>
</tr>
<tr>
<td>T2</td>
<td>180.4</td>
<td>128.2</td>
<td>351.2</td>
<td>235.3</td>
<td>213.9</td>
<td>250.8</td>
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<tr>
<td>FA</td>
<td>0.338</td>
<td>0.404</td>
<td>0.189</td>
<td>0.341</td>
<td>0.278</td>
<td>0.289</td>
</tr>
<tr>
<td>RA</td>
<td>0.315</td>
<td>0.398</td>
<td>0.232</td>
<td>0.342</td>
<td>0.277</td>
<td>0.291</td>
</tr>
<tr>
<td>Ecc</td>
<td>0.714</td>
<td>0.753</td>
<td>0.543</td>
<td>0.651</td>
<td>0.608</td>
<td>0.679</td>
</tr>
</tbody>
</table>

Figure 1 DOI (green point) localization forehead (in the both hemispheres) MS plaque localization (lilac circle): forehead and occipital lobe.
Encephalopathy is a common pediatric emergency associated with a high risk of morbidity, mortality and long term neurodevelopmental delay in survivors. Prompt diagnosis of the cause of encephalopathy enables the paediatrician to deliver specific medical or surgical treatment that will facilitate a better short and long term outcome. Diagnostic imaging plays a pivotal role in diagnosis.

Encephalopathy has many causes. The differential diagnosis includes non accidental injury, trauma, metabolic syndromes, meningo-encephalitis, toxins, hypoxia, demyelination, stroke, haemorrhage and tumours. We describe an approach that helps us formulate an imaging strategy using US, CT and MRI. The key information that helps both clinician and radiologist narrow the broad differential diagnosis includes the age of the child, nature of symptom onset, past medical history, birth history, genetic factors, exposure to toxins, as well as social and immunological factors.

Ultrasound can be used to diagnose periventricular/germinal matrix haemorrhage, birth asphyxia, some congenital malformations and tumours. It is an easily available and can be performed with minimal or no disturbance of the sick neonate. However, cranial US has a low sensitivity in term babies with hypoxic-ischemic injury. CT is widely available and often used in the acute setting as the initial investigation. It is of crucial importance to do this investigation as quickly as possible. An unenhanced CT is most often adequate. Contrast should be given when complications of meningitis and or venous thrombosis is suspected. CT is sensitive in the detection of haemorrhage, fractures, stroke, some forms of malignancy and congenital malformations. It is limited relative to MRI in the detection of white matter disease as well as neuronal necrosis.

MRI is the most sensitive for white matter disease and hypoxia/infarction. It should not be delayed by other imaging eg:- CT /US. A basic protocol should include T1,T2,DWI,FLAIR and gradient echo sequences. More advanced protocols for specific diagnosis include sequences specific for neonates and older children. T1 volume in epilepsy, MRA/MRV for vascular anomalies, proton density for non accidental injury, MR perfusion for a vasculitis or moya moya, MR spectroscopy and gadolinium enhanced sequences. The pattern of injury may be classified as symmetrical or asymmetrical. A symmetrical pat-
Congenital Cystic Eye with Corpus Callosum Hypoplasia

P. Soares Pinto, V. Ribeiro, B. Moreira
Department - Centro Hospitalar do Porto, Portugal

Introduction: Congenital cystic eye is a rare congenital malformation resulting from partial to complete failure in the invagination of the optic vesicle, which takes place at the fourth week of gestation. The cystic structure represents the primitive optic vesicle that failed to undergo differentiation into its adult components. The condition has also been called “anophthalmia with cyst”. Association with intracranial abnormalities is known, although its etiology remains unknown. So far MRI features of this entity were only sparsely reported in the literature.

Case Report: A 3 month-old male child was referred to our outpatient ophthalmology clinic due to a probable microphthalmos. The external appearance of the globe was of a cystic lesion anterior to the palpebral fissure. The lesion was noted, even with crying. The infant did not have any significant previous medical history; he was the product of a full-term vaginal delivery and the course of the pregnancy and labor was uneventful. There was no history of consanguinity or suspicion of familiar genetic diseases. Clinical examination disclosed a superficial bluish soft tissue mass in the left orbit, without and showed a complex mass filling and expanding the left orbit, with mild contrast enhancement. The infant was noted, even with crying. The infant did not have any significant previous medical history; he was the product of a full-term vaginal delivery and the course of the pregnancy and labor was uneventful. There was no history of consanguinity or suspicion of familiar genetic diseases. Clinical examination disclosed a superficial bluish soft tissue mass in the left orbit, without and showed a complex mass filling and expanding the left orbit, with mild contrast enhancement. The infant was noted, even with crying. The infant did not have any significant previous medical history; he was the product of a full-term vaginal delivery and the course of the pregnancy and labor was uneventful. There was no history of consanguinity or suspicion of familiar genetic diseases. Clinical examination disclosed a superficial bluish soft tissue mass in the left orbit, without and showed a complex mass filling and expanding the left orbit, with mild contrast enhancement. The infant was noted, even with crying. The infant did not have any significant previous medical history; he was the product of a full-term vaginal delivery and the course of the pregnancy and labor was uneventful. There was no history of consanguinity or suspicion of familiar genetic diseases. Clinical examination disclosed a superficial bluish soft tissue mass in the left orbit, without and showed a complex mass filling and expanding the left orbit, with mild contrast enhancement. The infant was not yet operated. The absence of primary optic invagination results in failure of ectodermal elements to develop. The aetiology of congenital eye cyst is still unknown due to its rarity. The presence of inflammatory cells in the solid component suggests an inflammatory cause. No related genetic changes had been described. Progressive enlargement of the cyst is possible and may be due to fluid production by gial tissue.

Recently Shields and Shields in 2004 classified congenital cystic eye under neural cysts, the other associated with ocular mal-development being microphthalmos with cyst and those associated with brain and meningeal tissue, cerebral cortex and optic nerve meningocoele, respectively.

Microphthalmos with cyst develops from incomplete closure of the fetal cleft. The eyes are microphthalmic and have uveal, retinal and lens colo-
tractography. In addition the cystic part usually is in the inferior part of the orbit bulging the inferior eyelid and not the superior as in our case. The main difference is however the complete absence of globe in congenital cystic eye. Extraocular muscles are usually absent or hypoplastic. Meningoencephalocele presents with a cystic structure in the superomedial canthal area and is caused by a defect of the cranio-orbital bones.

Congenital cystic eye is also commonly associated with other malformations, such as contralateral microphthalmia with cyst and non-ocular abnormalities, including facial midline malformations. Intracranial abnormalities are rarely described in literature, such as agenesis of corpus callosum, basal encephalocele and midbrain deformity. Nonocular abnormalities are more frequent when there is a midline involvement.

In our case MRI helped making the diagnosis and by depicting correctly the two components of the lesion and the absence of intracranial extension can have an important role in preoperative management. In addition, it is essential to rule out brain anomalies, like the corpus callosum hypoplasia observed in our patient.

Evaluation of Midline Interhemispheric Variant of Holoprosencephaly (Syntelencephaly) by Diffusion Tensor Imaging and Fiber Tractography

E. Zan, E. Pasaoglu, N. Bulakbasi Meditom Imaging Center; Ankara, Turkey

Purpose: The middle interhemispheric variant of holoprosencephaly (HPE) is a rare malformation characterized by failure of separation of cerebral hemispheres in the posterior frontal and parietal region. Our aim is to demonstrate the structural changes in white matter tracts by diffusion tensor imaging (DTI) and fiber tractography.

Approach/Methods: Three pediatric patients with seizures and developmental delay were evaluated with conventional MR imaging and DTI. Images were acquired using 8-channel SENSE head coil on 3 T whole body MR scanner equipped with explorer gradients (40 mT/m). Diffusion tensor imaging sequence was obtained by using single-shot spin-echo echo-planar sequence (SE-EPI), with diffusion gradients applied in 16 noncollinear directions and b = 800 s/mm² (shortest TR: 80 ms; TE: 2 NSA) in 6 min.

Sixty axial slices were acquired with 224 x 224 mm field of view and 2 mm slice thickness. A 3D TFE T1 sequence also was acquired for background imaging. Diffusion tensor imaging data were analyzed by using fiber track package (release 2.5.3.0.). Fiber tracking was performed by line propagation method using minimum FA value of 0.15, maximum angle change of 27 degrees and minimum fiber length of 10 mm.

Findings/Discussion: The posterior frontal and parietal lobes were fused with normal interhemispheric separation of the basal forebrain, frontal and occipital poles. In all cases the body of corpus callosum was dysgenetic, septum pellicudum was absent and anterior cerebral artery was unpaired. Anterior interhemispheric fissure and falk were present. Subependymal nodular gray matter heterotopia was evident. The sylvian fissures were connected abnormally across the midline. The midline 3rd ventricle was intact in all cases and thalamus, caudal nuclei and lentiform nuclei were located appropriately and separated. Diffusion tensor imaging provided precious information about the relation between the remnant tracts of corpus callosum, atypically located superior longitudinal fasciculus, abnormal intra- and interhemispheric fissures and distorted upper corticospinal tracts.

Summary/Conclusion: MR tractography can demonstrate precisely the structural changes in white matter tracts as well as in their connections influenced by abnormal fusion of posterior frontal and parietal lobes. Diffusion tensor imaging can delineate efficiently the association between affected white matter tracts and heterotopic gray matter. Even though clinically correlated further studies are necessary, DTI can be a promising method to prognosticate developmental achievements of the affected children.

Metabolic Pathology I

Chairs: R. Raininko, P. Ambrosotto

Neuroimaging of Toxic Encephalopathy

C. Chen
Tri-Service General Hospital; Taipei, Taiwan

Toxic encephalopathy refers to neurobehavioral disturbances after exposures to external or internal toxins, which are produced by acquired (in this talk to exclude the inborn error) metabolic derangements. In cases where the brain damages are limited to the cerebral white matters, it is then referred to as toxic leukencephalopathy. The diagnosis requires a high index of suspicion by the clinicians who see the patients at outpatient clinics in chronic cases and ER or ICU at acute setting. The same suspicion index applies to radiologists who read the imaging. So, it is important for the radiologist to know the possible etiologies, the underlying pathophysiological mechanisms, the important factors that might aggravate the CNS injury, and the role of imaging techniques in exploring the various aspects of brain damages in toxic encephalopathy.

The etiologies for toxic encephalopathy could be categorized into external and internal metabolic factors. External causes include therapeutic drugs (antineoplastic , antibiotics, immunosuppressants and anti-epileptic, recreational drugs (coca, cocaine, heroin, N2O, ethanol e.t.c.), environmental and occupational exposure (CO, mercury, methyl bromide, industrial solvents, arsenic, and lead), and accidental intake of poisonous substances or suicidal attempt (CO, methanol, ethylene glycol, cyanide and hypoglycemics); internal causes encompass metabolic derangements that involve the amino acids (ammonia and manganoses), electrolytes (sodium) and glucose (hyperglycemia) and nutritional deficiency (thiamine and cobalamin). The mechanisms of brain damages after exposure to the toxins remain unclear in most of the cases. However, understanding the basic pathophysiologies may help in interpreting the patterns of brain injuries. For example, there is a couple of external or internal toxins that may cause cellular energy failure either involving the electron transport chains in mitochondria or consumption of carbohydrates to energy. In Wernicke's encephalopathy, with thiamine deficiency, the lesion distributions are typically implicated in gray matters vulnerable to energy failure such as the peri-aqueductal grey matter, dentate nuclei of cerebellum and dorsomedial thalamic nuclei. Similar pattern and mechanism of injuries could be seen in medronidazole encephalopathy and methyl bromide intoxication. While tissue hypoxia as a result of the deprivation of oxygen supply or the usage of glucose as energy source in CO intoxication, cyanide poisoning or hypoglycemia caused by suicidal intake of hypoglycemics, the lesion distributions are more or less embolized in the basal ganglion, thalami and sensorimotor cortex. When targets of toxins are considered, particularly in toxic leukencephalopathy, the damaged cellular areas are often localized such as myelin (by toluene, for example...
Efficacy and Safety of Iron Chelating Agent Deferiprone in Patients with Pantothenate Kinase-Associated Neurodegeneration (PKAN)


Objectives: To assess the efficacy and safety of iron chelating agent Deferiprone in patients with Pantothenate Kinase-Associated Neurodegeneration (PKAN) by 1) measuring iron concentration in the globus pallidus on brain MRI, and 2) evaluating the changes in the scores of Burke-Fahn-Marsden Dystonia Rating Scales (BFMDRS) and health-related quality of life scales (SF-36 and CHQ-PF50) after 6-month therapy. Safety endpoints included hematological and neurological examinations. Background: PKAN is a rare autosomal recessive disorder associated with brain iron accumulation. The disease has onset in early childhood with dystasia as predominant feature, associated with retinopathy, parkinsonism, ataxia, spasticity. Brain MRI changes are virtually pathognomonic of PKAN. The diagnostic changes seen on T2-weighted images include a central hypertense signal in the medial globus pallidus (GP), surrounded by a region of signal hypointensity, called the “eye of the tiger sign”. At present, no cure is available. PKAN is caused by a defect in the pantothenate kinase 2 gene (PANK2) that encodes a pantothenate kinase that is specifically expressed in the brain and is essential for coenzyme A biosynthesis. Phosphopantothenate, the product of pantothenate kinase, normally condenses with cysteine in the following steps of coenzyme A synthesis. High cysteine concentration has been found in the GP of patients with PKAN. This abnormal deposition might account for the regional iron accumulation seen in these patients and may be responsible for oxidative damage in these regions. Rationale of the study: Oxidative damage has generally been implicated in pathologies associated with organ iron overload and in some neurological disorders in which iron accumulates in specific areas of the brain. In systemic iron overload, the use of iron chelators has an unquestionable therapeutic record, particularly in the treatment of hemochromatosis and more recently in preventing or reversing iron-provoked cardiac failure in thalassemia. Major contributions to the recent success in the treatment of iron overload are the advent of non-invasive techniques for assessing organ iron load and the introduction of MRI measurements of iron accumulation in organs such as liver, heart and brain. Recent data suggest a radiological and clinical improvement with iron-chelating treatment in patients affected by Friedreich’s disease histopathologically characterized by iron accumulation in heart muscle, dentate nuclei and spinal cord. This evidence led to the suggestion that chelation of iron in the most focal brain deposits may be a possible treatment for PKAN and other neurological disorders. In PKAN, despite the evidence of iron accumulation in GP, the pathophysiological role of iron accumulation as causative factor in neuronal damage remains to be established. Furthermore, the notion that accumulated iron can directly lead to oxidative damage is still to be proved. In addition, the design of an orally active iron chelator not interfering with basic functions is a definite challenge. Deferiprone, an iron chelating agent effective in promoting iron excretion and in preventing the progression of iron accumulation. Design-setting: Phase II two-center clinical trial study. Methods: We conducted an open oral administration of Deferiprone (25 mg/kg/day) in 9 patients (3M/6F, age range:10-38) with genetically confirmed diagnosis of PKAN. Subjects were taking a Siemens Magnetom Avanto 1.5 T system before and after chelating treatment. In order to detect iron deposition in the GP, T2* Relaxometry was performed with a multi-echo gradient echo sequence (GRE) (12 echo times 5/55 msec). R2* maps were calculated measuring the signal decay of the multi-echo GRE sequence and estimating the mean value of iron concentration for each nucleus and for each time point. The differences in iron concentration between the two time points, i.e. the different R2* values, were compared using a paired two-tailed t-test. Clinical assessment, including standardized videotape recording and evaluation of dystasia with the BFMDRS, was repeated every two months; evaluation of health-related quality of life was conducted before and after treatment. Blood cell count was performed weekly, complete haematological assessment was performed every two months. Results: One patient dropped out because of neutropenia. Deferipone was overall well tolerated. There was no change of the clinical status and in the scores obtained at the BFMDRS and at the SF-36 scales before and after treatment. T-test showed a significant reduction of iron content in GP after treatment (p = 0.0486). Conclusions: Our data demonstrate the effect of Deferipone in removing iron from specific brain areas in PKAN, without affecting hematological parameters. These results depend on the small number of patients.
Radiological Features of Cask Mutations

S. Yuasa 1, J. Takanashi 1, H. Arai 1, S. Hayashi 1, J. Inazawa 1, N. Okamoto 1, A. J. Barkovich 2
1 Kamedo Medical Center, Department of Pediatrics; Kamogawa, Japan; 2 University of California San Francisco, Department of Radiology and Biomedical Imaging; San Francisco, CA, USA

Objective: Mutations of the calcium/calmodulin-dependent serine protein kinase (CASK) gene are associated with X-linked mental retardation with microcephaly and disproportionate brainstem and cerebellar hypoplasia in females. The purpose of this retrospective study was to investigate MRI in female patients with CASK mutations to find out whether they have characteristic radiological findings.

Methods: The areas of the cerebrum, corpus callosum, pons, midbrain, and cerebellar vermis and hemisphere, and a ratio of cerebrum/corpus callosum areas were measured in five female patients with CASK mutations, 67 female controls, and five patients with pontine hypoplasia.

Results: MRI in patients with CASK mutations revealed normal size of the corpus callosum and low ratio of cerebrum/corpus callosum with reduced area of the cerebrum, pons, midbrain, and cerebellar vermis and hemisphere. The five patients with pontine hypoplasia showed thinning of the corpus callosum and a high ratio of cerebrum/corpus callosum, irrespective of the size of the cerebrum.

Conclusions: The normal size of the corpus callosum, which gives an impression of callosal thinning at first glance, may be an imaging clue to detect patients with CASK mutations among female patients with pontocerebellar hypoplasia.

Diffuse Weighted MRI Imaging and MR Spectroscopy Findings in Neonatal Nonketotic Hyperglycinemia

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Background and Purpose: Nonketotic hyperglycinemia is caused by a defect of the glycine cleavage system leading to accumulation of glycine in body fluids and the central nervous system with its subsequent neurotoxicity.

We describe diffusion weighted MR imaging (DWI) and proton MR spectroscopy (MRS) findings in neonatal nonketotic hyperglycinemia.

Subjects and Methods: Five neonates, 3 male and 2 female, presented with post natal acute encephalopathy, were studied between 4 and 15 days of life. MR imaging examination was performed on 1.5T MR unit with conventional sequences (Fast Spin Echo T1-T2 weighted images), DWI (Axial diffusion-weighted MR images with TE 106ms TR 10000ms b factor 1000 s/mm2) and Single voxel MRS (short echo time 35 ms and long echo time144 ms) located in the basal ganglia and the centrum semiovale.

Results: Conventional MR imaging revealed in all cases hyperintense T2 lesions in the dorsal midbrain, pons and dentate nuclei with corpus callosum agenesis in one case. DWI showed hyperintense lesions of restricted diffusion. The lesions were more conspicuous than on T2-weighted images with additional bilateral lesions of restricted diffusion in the posterior limbs of the internal capsules and cerebellar peduncles. Glycine peaks were shown by MRS at 3.56 ppm on long echo time.

Discussion/Conclusion: Abnormalities of myelinated white matter with restricted water diffusion reflected the spongiosis of the myelinated brain tissue due to myelin vacuolation. Demonstration of high glycine peaks on MRS confirms the diagnosis of nonketotic hyperglycinemia.
Our Experience with the MR Diagnostics of Late Infantile Form of Neuronal Ceroid Lipofuscinosis

I. Zsigmond 1, A. Tegzes 1, P. Barsi 2
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Introduction: Neuronal ceroid lipofuscinosis is a progressive neurodegenerative disease. Four forms are differentiated: infantile, late infantile (LINCL) or Jansky-Bielschowsky, juvenile, and adult form. MRI literature mentions 1. widening of the ventricles and outer CSF spaces of varying degree with pericerebellar predominance in LINCL, diffuse white matter hypointensity predominantly in the periventricular white matter, and sometimes 3. hypointensity in the basal ganglia.

Material and Methods: We summarize the MRI data of our 6 cases of histologically proven LINCL.

Results: We have found periventricularly predominant WM hypointensity in 100%, hypointensity in the basal ganglia in 100%, and predominantly cerebellar atrophy in 66%. We have detected symmetric hypointensities in the subinsular WM in 100%, not mentioned previously in the literature.

Conclusion: In cases of a suspected neurometabolic disorder in children, periventricularly predominant WM hypointensity, pericerebellar atrophy, and basal ganglia T2 hypointensity should raise the suspicion of LINCL. Symmetric subinsular T2 hypointensity may be an important new sign.

Infantile Neuraxonal Dystrophy (INAD): Contribute of MRI Patterns Correlate to Clinical Findings in Differential Diagnosis

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Background: Infantile neuronal axonal dystrophy (INAD), is a rare neurodegenerative disorder, involving axons on both the central and the peripheral nervous system with presence of axonal swelling and spheroid bodies (SB) as pathological hallmark. The disorder is characterized by infantile onset with arrest and rapid regression of motor and cognitive developmental milestones, hyperintense waves in spastic tetraplegia, and visual impairment. Eighty percent of patients with INAD had mutations in PLA2G6 gene. In addition, more recently, two different syndromes with allelic disorders of the same gene, causing atypical neuronalaxonal dystrophies with brain iron accumulation (NBI), are been identified: the Karak and the Kurian syndrome, overlapping clinically with neurodegeneration caused by PANK2 gene mutations (Halleworden-Spatz). The thirteen Kurian’s patients showed homogeneous clinical phenotype, cerebellar atrophy and gliosis, w.m. abnormalities, and atrophy of corpus callosum. Ten children had increased iron deposit in the globus pallidus (GP), seven had axonal neuropathy with SB. Previous studies found that SB were not expected to be seen in all tissue specimens of INAD patients. The negative result may be due to early biopsy after disease onset. In the early stage of the disease, the diagnosis of INAD may be difficult, based on clinical and neurophysiological findings only. Traditionally, the definitive diagnosis of INAD required the demonstration of axonal SB by biopsy. The evidence that large proportions of INAD have a mutation in the PLA2G6 gene, allows molecular diagnosis and often negates the need for more invasive procedures, such as biopsy. The recent advances in molecular diagnosis have increased the genotype-phenotype correlation. The most frequent MRI sign of INAD, is a diffuse and progressive cerebellar atrophy that at a very early age it is mainly involving the inferior part of the vermis. The high T2 signal of the cerebellar cortex, likely resulting from gliosis, was initially considered a “pathognomonic” sign of the disease but it is not always present and it may appear only in an later phase of the disease.

Purpose: Our purpose was to review the clinical reports, the longitudinal MRI studies, and the available neuropathological features of a group of patients, to establish clinical and radiological INAD phenotype in order to identify the earliest and most important MRI signs of the disease and their evolution, and to correlate the clinical/radiological phenotype with the genetic mutations when results of molecular study were available.

Materials and Methods: Detailed reviews of the clinical and MRI features of nine patients (four boys and five girls) with clinical and MRI onset and evolution strongly supporting INAD diagnosis, were analyzed in order to identify the earliest and most important features suggesting diagnosis. All the patients had the clinical onset within the first two years of life. The mean age at the onset was ten months. We evaluate the MRI findings in the first study as well as in the follow up and correlate these findings with the clinical features present at the time of the exam and with the patient’s age. The MRI signs investigated were: presentation of the clinical and radiological phenotype of cerebellar atrophy, “cerebellar gliosis”, T2 signal of the GP and substantia nigra/subthalamic nuclei, cerebral white matter abnormalities, cerebellar atrophy, corpus callosum changes and optic pathway atrophy. In addition, five patients had Proton MR Spectroscopy (H+MRS), diffusion MRI (DWI), and diffusion tensor (DTI) imaging.

Results and Conclusions: Progressive cerebellar atrophy was the only MRI finding reported in all patients. The high signal cerebellar cortex was not a constant finding, it was also noted in two cases, without a definitive genetic or pathologic evidence of INAD. We did not observe decreased T2 signal in the GP or substantia nigra, reported in NBI due to PANK2 gene mutations or to rare atypical NBI with mutation in the PLA2G6 gene. The value of other cerebral and optic nerve MRI abnormalities and the role of advanced MR techniques, as H+MRS, DWI and DTI, was evaluated. Three children presented the clinical onset after a respiratory illness, a presentation which mimics many inborn errors of the metabolism. Most of the children in our group were investigated for such possibilities, resulting negative. The recognition of MRI and clinical features consisting with INAD, reduces the need for extensive metabolic testing and steers the molecular analysis, avoiding biopsy to confirm diagnosis. On the other hand, some patients with typical clinical and pathological features of INAD are negative for PLA2G6 mutations; therefore, the absence of either PLA2G6 mutations or pathological evidence may not exclude the diagnosis of INAD strongly suggested by clinical and MRI diagnostic criteria and it allows the possibility of genetic heterogeneity for INAD phenotype.
Brain Tumors I

Chairs: D. Montanaro, M. Uusvåli
14.30-15.00

Introductory Lecture

Advances in MR Imaging and New Analysing Methods to Assess Treatment Response in Brain Tumour

P. Maly Sundgren 1, C Galban 2, C Tsen 1, D Hamstra 1, CR Meyer 1, BD Ross 1, TL Chenevert 1
1 Lund University, Lund, Sweden;
2 University of Michigan Health System; Ann Arbor, MI, USA

Glioblastoma multiforme (GBM) is a common primary brain tumour in adults. High grade gliomas have a poor overall survival rate despite improvements in surgery, radiation -, and chemotherapy. A contributing factor to the poor survival of patients with high-grade gliomas is the inability of currently available imaging techniques to accurately delineate the tumour, as a result of which targeted local treatments may not be effective. In addition, conventional imaging is not able to give an early assessment of the effectiveness of radiation and/or chemotherapy. Other problems are the difficulty to differentiate between radiation-induced necrosis from tumour recurrence and to distinguish true progression from pseudo-progression. Early identification of patients with a poor treatment response or who suffer from tumour recurrence can be of great advantage: it provides the opportunity to adjust individual treatment regimes more rapidly, and sparing patients unnecessary morbidity, expense and delay in initiation of effective treatment. Accurate response assessment in malignant gliomas has important clinical implications in patient management as well as in proper inclusion of patients in subsequent clinical trials. In recent years different functional imaging approaches such as dynamic contrast-enhanced (DCE) and dynamic susceptibility-weighted contrast (DSC) MRI methods, diffusion weighted imaging and MR spectroscopy have been studied to complement anatomical MRI scans and are increasingly being evaluated in oncology practice for diagnosis and treatment response assessment. Different approaches are used to quantify perfusion and diffusion MRI as well as MR spectroscopy changes for use as early imaging biomarkers of treatment response. However, the optimal analytic approach for quantification of perfusion and diffusion changes for use as early imaging biomarkers of treatment response has not been established. In addition the value of MR spectroscopy as an imaging biomarker is still disputed.

In this lecture different methods to assess treatment response will be discussed. In addition, a novel recently published and very promising technique will be described - the parametric response mapping (PRM), a novel voxel-wise analytical method of monitoring physiological and environmental changes in a tumour volume during treatment will be presented. The parametric response maps predictive capabilities as an imaging biomarker for early treatment response assessment will be compared to the traditional used - whole tumour analysis. In addition, the predictive value of PRM for both diffusion and perfusion MR compared to different baseline metrics which have been reported in a prospective studies to correlate with overall survival will be demonstrated. The value of MR spectroscopy as well as which metrics to use, and if the technique can be used as early imaging biomarker for treatment response and if helpful in differentiating radiation injury from tumour recurrence or tumour progression will be discussed.

15.00-15.15

Correlation of MRI and Various Perfusion Parameters with Histopathological Grading of Tumours

S. Soneji, R. Bhangale, R. Gandhi, R. Kakkar, S.B. Desai
Jaslok Hospital and Research Centre; Mumbai, India

This was a prospective study of 30 patients done in MRI department of Jaslok hospital and Research Centre, on 3 Tesla Magnatom Trio Tim MRI scanner; in patients who were suspected to have CNS neoplasms. These patients had a plain and contrast MRI with perfusion and were subsequently followed up with either a stereotactic biopsy or surgery and histopathological grading of the lesions. The parameters that were evaluated in perfusion MRI were rCBV, rCBF and rMTT. Tumours that were either grade I or II (who classification) were graded as low grade tumours and those grade III and IV were considered as high grade tumours. The intra and extra axial lesions were also analyzed together as well as separately. The results of the study were analyzed using non-parametric tests. It was seen that there was good correlation of the rCBV and rCBF with grade of intra axial tumours.

15.15-15.30

Impairment of Default-Mode Network Connectivity in Patients with Cerebral Glioma

R. Esposito 1, D. Mantini 1,2, G.L. Roman 1, A. Tartaro 1, M. Calò 1
1 ITAB, Institute Advanced Biomedical Technologies; University G. D’Annunzio; Chieti, Italy; 2 Laboratory of Neuro-Psychophysiology, R.U. Leuven Medical School, Leuven, Belgium

Purpose: The study of the DMN has been shown to be clinically relevant in understanding brain disease, due to the reported link between pathological conditions and the disruption of DMN areas [Buckner, 2008]. Our aim was to evaluate changes in functional connectivity of the default-mode network (DMN) in patients with cerebral glioma and to correlate these results to tumor grading, allowing for a quantification of impaired neuronal connectivity.

Materials and Methods: From January 2004 to December 2007, 28 patients cerebral tumor in the left hemisphere (14 high-grade and 14 low-grade glioma) and 14 healthy right-hand volunteers were enrolled in the study, approved by the local ethics committee. The subjects were examined by functional magnetic resonance imaging (fMRI) during the performance of language tasks, intended
for presurgical mapping. The data were analyzed by the Independent Component Analysis (ICA), for identification of the DMN. The DMN connectivity maps were obtained for each of the three groups by random-effect analysis (p < 0.001, FDR-corrected). An analysis of variance (ANOVA) across the three groups (p < 0.05) was performed. Post-hoc t-test contrasts between pairs of groups were also calculated (p < 0.05, FDR-corrected).

**Results:** All the three groups of subjects showed typical DMN areas, but reduced DMN connectivity was detected in tumor patients with respect to controls. A significantly greater and reduced integration in the DMN of the hippocampal and the prefrontal areas (p < 0.05) was observed, respectively. These changes were found to be closely related to tumor grading. Moreover, the DMN lateralized to the hemisphere to tumor area in the low-grade (p < 0.05), but not in the high-grade tumor patients.

**Conclusions:** this study showed a modification of DMN functional connectivity in brain tumor patients in relation with tumor grading. We have observed alterations related not only to the local brain injury, but also to a global network disruption. DMN connectivity measures were reduced in tumor patients with respect to controls. 

**Methods and Materials:** We retrospectively evaluated FCMRI in 40 right-handed patients with a left hemisphere brain glioma and in 14 healthy subjects. Patients and controls underwent fMRI to lateralize language functions in the cerebral hemispheres. For each subject, whole-brain connectivity maps were created positioning a seeding in the left inferior frontal gyrus (left Broadman 44/45) using the region with maximum BOLD signal as reference and accounting for any eventual anatomical derangement due to the presence of the tumor. Five seed regions (right Broadman 44/45, Superior Temporal Sulcus and Temporo-Parietal Junction of both the hemispheres) were derived from connectivity maps. Cross-correlation matrices of BOLD signals fluctuations were calculated for each subject. Group-level analyses were performed by independent-samples t-tests and ANOVAs.

**Results:** The global FCMRI was significantly reduced in tumor patients compared to controls (p < 0.001). FCMRI was significantly reduced within seed regions of the affected hemisphere (left intra-hemispheric FC) and within the right hemisphere (right intra-hemispheric FC) (p < 0.05); inter-hemispheric FCMRI was also significantly reduced in patients (p < 0.001).

Conclusions: the presence of a brain tumor in the left hemisphere significantly reduces the FC between language-related brain regions. Modification of the FC is not restricted to the area surrounding the tumor; remote and contralateral areas are also influenced.

**Role of Diffusion Tensor MR Tractography in Predicting Supratentorial Gliomas**

A. Castellano 1,2, C. Michelozzi 1,2, L. Bello 1, A. Iadanza 1, G. Scotti 1, A. Falini 1

1 Department of Scientific Sciences, Bioimaging and ITAB, University G D Annunzi, Chieti, Italy; 2 Department of Radiology, Catholic University, Rome, Italy

**Purpose:** Functional connectivity MRI (FCMRI) measures the spontaneous and synchronous fluctuations of the BOLD signal between spatially remote brain regions. The present study aims at investigating modifications of FCMRI within the language network in patients with a left hemisphere brain glioma.

**Methods and Materials:** We retrospectively evaluated FCMRI in 40 right-handed patients with a left hemisphere brain glioma and in 14 brain gliomas. Both the involvement of the fascicles as evaluated by tractography and the extent of residual tumor after surgical resection were analyzed, with the aim of seeking the predictive value of this technique to determine pre-operatively the degree of radicality of surgical resection.

**Patients and Methods:** 73 patients with high-grade gliomas (46 LGG, 27 HGG) were selected. All patients were studied on a 3T scanner according to a protocol including a morphological study (T2, FLAIR, T1 sequences) and diffusion tensor acquisitions. DTI data were collected using a single-shot echo planar imaging (EPI) sequence (TR/TE 8986/80 ms) with parallel imaging (SENSE factor, R = 2.5); 32 diffusion gradient directions (b = 1000 s/mm²) and one image set without diffusion-weighting were obtained, with isotropic voxel dimensions (2.5 × 2.5 × 2.5 mm³). The sequence was repeated two consecutive times and data were averaged off-line to increase signal-to-noise ratio; DTI datasets were aligned off-line to the echo-planar volume without diffusion weighting on a PC workstation using the AIR (Automatic Image Registration) software to correct artifacts due to rigid body movement during scan acquisition. Diffusion tractography was performed off-line based on a streamline algorithm using Dti Studio software, by reconstructing the inferior fronto-occipital (IFO), the superior longitudinal fascicle (SLF) and the corticospinal tract (CST). For each patient the relationship between each bundle reconstructed and the lesion was analyzed, and the possible infiltration and/or displacement of the fascicle was indicated. DT-MR Tractography reconstructions were merged with the preoperative anatomic MR images transferred to the neuronavigation system.

Initial and residual tumor volumes were measured on pre-operative and post-operative T2-weighted MR images and 3D Fast Field Echo T1-weighted images. Extent of resection was then expressed as percentage of pre-operative tumor volume.

**Results:** The preliminary analysis of data concerning the involvement of the inferior fronto-occipital fascicle, superior longitudinal fascicle and corticospinal tract showed that when these bundles were infiltrated (81%, 59 out of 73 patients) it was not possible to perform a total resection; when the fascicles were not involved by the lesion it was possible to achieve a total resection in all the cases. Extent of tumor resection, expressed as percentage of preoperative tumor volume, was greater for the involvement of inferior fronto-occipital and superior longitudinal fascicles than for corti-
cnsal tract (87.5% and 89% versus 76%, respectively). Percentage of residual tumor volume was maximum when all the fascicles were infiltrated by the tumor (67% of preoperative tumor volume).

Conclusions: The evaluation of the relationship between tumor and eloquent bundles by DT-MR Tractography allows to assess pre-operatively the degree of radicality of surgical resection, in order to identify the patients which may maximally benefit from surgery.

Brain Tumors 2

Chairs: D. Yousem, Y. Özsunar Dayanir

16:00-16:15

Multimodal MRI and Overall Diagnostic Accuracy in Non-Enhancing Brain Gliomas

S Gaudino, V S Lorusso, M. Carlo, A Tartaro, T Tartaglione, G. Di Lella, C. Colosimo

1 Ist. Radiologia - Università Cattolica del Sacro Cuore, Rome, Italy; 2 I.T.A.B. - Università G. D’Annunzio, Chieti, Italy

Introduction: Gliomas account for more than 70% of primary brain tumours and they present considerably heterogeneous neuropathological, genetic and clinical features. Regions of mixed degree of malignancy are possible within large cerebral gliomas. Gadolinium-enhanced structural MR imaging is not a completely reliable tool for distinguishing low grade from high grade gliomas, in fact 14-45% of non-enhancing supratentorial gliomas are malignant and some enhancing high grade gliomas, in fact 14-45% of primary brain tumors which may maximally benefit from surgery. The combination of PWI, DWI and MRS with conventional MRI significantly increases the diagnostic accuracy in differentiating high from low-grade NEGs. Therefore multimodal MRI examinations should be performed if available in the workup of brain tumors especially in NEGs.

Materials and Methods: Eighty-four patients (34 males, 50 females, mean age 61.6 years) presenting with 87 meningiomas were studied with our standard MRI protocol including conventional sequences with and without cut-off values for PWI, DWI and MRS (as based on the literature data).

Results: Some of the tumors displayed heterogeneous signal intensity on conventional MRI with a clear evidence of central necrosis. The apparently "solid" portion of all the gliomas was considered an area of diffusion restriction as typically hyperintense on T2- and hypointense on T1-w images, compared to normal appearing WM. All the tumors were non-enhancing on a visual assessment as for undamaged blood-brain barrier. On DWI the solid portion of the tumors was hyperintense with respect to the WM. rCBV maps demonstrated significantly higher values of CBV in high grade compared to low grade gliomas. Two low grade Oligodendrogliomas (ODGs) had a high CBV. Using the ROC curves, a high probability for a neoplasm to be a high grade lesion was associated with an rCBV > 1.5 and an ADC value higher than 1.120 x 10⁻³ mm² s⁻¹. The mean Cho/Cr ratio was able to discriminate between Grades II and III/IV. The best performing single parameter for group classification was the rCBV value, although the best results for differentiating low and high grade gliomas were achieved combining conventional with "functional" sequences and applying cut-off values.

Conclusions: The lack of contrast enhancement on MR studies of brain gliomas does not always couple with a low grade tumor. Up to 25% of high grade gliomas are faintly or completely non-enhancing. Recently, DWI, PWI, and MRS have increased the accuracy of MRI for discriminating low grade from high grade gliomas.

In our case series, all the high grade gliomas showed reduced diffusion on DWI, likely related to higher cellularity; nevertheless also few low grade gliomas demonstrated reduced ADC values.

The degree of perfusion MR changes (rCBV maps and values) is known to reflect the degree of neo-angiogenesis. In our case series, the sensitivity of rCBV in grading gliomas was 100%, indicating that all high-grade tumors were correctly classified with the use of a cut-off value. The presence of high rCBV in two low grade ODGs reduced the specificity of rCBV to 84%.

MRS metabolite ratios such like Cho/Cr showed good correlation with glial tumor grade, Cho/Cr ratio demonstrated good sensitivity and specificity, but few low-grade gliomas had elevated Cho/Cr values likely related to high cell density.

Our results suggest that rCBV measurement may be slightly more accurate than DWI and MRS in the identification of high-grade tumors. In conclusion, the combination of PWI, DWI and MRS with conventional MRI significantly increases the diagnostic accuracy in differentiating high from low-grade NEGs. Therefore multimodal MRI examinations should be performed if available in the workup of brain tumors especially in NEGs.

Contribution of Diffusion Weighted MRI in the Differentiation of Intracranial Meningiomas and Correlation with Immunohistochemistry

L. Castelletti, M. Bendini, L. Saitta, L. Bonzanò, F. Di Paolo, L, Castellan

Purpose: To correlate the histological grade of intracranial meningiomas (according to the WHO classification 2007) with ADC values on MRI and to assess whether it is possible to identify typical from atypical/anaplastic meningiomas.

Materials and Methods: Eighty-four patients (34 males, 50 females, mean age 61.6 years) presenting with 87 meningiomas were studied with our standard MRI protocol including a diffusion-weighted sequence. ADC maps were calculated and post-analysys was performed with Analyze Mayo Clinic USA by manually placing one ROI (Region of Interest), ranging from 30 to 130 mm², in the tumour, avoiding any calcified or cystic component. In very large meningiomas, the average ADC value from three ROIs was calculated. Subsequently the patients underwent surgery for resection of the tumor. All specimens were histologi-
cally classified according to WHO and evaluated for Ki 67 (%), as index of cellular proliferation, which is measured by immunohistochemistry as the percentage of nuclei resulting positive for antibodies that recognize cell cycle progression.

Results: The average ADC values for anaplastic meningiomas (0.68±0.09 x 10⁻³ mm²/sec) and for atypical (0.71 ± 0.06 x 10⁻³ mm²/sec) were found to be significantly lower than for typical meningiomas (1.01 ± 0.21 x 10⁻³ mm²/sec) according to the Mann-Whitney U test (p <0.001), thus confirming an inverse correlation between the values of ADC and the WHO grade of the tumour. A statistically significant correlation between ADC value and Ki 67 (%) (Spearman rank correlation; r = 0.65, p <0.001) was also found.

Conclusions: In our series the diffusion is slightly narrower and the value of a low in anaplastic/atypical than in typical meningiomas. The ADC value in meningiomas is inversely related to cellular proliferation showed by Ki 67 (%) index. Diffusion weighted MRI, despite the controversial recent literature, could be considered a feasible and reliable tool to predict tumour grade in meningiomas. Such statement is also reinforced by the correlation with immunohistochemistry techniques.

16.30-16.45
10’
Intratumoral Topography of CNS Gliomas Revealed by Diffusion Tensor Imaging: Correlations with Tumor Volume and Grade
A. Jakab1, P. Molnár2, M. Enri3, E. Berényi1
1 University of Debrecen Medical and Health Science Center, Department of Biomedical Laboratory and Imaging Science; Debrecen, Hungary; 2 University of Debrecen Medical and Health Science Center, Institute of Pathology; Debrecen, Hungary; 3 University of Debrecen Medical and Health Science Center, Institute of Nuclear Medicine; Debrecen, Hungary

Introduction: Intratumoral heterogeneity can be defined as variability of cytological and histological features which is a highly characteristic feature of brain gliomas. In a broader sense, intratumoral diversity reflects an adaptive response of the proliferative tissue to its own physiological micro-environment. Once the tissue volume exceeds those limits within which diffusion suffices to provide oxygen and nutrition, neovascularization is inevitable and is another feature of gliomas which is most active in these tumors. New vessel growth progresses from the periphery and it is a common finding that the tumor center is necrotic. It is a widely acknowledged fact that various intratumoral, local, micro-environmental alterations are largely dependent upon the total tumor volume. Presumably tumor growth manifests changes in the topography of diffusion characteristics. In vivo diffusion can be measured using diffusion tensor imaging (DTI) which finely depicts the direction-related characteristics of diffusion and its anisotropy. The tensor dataset allows visualizing diffusion features as grayscale images and enables thorough statistical analysis for neuro-oncology research. In the present study, we used our previously established glioma DTI database to gain insight into the intratumoral topology by showing variations of DTI-related parameters measured in the central and peripheral tumor areas. Furthermore, we measured how tumor size may affect the diffusion topology and evaluated the contribution of tumor grade to such changes in diffusion.

Materials and Methods: In this pilot study, diffusion tensor imaging was part of the preoperative radiological workup of 25 patients with CNS gliomas. Pathologically proved diagnoses comprised 12 grade II oligoastrocytomas, 3 grade III glioblastomas, 4 grade II oligodendrogliomas and 6 grade IV astrocytomas. The following DTI-related maps were calculated: B0, fractional anisotropy (FA), apparent diffusion coefficient (ADC). Tumor margins were drawn on B0 images for the whole 3D volume. Then, morphological operations were performed to extract the central part of the tumors and the periphery, the latter defined as a 5mm zone inside the outlined tumor border. Statistical descriptors of intratumoral voxel-value distribution were determined for each case, separately referring to the peripheral and central areas, moreover, differences between low and high grade cases were evaluated. We defined the topology indices as the ratios of the diffusion measures of central to the peripheral areas. The relationship between topology indices and tumor volumes were assessed by Pearson test of correlation, separately measured for low and high grade gliomas.

Results: We found that due to the strongly skewed distribution of voxel intensities, the mean of median values were not useful in statistical workup, it was necessary to calculate the mode values to form the topological indices. Among all variables derived from DTI maps, the fractional anisotropy topography index (FAindex) showed the strongest, negative correlation with tumor volume (Pearson score: -0.627, P=0.001). Among the measured gliomas, the largest the tumor volume was, the lower the fractional anisotropy values of the central areas were, relative to the peripheral zone. A cut-off value of 60cm3 was used to separate tumors into two size categories with significantly different FAindex: it was 1.04 ± 0.14 for smaller tumors and 0.81 ± 0.17 for tumors larger than 60 cm3 (P<0.004, Mann-Whitney U test). The same tendency was discovered when low and high grade tumors were observed separately, nevertheless, volume correlation was more significant in low grade gliomas. Repeating these measurements using iDWI or ADC indices did not reveal significant differences in the two topological areas, nor were they correlated with tumor volumes.

Discussion: Based on the available experimental data, it can be hypothesized that the structural and diffusion features of tumor core will differ from those detected in the periphery. The degree of anisotropy (i.e. describing how ordered the diffusion is) was only found to be correlated with tumor size after defining a center-to-periphery index. The tendency towards lower fractional anisotropy values in larger tumor volumes reflects greater disorganization of the cellular (and extracellular) architecture. However, these assumptions need to be further investigated on a larger scale of cases and eventually validated by successive histomorphological workup. Data collection about these regions from within gliomas of different cyto- and histological characteristics of different grades and locations will permit significant predictions about drug distribution.

Table 3: Correlation between fractional anisotropy indices and volume. Values determined separately for low and high grade gliomas.

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<th>Fractional Anisotropy Indices</th>
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Figure 1: Intratumoral diffusion topography revealed by DTI. Fractional anisotropy ratio of the central to peripheral zone correlated with tumor volume.
Analysis of Brain Tumors and Metastases by Quantitative MT Imaging with bSSFP: Initial Experiences

M. Garcia, M. Globoi, O. Bieri, F. Jax, K. Scheffler, C. H. Stippich
Department of Neuroradiology, University of Basel Hospital, Basel, Switzerland, Medical Physics, University of Basel Hospital, Basel, Switzerland

Introduction: MRI is sensitive for the detection of abnormalities of the CNS, but lacks some specificity for their pathological substrates. In contrast, magnetization transfer (MT) techniques based on MTR analysis have been reported to show increased pathologic specificity for the characterization of brain tissue, e.g., for the pathologic specificity for the characterization of brain tissue. However, MTR analysis only provides qualitative information of the MT-effect. In this study, the efficacy of quantitative MT (qMT) imaging for the characterization of benign and malignant brain tumors and metastases was analyzed with balanced steady-state free precession (bSSFP). MT effects are derived from MT images, from relaxation times (T1, T2), from MT exchange rates (kf), and from the macromolecular content (F).

Methods: Eleven patients (mean age: 60, 7F, 4M) with 3 different brain lesions (4 glioblastoma multiforme (GBM), 4 meningiomas and 3 metastases) were investigated on a clinical 1.5T MR scanner (Avanto, Siemens, Erlangen, Germany). The MR examination consisted of a complete conventional MRI imaging protocol including T1, T2w, FLAIR and T1w+ contrast enhanced images (bSSFP), MT images, images, from relaxation times (T1, T2), from MT exchange rates (kf), and from the macromolecular content (F).

Results: Mean values for the ROIs within the different lesions and the non-affected brain tissue are summarized in Table 1. As expected, MTR was higher in the normal appearing than in the damaged brain tissue. For quantitative estimates, F and kf were found to be significantly lower and relaxation times significantly higher in tumors and metastases than in normal appearing brain tissue. Within the lesioned tissue, F- and MTR-values were higher for the perifocal edema than for the CE-areas, despite similar kf. Also, between the different pathologies several divergences were found. For the CE-areas, highest F was observed in metastases, whereas kf was highest in meningiomas, and relaxation times were markedly shorter for meningiomas than for GBMs and metastases. For edema, CEDF and F tended to be higher in metastases than in the other lesions investigated, whereas T1 and T2 were markedly higher for meningiomas than for GBM and metastases. Despite similar MTR for the CE-areas in GBM and meningiomas, kf tended to result in higher and relaxation times in significantly lower values in meningiomas compared to GBM, despite similar F.

Discussion: Differences in MT-values for the CE-regions and the surrounding edema in different brain pathologies might be attributed to differences in edema characteristics (e.g., edema intensity), in cell infiltration and density as well as MT-properties. Differences in relaxation times despite similar MTR-values between GBM and meningiomas indicate a higher diagnostic potential for qMT in comparison to the semiquantitative analysis obtained with MTR.

Conclusion: In different pathologies, contrast enhancing tissue and surrounding edema, which appear similar in signal intensity on conventional MRI, show differences in F, kf and relaxation times. Thus, MT imaging might play a major role in adding information to diagnostic tumor characterization. However, more data have to be collected to confirm the value of complementary qMT imaging in the clinical setting.

References

New Distant Tumors in Patients Successfully Treated for Glioblastoma Multiformes: 10 Years Experience

G. Di Lella, C. Falcone, E. Pravatà, S. Gaudino, A. M. Costantini, C. Colosimo
Università Cattolica del Sacro Cuore - Istituto di Radiologia, Rome, Italy

Purpose: Despite current multimodal treatment, most Patients with Glioblastoma Multiformes (GBM) have a fatal outcome within 12-20 months. Relapse is usually local, however about 10% of the new lesions are reported to emerge remotely from the primary tumour field, and not all distant recurrences can be explained by either WM continuity infiltration, or by CSF seeding. In the present work, we aimed to:

Reassess GBM recurrences modalities in "long-surviving" Patients, with special reference to Distant Recurrences. Describe the MRI features of the new distant relapsing tumors. Hypothesize mechanisms of development for the "new" GBMs.

Subjects and Methods: We performed a retrospective evaluation in Patients with GBM who survived more than 20 months, without multieentric/multifocal disease at 1st diagnosis. Then, we included all those who subsequently presented a Distant Recurrence (DR) without evidence of relapse around the primary tumor site/surgical field, T2 signal abnormalities between primary tumor site and DR or leptomeningeal spreading/involvement.

Study population: Out of the 750 Patients with GBM we evaluated in the last 10 years, only 68 (9%) survived longer than 20 months. Twelve out of the 68 long-surviving Patients (17%) (7M, 5F, 37-58 years) who showed new DRs without any of the above mentioned exclusion criteria, were included in this study. All 12 Patients had a long-surviving Patients (17%) (7M, 5F, 37-58 years) who showed new DRs without any of the above mentioned exclusion criteria, were included in this study. All 12 Patients had a long-surviving experience, T2 signal abnormalities between primary tumor site and DR or leptomeningeal spreading/involvement.

Results: Out of the 68 long-surviving Patients, 12 out of the 68 long-surviving Patients (17%) (7M, 5F, 37-58 years) who showed new DRs without any of the above mentioned exclusion criteria, were included in this study. All 12 Patients had a long-surviving experience, T2 signal abnormalities between primary tumor site and DR or leptomeningeal spreading/involvement.
the brainstem. Contrast enhancement was found in 10 out of 12 lesions at appearance of DR, and PWI (performed in 4/12) showed an increased r-CBV within the new lesions. MRS (performed in 5/12) revealed increased Cho peak and Cho/NAA ratio.

Discussion: Several hypotheses have been proposed to explain GBM DR, such as promoting effects from PT, spreading along WM fibers, CSF seeding, or vascular/perivascular dissemination; however, no single theory could fully explain the genesis of new recurrent lesions in our series. Among most recent hypotheses, Lim et al. found a direct association between multifocal tumor phenotype and the relationship of GBMs to neural stem cell regions. However, we found cases where the primary tumor site was not contacting the neural stem cell regions indicated by the above Authors, despite these patients developed a DR in the contralateral hemisphere, as well.

Conclusions: The development of “new” distant GBMs after successful treatment of the primary tumor is a relatively frequent occurrence in long-time survivors. As a consequence, during MRI follow up of GBM Pts a careful scrutiny must be devoted to the entire brain. More effective treatments and longer survival times may allow development of “new” GBMs, that could be considered Multicentric Metachronous Malignant Gliomas. Such an hypothesis would revalue the old theory of the GBM as a “cancer of the brain as whole”, that would be easier accepted on the basis of our current knowledge in oncogenesis.

References

Comparison of 1.5 and 3.0 T Diffusion-Weighted MR Imaging for Brain Tumors

Z. Merhemic1, F. Gavrankapetanovic1, N. Bilalovic1, M. Niksic1, Z. Kadenic1, E. Avdagic1, M. M. Thurnher1

1 Clinical Centre University Sarajevo; Bonnia Herzegovina; Medical University of Vienna; Austria

Purpose: Diffusion-weighted MR imaging (DWI) has been proven useful for vascular disorders, infections and evaluation of brain tumors. The aim of this study was to compare apparent diffusion coefficient (ADC) values of brain tumors measured on 1.5T and 3.0T.

Materials and Methods: Conventional MR sequences and DWI were performed at both 1.5T and 3T in 34 patients (18 women and 16 men, age range 9 to 75 years) suffering with brain tumors. Histological analysis revealed seven meningiomas, six glioblastomas, three astrocytoma G3, five astrocytoma G2, seven metastasis, one oligodendroglioma, three astrocytoma G2, seven metastasis, one oligodendroglioma, neurocytoma, choroid plexus papilloma, craniopharyngioma, lymphoma, and neurinoma, respectively. Three regions of interest (ROI) were placed in the solid tumor parts on ADC maps, and the mean ADC value was calculated for each tumor on 1.5 and 3.0 T.

Results: The mean ADC of meningioma was 0.88x10–3 mm2/sec on 1.5T and 0.90x10–3 mm2/sec on 3.0T; astrocytoma G2 1.4x10–3 mm2/sec on 1.5T and 3.0T; metastatic lesions 1.1x10–3 mm2/sec on 1.5T and 3.0T; meningioma 1.8x10–3 mm2/sec on 1.5T, and on 3.0T; choroid plexus papilloma 0.9x10–3 mm2/sec on 1.5T and 3.0T; of craniopharyngioma 1.8x10–3 mm2/sec on 1.5T and 3.0T; of lymphoma 1.8x10–3 mm2/sec on 1.5T and 3.0T; of neurinoma 0.89x10–3 mm2/sec on 1.5T and 3.0T; of some neurocytoma 0.79x10–3 mm2/sec on 1.5T and 3.0T. Statistical analysis showed good agreement p<0.849 (T=1157.000 Mann-Whitney Rank Sum Test) between measurements when comparing 1.5 and 3.0 T.

Conclusion: Despite a limited number of brain tumor cases in this study, the results of ADC measurements show good agreement between 1.5 T and 3.0 T MRI. Further studies with larger patient sample are necessary for more solid conclusions.

Figure 1 Axial T1-CE and FLAIR images of a patient with a meningioma.

Figure 2 Exemplary ROI placed in the CE-part of the meningioma shown in Figure 1. Mean values, for the ROI were calculated based on maps of T1, T2, MTR, Fand kf.

Table 1 MTR and quantitative MT parameter estimates for the contrast-enhancing area, the healthy appearing tissue for the different brain lesions investigated. Given are the mean and standard deviation (± SD).

<table>
<thead>
<tr>
<th>CE-partition</th>
<th>GBM</th>
<th>Meningiomas</th>
<th>Metastases</th>
<th>Edema</th>
<th>Meningiomas</th>
<th>Metastases</th>
<th>Healthy tissue</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1 [sec]</td>
<td>1.70±0.87</td>
<td>1.41±0.14</td>
<td>2.24±0.24</td>
<td>2.43±0.19</td>
<td>1.14±0.07</td>
<td>1.73±0.16</td>
<td>1.39±0.08</td>
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<tr>
<td>T2 [sec]</td>
<td>0.91±0.05</td>
<td>0.93±0.05</td>
<td>1.43±0.05</td>
<td>1.39±0.06</td>
<td>0.90±0.05</td>
<td>0.94±0.06</td>
<td>0.94±0.05</td>
</tr>
<tr>
<td>MTR [%]</td>
<td>35.0±4.0</td>
<td>33.5±1.1</td>
<td>32.7±1.9</td>
<td>31.5±1.9</td>
<td>31.2±1.9</td>
<td>31.5±1.9</td>
<td>31.2±1.9</td>
</tr>
<tr>
<td>kf [L/s]</td>
<td>0.6±0.1</td>
<td>0.6±0.1</td>
<td>0.6±0.1</td>
<td>0.6±0.1</td>
<td>0.6±0.1</td>
<td>0.6±0.1</td>
<td>0.6±0.1</td>
</tr>
<tr>
<td>F [%]</td>
<td>52.0±0.9</td>
<td>52.0±0.9</td>
<td>52.0±0.9</td>
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Palazzo della Cultura e dei Congressi - White Hall 2
Tuesday, 5 October - 14:30-17:45

COMMUNICATIONS

Management 1
Chairs: B. Gomez Anson, D. Goettmann
14:30-14:45
Introductory Lecture

Teleradiology in Neuroradiology: Present and Future

B. Gomez Anson 1, L. van den Hauwe 2, R. Jäger 3, C. Schorlemmer 4, Y. Vives 5
1 Neuroradiology, Hospital Santa Creu i Sant Pau; Barcelona, Spain; 2 Neuroradiology, Uniclab; Nymegen, Belgium; 3 National Hospital for Neurology and Neurosurgery; London, U.K.; 4 Telemedicineclinic.Com; Barcelona, Spain; 5 Píc. Iba, Universitat Autonoma; Barcelona, Spain

A debate session about Teleradiology specifically for Neuroradiology is proposed.

Aims: The main aim is to generate discussion about the current state of practice in the field worldwide, as well as what the future will or should be.

Challenges and opportunities for neuroradiologists, concerns about the profession, quality assurance issues, regulations at national and international levels, problems arising from this particular working environment, and fears, should be brought upon, and discussed. A variety of professionals coming from different fields, such as academic, tertiary referral hospitals, private teleradiology enterprises and managers at an international, world-wide level, and researchers from the academia and industry are suggested as main speakers, in order to estimate thoughts from the audience.

Structure: The structure that is being proposed is the following:
1. Brief Introduction.
2. Current state of dedicated Tele/Neuroradiology.
3. Opportunities/challenges for Neuroradiologists, and related issues.
5. Research/Development component related to Teleradiology in Neuroradiology.

Teleradiology in Neuroradiology - Considerations about and Implications for Quality of Service

D. Goettmann
Head & Neck Radiology; Stuttgart, Germany

Within the last years, there was an increasing need in radiologic diagnostic. On one hand, this was due to demographic changes in population not only in age but even more in the increase of elderly and old people. In special, people at the end of their working lifetime have increasing demands of health services. In parallel, are also increasing demands in quality of diagnostic and treatment. This is potentiated by developments in diagnostic and therapeutic possibilities. In the field of neuroradiology there are MRI sequences and new applications as e.g. DWI/DTI, perfusion imaging, MR spectroscopy.

In some regions of our continent these needs seem difficult to be satisfied locally. This applies to Northern European countries but also everywhere else where the population is low and the distances are far. Then, one possible solution was outsourcing of radiological diagnostic which became more and more feasible with overall technical improvements. But there are obstacles doing this. Because the reading radiologist is residing outside the scope of patient as well as clinician. Sometimes he does not get nor has the possibilities to get important clinical data. In result his report may requires at least full access to the clinical information system of the hospital.

Currently, two types of quality criteria seem to be applicable in Teleradiology. First, experience of the radiologist in terms of number of reports, either in her or his lifetime either per year. Obviously, the sole number of reports doesn’t say much about experience in special topics or quality. Second, double reading. Pushed as an instrument to gain sensitivity in screening examinations like mammography, it became clear to raise the rate of false positives only. This often leads to further examinations just to exclude an imaging finding. Furthermore, in specialized topics the problem of availability of resources increases because the double readers should have the same, at least a comparable level. Mixing this will merely lead to a teacher-student relation. These are unlikely to be sufficient criteria assuring quality in service. At least, no structured ones.

Thus, there should be other ways to accomplish quality assurance in consulting service. Some of those that are possible nowadays are:

1. Professional excellence in structured terms: Currently there are not much structured education programs in Europe. One not only continent-wide but also highly recognized are the European Courses in Neuroradiology. More specialized courses are in the phases of beginning, starting or just planning nowadays, unfortunately. The proposal should be not only to finish an ECNR cycle but also to continue repeating the individual courses in reasonable intervals.

2. Access to clinical data. Like consultants in business affairs, teleradiologists should have access to all data that could be of possible importance regarding their task. That requires at least full access to the clinical information system of the hospital. There should be possibilities for short communications with the clinicians in addition. In times of homeworking abilities for the clinic’s personnel this is more an administrative than technical problem.

3. Time. Seriously reading an examination regarding all available clinical aspects and up to date literature correlation needs a certain amount of time. Time costs money and has to be paid. The time neede for an examination will always be questionable and part of discussion. But in some European countries there are accepted data about allowed reading time for an examination. These where created by radiological societies and health care authorities and accepted by both. They should and can be taken for orientation for what is needed for an examination.

All of these named proposals have in common to be measurable, at least to an extent.

14:45-15:00

10’

Teleradiology in Neuroradiology - Considerations about and Implications for Quality of Service

D. Goettmann
Head & Neck Radiology; Stuttgart, Germany

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Exam Portability in Europe: First Steps of a Global Project

A. Fernandes, T. Baptista
Centro Hospitalar Lisboa Central;
Lisbon, Portugal

A truly global Radiology would exist when patients could visit any European physician without their CDs or films. It would be possible to any patient to go to a hospital or a clinic in any European country and have their exam (done in other country) analysed and eventually compared with the exam done at that hospital.

This possibility would improve efficacy in European Radiology and create a true network of images and knowledge that can be the seed to improve decision making systems, providing a “value-added framework” for clinicians.

Developing Outcome Prediction Models for Acute Intracerebral Hemorrhage Patients: Evaluation of a Support Vector Machine Based Method

A. Jakab, L. Lánecz, L. Csiba, I. Széli, E. Berényi
1 University of Debrecen, Medical and Health Science Center, Department of Biomedical Laboratory and Imaging Science; Debrecen, Hungary;
2 University of Debrecen, Medical and Health Science Center, Department of Neurology; Debrecen, Hungary

Background and Purpose: Hemorrhagic stroke or intracerebral hemorrhage (ICH) causes 6.5% to 19.6% of first-ever strokes with a 30-day mortality rate of approximately 45%; furthermore, almost half of the patients die within the first 48 hours. The first line imaging tool in the diagnosis of ICH is nonenhanced CT scan. It finely depicts blood therefore allows the measurement of an important prognostic marker: the volume of the hematoma. Many models exist that predict the poor clinical outcome of ICH, they vary in the case of use and complexity. Computer-based diagnostic support systems are increasingly used for that purpose as well. Supervised learning systems can evaluate relationships between complex databases and subtle functions like biological behaviour or clinical outcome. Objective data derived from radiological scans along with clinical and laboratory parameters provide a valuable source for such research. Support vector machines (SVM) are a collection of up-to-date methodologies that can be extensively used for classification. An SVM achieves that by constructing a multidimensional plane in the feature space (e.g. a space defined by clinical variables) to optimally separate the data into two categories. It’s a widely acknowledged fact that the outcome of ICH correlates with the size of the hematoma or the ventricular extension of the hemorrhage. Such volumetric variables can be determined by segmenting CT images. The purpose of the present study was to develop a model with SVM algorithms that uses data derived from image segmentation and clinical information; and to evaluate its accuracy of 30-day ICH mortality prediction.

Methods: Noneenhanced, CT scans and clinical data of 125 consecutive patients with spontaneous, non-traumatic intracerebral hemorrhages were analyzed retrospectively in this study. A semi-automatic image segmentation method was employed to measure the intraparenchymal and intraventricular components of the hemorrhages. Additionally, we defined a variable that assesses the degree of the pre-pontine cistern affacement. Volumetric variables were normalized to the intracranial volume. Model creation was carried out including all available clinical parameters and then using only the significant predictors of ICH mortality. To assess the feasibility of the SVM method, we compared the accuracy, specificity, sensitivity and AUC values with the results of logistic regression. Precision was measured with cross-validation and running the model on a separate testing sample.

Results: Prediction accuracy on the training sample was 100% for each model. The SVM model using all available clinical variables correctly predicted 93.6% of the test sample (cross validation: 93.6%, specificity: 85.7%, sensitivity: 100%, AUC: 0.954). Logistic regression was superior in specificity (92.8%) but presented lower accuracy during cross-validation (81.5%), lower sensitivity (82.4%) and lower AUC (0.938). After removing the less significant clinical predictors of ICH mortality, the results of SVM prediction were the following. Cross-validation accuracy: 81.45%, test accuracy 90.32%, specificity 92.86%, sensitivity 88.24%, AUC 0.903.

Discussion: We have quantitatively shown that segmentation of acute CT acquisitions provides useful data for outcome prediction. Computer-aided prediction using support vector machines seem to have a potential to improve decision making systems, providing a „value-added framework” for clinicians.

Comparison of Magnetic Resonance Imaging Findings with Complaints and Physical Examinations of the Patients

A. Arslanoglu, H. Celik
1 Beytepe Military Hospital Dept. of Radiology; Ankara, Turkey;
2 Yuksek Ihtisas Hastanesi Dept. of Neurosurgery; Kirikkale, Turkey

Purpose: In this prospective study, complaints, physical examination and magnetic resonance imaging (MRI) findings of patients were investigated.

Material and Methods: In present study, 50 male patients (average 26.6) with normal physical examination underwent MRI due to severe pain. Results: We detected significant changes on MRI for the patients who had no norological loss. The most pathological result was at the L4-5 level. Extruded disc herniations were found mostly. 35 patients advised for surgery, but only 13 patients accepted surgery. The other patients underwent medical therapy and physiotherapy.

Conclusion: Lumbar disc disease is very common clinical status. Anamnesis, physical examination and radiological investigation are are very important in the diagnosis of lumbar disc herniations. MRI is accepted gold standard for the lumbar disc herniation diagnoses. Patients with
Patient Records, Datamining and Best Practice - How Much Information Is Enough, and How Do We Get It?

P. Summers¹, P. Bijlenga², J. Byrne³, J. Macho⁴, S. Coley⁵, T. Sola⁶, T. Doçi⁷, J. Van Der Lei¹, D. Rufonach²
¹University of Oxford; United Kingdom; ²University Hospital of Geneva; Switzerland; ³Hospital Clinic I Provincial de Barcelona; Spain; ⁴University of Sheffield; United Kingdom; ⁵Hospital General de Catalunya; Barcelona, Spain; ⁶Medical School; Peja; Hungary; ⁷Erasmus Medical Centre; Rotterdam, The Netherlands; ⁸Hirslanden Klinik; Zurich, Switzerland

The @neurIST Project has developed and demonstrated a system that allows electronic clinical records from separate sites to be connected in a form of virtual database; an approach that may reduce costs and effort for inter-institutional research. We discuss issues identified in the course of the project that bear on this vision of future collaboration and research.

A first institutional obstacle to the project effort was the very digital systems available within the institutions, as manifested through:
- inaccessibility due to preexisting paper record transcription,
- hospitals without a unified strategy/managment structure for clinical records, resulting in disjoint record systems with different data structures,
- records systems without adequate access.

The first of these should diminish over time. The latter two need intervention by decision-makers aware of the needs to specify accessibility and adherence to standards such as DICOM, and HL7 for the records systems being adopted by their institutions.

A second institutional obstacle was reluctance by clinical centres to allow digital access to medical records of consenting patients by users outside their institutions. Most centres in the project, adopted the extraction of pseudonymized data for hosting in a hospital controlled “demilitarized zone” where secure access is allowed. Within a national health service research framework, such an intermediate step would not be necessary.

A survey of the points of information collected in the course of patient care from diagnosis through follow-up was made in a joint interventional neuroradiology and neurosurgical practice, to which were added suspected risk factors from the literature, recruitment and consent items. Over 950 items, forming a clinical reference information model were identified. Although recording data to preconceived forms is a universal source of frustration, and is considered by many to interfere with their care of the patient, most clinical centres in the project needed to resort to this approach in parallel to clinical care due to lack of access to the various intra-institutional data systems. Integrating data collection into the patient journey at one site made collection more manageable. Notably however, many pieces of clinical data are placed directly in a human-readable context in the form of reports. An ontology of terms related to intracranial aneurysms, developed in the course of the Project, is a key step towards the automated extraction of data items directly from free text clinical reports, without the need for human intervention.

Despite common training and use of a specifically developed data entry interface, differences were evident in data collection between clinical centres as well as between different types of centres, presenting difficulties when looking to compare outcomes. This leads to the question of which data to collect and how to use it. A Cochrane review of the literature identified twenty-four factors as having evidence in the literature of influencing the risk of subarachnoid haemorrhage in intracranial aneurysm. The risk factors have been incorporated into risk assessment software (@neuRisk). An anticipated development is to build into existing clinical practice workflows to provide new risk assessment, but connections to the relevant literature to aid in decision-making, and guidance on the data appropriate for the determination of each decision. This system requires a relatively brief but concerted effort from experts in aneurysm care to establish the decision points, and identify the working knowledge needed at each point. Taking this step would set an important point of reference for establishing best practice that can be applied throughout the community.

The role of haemo and morphodynamics in aneurysms has been slow to develop due in part to the expertise and extensive computing resources needed to carry out simulations. The @neuFuse software package now provides a software pipeline for performing these processes. Over 500 3D angiographic datasets have been acquired in the course of @neurIST and are undergoing analysis. The software and possible “cloud” computational facilities make simulation easier, but do not overcome the need for expert knowledge on performing and analysing such simulations, before their clinical relevance is realized.

The @neurIST project created a suite of software tools that could change the face of aneurysm research if adopted widely and coherently applied. Recruitment on a Europe-wide scale for one year would vastly outsize even the largest clinical studies in intracranial aneurysms to date. Moreover, with the clinical records as the basis of the database, costs for research nurses and record transcription could possibly be reduced. The ESNMT consortium has adopted the mission of propagating the @neurIST vision into the future.

Japanese Society of Neuro-Endovascular Therapy (JSNET) Specialist Qualification System Eight Years Examination Experience

T. Hyogo, W. Taki, JSNET SQC Board Members JSNET Specialist Qualification System Committee, Japan

Introduction: As the spread of interventional procedures or endovascular treatment, and increasing the numbers of the patients and procedures, a certain therapeutic level is required as a social request. The basic therapeutic level should be secured by the Society to avoid unnecessary complications which are caused by improper techniques and immature experiences.

Materials and Methods : Japanese Society of Neuro-Endovascular Therapy (JSNET) started preparation of specialist qualification system in 1997 and the first examination was done in 2002.

Results: Till 2009, now we have 560 specialists including 134 consulting specialists. Recent three years successful percentages were 70.4 % (2007), 57.7 % (2008) and 46.4 % (2009).

Discussion: Building up the system of education and training of the interventional and therapeutic neuro-radiology is necessary for the safety of the procedure and the safety of the patients. But we know it needs huge efforts and costs. Specialist certification or specialist examination system is one of the goals of these education and training. We JSNET set its goal first, and the training and the education have been following to the requirements of the examination. Re-registration system of specialty is also important to secure the constancy of the level of these treatments.
Conclusions: JSNET started the specialist qualification system first ever in interventional neuroradiology, and that has been seemed to be successful until now and at present. Now this system and the society are recognized socially in Japan and the introduction of new treatment is scheduled based on our society and this system. The JSNET will continue to refine the specialty system and aim to provide better IVNR treatment in Japan.

16.15-16.30 10'
Cost-Effectiveness in Endovascular Treatment of Wide Necked Aneurysms: A Comparison between Stent Assisted Coiling vs. Flow Diverter Stents
L. Lemme-Plaghos, W. Casagrande, S. Garbugino, D. Avataneo
Centro Endovascular Neurologico; Buenos Aires, Argentina

Objective: Wide necked brain aneurysms are currently treated either by stent assisted coiling or with the introduction of new devices. We report our initial experience comparing the cost-effectiveness between the two series of cases treated with each technique.

Methods: All patients included were registered in a prospectively maintained database. We assessed clinical history, indications for stent use, aneurysm dimensions, procedure technical details, degree of aneurysm neck occlusion, angiographic and clinical findings at follow-up, and complications.

First group of patients were treated with self expanding Neuroform3 (Boston Scientific, Boston, USA), a well known open cell stent which, deployed over the aneurysm neck, which pruduced from platinum coils migration after their detachment in the aneurysm sac. The second group of patients were treated using solely the Silk Stent (Balt Extrusion, Montmorency, France) which is a nitinol, flexible, specifically designed with microcell, self-expanding device, available in Argentina since mid-2008. Patients continued three month antiplatelet medication and follow-up angiogram was performed at the fourth and twelfth. For the purpose of this report’s analysis it was considered as final results those observed after a one year complete follow-up which included a 3 and 12 month follow up angiogram. For the purpose of cost analysis a conventional stent assisted coiling was considered as one “embolization unit” which included one Neuroform3 stent device as well as 12.6 coils of bare platinum coils (media of number of coils used per procedure observed in the cases treated in this series).

Results: Both groups consisted in consecutive cases of patients with wide necked (more than 4 mm) large (from 10 to 20 mm) aneurysms, treated after 2008 and completely followed up. Stent and coils group included 13 patients while Silk flow diverter group included ten cases. First group required of 18 procedures since a second embolization was performed in five cases due to coil compaction observed in their 3 month follow up angiogram. Second group required only one Silk deployment procedure per case. Stent and coils cases group showed complete occlusion (grade A ISAT) of the aneurysm in 7 (53%) patients and neck remnant (grade B ISAT) in 2 (15%) while flow diverter group showed 7 (70%) complete occlusions and 2 (20%) subtotal occlusion. Two (15%) of the stent and coil cases presented with intra operative stent occlusion with no permanent deficit while three (30%) flow diverters presented with intra procedural occlusion with recanalization after ReoPro administration and no permanent morbidity.

Cost analysis showed that stent and coils treatment due to second embolization procedures demanded 1.29 embolization units while flow diverter cases although using a more expensive device than the conventional stent but not using coils and not needing second procedures kept a 1.35 embolization units cost.

Conclusion: The Silk flow diverter stent is a new device that allows appropriate embolization of wide necked large cerebral aneurysms with better result than stent assisted coiling therapy while having a slightly higher procedure cost. Anyhow more experience and longer term follow-up are required to establish final occlusion rates and evolution of stented aneurysms with this devices.

Contrast Media 1

Chairs: E.M. Larsson, B.G. Ziedes des Plantes
16.30-16.45 10'
Preliminary Experience with Gadobenate Dimeglumine for High-Resolution Steady State MR Angiography of the Carotid Arteries
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1 University of Rome - La Sapienza; Rome, Italy; 2 Bracco Imaging SPA, Milan, Italy

Background: First-pass (FP) contrast-enhanced magnetic resonance angiography (CE-MRA) is accurate for detection of significant (70-99%) symptomatic stenosis of the carotid arteries. Although dedicated intravascular “blood pool” contrast agents permit acquisition of additional higher-resolution steady state (SS) images during the equilibrium phase of contrast circulation, such agents are relatively costly and have limited clinical applicability beyond vascular imaging.

We report our preliminary experience comparing gadobenate dimeglumine (Gado-Dakin®; Bracco Imaging SpA, Italy) to other conventional FP gadolinium contrast agents in terms of pharmacokinetics and safety; however, due to its unique chelate structure, it interacts weakly and transiently with serum proteins, resulting in increased relaxivity in blood. Gadobenate dimeglumine has been shown to be well-suited for CE-MRA, with a diagnostic performance comparable to that of digital subtraction angiography (DSA) for detection of clinically-relevant carotid artery stenosis. Here, we prospectively evaluate the potential of gadobenate dimeglumine for high-resolution SS CE-MRA of the carotid arteries as an adjunct to conventional FP MRA, with computed tomography angiography (CTA) and DSA as reference standards.

Materials and Methods: Forty consecutive carotid arteries of 20 patients underwent conventional FP MRA with 15 mL gadobenate dimeglumine (0.1 mmol/kg bodyweight for a 75 kg person) using a conventional 3D FLASH sequence (TR 3.5 msec, TE 1.2 msec, FA 30, slice thickness 0.7 mm, matrix 384 x 384, acquisition time 14 seconds).

Immediately afterwards, SS images were obtained using a high-resolution coronal 3D FLASH sequence (TR 7.5 msec, TE 2.3 msec, FA 30, slice thickness 0.7 mm, matrix 512 x 512, acquisition time 240 seconds). All patients also underwent CTA and conventional DSA within 8±3 days. Three experienced radiologists assessed FP and SS image quality, and calculated sensitivity, specificity, accuracy, and positive and negative predictive values for stenosis grade and length, plaque morphology, and tandem lesions, using DSA as the reference standard. Interobserver agreements were quantified and compared.
The Neuroradiology Journal 23 (Suppl. 1): 149-155, 2010

formation that is comparable to that can provide additional diagnostic in-
mediately after routine FP imaging.

The inclusion of an additional gadobenate dimeglumine is feasible.

Increased diagnostic confidence was achieved on SS imaging. While an im-
resolution achievable on SS imaging.

Superior accuracy was apparent for combined FP+SS MRA compared to the combined FP+SS MRA reading.

Conversely, three cases were judged as moderate (grade III) of severe (grade IV) stenosis at DSA during the FP MRA reading compared to the combined FP+SS MRA reading and the CTA for the grading of stenoses, with accuracy values of 97.4%, 97.5%, and 98.7%, respectively. Overestimation of a moderate (grade III) stenosis on DSA as severe (grade IV) occurred in one case on FP MRA images and in two cases each during the combined FP+SS MRA reading and the CTA reading. Conversely, three cases of severe (grade IV) stenosis at DSA were judged as moderate (grade III) during the FP MRA reading compared with only two cases of severe (grade IV) stenosis at SS imaging. Superior accuracy was apparent for combined FP+SS MRA compared to FP MRA for both the evaluation of plaque morphology (94.5% vs 83.8%) and the depiction of ulcers (97.4% vs 87.2%), reflecting the higher spatial resolution achievable on SS imaging. Increased diagnostic confidence was noted for 49 (61.3%) vessels due to additional SS images, while an impact on final diagnosis was noted in 8 (10%) cases. Good correlation was obtained between SS image quality and impact on final diagnosis (R² = 0.7; p<0.0001).

Conclusion: High-resolution SS imaging of the carotid arteries with gadobenate dimeglumine is feasible. The inclusion of an additional 4 minute SS imaging sequence immediately after routine FP imaging can provide additional diagnostic information that is comparable to that available on CTA and DSA.

Pharmacokinetics and Safety of Gadobenate Dimeglumine (Multihance®) in Patients from 2 to 5 Years of Age Undergoing Clinically Indicated MRI of the CNS

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Purpose: To assess blood pharmacokinetics and safety of gadobenate dimeglumine in 2-5-year-old patients.

Materials and Methods: A single-center, open-label pharmacokinetic study enrolled 15 subjects (7 males, 8 females; mean age: 3.53 years [range 2 to 5.1 years]; mean weight 16.6 kg [range 11 to 22 kg]). All subjects had at least one medical abnormality reported at enrollment. Each patient received one gadobenate dimeglumine as a single intravenous injection of 0.1 mmol/kg body weight at a rate not exceeding 2 mL/sec followed by a saline flush. All subjects received thiopental sodium or propofol for sedation before the MR exam. Blood samples (1 mL) were drawn within 1 h predose, 5 min, 10 min (pre-MRI), 30 min, 1 h, 2 h, and 6 h postdose (post MRI). Cumulative urine collection began from the time of administration of gadobenate dimeglumine up to 24 hours postdose. Blood and urine samples were analyzed for gadolinium (Gd) using inductively coupled plasma-atomic emission spectroscopy (ICP AES). Adverse events were monitored from the time informed consent was obtained through 72 h postdose. Physical examinations were performed predose and 24 h postdose. Vital signs and ECGs were acquired within 1 hour predose; again before sedation/anesthesia; and then again at 1, 2, and 24 h postdose.

Blood and urine samples for clinical laboratory investigations were collected predose and at 24 h postdose. The pharmacokinetic parameters were calculated from the blood Gd concentration-time data using compartmental and non-compartmental techniques. Pharmacokinetic parameters were summarized using descriptive statistics (mean + SD, median, range). Diastolic and systolic blood pressure was summarized using descriptive statistics (mean + SD, median, range). Data were summarized for the whole population, as well as for subgroups by age (2 to 3 years; 3 to 4 years; and 4 to 5 years) and sex.

Results: For the Gd assay, all predose blood samples were below the level of detection (0.341 mcg Gd/mL). The peak Gd concentration (range: 50.3 to 2.1 mcg Gd/mL) was observed immediately after completion of contrast injection. After reaching peak concentrations, Gd blood levels dropped rapidly during the next 30-60 minutes, followed by a slower rate of decline. At the last scheduled sampling time (6 hours), the residual Gd in the blood of all subjects was close to 1.0 mcg Gd/mL, indicating that Gd was successfully cleared from the blood by 6 hours postdose. The mean estimated elimination or terminal half-life was 1.2 hours. The concentration profiles by age group or gender were superimposable. No pharmacokinetic parameters were consistent whether determined by noncompartmental or compartmental analyses. Some subjects had incomplete urine collection because of diaper usage or difficulty with compliance of very young patients during the urine collection period; nonetheless, approximately 81% of the dose of Gd was recovered from urine within 24 hours. Four adverse events were reported for 2 (13.3%) subjects. All events were mild in intensity and unrelated to gadobenate dimeglumine administration. Abdominal pain, vomiting, and partial seizures were each reported by 1 subject (6.7%). The abdominal pain was considered related to the placement of a urinary catheter, the vomiting was considered related to the sedation, and the complex partial seizures were considered related to the subject’s underlying neurological condition. No clinically meaningful differences were observed at any time point between predose and postdose changes for any vital signs, ECG parameters, and laboratory tests.

Conclusions: Administration of gadobenate dimeglumine was well tolerated in pediatric subjects undergoing MRI procedures. No differences in whole blood or urinary pharmacokinetic parameters were observed between pediatric subjects 2 to 5 years of age when compared to adult subjects studied previously. Adjustment of gadobenate dimeglumine dosage for pharmacokinetic or safety reasons does not appear to be necessary for pediatric subjects.
Contrast-Enhanced Carotid MRA in the NSF Era: Possible Contrast Dose Reduction with a High Relaxivity Contrast Agent

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Purpose: Higher doses of gadolinium-based contrast agents (GBCA) are often used for contrast-enhanced MRA (CE-MRA). Patients with moderate-to-severe (stages 3-5) chronic kidney disease undergoing contrast-enhanced MR imaging are known to be at increased risk for developing nephrogenic systemic fibrosis, particularly with higher doses or repeated exposure to GBCA. Herein we review information on the application of lower doses of the higher-relaxivity contrast agent gadobenate dimeglumine (MultiHance; Gd-BOPTA) for CE-MRA of the carotid arteries.

Methods and Materials: A total of 24 subjects were studied in 2 intraindividual crossover studies comparing gadobenate dimeglumine (Gd-BOPTA) to a conventional contrast agent, gadopentetate dimeglumine (Gd-DTPA) for CE-MRA. In 1 study, equal 0.1 mmol/kg doses of Gd-BOPTA and gadopentetate dimeglumine (Gd-DTPA) were compared. In the other study, 0.1 mmol/kg Gd-BOPTA was compared to 0.2 mmol/kg Gd-DTPA.

Results: In the study in which a single dose of Gd-BOPTA was compared with a single dose of Gd-DTPA, the use of Gd-BOPTA resulted in statistically significant improvements in signal intensity (SI) and signal-to-noise ratio (SNR). In the study in which a single dose of Gd-BOPTA was compared with a double dose of Gd-DTPA, Gd-BOPTA resulted in significantly greater increases in SI and SNR than the comparator despite the lower administered dose.

Conclusion: Intraindividual CE-MRA studies of the carotid arteries demonstrate that the higher-relaxity Gd-BOPTA may be used at lower dose without compromise of diagnostic efficacy, potentially limiting patient exposure to GBCA.
nation showed bilateral hearing loss, left upper limb plegia with atrophy of muscle mass, spastic paraparesis with pyramidal signs and gait ataxia. The analytical/genetic study was consistent with hereditary hemochromatosis. The imaging study showed, in addition to typical findings of siderosis (MRI), an aneurysm of the internal carotid artery (Angio-CT and Angiography) and C6-D1 pseudomeningocele (MRI).

**Conclusion:** Although rare, it is an entity we should be aware, mainly in the imaging study in patients with deafness or ataxia and in those with lesions of the brachial plexus. The imaging signals are subtle and can easily go unrecognized. The radiological investigation must be extensive to find the primary cause.
The Dehydrated or Dark Disk: Imaging Features and Morphological, Biochemical and Biomechanical Features

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MR imaging of the lumbar spine often is requested to identify the cause of back or radicular pain. Official reports of lumbar spine images tend to focus on changes in the disk margin that may cause nerve root compression. The potential role of the dark disk, in back pain has not been adequately emphasized. The purpose of this review is to discuss the dark disk that has not produced nerve root compression. The goal is to suggest the clinical significance of finding a dark disk on an MR image. Correlations of MR images with anatomic studies in cadaveric lumbar spines show that dark disks invariably have a radial tear in the annulus fibrosus. The radial tear may be evident as a “high intensity zone” or a linear region of contrast enhancement or may not be evident on the MR study. The tear involves all layers of the annulus fibrosus. Discography in dark disks invariably shows leak of contrast medium from the nucleus pulposus into the epidural space, confirming the presence of a radial tear. At least 20 studies have been published documenting this point. Furthermore, concordant pain results from the injection of dark disks, in most patients selected for discography. The radial tear that characterizes the dark disk should not be confused with a concentric tear, which is an accumulation of fluid between adjacent lamellae of the annulus fibrosus, or a transverse tear which is a focal avulsion of fibers in the annulus fibrosus from the ring apophysis. Concentric and/or transverse tears may co-exist with the radial tear, as incidental findings. These two types of tears, unlike the radial tear, have no role in the pathogenesis of disk degeneration. All dark disks, having a radial tear of the annulus fibrosus, are subject to “healing by second intention,” which is the ingrowth of granulation tissue into the disk. Granulation tissue contains nerve endings, converting the intervertebral disk from a non-innervated structure to one with innervation. If the nerve endings are nociceptors, pain may result, which can be non-specific low back pain or pain in the distribution of the nerve that supplies nerve endings to the granulation tissue, with the result that pain may be experienced by the patient referred to a lower extremity, simulating the radicular pain resulting from nerve root compression. Chemically, dark disks differ from normal disks. Water content is diminished in these disks. The decreased water content reflect a diminished glycosaminoglycans concentration in the disk. Biomechanically, dark disks differ from normal disks. The loss of integrity, (in mechanical terms “failure”) of collagen fibers in the annulus fibrosus results in abnormal responses to force and torsion. Biomechanical studies show that dark disks have diminished stiffness, especially to axial rotatory torques, compared to normal disks. Therefore the application of a torque to the spine produces more rotation at the level of a dark disk than at other levels. Consequently, neural foramina may narrow critically as the subject with the dark disk moves the torso within a normal range of motions. The intermittent “occur lateral stenosis” may cause injury nerve in the neural foramen, a potential mechanism for chronic pain. Additionally, motions of the torso cause increased stresses in intervertebral ligaments at levels with a failed disk, also potentially causing pain. Dark disks differ from normal disks in their gross morphology, water and biochemical makeup, biomechanical properties and of course imaging features. A dark disk, without evidence of disk herniation or bulging may be a cause of back pain or radicular-like pain. The finding of a dark disk in an MR image of a patient with back pain is therefore a clinically significant finding. Dark disks are found in asymptomatic persons as well. Dark disk must be considered in the search for potential cause low back or radicular pain.
MR myelography: In T2-weighted MR images the spinal cord and nerve roots are well-depicted as dark structures within the bright water signal from the CSF. When sectional CT or MR imaging techniques are applied to assessment of nerve root compression, the course of the nerve root is difficult to follow from one section to another. Ideally, the nerve roots should be presented as a 3D image instead of a series of sections: MR myelography. Heavy T2-weighting producing a bright CSF signal can be achieved using a fast spin echo (FSE) long-TE/long-TE (6500/1270msec) sequence to maximise the water signal of the CSF. The dural sac, intradural nerve roots and extradural root sleeves are well depicted by this combination, while bony and ligamentous extradural spinal structures remain invisible. The field of view (FOV) is relatively small (150mm) to increase spatial resolution: this provides sufficient anatomic coverage to depict the nerve roots departing at the lowest three lumbar levels while signal-to-noise (SNR) remains good. Left and right oblique multislice sets of overcontiguous 4mm sections, are acquired in the plane of the emerging nerve roots, and these sets are fused by maximum intensity projection (MIP) technique. The resulting set produces a 3D image of the dural sac in which nerve roots and root sleeves can be easily followed and compared to similar contralateral structures. In high-field MRI systems the anatomic resolution of dural and intradural structures achieved by this technique is equivalent to conventional X-ray myelography. The disadvantage of the multi-slice multi-shot technique described above however, is its relatively long acquisition time of 6:30 mins per oblique projection; 15mins for the two-projection myelographic study. The acquisition speed of a myelographic sequence can be improved by employing a single-shot FSE technique. If the echo train length is increased to equal the number of acquired profiles, a heavily T2-weighted single shot image is produced after only a single excitation. The quality of such a single-shot image is poor however, therefore the acquisition is repeated a number of times (e.g. 5) to improve SNR. A single 30mm slab is acquired encompassing the entire dural end-sac and root sleeves. This multi-excitation single-shot single-slab acquisition produces an MR myelographic image quality equivalent to the multislice multi-shot technique, but with an acquisition time of only about 30-60sec (depending on the MRI system) per projection instead of the 6:30min formerly necessary.

Conclusions: MR myelography is a useful adjunct to the lumbar spinal MRI examination in patients with suspected radicular compression when the standard MR images demonstrate a herniated disc which may or may not be compressing a nerve root. The presentation of a 3D image of the dural sac, nerve root and root sleeve allows a better assessment of the state of the root and an easier comparison with adjacent and contralateral roots and root sleeves, compared to sectional images. MR myelography is an adjunct to the standard spinal MR examination however, and can never replace it. The MR myelographic picture should always be carefully matched against the standard MR images for optimal results, but valuable ancillary diagnostic information is provided. In view of its acquisition time of only 1-2 minutes an MR myelographic study should be incorporated in the standard lumbar spinal MRI examination.

The Axial Loaded Imaging of the Lumbar Spine 18 Years After. Is It Still A Valuable Examination?
R. Cartolari
UOD Neuroradiologia - Ospedale Belcolle, Viterbo, Italy

Introduction: A retrospective evaluation of Axial Loaded - Computed Tomography (AL-CT) and Axial Loaded - Magnetic Risonance (AL-MR) has been made after 18 years experience in Our Institute.

Material and Methods: More than 12,000 Patients have been evaluated both with AL-CT and AL-MR from 1992. Of these Patients more than 30% of the Patient underwent post-op study of the spine (24-72) whose MRI examinations were successfully carried out in 75 subjects (41 M; mean age 47 y/o; range: 15-80 ). The MR scanner (G-Scan, ESAOTE, Genova, Italy) used in this study is a low field (0.24 T) fully tilting open MR scanner device (0-90°; 2° steps) unlike other similar equipment the entire scanning protocol includes Fast Spin-echo sequences in axial and sagittal planes (slice thickness 3-5 mm, slice gap 0.5mm). Standing scanning is performed 5-10° off the vertical line to improve patient stability. The image quality was rated good in all normal subjects. The quantitative and computed assessment of lumbar spine and morphometric data with dedicated software was performed in 15 patients (9M; mean age 44.4 y/o; range 24-72) whose MRI examinations were free of motion artefacts. The spinal canal volume, lordosis angle, foramina cross-area, vertebral wedging, listhesis index, vertebral collapse index, intervertebral translations and intervertebral angle for each pair of somites from L1-L2 to L4-L5 were calculated and measured for each image set in both upright and recumbent position. Statistical analysis comparing the results obtained was performed.
Using the Wilcoxon test (nonparametric test for paired data; \( p = 0.05 \)).

**Results:** Our data showed a reduction in the volume of the spinal canal in 80% (12/15) of patients examined with a statistically significant difference \( (p = 0.041) \) in upright standing position compared with the recumbent position as well as an increase in the lordosis angle in 86.7% (13/15) of patients examined with a statistically significant difference \( (p = 0.001) \) and a decrease in the foraminal cross-area in 77.3% (116/150) of all the foramina examined with a statistically significant difference for all of conjugation foramina examined \( (p \text{ range 0.001-0.031}) \).

**Conclusions:** Dynamic MRI imaging of the lumbar spine allows to evaluate and study the physiological and pathological changes that occur in the transition from recumbent to the upright standing position. To build on the comparative studies published so far in the literature, our study was aimed at a quantitative analysis of dynamic changes of morphometric parameters of the lumbar spine in the supine vs. upright position and through the application of an original dedicated software. Large cohorts of patients will have to be studied to verify the potential value of a lumbar spine geometric approach in a clinical context.

**15.30-15.45**

**Magnetic Resonance Imaging of Spondylolysis and Spondylolisthesis**

P. Niggemann, J. Kuchta, H. Beyer, D. Grosskutsch, Ks Delank

**Purpose:** Spondylolysis and isthmic spondylolisthesis are common multi-factorial disorders with a high prevalence. A familiar predisposition is known. Even though many patients never get symptomatic throughout their life, irradiating low back pain or radicular symptoms are common. The extent of the slip of the spondylolytic vertebra and an associated instability is considered a major predictor for prognosis and further follow-up. Verterbral hypoplasia is a common finding associated to spondylolysis. The purpose of this study is to evaluate the incidence of hypoplastic vertebral bodies in patients with spondylolysis and in the general population and to analyse the impact of the findings on osteology, measurement, and grading of spondylolysis.

Furthermore, the incidence of three different types of instabilities found using positional Magnetic resonance imaging (MRI) in patients with spondylolysis is investigated. Clinical findings are correlated with imaging findings, and the imaging findings are analysed with regards to their clinical implications.

**Material and Methods:** 140 patients with 141 levels of spondylolysis identified by MRI were included in this study. A complete clinical history was obtained in all patients. Based on the clinical findings the patients were classified as presenting with either radicular or non-radicular symptoms. The slip of the spondylolytic vertebral body and the size in the midline sagittal image were measured and correlated. The patients were graded after the Meyerding classification. Taking into account the hypoplasia of the vertebral body, the shortening of the hypoplastic vertebral body in the sagittal plane was subtracted from the total slip and the patients were graded again after the Meyerding classification. In addition, a control group of 700 patients without spondylolysis was evaluated to test the hypothesis that shortened, hypoplastic vertebral bodies can also be found in the general population. In patients with spondylolysis or isthmic spondylolisthesis, using positional MRI, the instability of the slip, an increased angular movement and a movement in the spondylolytic cleft were assessed. The incidence of the instabilities was recorded and correlated with the incidence of radicular symptoms.

**Results:** Shortened, hypoplastic vertebral bodies were found in 50 patients with spondylolysis (35 %) and only found in four patients in the control group (0.1%). These shortened vertebrae mimicked spondylolisthesis. In 19 patients with a hypoplastic vertebra in the group of patients with spondylolysis and spondylolisthesis, the slip equalled the shortening, thus mimicking spondylolisthesis although only spondylolysis was present. The grade after Meyerding changed in 33 patients out of the 50 patients with spondylolysis and isthmic spondylolisthesis, when taking into account the sagittal shortening. Using positional MRI, the following pathological movements were found: Fifteen patients with spondylolysis and isthmic spondylolisthesis had an unstable slip (anterior instability), 35 an increased angular movement (angular instability) and 34 a movement in the spondolytic cleft (posterior instability). All forms of instability could be found together. No instability at all was found in 76 patients. Radicular symptoms were found significantly more often in patients with one or more of the described instabilities compared with patients without instability.

**Conclusion:** Sagittal shortening of the spondylolytic vertebra is common in patients with spondylolysis or isthmic spondylolisthesis and may mimic spondylolisthesis. However, it is not an exclusive finding and can be found in the general population, too. Since the incidence in the general population is low, it may still be considered a hall-mark of spondylolysis or isthmic spondylolisthesis. The presence of vertebral hypoplasia in the general population suggests that it may be an inborn variant predisposing to spondylolysis rather than an acquired condition due to spondylolysis.

In order to define and measure spondylolisthesis sagittal shortening of the spondylolytic vertebra has to be taken into account and the Meyerding classification should be adjusted accordingly. All three described forms of instability are common in patient with spondylolysis or isthmic spondylolisthesis and associated with radicular pain. This finding stresses the value of positional MRI in the evaluation of patients with spondylolysis and isthmic spondylolisthesis, especially if radicular symptoms are present.

**15.45-16.00**

**Evaluating Marrow Signal Intensity: Comparison of T1 FLAIR and T1 FSE Images**

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**Objective:** At most institutions, T1 FLAIR sequences have replaced T1 FSE images in routine MR imaging of the spine. T1 FLAIR better delineates soft tissue, CSF, disc, and bone interfaces, compared to T1 FSE. The purpose of this study was to determine if there is a difference in marrow signal intensity on T1 FLAIR sequences vs T1 FSE images, and if so, whether the difference is specific to a particular age group.

**Materials and Methods:** We reviewed the studies of 217 patients who had a lumbar spine MR at our institution over a three-month period. Patients were excluded if they had predisposing medical conditions that could affect normal marrow signal intensity, such as HIV disease, multiple myeloma, metastatic disease, severe degenerative disease and renal failure. Patients > 75 years of age and those with significant surgical hardware were also excluded. After excluding all such individuals, 93 patients were included in the study.
A midline sagittal T1 FLAIR and T1 FSE image from each MR exam were compared by three board certified radiologists with > 5 years of MR experience. The reviewers compared the images and rated the marrow darker on one of the sequences, or equal on both. There were three ratings per image for a total of 270 ratings.

Results: In patients 0-30 years of age, the signal intensity of the marrow was rated lower on T1 FLAIR images in >60% of cases. In the 31-40 age group, the signal intensity was rated lower on T1 FLAIR images in >60% of cases. In the 41-50 age group, the signal intensity of the marrow was rated lower on T1 FLAIR images in >70% of cases. In the 51-60 age group the signal intensity of the marrow was lower on T1 FLAIR images in >50% of cases. In the 61-75 age group, the marrow signal was lower on T1 FLAIR images in >60% of cases. Differences among age groups was not significant, in particular when comparing young adults (0-30), adults in middle age (31-60) and those older than 60 (60-75). Across all age groups, the marrow signal intensity was lower on T1 FLAIR images in 61%.

Conclusion: Marrow signal intensity on T1 FLAIR images may appear abnormal in normal individuals. It is important to recognize this difference, in order to prevent misdiagnoses and unnecessary additional testing.

16.00-16.15 10’
MR Findings of Seronegative Spondyloarthritis, Fat Saturation Sequences and Contrast Medium
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Seronegative spondyloarthritis is a general term for a group of inflammatory diseases of the spinal joints that are not associated with rheumatoid factors. Five subgroups of spondyloarthritides are distinguished: ankylosing spondylitis, psoriatic spondyloarthritides, reactive spondyloarthritis, spondylitis associated with inflammatory bowel disease and undifferentiated spondyloarthritis. These conditions may have overlapping symptoms and subtypes are distinguished on the basis of the patient’s history and clinical findings. Between 2005 and 2009, we examined 200 patients affected by spondyloarthritis (age range 12-78 years). In all cases, MR diagnosis of seronegative spondyloarthritis was supported or confirmed by rheumatologists (40% of the patients did not know to be affected by rheumatic disease). We used an MRI machine of 1.5 Tesla. We used a MRI protocol that included T2-weighted sequences with fat saturation and T1-weighted sequences with fat saturation after intravenous contrast medium administration. We evaluated inflammatory changes of both anterior and posterior spinal joints (spondylitis, costovertebral osteoarthrosis, facet joint osteoarthrosis, sacroiliitis, inflammatory ligamentous changes). MRI can be considered the imaging modality of choice for early diagnosis of spondyloarthritis. In our experience, T2-weighted sequences with fat saturation and T1-weighted sequences after contrast medium administration provide better visualization and definition of inflammatory changes of the spine joints. Moreover, MR examination is useful in therapeutic monitoring of the patients.

16.15-16.30 10’
Extra-Spinal Cord Pyogenic Infections: Neuroimaging Findings in Four Spinal Epidural Abscesses and One Subdural Empyema
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1 Hospital Fernando Fonseca, Neurology Division; Lisboa, Portugal; 2 Children’s Hospital of Pittsburgh, Department of Pediatric Radiology; Pittsburgh, USA; 3 Hospital Fernando Fonseca, Department of Neurology; Lisboa, Portugal; 4 Hospital Egas Moniz, Department of Neurosurgery; Lisboa, Portugal

Background: Spinal epidural abscesses (SEA) and spinal subdural empyema (SSE) are rare conditions that can be fatal if left untreated. SEA is defined as an inflammation that involves a collection of pus between the dura mater and the vertebrae. SSE is a collection of pus extending about the subdural space between the dura mater and the arachnoid. Risk factors for SEA and SSE include immunocompromised states such as diabetes mellitus, alcoholism, cancer, and acquired immunodeficiency syndrome, spinal trauma, as well as spinal procedures including discography, epidural anesthesia and spinal surgery. SEA has been reported in patients with no predisposing risk factors. Hematogenous spread from a distant focus is the most common route of infection for SSE. The signs and symptoms of spinal epidural abscess and spinal subdural empyema are non-specific. Symptoms can range from back pain to sepsis and include fever, radiculopathy and neurological deficits that vary according to the spinal level of the lesion. Frequently, diagnosis of SEA or SSE is understandably delayed because the initial presentation may be only back pain. The most common causative organism in spinal epidural abscess and spinal subdural empyema is Staphylococcus aureus. Nonsurgical treatment may be appropriate in selected patients.

Methods: We hereby describe neuroimaging findings in four patients affected by SEA (3 males, 1 female, average age of 68 years) and in one patient affected by SSE (54 years old female). Clinical presentation of the SEA cases was cervical pain and neurological deficits (unilateral superior limb weakness, tetraparesis and paraparesis) without fever. SSE clinical presentation was low back pain, fever and paraparesis. The diagnostic modality used for studying all the cases was MR imaging because of the presence of neurological symptoms. The MR protocol used included sagittal and axial T1 and T2 weighted images (WI) with gadolinium and sagittal T2 WI with fat-saturation. For the SSE it was also performed gadolinium-enhanced sagittal T1 WI with fat-suppression.

Discussion: In our casuistry the most common presentation was spinal pain. Three of the epidural abscesses were located on the cervical spine and the other on the dorsal spine. Three of the SEA patients involved the anterior epidural space and one the lateral and posterior epidural space. The main MRI aspects of the SEA was presence of an epidural mass iso-hypointense to cord in T1WI, hyperintense in T2WI and with peripheral Gad-enhancing necrotic abscesses. For the SSE the MRI findings included effaced CSF and intermediate signal intensity in T1 WI, hyperintensity on T2 WI with mass effect on the cord and gadolinium-enhanced rim-enhancing fluid collection on T1WI. The subdural lesion can extend in the potential space-subdural space-in the more longitudinal fashion. Epidural abscess is more localized and may extend along the neuroforamina to the paravertebral and paravertebral regions. The most common infection detected was Staphylococcus aureus (2 SEA, 1 SSE). In two of the SEA patients no agent was identified. On the SEA group patients, one patient was diabetic, other had a spinal osteomyelitis and discitis and two had no risk factors. The SSE patient was also diabetic. The SEA patients underwent surgical drainage with sustained intravenous antibiotic treatment. The SSE patient was treated with antibiotics.

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Spine 2

Chair: V. Haughton, K. Murphy
16.30-16.45

Clinico-Radiological Profile of Spinal Cord Multiple Sclerosis
G. Roberson, A. Bag, B. Patel
University of Alabama at Birmingham; AL, USA

Objective: MRI examination of spinal cord, particularly cervical spinal cord, is used to demonstrate dissemination of multiple sclerosis (MS) in space. Cervical spinal cord is most commonly involved in multiple sclerosis. This paper is to evaluate the radiologic pattern of spinal cord involvement in MS and to find out whether lesion location has any correlation with symptoms and type of MS.

Methods: We retrospectively evaluated 723 patients with radiological diagnosis of spinal cord MS or demyelinating diseases. From this patient population, only 166 patients with clinical diagnosis of MS were included. MRI of cervical spinal cord was obtained in all the patients. MRI of thoracic cord and conus were obtained in patients with related symptoms. MRI protocol involved sagittal and axial T2 weighted fast spin echo sequence and sagittal short tau inversion recovery (STIR) sequences. Axial and sagittal T1 weighted spin echo sequence before and after administration of gadolinium based contrast were also obtained. Following parameters were obtained from the MRI: number of plaques in each patient; location of the plaques; length of the longest plaques. Clinical assessment for each patients included age, sex, clinical presentations and pattern of disease progression in time.

Results: The male to female ratio was 1:2:9. Age of the patients ranged from 17 to 75. Expectedly the disease was more prevalent in Caucasian than African-Americans (1.84:1). MS plaques were found in 158 of 166 patients (95.18%). Total 340 lesions were identified. Of these 166 patients, 119 (71.68%) had relapsing remitting course, 40 (24.09%) had secondary progressive course and 7 (4.21%) had neuromyelitis optica. 71 (42.77%) patients presented with sensory symptoms (paresthesia, numbness and tingling, chronic pain), 63 (37.95%) patients had objective weakness of extremities, 36 (21.68%) had gait abnormality, 21 (12.65%) had bowel and bladder dysfunction and 5 (3.01%) had Lhermitte’s symptoms. 21 (12.65%) patients did not have any spinal cord related symptoms.

Total 340 lesions were found. 158 (46.47%) of them were dorsal, 95 (27.94%) ventral, 76 (22.35%) central, and 11 (3.23%) diffuse. Distribution in the spinal canal was provided in bar diagram (Fig 1).

The average length of the longest plaque was 18.2 mm, range was 105 (3 mm -108mm). Only 15 of the 340 lesions showed enhancement with contrast. All patients who presented with gait abnormality had dorsally located MS plaques. There was no correlation between lesion location and other clinical presentations.

Conclusion: Sensory symptoms were most prevalent. Most of the MS plaques were located dorsally and at C2-C3 segments of the spinal cord. Other than the gait abnormality, there was no correlation between the lesion location and clinical presentation.

16.45-17.00

Spinal Cord MR in Multiple Sclerosis and Other Idiopathic Demyelinating Diseases
A. Rovira, C. Auger
Hospital Vall d’Hebron; Barcelona, Spain

The spinal cord is commonly affected in multiple sclerosis (MS) and other idiopathic inflammatory demyelinating diseases, such as acute demyelinating encephalomyelitis and neuromyelitis optica. The prevalence of cord abnormalities is as high as 74% to 85% in established MS. In clinically isolated syndromes (CIS), the prevalence of asymptomatic cord lesions is lower, although they can be found in 30% to 40% of patients with this condition.

MRI of the spinal cord can provide important diagnostic information in several clinical settings. Patients initially diagnosed with MS, but showing signs or symptoms of myelopathy, are typically evaluated by spinal cord MRI to exclude treatable lesions. Moreover, the presence of cord lesions may help to determine dissemination in space according to the 2005 McDonald diagnostic criteria, and can strengthen the diagnosis of MS in patients fitting the clinical criteria for MS, but with negative or inconclusive brain MRI findings. Similarly, diagnostic certainty can be increased in patients with non-specific brain findings, particularly those >50 years old, because asymptomatic cord lesions are relatively frequent in MS, but are rare in other white matter diseases.

Spinal cord abnormalities, as seen on conventional MRI scans, mainly reflect demyelination, but underestimate axonal damage, which is likely the reason why the relationship with disability is poor. The progressive refinement of modern quantitative techniques (e.g., diffusion tensor imaging, MR spectroscopy, and magnetization transfer) should result in a more complete in vivo picture of spinal cord pathology in MS and ultimately, a better relationship with the clinical picture.

17.00-17.15

The Study of the Spinal Cord White Matter with a 3-Tesla Device
L. Albini Riccioli, A.F. Mariani, F. Tonion, M. Leonardi
Neuroradiology Department Bellaria Hospital; Bologna, Italy

The spinal cord is a clinically eloquent site containing important sensory and motor tracts; spinal cord disease resulting from a number of pathologic processes is therefore an important cause of disability. The spinal cord study with a high field strength MR system is hampered by the small size of the spinal cord surrounded by pulsating cerebrospinal fluid (CSF), and the motion of the body and its organs during the examination. Thanks to its high spatial resolution, temporal resolution and signal/noise ratio, use of a 3 Tesla MR device and a dedicated phased array coil, has clearly displaying the anatomic details most difficult to examine and can facilitate early diagnosis of MS in patients who have clinically isolated syndromes. The morphological study of the spinal cord with high field MR scan can be considered reasonably sensitive to detect white matter lesions, however, is neither specific or sensitive enough to identify the axonal loss. So it is es-
sential to obtain data about the metabolism and microstructure of pathological and healthy tissue to assess the degree of disease, monitor it over time and the efficacy of therapies using non-conventional techniques such as 1H-MRS, DWI and DTI.

We describe normal and pathological neuroradiological findings in spinal cord white matter and the parameters of optimized sequences for use with the 3T MR systems.

Material and Methods: Imaging was performed on a Sigma GE 1.5 T HDxt MRI scanner, with CTL and Neurovascular Coils. The protocol included sagittal T1 weighted and sagittal and axial T2 weighted acquisitions. Diffusion tensor imaging was performed in both sagittal and axial plans, using 9 diffusion encoding directions and a b value of 750 s mm⁻². Patients presented with a normal sized cervical canal and spinal cord despised minor discatrosic changes, 9 had focal discarthrosis stenosis with focal dispalcement of the spinal cord and among them 3 had spinal abnormalities on T2 weighted images at the level of the focal stenosis. 1 patient presented with a cervico dorsal syringomyelia.

Results: DTI imaging was reliably obtained in every patient. Fractionnal anisotropy was calculated for each voxels using Functool GE software at different levels of the cervical spine; in addition, diffusion tensor tractography based on a streamline approach was obtained. The range of FA was 0.6 to 0.7 in the normal cervical spinal cord. Changes in FA and tractography were observed in patients with focal spinal stenosis. Tractography demonstrated the disorganisation of spinal fibers in the patient presented with syringomyelia.

Conclusion: Our results confirm that DTI can be performed in a routine spinal examination. This preliminary study is promising and suggest that this technique combined with other MR data can add a valuable point to the evaluation of spinal condition and therefore to the follow up and therapeutic staging.

References
January 20-25, 2011
EUROPEAN COURSE OF PEDIATRIC NEURORADIOLOGY
Marseille, France

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The Course has limited places available

Deadline for early registration is
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Course Directors
Andrea Rossi
(Genoa, Italy)
Maria I Argyropoulou
(Ioannina, Greece)
Nadine Girard
(Marseille, France)
Wednesday, 6 October
Oral Sessions
No one in neuroradiology can argue against the fact that precise anatomical knowledge is absolutely needed to properly analyze and understand any kind of medical images. Both disciplines made substantial progresses in the identification of all the details of neural structures. An important contribution was made by Henri Duverney making injections of vessels on fresh brains in order to produce an angiarchitectonic map of all the structures of CNS including the very tiny capillary network. But in fact the clear advantage of the medical imaging techniques is to produce dynamic sequences, which is particularly important for vascular system and the recent diffusion imaging technique becomes a very precious tool to better know the functional behavior of nervous fibers, pathways and nuclei. On the other hand, anatomy tries to be more oriented to a comprehensive approach allowing understanding the how and why of the anatomical systems instead of only memorizing them. The goal of this presentation is to demonstrate those principles by giving two examples. First the correspondence between microanatomy of hippocampus and medical imaging and second the functional value of two original features of the internal carotid artery: carotid temporal canal and cavernous pump.

The human hippocampal anatomy is one of the most complex of the CNS. That is perfectly reflected in its confusing and changing terminology all along the history starting in 1587 by Arantius comparing the protrusion visible on the floor of the ventricular temporal horn to a hippocampus or sea horse. At the present time, hippocampus comprises two cortical laminae rolled up during growth one inside the other: the cornu Ammonis (hippocampus proper) which refers to the ram horn dedicated to the Amon god and the gyrus dentatus (fascia dentata). They have only three layers forming the allocortex which joins the isocortex of the temporal lobe (parahippocampal gyrus) by the subiculum. Cornu Ammonis has six different parts which are anatomically well described and was divided by Lorente de Nó (1934) in 4 fields in relation with their histological features: CA1 to CA4. They are concerned with the different mechanisms of memory with two identified different circuits: one integrating all the hippocampal structures for the spatial and episodic memory and the other made only by CA1 for the semantic memory. Those structures are permanently working playing the crucial role of selective filter of inputs. In fact they have very rich pathological expressions which still need to be better explored. The complex vascularization of hippocampus is closely related to the cortical enrollment occurring during growth. They are dorsal and ventral hippocampal arteries and subependymal and sulcal veins following the vestigial hippocampal suture. The particular sensitivity to anoxia of CA1 (or Sommer sector 1880) was related in the past to the particular length of the ventral arteries, but seems to be more in relation with neuronal receptors. The important density of the hippocampal vascular network well described in anatomical microinjections can explain the difficult correspondence with images of angiographic explorations. The high magnetic field recent images can be usefully analyzed with the precise anatomical data we have. Anyway the basic principles of the study of MRI sections of hippocampus will be carefully defined on coronal and sagittal sections in order to avoid the common mistakes due to a misinterpretation of morphology and volume in relation with an imperfect symmetry of the sections and sometime with an incomplete anatomical knowledge.

Regarding a possible example of comprehensive anatomy, we chose two anatomical features described on the internal carotid artery: the temporal bony canal and the cavernous pump. When penetrating through the skull base, ICA is included within a rigid bony canal (canalis caroticus) of few centimeters. The arising question is to try to understand why. According that we have the solution and not the problem, because humans did not build humans, it is needed to identify what is the technical problem. All the arterial vessels are viscoelastic tubes with a contractile wall having smooth muscle fibers innervated by the sympathetic nervous system. Therefore the propulsion of the blood pulse wave starting from the heart ventricular contraction takes advantage of this variable viscoelasticity to be able to reach all parts of the body and particularly the very rich capillary network of the brain with a relatively low energy pressure coming from the heart pump. In case of arteriosclerosis, the vessels are becoming rigid and the heart pressure is of course increasing. But this arterial pulse wave can be reinforced when the heart is pulsating more strongly during physical exercise or sport. The risk is indeed to get a vessel rupture with tragic clinical consequences. That’s why it is possible to consider the rigid bony temporal canal as a high pulses braking system ensuring a protection of the distal nervous capillary network. Anyway when the skull is surgically open, one can observe following the heart beats the pulsation of all the brain acting as a vascular sponge. The second original feature is the cavernous pump. The ICA is entering within the cavernous venous sinus at its posterior part and then makes a double loop as a siphon. Is this feature corresponding to the solution of a particular technical problem? One can demonstrate that the ICA pulsating within an inextensible fibrous chamber filled mainly by the blood coming from the ophthalmic veins draining the retina is creating a pump effect avoiding the retinal blood stasis and facilitating the blood venous flow into the jugular vein.

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The basal perforating arteries of the brain are important, because they are often involved by lacunar infarcts and intracerebral hemorrhage, and intra-operative injury to them can cause serious complication of hemiplegia. The purpose is 1) to review the anatomy of the basal perforating arteries, and 2) to show clinical utility of visualizing them on three-dimensional Time-Of-Flight MR Angiography using 3.0-Tesla machine in clinical cases.

We review the anatomy of the basal perforating arteries by cadaver specimen microangiograms, and examine multiplanar MR images showing the extents of cerebral infarcts involving the supply areas of individual arterial groups. Medial striate arteries (MSA), subcallosal artery from the anterior communicating artery, and lateral striate arteries (LSA), perforators of the anterior choroidal artery (ACHA), direct perforators of the internal carotid artery, and thalamic arterial group including thalamotuberal arteries (TTA), thalamoperforate arteries (TPA), thalamogeniculate arteries (TGA), and medial (MPChA) and lateral posterior choroidal arteries (LPChA). The arteries supplying the pyramidal tract in the corona radiata and posterior limb of the internal capsula are also shown.

The basal perforating arteries are also demonstrated by means of multplanar reformations as well as maximum intensity projections of 3.0-Tesla MR angiography data in volunteers. Finally, clinical application of 3-Tesla MRA to preoperatively viewing the basal perforating arteries will be demonstrated in tumor cases involving the basal ganglia and/or insulo-opercular regions.

Knowledge of vascular supply of the brain may be of help in interpreting not only cerebral infarcts but also other brain lesions including arteriovenous malformation, moyamoya disease, and feeding of brain tumors, and should be essential to interventional neuroradiology and neurological treatment.

10.15-10.35
Neuroanatomy of Visual Pathway and Brain Stem: Demonstration with Modern MR Technology

Y. Korogi, S. Kakuda, T. Yoneuda
University of Occupational & Environmental Health, Kitakyushu, Japan; Kumamoto University School of Health Sciences, Kumamoto, Japan

The advent of MR imaging has allowed the topography of the brain to be studied noninvasively with a high degree of spatial resolution. For example, the visual cortex (striate cortex) can be identified with precise knowledge of the MR topography of the calcarine sulci. The striate cortex has a unique structure called the line of Gennari. The line of Gennari is the most useful marker for the identification of the striate cortex, traditional MR imaging fails to visualize the line of Gennari in most cases. The line of Gennari occupies almost the entirety of the external sagittal stratum. It begins at the lateral geniculate body, passes through the temporal and parietal lobes, and terminates in the calcarine area. Many pathologic conditions involve the optic radiation and cause various abnormalities of the visual field. The hyperintense layer on T2-weighted images represents the external sagittal stratum, or optic radiation. The signal intensity of the external sagittal stratum reflects histologic characteristics of low axonal density.

The brainstem concentrates structures of vital importance in a relatively small area. When conventional MR image contrast is used, however, many internal structures of the brain stem cannot be clearly delineated. The some anatomic structures of the brain stem have previously been identified on diffusion tensor images; in these reports, however, the finer structures have not been clearly defined. Even the diffusion tensor images obtained with the highest resolution may not be sufficient to resolve these anatomic structures of the brain stem.

Recently, phase-weighted MR imaging, in which phase difference between objective and surrounding tissue was selected in order to enhance the contrast of objective tissue, has been utilized in clinical settings. By choosing appropriate phase difference, we can create various contrasts of tissues using the single scanned MR data. In this lecture, therefore, I will demonstrate the anatomic microstructures of the visual pathway including the line of Gennari and brainstem using the phase-weighted MR imaging together with routine MR imaging, and try to demonstrate the pathological changes of the small internal structures in various diseases.

The fast imaging employing steady-state acquisition (FIESTA) sequence has high spatial resolution and can depict microanatomy in intracranial lesions. The contrast enhanced FIESTA images can demonstrate a relationship between the enhanced tumors and unenhanced adjacent structures with fine spatial resolution. In addition, therefore, I will demonstrate the fine anatomy of the optic nerve/ optic chiasma as well as the relationship between them and the sellar/parasellar tumors with the CE-FIESTA images.

10.35-10.55
Cranial Nerves: Neuroanatomy and Pathologies
K. Karaali
Department of Radiology, Akdeniz University, Faculty of Medicine; Antalya, Turkey

Cranial nerves are structures that originates from brain and brainstem and they mostly innervate the structures located within head and neck. Their functions include sensory and motor innervations. Motor functions can further be divided into somatic (skeletal muscle innervation), visceral (smooth muscle and salivary gland innervation), and branchial (innervation of structures derived from branchial arch). Sensory functions are also divided into three categories; general somatic, special (visual, auditory, balance, taste, olfaction) and visceral (senses that originate from visceral organs). There are 12 cranial nerve pairs. First two can be considered as an extension of the brain. The remaining 10 originates from brain stem structures. In the evaluation of a patient with a symptom suggesting cranial nerve dysfunction, history and physical examination are usually not sufficient to localize the exact place of the lesion. Therefore, imaging is almost always necessary and it should include the whole anatomical tract from the nerve nucleus to the end organ. MRI is the preferred method for most of the cases whereas CT is mandatory for traumatic lesions. For an appropriate evaluation, a radiologist should know detailed anatomy of the cranial nerves. As well, routine MRI sequences may not be adequate for an ideal visualization and the radiologist should be familiar with the optimal sequences for the certain cranial nerves. In this presentation, neuroanatomy of cranial nerves will be given with MRI images. Optimal sequences which can be used for the demonstration of certain nerves and their advantages and drawbacks will be discussed. Pathologic processes involving cranial nerves will be demonstrated. Some examples are: Esthesioneuroblastoma, Kallmann syndrome, traumatic lesions (for the olfactory nerve), glioma, meningioma, neuromas (for the optic nerve), aneurysmatic compression, lymphoma, sarcoidosis (for the oculomotor, trochlear and abducens nerves), neurinoma, vascular compression (for the trigeminal nerve), neurinoma, vascular and tumoral compression (for the facial and vestibulocochlear nerves), and traumatic, tumor and vascular lesions (for the other four cranial nerves).
Despite olfactory system is common almost in all the creatures, the understanding odour processing and interaction with memories and emotions is limited. The application of fMRI for studying human olfactory system is quite recent, due to its complex anatomical distribution compared with other functions (language, movement, auditory) that activate well-known cerebral areas. Moreover, in vivo fMRI study of the human olfactory system is difficult for the less extended devoted areas in human cortex and for high magnetic susceptibility around the olfactory stations that causes numerous artefacts.

The olfactory stimulations during fMRI studies need two fundamental constraints: the use of a MR-compatible olfactometer, able to deliver an adjustable airflow into the nostrils of a subject during a MRI-scanning session; the choice of not toxic for human stimulating molecules.

During fMRI studies, stimulating molecules must be alternated with rest conditions considering the good performances in terms of olfactory perception and reduced risk of adaptation. With fMRI is possible to distinguish different receptorial responses in human administering molecules that have exclusively olfactory or other sensorial perception pathways: for example, the so-called cooling-agents have the property of stimulating peripheral end terminations of the nerves responsible for the sensation of cold. An intra-laboratory protocol consisted of olfactory stimulation with Menthol and Heliotropyl acetone, a pure olfactory molecule. Different temporal block designed paradigms for the stimulation can be applied for each molecule: a regular block design, alternating ten times 20 seconds of OFF condition with 10 seconds of ON condition; a randomized design, with variable ON durations (for example, of 4, 8 and 12 seconds long, with a total stimulation time equal to the block design one). The stimulation designs are tested to look for a better olfactory perception and reduction of the habituation phenomenon.

The fMRI signal during an olfactory experiment is very low and sometimes it could be very difficult to distinguish from natural or electronic noise, so software and dedicated analysis system must be applied: in the AFNI software images are spatially realigned to a reference image in the factory experiment is very low and habituation phenomena.

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brain. Like epilepsy, we have patients with chemical disturbances and some others with morphologically proven lesions. Patients with neurotransmitter impairment can be successfully treated when we find the appropriate antagonist or competitor in the receptors. Patients with objective, morphological lesions are more difficult to treat, as in many cases the nerve in tissue is missing. In the first case we can trace the lesion using functional or metabolic imaging approaches: PET (positron emission tomography), SPECT (single photon emission tomography), MRS (magnetic resonance spectroscopy) or fMR (functional magnetic resonance).

Drug abusers start with metabolic damage to the brain; we can see it using PET or SPECT and even MRS. Examined with PET and fMR, drug abusers demonstrate poor judgment and irresponsible behavior, including poor judgment in business and personal decisions (London E, Ernst M et al, 2000). Craving was demonstrated to arise from the amygdala, using the same methods. On the other hand we have morphological changes related to psychiatric disease. Lesions in the dominant hemisphere produce depression. The reversal of the standard asymmetry, dilated non-dominant ventricle in the right hemisphere, was referred to as patients’ refractory to treatment and in a great majority with suicidal thoughts. Schizophrenics on the other hand have very small lateral ventricles and tend to asymmetry: no dominant hemisphere was developed as stated by T.J. Crow (Int.Rev.Psych, 1997). Dementia is a large and complex field. Magnetic resonance imaging is extremely helpful to establish affected areas and progression of disease. Creutzfeldt Jakob dementia has characteristic features on magnetic resonance, such as restricted diffusion in basal ganglia and edematous component in cortex. PET is contributing in molecular imaging of Alzheimer disease (18F-AV-45), strionigral degeneration (123I-CIT), and Creutzfeldt Jakob dementia, which is known to have characteristic features on magnetic resonance (18F-FDG).

The advent of functional Magnetic Resonance Imaging (fMRI) allowed a better definition of the activity of these limbic structures, not only in the normal population, but also in some clinical applications. At our Neuroscience Department we applied fMRI to two very different pathologies: panic disorder and ulcerative colitis.

Panic Disorders: Aim. Panic disorder (PD) is an anxiety disorder characterized by recurring severe panic attacks and chronic hyperarousal. It has been shown that, in normal population, amygdala activates in response to fearful faces even if presented below the threshold of conscious visual perception. Our aim was to establish whether the amygdala was engaged by the two different presentations of fearful faces and whether its responses were different in PD patients and controls.

Materials and Methods. 13 PD patients and 15 healthy volunteers underwent two passive viewing tasks during a 3T fMRI scanning: 1) presentation of faces with fearful vs neutral expressions (17 ms, subliminal stimulus) using a backward masking procedure; 2) presentation of the same faces vs neutral expressions (200 ms, consciously perceived stimulus), whose spatial frequency contents had been manipulated by low-pass filtering (low spatial frequencies, LSFP). Results. Whereas controls showed a bilateral activation for fearful masked faces and left amygdala activation for the LSF condition, patients failed to show any activation within the amygdala in both conditions. Conclusions. Findings showed that the chronic hyperarousal in PD patients is correlated with a reduced amygdala activation to potentially threatening visual stimuli, thus becoming maladaptive. Therapeutic approaches should consider not only the clearly visible overreaction to harmless stimuli, but also the hyporeaction to real danger that chronic PD patients might have developed over time.

Ulcerative Colitis: Aim. The aim of this study was to investigate the emotional system in patients suffering from Ulcerative Colitis (UC). To this aim, we focused on Amygdala, perigenual Anterior Cingulate Cortex (pACC), anterior part of Middle Cingulate Cortex (aMCC) and medial Prefrontal Cortex (mPFC), the main nervous structures crucially involved in the emotional processing. We used fMRI to evaluate the changes in Blood Oxygenation Level Dependent (BOLD) signal induced by single and repeated visual emotional stimulations, within the aforesaid limbic structures, in patients with mild UC in clinical remission, compared to healthy people. Materials and Methods: We tested the 10 UC patients having mild disease in clinical remission and 10 healthy Control subjects by 3T fMRI, during a visual emotional stimulation (by using International Affective Picture System (IAPS) images). Two identical visual emotional stimulations were repeated for each subject in the same session, in order to study amygdala, pACC, aMCC and mPFC ROI-based BOLD signal changes in the 1st response (1st Trial) and habituation (2nd Trial). A repeated measures ANOVA was used for the statistical analysis of the results. Results. UC patients showed a different emotional activation pattern with respect to Control subjects. In the 1st Trial, UC patients showed a significantly lower bilateral fMRI BOLD signal in all the limbic structures examined, with respect to the Control group. In the 2nd Trial, the Control group was characterized by a bilateral amygdala pathway to the vagus, which, in turn, exerts its tonic anti-inflammatory output to the bowel. These pathways could represent the neural correlates of the occurrence of intestinal responses to emotions. The different activity and the lack of habituation to emotional stimuli, we found in UC patients, may be interpreted as an altered neuronal processing, which could increase inhibition on the vagal anti-inflammatory tone and, consequently, prevent the protective anti-inflammatory effect to occur.

Chair: J. Walecki

12.20-11.00
The Virtual Atlas of Brain Vascular Anatomy

W.L. Nowinska, B.C. CHu, G.Y. Qian
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Biomedical Imaging Lab, Agency
Our objective is to create the most advanced human brain atlas. The atlas developed is comprehensive, very detailed, completely parcellated, fully labeled, three-dimensional (3D), spatially consistent, realistic, of high resolution, volumetric, stereotactic, explorative, dissectable, deformable and interactive. The atlas contains 3D models of the brain's structure, vasculature and tracts derived in vivo from the same specimen, in contrast of presenting these systems separately for various specimens. Multiple 3T and 7T scans (MP-RAGE, 2D/3D TOF, SWI, SPGR, DTI) of the same subject (WLN) were acquired and co-registered. The cerebrum including the cortical areas, cerebellum, brainstem, spinal cord, arteries, veins, sinuses, white matter, subcortical structures, tracts, and systems were parcellated into about 1,500 3D components and labeled with names (the number of these components is continuously increasing). The vessels were additionally labeled with their diameters, the smallest is of 80 microns. This new brain atlas is constructed by extending a previously developed atlas derived from 3T scans. Atlas construction is based on the “pyramidal principle” and exploits a novel interaction paradigm “from blocks to brain”. Scalability and decomposition are two main features of the pyramidal atlas. Scalability of content and functionality enables the atlas to expand by parcellating the existing content and adding new materials, while keeping its complexity and performance manageable. Brain model composition and decomposition enables to build the whole brain and any part or circuit of it from the individual components. The 3D brain is dissected electronically into gross components (hemispheres, cerebrum, cerebellum, brainstem, spinal cord; and groups of vessels and tracts), selectable individual components (structures, vessels, tracts), layers (cortex, white matter, subcortical structures). The cerebral model is spatially consistent as it is derived from a single specimen. The parenchyma can additionally be exposed with 3D cutting planes in predefined and 1 arbitrary directions. In addition, the atlas is stereotactic and coordinates are available at any location. This interactive atlas provides exploration tools. The user can create any subsystem from groups and/or individual components including vessels, structures, and tracts. This enables the user to construct cerebral models and captures their images, which are not easily found in the classic textbooks. For instance, the white matter tracts can be displayed with 3D cutting planes in any region; the vasculature can be displayed along with white matter; and the deep gyral anatomy can be easily exposed in 3D. This new generation brain atlas has a rich content, powerful functionality, and is easy to use. It enhances understanding of the 3D brain just in a few clicks. This solution shifts the paradigm from reductionistic to holistic, and combines science with art. The atlas is a foundation of multiple education, research, and clinical applications, including an atlas of neurological disorders, atlas-aided deep brain stimulation, and atlas-assisted stroke image analysis.

References
COMMUNICATIONS

Stroke 3

Introductory Lecture
4D-DSA and 4D (OmniPlane) Fluoroscopy: New Techniques for the Angiography Suite

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Over the last fifteen years 3D-DSA has become an integral component in the evaluation and treatment of patients with people with a large variety of central nervous system vascular diseases. Recent introduction of angiographic systems with flat panel detectors has expanded the capability of angiographic systems so that now high quality CT tomographic image volumes can also be easily acquired. When combined with an IV injection of contrast medium combinations of the 3D vascular volumes and the CT images offer some advantages over available CT angiography in that: a) there is no limitation in vascular visualization associated with the skull base, b) there is some reduction in the amount of contrast medium required, c) there is some advantage in spatial resolution and, d) there is full coverage of the brain. Combined with these hardware and software advances has been an evolution of hybrid image processing algorithms which utilize combinations of fundamentally different data sets to form new ones which will then include the attributes of both of the originals. We have extended this concept to the processing of both rotational DSA and fluoroscopic acquisition such that a time resolved conventional 2D-DSA or 2D (biplane) fluoroscopic acquisition can be used to constrain the reconstruction of a time resolved 3D rotational (3D and no time) to generate a new data set that maintains the high spatial resolution of the 3D volume while also containing the temporal resolution of the 2D acquisitions i.e. 4D-DSA. This approach also allows creation of arbitrary fluoroscopic views over selectable sub-volumes without need for C-arm gantry movement i.e. omniplane road-mapping.

We have evaluated these applications in both animal and human studies and will present the results of these studies in this presentation. The application of multiplicative projection processing using a constrained reconstruction of a 3D-DSA rotational acquisition embedded with the temporal information from a 2D-DSA acquisition provides a means to derive 4D-DSA and 4D-Fluoroscopy. This seems likely to enhance the ability to diagnose and to treat patients with complex cerebrovascular diseases.

Quantitative Analysis of Brain Metabolite Concentrations Using MRS in Acute Hypoxia Ischemic Encephalopathy

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Objective: To explore the dynamic changes of brain metabolite concentrations using absolutely quantitative external standard MRS in acute hypoxia ischemia encephalopathy (HIE) piglet model.

Method: Eight 7-day-old healthy piglets were subjected to insult for hypoxia ischemia (H). The animals and an external standard phantom containing detectable metabolites of known concentration were studied by using 1.5T GE Signa scanner with a standard head coil. The single-voxel proton magnetic resonance spectroscopy (1H-MRS) data were acquired from a 20-mm cubic VOI, which was placed in both the piglet brain and external standard solution. The quantification of N-acetylaspartate (NAA), creatine (Cr) and lactate (Lac) were accomplished by the LCModel. The dynamic changes of brain metabolite concentrations of 2 piglets in different time were acquired.

Results: One piglet was excluded because it was over anesthetized to dead. Seven piglets’ data were analyzed. The concentration of NAA in the pre- and post-HI was 6.86±0.49mmol/kg and 5.73±0.88mmol/kg respectively; Cr was 4.65±0.73mmol/kg and 4.40±0.80mmol/kg; Lac was 0.0mmol/kg and 0.43±0.39 mmol/kg. The concentration of NAA in the post-HI was decreased, and the difference was of statistical significance (t=0.579, P=0.002); The concentration of Cr was decreased, but the difference was not of statistical significance (t=0.579, P=0.584). The concentration of Lac was increased, and the difference was of statistical significance (t=2.933, P=0.026).

Conclusion: External standard MRS using LCModel has great value in quantitative analysis of brain metabolites. The concentration of NAA and Cr were decreased, and Lac increased in the animal model of acute HIE. Cerebral metabolites change dynamically in acute HIE.

Comparing b 1000 and b 2000 Diffusion Imaging in Acute Stroke at 3T MRI

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Jean Minjoz Hospital; Besançon, France

Purpose: analyse and compare b 1000 and b 2000-weighted diffusion imaging at 3T MRI in acute stroke

Patients and Methods: 68 patients underwent 3T MRI in the first 6 hours after acute neurological deficit. b 1000 and b 2000-weighted diffusion imaging, FLAIR, T2*, 3D TOF MRA have been obtained. EPI diffusion imaging was obtained with the following parameters: TR/TE 7000/88 in b 1000 and 7000/103 in b 2000; 5.0 thk/1.5 sp; 22 slices; acquisition time of 56 sec. MR follow-up was performed at 4 weeks. The final diagnosis was stroke in 38/68
patients and TIA in 30/68 patients.

Results: In 30/68 cases of stroke, there was no significant differences between b 1000 and b 2000 diffusion imaging. The ischemic lesions were better delineated in 2 cases and more extensive in 3 cases at b 2000 as compared to b 1000. In 2 patients with equivocal hyperintensity at b 1000, b 2000 showed the lesion better. Moreover, in 1 patient presenting with acute dysarthria and left hemideficit, b 2000 imaging was the only sequence able to demonstrate an ischemic lesion in the medulla.

b 1000 (a) and b 2000 (b) diffusion in acute left hemideficit; the lesion of right posterior external capsula and lentiform nucleus (arrow) is better delineated on b 2000 diffusion

Conclusion: good correlation between b 1000 and b 2000 diffusion imaging has been found in most cases of acute stroke. In some cases, b 2000 has offered a better visualization of the ischemic lesions and has increased confidence in diagnosis. Our study has demonstrated there is no benefit to perform routinely b 2000 diffusion. b 2000 diffusion can be useful in case of discrepancy between negative b 1000 diffusion imaging and clinical symptoms.

ADC maps. Here we compared Neurinfarct with the PWI/DWI mismatch in a multicenter prospective cohort of acute MCA stroke patients called VIRAGE.

Materials and Methods: We included 81 from the 111 patients of the VIRAGE cohort after excluding 30 patients for incomplete clinical or imaging data. All of the remaining patients were treated with tPA. Initial (V1) and final (V2) infarct volumes were measured on the initial and control DWI. Infarct growth (IG) was defined as the difference between V2 and V1. The PWI-DWI mismatch was defined as the difference between the PWI abnormality (TTP>4sec) and V1. Neurinfarct predicted infarct volumes (PIV) were obtained using a 0.85 ratio ADC threshold value. This value was obtained by recalibrating the algorithm on the VIRAGE cohort using a bootstrap evaluation of the best concordance correlation coefficients between PIV and V2. The Neurinfarct “mismatch” was defined as the difference between PIV and V1. We calculated the Spearman rank correlation coefficients (p) between IG and PWI-DWI mismatch, IG and Neurinfarct “mismatch”. We also correlated PWI-DWI mismatch and Neurinfarct mismatch, and V2 with PWI abnormalities or PIV0.85.

Results: Median V1 and V2 were 12.8 ml (IQR: 4.7-33.1) and 25.7 ml (10.9-61.3) and median IG was 11.6 ml (4.5-28.4). Median PWI-DWI mismatch was 21 ml (-0.4-62.7) and Neurinfarct mismatch was 11.8 ml (2.6-37.8). The p values of the correlations between IG and mismatches were 0.889, and 0.444 (p < 0.0001) for PWI-DWI, and Neurinfarct 0.85, with no superiority of one method (p=0.71). The PWI-DWI and Neurinfarct mismatches were also significantly correlated (0.247, p<0.05). V2 was significantly correlated to PIV0.85 (p: 0.849, p<0.00001), and to PWI abnormalities (p: 0.673, p<0.00001). The p value was significantly higher for the PIV-V2 correlation than for the PWI abnormalities-V2 correlation (p<0.01). The PWI abnormalities correlated with the Neurinfarct PIV0.85 (p: 0.551). These p values are significantly smaller than those of the Neurinfarct PIV-V2 correlations (p<0.005).

Conclusion: In the VIRAGE multicenter prospective cohort, the Neurinfarct DWI-based assessment of ischemic penumbra was as efficient to predict real infarct growth and more efficient to predict final infarct size than the PWI-DWI method based on TTP map analysis.
In patients with chronic ischemia of the brain, a wide spectrum of findings such as multiple patchy ischemic lesions or lesions quite remote from the actual site of ischemia can be seen. In crossed cerebellar diaschisis (CCD), there is metabolic depression in the cerebellum contralateral to supratentorial lesions. This entity has been described in PET and MR perfusion studies. However, to our knowledge, it has not been described on conventional CT perfusion due to obvious reasons of limited coverage. With the availability of whole brain CTP, we have seen evidence of CCD in patients with supratentorial lesions (Figure 4). In case of chronic occlusion of a major artery with chronic hemispheric ischemic symptoms, surgical revascularization is an option. Assessment of cerebrovascular reserve is critical to determine whether patients will benefit from bypass surgery. Whole brain CTP can provide information regarding global cerebral hemodynamics which is of critical importance in this clinical scenario (Figure 5).

Arterio-venous malformation (AVM): Although focal, AVMs can affect the global hemodynamics of the brain. This is dependent on the size and presence of high flow channels. We have observed similar findings on whole brain CTP. The CBF and CBV are markedly elevated within the AVM nidus reflecting high vascularity. However, the perinidal areas demonstrated low CBF and CBV suggestive of perinidal ischemia. In two of our patients with supratentorial AVMs, we found low CBF and CBV in the contralateral cerebellar hemisphere consistent with crossed cerebellar diaschisis. Similar findings have also been described in the nuclear medicine literature.

Brain tumors: Most brain tumors can be assessed with limited slice CTP as localization of the lesion is usually not an issue. The major limitation is the selection of the arterial input function in tumors located at the extreme ends of the brain, i.e., either near the vertex or in the posterior fossa. The limited coverage of a large tumor on limited slice CTP may also be inadequate in depicting tumor heterogeneity, which is an important characteristic for the grade of brain tumors on imaging.

Conclusion: We highlight the advantages and new implications of whole brain CT perfusion compared to the limited slice CT perfusion. Other avenues of uses of whole brain CT perfusion will be opened up with further experiences in this field. Using different protocols, the radiation dose can also be reduced for whole brain CTP.

16.30-16.45

3.0T MR Imaging of the Cranial Arterial Wall for the Strategy of Stroke Prevention

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Object: 3.0T refined MRI reveals the anatomical structures clearly. Operative findings correspond well with MRI findings. The use of this equipment for prevention of stroke. Especially evaluation of the arterial wall is important for this purpose. Showing illustrative cases including operative ones, we discuss the MRI findings and strategy of treatment.

Method: The examinations of the carotid artery (CA) and vertebro-basilar artery (VBA) were performed with 3.0T MRI (Philips Achiva 3.0T, Holland). Specialized sequences for each arterial wall were planned after TOF-MRA screening. The sequences include Ti, T2 VISTA (3D Fatsaturation Vol-
Communications

Aneurysms 3

Chairs: A. Tournade, M. Muto

14.30-14.45

Introductory Lecture

Endovascular Treatment of Complex Intracranial Aneurysms: Technical Review

Z. Wu
Beijing Neurosurgical Institute and Beijing Tiantan Hospital, Capital Medical University; Beijing, China

Complex intracranial aneurysms include not only large and giant aneurysms (classically larger than 10 mm in diameter) but also smaller aneurysms in difficult locations of the human brain and cranial base. Such lesions are associated with a high risk of subarachnoid hemorrhage and progressive neurological deterioration or death caused by mass effect or stroke. In the past decade, the understanding and treatment of these lesions have advanced considerably. Therefore, a deep understanding of these lesions, including the nuances of blood flow dynamics, natural history, and potential therapeutic options, is necessary when one is managing such aneurysms.

14.45-15.00

Technical Strategy for the Management of Ruptured Vertebrobasilar Aneurysms. A Single Center Experience

X. Ding
Department of Neurosurgery, the Second Hospital of Shandong University; Jinan, China

Objective: To explore the technical strategy for the management of ruptured vertebrobasilar aneurysms.

Method: We treated 42 cases with 43 ruptured vertebral aneurysms, surgical clipping was performed in 9 cases, parent artery occlusion in 8, coil embolization in 12, and combined stent and coil embolization in 13 cases.

Results: Immediate postoperative angiography of 40 patients showed complete occlusion, while 2 showed occlusion of the major part. Angiography of 34 cases at 3 and 12 months after follow-up revealed recurrence of the aneurysm in 2 cases, and 1 patient died.

Conclusion: The therapeutic choice for vertebrobasilar aneurysm should be based on the site and morphology of the aneurysm and its relation with the peripheral blood vessels. Endovascular treatment should be the first choice; surgical clipping is preferred for cases where the lesions are easy to expose surgically, preoperative systemic state is good, and urgent clearance of the hematoma is needed to save the life of the patient.

15.00-15.15

Endovascular Treatment of Ruptured and Unruptured Fusiform Vertebral Artery Aneurysms

Y. Li
Beijing Neurosurgical Institute and Beijing Tiantan Hospital; Beijing, China

Objective: To analyze the success of endovascular management of ruptured and unruptured fusiform vertebral artery aneurysms.

Method: Sixty-three patients with 65 vertebral fusiforms (both acute dissection and chronic fusiform aneurysms are included) treated at our hospital form the basis of the analysis. Clinical outcome was evaluated using the modified Rankin Scale. Angiographic follow-up data was obtained for 44 patients (69.8%) for periods ranging from 3 to 16 months (mean, 8 mo).

Results: The patient population included 33 patients (52.4%) with unruptured aneurysms, 30 (47.6%) with unruptured aneurysms. The aneurysms located 27 (39.7%) at the distal to PICA, 23 (33.8%) at the proximal to PICA and 18 (26.5%) at the VA-PICA. Follow-up angiograms were obtained in 44 (69.8%) of 63 patients. Complete or virtually complete thrombosis was confirmed on early posttreatment angiography in 39 (88.6%) of 44 patients. A slight reduction in the size of the lesion was noted in 3 patients and there was a significant residual lesion in 24 (55%) patients. Clinical follow-up revealed 90.5% patients in the mRS 0-2 category, 4.8% patients in the mRS>2 category, and 4.8% patients were deceased (mRS 6). Three patients died of rebleeding (n=1) or progressive mass effect/brainstem ischemia (n=2).

Conclusions: Endovascular coil embolization of fusiform vertebral artery aneurysms is an effective treatment in the short term but is associated with incomplete coil embolization, which requires close surveillance, possible retreatment, and can very rarely lead to rehemorrhage.

15.15-15.30

True Posterior Communicating Artery Aneurysms

A. Taylor, D. Lefevvre
University of Cape Town, South Africa

Carotid artery aneurysm’s arising near the posterior communicating artery (pcom) are common, accounting for up to 35% of all saccular aneurysms. Aneurysms arising directly from the posterior communicating artery are however rare. Although close the two regions are embryologically distinct and confer different treatment risks due to perforator proximity and anatomical access. We review the anatomy and treatment of 5 patients presenting with ruptured aneurysms on the pcom artery. Four patients had endovascular treatment and one had surgical clipping of the aneurysm. All were successfully occluded.

15.30-15.45

Onyx HD 500 in the Treatment of 184 Large Necked Intracranial Aneurysms - Long Term Results

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CNA - Centro de NeuroAngiografia. Hospital Beneficência Portuguesa de São Paulo; Brazil

Introduction: the main concern in treating endovascularly large necked aneurysms is the low rate of complete occlusion and high rate of recanalization when using platinum coils. The liquid embolic system Onyx HD500 has been used successfully in large necked
aneurysms with a higher rate of complete occlusion and lower rate of recanalization when comparing with other endovascular techniques.

**Material and Methods**: from July 2002 until now we have treated 146 patients harboring 176 large necked intracranial aneurysms, being 108 small and 68 large aneurysms. All of them have a large neck - neck diameter >4mm and/or domus-to-neck ration <1.5. All lesions are lateral to the parent vessel and most of them located in the carotid-opthalmic segment of ICA. Follow up with DSA was done at 6 and by DSA or MRA at 18 and 36 years after the treatment.

**Results**: the rate of complete occlusion at the end of the procedure, at 6, 18 and 36 month follow up were 85%, 95%, 95% and 93% respectively for small aneurysms and of 55%, 75%, 80% and 82% for large aneurysms. The rate of recanalization was 1.5% for small and 5% for large aneurysms. Recanalization occurred only on the control at 6 months, showing stability of the procedure after this period of time. Ten patients had control at 5 years after the treatment showing stable results. The aneurysms with incomplete occlusion after 6 month were stable in the late follow up. Many aneurysms had a progression from initial incomplete to total occlusion on the follow up, due the intense reaction of neo endotolization that Onyx induces at the neck. Morbidity occurred in 8% of the patients, being permanent in 1.3%. Dead occurred in 3 patients (2%), in 2 (1.3%) related to the procedure.

**Conclusion**: in this large series the treatment with Onyx for these difficult and challenging aneurysms showed higher rates of complete occlusion than regular techniques, with a similar rate of complication. The high rate of complete occlusion is achieved due the fact that Onyx is a reconstructive technique, filling almost 100% of the aneurysm cavity and induces a stronger reaction of neo endotolization at level of the neck than platinum coils and stents. An important advantage of Onyx is the stability gives to the treatment in the long term follow up, which is different from other techniques, where recanalization can happen in the long term follow up. The Onyx technique is similar to the remodeling, being safe and efficient.

### Aneurysms 4

**Chairs**: E. Houdart, R. Piske

**Y-Stenting Assisted Embolization of Wide Neck Aneurysms Using Fully Removable and Detachable Intracranial Stents**

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Endovascular treatment of wide necked aneurysms poses a challenge to the endovascular therapist. The Y-stenting assisted technique had been used for stent assisted embolization for wide necked bifurcation aneurysms. This technique had been described for basilar tip aneurysms and middle cerebral artery bifurcation aneurysms using Neuroform and Enterprise stents. We describe cases of wide necked bifurcation aneurysms treated with Y-stenting assisted embolization using fully retrievable and detachable intracranial stents (Solitaire AB). We will describe the advantages of fully retrievable and detachable stent and its feasibility in forming a Y configuration in basilar and middle cerebral artery aneurysms. We’ve experience of more than 3 cases using this new fully retrievable and detachable stent to form Y-stenting for assisted technique in EVT of basilar and MCA wide neck aneurysms. We will share the advantages and disadvantages of the stent as the primary stent to form the Y-stenting in the lecture, using our cases. We will also describe the feasibility and problems using both fully retrievable and detachable stents or combination with other stent in forming the Y-stenting.

16.00-16.15 10' **Treatment of Wide-Necked Basilar Tip Aneurysms Using Kissing-stent Placement plus Coiling**

T. Li, L. Li, J. Xue, Z. Wang, W. Bai, Z. Li

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**Abstract**: We present a 52-year-old woman presented dizziness, diplopia, nausea and vomiting. She also lurched to right side while walking, a wide-necked (10.2 x 8.5 x 7.3 mm) basilar tip aneurysms was revealed. After presentation of risks, benefits, and alternatives, the patient selected endovascular treatment. The treatment was performed under general anesthesia. Intraprocedural hemorrhaging was monitored with a target activated clotting time between 250 to 300 seconds. Preoperative diagnostic angiography revealed the wide-necked basilar tip aneurysms incorporated the P1 segments of both PCAs. Bilateral Posterior Communication Arteries (PcomMA) were not found open. Operation plan was made and carried out in the following details. Bilateral femoral routes with two 6F guiding catheters were used. An favorable angle was chosen to well display the aneurysm, basilar artery and both P1s in a visualization style. After occluding the aneurysm, the guiding catheter was placed to the both vertebral artery and a digital subtraction road map was made. Two micro guidewires (Trancend 300) were placed past the aneurysm into both P2 branches through bilateral guiding catheter respectively. Simultaneously, two Neuroform-3TM (3.0x20mm, 3.5x20mm) were navigated to proper position to well cover the neck of the aneurysm. The Neuroform stent were subsequently deployed at the same time. Next, the microcatheter pre-shaped 45 SL-10 (Boston ScientificTarget) was inserted into the aneurysm followed by coiling. Complete obliteration of the aneurysm cavity was obtained without any compromise of distal flow. Postoperation, the low molecular weight heparin clopidogrel and aspirin were prescribed. In the present case, we described and conducted an creative placement of two stents in a paralleling style to form a kissing configuration. Both proximal ends were place in basical artery, while the distal ends were placed in bilateral PCA respectively. The main reasons that we choose this method to treat this individual case were displayed in the following paragraph in details. Firstly, placement of stents in the parent arteries would not only keep the patent arteries patent, but also enable interventionist to totally occlude the aneurysm. Secondly, For our case, the diameter of basical artery is obviously bigger than both PCA. Choosing of the two stents is based on the size of the PCA, so a 3.5 mm Neuroform stent was used in larger right PCA while a 3.0 mm Neuroform stent was used in smaller left PCA. Proximal portion of the two stent share the spase of basical artery, accordingly two ends of the stent expand to a simily diameter. We really believe that this structure will help the stents keep stable without any migration. Last but not least, placement of two stents in a paraparelleling style will not make any mechanical damage to the stent itself.

16.15-16.30 10' **Stent Reconstruction for Bifurcation & Terminal Geometry Intracranial Aneurysms in over 70 Cases: Clinical Applications in Evolution**
Background & Purpose: Endovascular surgery of wide-neck aneurysms involving bifurcation/terminus (B/T) geometries (e.g. MCA, ACoA, BA,) frequently is difficult and/or produces suboptimal results owing to unfavorable factors (e.g. acutely angled branch origins, very wide necks, and partial or complete branch incorporation into the aneurysm). Various stent-in-stent reconstructions, such as the “Y” or “T” (Y/T) configuration have been described to address some of these problems, but in only small case series and limited anatomic applications. This led us to review our cumulative experience with these techniques.

Patients and Methods: 72 consecutive cases of B/T branch reconstruction using Neuroform (NF) and/or Enterprise (Ent) stents were retrospectively identified. Technical approaches evolved over time, including staged Y/T, Stent-Assisted-Coiling (SACRED)-by End-on-Deployment (SACRED), SACRED-L, single session Y/T (NF or NF+Ent) and incorporated branch reconstructions. Over the last 3 yrs, delivery of the NF via an empty microcatheter (STEM technique) was employed.

Results: Early B/T reconstructions consisted of unintentional (i.e. failed single branch neck-bridging) and intentional staged Y/T stent-in-stent configurations using exclusively NFs (mostly for BA and ICA terminals). Intentional straight-on intra-aneurysmal deployment of a NF (SACRED technique) was adopted for some more challenging geometries (e.g. MCA) and then followed by combining SACRED with a single branch telescoping stent. Recently, most B/T reconstructions utilized combination of NF & Ent, which are typically performed in one session. These later techniques also have been adapted for single & double branch incorporations. Several representative examples of these B/T reconstruction techniques will be presented. Technical success rate for single & multiple stage procedures is 97%. Overall attributable mortality =0%, neurologic morbidity (Mj&Mn) =7%.

Conclusions: Evolving technical strategies and enhanced technology has enabled consistently safe and successful treatment of even the most challenging B/T aneurysm geometries. Most cases now can be performed in one sitting, using the combined advantages of open-cell and closed-cell designs of the NF and Ent, respectively.

16.30-16.45 10’ Multicenter Prospective Study on the Safety and Efficacy of the Neuroform3TM Stent for Aneurysm Treatment (Senat Study): Preliminary Clinical Results

A. Biondi1, A. Bonafe1, and Senat Investigators
1 Pitié-Salpêtrière Hospital, Paris VI University School of Medicine; Paris, France; 2 Gu de Chaillu University Hospital, Montpellier, France

Purpose: Neuroform3TM (Boston Scientific, Neurovascular, Fremont, CA) is a self-expandable nitinol stent, specifically designed for treating intracranial aneurysms. The first goal of SENAT study is to evaluate the morbi-mortality of Neuroform3TM stent-assisted procedure in the endovascular treatment of intracranial aneurysms.

Materials and Methods: SENAT study is a prospective, multicenter, consecutive registry carried out in France from July 2008 to July 2009. Ten French centers have participated to this study. One hundred eighteen patients, in whom a stent-assisted coiling procedure was planned for the treatment of an intracranial aneurysm, were included in the study. There were 79 women and 39 men ranging in age from 23 to 77 years (mean age: 52.4 years). Most of the aneurysms were unruptured (n=109, 92.4%). Inclusions and results were controlled by an independent clinical monitoring lab.

Clinical evaluation, assessed by modified Rankin Scale (mRs) or WFNS, was performed before and after embolization and then at hospital discharge. Clinical follow-up was assessed at 1 month, 6 months and 1 year after the procedure. The occlusion rate of the aneurysm after the procedure was determined by angiographic analysis. Angiographic follow-up was scheduled at 1 year. Intermediate follow ups were optional. Technical and clinical complications were recorded systematically. Adverse clinical events, even if unrelated to the aneurysmal pathology and treatment, were also recorded.

Results: Successful deployment of the stent was achieved in 95.7% of procedures. After the stent-assisted procedure, complete occlusion of the aneurysm was observed in 62.7% of cases, a residual neck in 23.7% and a residual sac in 13.6% of cases. Technical complications, with or without clinical consequences, were encountered in 9.8% of patients. At 1 month follow up, 93% of patients were unchanged in relation to their pre-operative neurological status, 6.5% improved and 1% worsened. According to mRS, 90.2% of patients had a score of 0 or 1; 4.4% a score of 2, 1% a score of 3; and 4.4% a score of 4. Mid-term follow up results are under analysis.

Conclusion: Analysis of the preliminary clinical results observed in the patients enrolled in this multicenter, prospective, consecutive and controlled study shows that the use of Neuroform3TM stent in the treatment of intracranial aneurysms is relatively safe. The use of Neuroform3TM stent does not seem to increase the percentage of complications and the incidence of morbi-mortality in relation to coiling procedures performed without stenting.

16.45-17.00 10’ Wide Neck Aneurysms Treated Using Stent Solitaire2

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1 Therapeutic Neuroangiography Service, Hospital General de Catalunya; Barcelona, Spain; 2 Clinica Nuestra Señora del Rosario; Madrid, Spain

Objectives: Demonstrate the usefulness of Solitaire® stent to treat wide-necked aneurysms in the middle cerebral, the basilar tip and anterior communicating artery.

Materials and Methods: We treated 17 aneurysm (3 large and 14 small) in 16 patients. There were 9 women and 7 men, their average age is 51.4 years (between 19 and 72 years). 8 aneurysms was located at the middle cerebral artery (MCA), 5 in the basilar tip (BT) and 4 in the anterior communicating artery (ACom). Five aneurysms had been treated previously (1 surgery and 4 coils). In 2 cases, stent was placed, in the other 3 cases stent and coils were placed. Of the 12 aneurysms treated again (11 accidental discovery and 1 headache), only 1 case (microaneurysms ACom) just stent was used, the remaining 11 were treated using coils Solitaire. 3 patients had aneurysms in other locations. All interventions have been done under systemic heparin therapy and antiplatelet.

Results: All stents were successfully deployed. The coils were introduced through the stent mesh. In one case there was a bleeding complication that forced to use protamine, then in the same case was presented a clot in the proximal stent, which resolved with intra-arterial urokinase. In the basilar tip aneurysms treatment, the last coil protruding to the lumen of the vessel and the second stent Solitaire was placed and directed to the contralateral posterior cerebral artery

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Intracranial Aneurysms: Endovascular Reconstruction with Stents; Medellin Experience

B. Pabon, S. Vargas, P. Urena
1. Americas Clinic / Incare / Ces Clinic; Medellin, Colombia; 2. HUSVP / Americas Clinic / Incare / Vegas Clinic; Medellin, Colombia; 3. Husvp, Medellin, Colombia

Objective: To report our experiences in the treatment of wide-necked, giant and complex intracranial aneurysms with stents

Methods: From June 2002 to January 2010, a total of 205 patients with 214 aneurysms were treated in our institution with stent technique. Data regarding technical success, initial and final angiographic results, mortality, morbidity, and final clinical outcome were collected and analyzed retrospectively.

Conclusions: Our retrospective study indicates that intracranial wide-necked and complex aneurysms may be safely and successfully treated with stents placement getting complete occlusion in a higher percentage. Thus, although endovascular treatment with stents looks promising for patients with cerebral aneurysms, multicenter trials are needed to confirm and extend our observations.

Endovascular Treatment of Blood Blister-like Aneurysms: Initial Experience with Stent-Assisted Coil Embolization

S. Meckel, M. Cronqvist, T.P. Singh, C.C. Phatouros, W. McAulife
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Purpose: Blood blister-like aneurysm (BBA) is a rare type of intracranial aneurysm which generally presents with severe SAH associated high degree of morbidity and mortality. Due to their fragile walls and awkward geometry they are difficult to treat both surgically and endovascularly.

The aim of this study was to present clinical and angiographic results of endovascular BBA treatment using predominately stent-assisted coil embolization.

Methods: 13 patients, harbouring 11 ruptured BBA, from two different institutions (men/women, 6/7; mean age, 49.3 years) were included in this study from September 2006 — May 2009. Clinical and angiographic findings, treatment strategies, anticoagulation routines, procedure-related complications, and outcome immediate post-coiling and mid-term follow-up (mean, 12 months [6-27 months]) were retrospectively analyzed.

Results: 11 BBAs were located in the supraclinoid ICA and two the basilar artery trunk. Most BBAs showed early growth (61.5%), 10 were <= 3mm in largest diameter.

Primary stent-assisted coiling was performed in 11 patients. Complementary treatment due to early/late aneurysm regrowth after incomplete occlusion was required in three patients including parent artery occlusion in two.

Two patients had early re-hemorrhage, one presented with asymptomatic minor bleeding, and one with major fatal hemorrhage.

Late angiographic follow-up showed complete occlusion/progressive occlusion in 92.3% (12/13). At mid-term clinical follow-up, 92.3% (12/13) showed good functional outcome (MRS 0-2).

Reduced heparinazation (50%) and antiplatelet routines (30%) were used in stent-assisted procedures without evidence of early or late thrombemboli.

Conclusion: Stent-assisted coiling for treatment of ruptured BBAs is technically challenging but feasible. Reduced anticoagulation/antiplatelet regimes appear safe relative to symptomatic thrombotic complications.

Regrowth and early re-rupture remains a problem in incompletely occluded BBAs underlining the importance of early angiographic follow-up, and re-treatment including PAO may be necessary for definite occlusion. The mid-term angiographic and clinical outcome was excellent in our series.
COMMUNICATIONS

Research 4

Chairs: I.E. Gonzalez Toledo, C. Bortolotti
14.30-14.45 10’

Helps Trial: Angiographic Primary Trial Results

P. White, R. Sellar
Dept. Clinical Neurosciences, Western General Hospital; Edinburgh, United Kingdom

HeLPS Trial: Presentation of Blinded Data and an Update on Progress. White, P. M. On behalf of the HeLPS Trialists Centre for Interventional Neuroradiology Edinburgh; Edinburgh, United Kingdom.

Purpose: To provide the primary trial results from the randomized control trial of hydrocoil versus bare platinum in endovascular aneurysm treatment (HeLPS).

Materials & Methods: HeLPS is a multicenter international randomized controlled trial with concealed allocation. Primary outcome is angiographic outcome in hydrocoil vs bare platinum arms. Groups are matched using appropriate minimization criteria. Angiographic analysis was performed by an independent core lab blinded to the patient allocation (CHUM, Montreal).

Secondary outcomes include independently assessed clinical outcome [Modified Rankin Score], coil lengths used, packing density achieved, rebleed and retreatment rates. Analysis of results is on an intention to treat basis. The funders (Microvention Inc. and UK NHS) and trial sponsor (London Health on behalf of UK NHS) have no control over the running of the trial and no access to the trial data. HeLPS is still actively recruiting. 499 patients were randomized.

Results: The trial primary outcome angiographic data with full statistical analysis both intention to treat and per protocol will be presented at the symposium.

Conclusion: HeLPS is the first randomized control trial examining coated-coil technology for cerebral aneurysm treatment and demonstrates that trials of new technologies are feasible. Trial results and implications for practice will be discussed.

14.45-15.00 10’

MR Clean - Multicenter Randomized Clinical Trial of Endovascular Treatment for Acute Ischemic Stroke in The Netherlands (NTR1804)

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1 AMC, Radiology; Amsterdam, The Netherlands; 2 AMC, Neurology; Amsterdam, The Netherlands; 3 Erasmus MC, Radiology; Rotterdam, The Netherlands

Rationale and Aim: Endovascular treatment increases the likelihood of recanalization in patients with acute ischemic stroke caused by proximal intracranial arterial occlusion. The purpose of the Multicenter Randomized Clinical trial of Endovascular treatment for Acute ischemic stroke in the Netherlands (MR CLEAN) is to assess the safety and effect on functional outcome of endovascular treatment in these patients.

Study Population: Patients should have a clinical diagnosis of acute ischemic stroke, MRI or CT ruling out intracranial arterial occlusion, demonstrated by neuro-imaging and the possibility to start endovascular treatment within 6 hours after stroke onset.

Intervention: Endovascular treatment may consist of intra-arterial thrombolysis with urokinase or alteplase, mechanical treatment or both). Mechanical treatment refers to retraction or aspiration of the thrombus with a catheter guided device, or stenting. The exact choice of endovascular treatment modality for each patient is left to the discretion of the local investigator and treating physicians. The steering committee will provide recommendations and guidelines for treatment and selection of patients in the study. Background medical management is delivered according to national standards and guidelines. It may include intravenous alteplase within the first 4.5 hours after onset.

Outcome Measures: The primary outcome is the score on the modified Rankin scale 90 days after inclusion in the study. Secondary outcomes are the NIHSS score at 24 hours, vessel patency and infarct size at 24 hours, infarct size at 5 days, and the occurrence of major bleeding. The randomization will be stratified for use of intravenous alteplase, planned treatment modality (intra-arterial thrombolysis, mechanical thrombectomy or both) and center. We will estimate the effect of treatment by means of the sliding dichotomy approach, which considers the whole range of the mRS.

In total, 500 patients will be included.

Discussion: MR CLEAN is a pragmatic trial. Inclusion of patients will take 4 years, and starts early in 2010.

15.00-15.15 10’

Meta-Analysis of Clinical Outcome & Procedural Complications in Patients with Unruptured Cerebral Aneurysms in the Helps and Cerecyte Trials

P. White 1, A. Molyneux 2, C. Williams 1, L. Forrest 2, M. Saade 2
1 ONNRU, Oxford University: Oxford, United Kingdom; 2 ONNRU, Oxford University: Oxford, United Kingdom

Aims: To determine clinical outcomes at discharge and first follow-up in patients with unruptured intracranial aneurysms (UIA) who were prospectively enrolled in the Hydrocoil endovascular aneurysm packing Study (HeLPS) and the Cerecyte Coil trial (CCT). Until now there have been no randomised data on outcomes for coiling of UIA.

Methods: HeLPS and CCT prospectively enrolled 490 patients with UIA. Independent statistician performed pre-specified meta-analyses.

Results: 501 patients with an unruptured aneurysm and 8 with not recently ruptured aneurysm (> 30 days after SAH or possible SAH with delayed presentation) were ran-
domed into HELPS/CCT. Coated and bare platinum arms were well matched. Procedural complications were 5.1% and 4.7% coated and bare arms respectively; not statistically different. Patients discharged home = 86%; not different between groups. WFNS at discharge was 0/1 in 96.4% of both coated coil bare platinum coil patients. Procedural mortality rate was 1/501 (0.2%) and mortality rate by first follow-up was 3/501 (0.6%). In the coated coil arm at clinical follow-up there was good outcome (Rankin 0-2 inclusive) in 91.5% and in control arm good outcome rate was 93.7%, not statistically different. The factors and predictors of poor outcome and reported complications will be analysed and presented together with final updated numbers following completion of the follow-up.

Conclusions: Coiling of unruptured aneurysms has very low mortality but approximately 5% procedural morbidity with no statistical differences was observed between coated and bare platinum groups. There is however, an overall poor Rankin score at clinical follow-up, which is rather greater at 7.4%.

1515-16.50 10’
Analysis of Risk Factors During Endovascular Treatment of Intracranial Ruptured Aneurysms: Results of Clarity Study
C. Cognard 1, L. Pierot 1, R. Anxionnat 1, F. Ricolfi
CHU Toulouse, France; 2 CHU, Reims, France; 3 CHU, Nancy, France; 4 CHU, Dijon, France

Introduction: Our Goal is to analyze the clinical, anatomical and technical factors influencing the risk of the ruptured aneurysms coil.

Materials and Methods: Clarity is a multicentre, consecutive series performed in 20 French centers by 43 operators with independent clinical monitoring and independent core lab. 782 patients (514 males, 468 females; from 19 to 80 YO, mean: 51.3 ± 13.2 Y) were treated with GDC or Matrix coils for a ruptured aneurysm.

Results: Increased thrombo-embolic risks were associated with: - smoking (16.1% versus 10.1% for non smokers: p=0.015), - aneurysms > 10mm (28.0% versus 17.0% for aneurysms < 10 mm; p=0.001), - large (>4 mm) neck aneurysms (20.8% versus 11.0% for aneurysm neck < 4mm; p=0.004), - increased peroperative rupture risks were associated with: - middle cerebral artery aneurysms (85.5% versus 3.7% for other locations; p=0.029), - patients' age < 65 YO (5.0% versus 0.8% for patients’ age > 65 YO; p=0.032), - patients with no arterial hypertension (5.4% versus 1.5% in patients with arterial hypertension; p=0.017).

Conclusions: During ruptured aneurysms endovascular treatment, the rate of thrombo-embolic complications is significantly associated with aneurysm and neck size but not by the aneurysm location. Although the rate of peroperative rupture is significantly associated with an aneurysm location but not by aneurysm or neck size.

1530-15.45 10’
Post-Processing Imaging Analysis of Intra Aneurysmal Hemodynamical Modifications after “High Porosity” Self Expandable Stent Placement: An Experimental Study in an Animal Model
D. Bresson, C.Y. Couquet, C. Mounayer Centre Hopitalier Universitaire de Limoges, France

Background: Preventive platinum coil embolization for intracranial aneurysms treatment is often prone to recanalization: especially concerning wide-necked intracranial aneurysms. “High porosity” self expandable stent deployment at the aneurysm neck after endovascular coil placement might reduce this recanalization risk. However, this treatment modality presents a higher morbi-mortality risk and the hemodynamic effect of “high porosity” self expandable stents has not been well documented.

Purpose: The aim of the study is to analyze in vivo intra-aneurysm flow modification through image post processing and time-intensity curves computing.

Material and Methods: Intracranial aneurysms models (side wall aneurysms) have been created in swine (swines: n=8, aneurysms: n=12), then high frame rate 2D-DSA sequences before and after “high porosity” self expandable stent placement (Solitaire AB, ev3, inc.) have been performed (aneurysm stent placement: n=8). Flow analysis was performed using a public Java software (ImageJ) and time-intensity curves were compared before and after stent placement.

Results: The method used did not allow to prove significant hemodynamic alteration before and after a “high porosity” self expandable stent placement at the aneurysm’s neck. In two cases, increasing of flow velocity inside the aneurysm was noticed.

Conclusions: Flow analysis using post processing analysis is very difficult and has many limitations. Our preliminary results are not in favour of deploying “high porosity” stents for reducing recanalization in wide necked aneurysms for the only argument of flow modification.
Vertebral-basilar Dolichoectatic and Fusiform Intracranial Aneurysms: a Proposal of a Prospective Italian Register on Natural History and New Treatment Modalities in the Era of the Flow Diverters Technology

C. Bortolotti, C. Sturiale, M. Dall’Olio, C. Princiotto, M. Martinoni, L. Cirillo, M. Leonardi, F. Calbucci, A. Andreoli
Division of Neurosurgery and Neuroradiology, Bellaria-Maggiore Hospitals; Bologna, Italy

Vertebral-basilar non saccular intracranial aneurysms (NIA) represent a rare entity and little is known about their natural history. They were defined as an intracranial arterial dilatation greater than 1.5 times normal without a clearly definable neck. According to the Fleming (1) classification this category was further divided in three subtypes: 1) Fusiform aneurysms, a dilatation 1.5 times the normal diameter without a definable neck and involving a portion of an arterial segment (either vertebral or basilar artery), with any degree of tortuosity; 2) Dolichoectasia: uniform dilatation of an artery greater than 1.5 times its normal diameter and involving the entire basilar artery (BA) or vertebral artery (VA), with any degree of tortuosity; 3) Transitional (Dolichoectatic) aneurysms: uniform aneurysm dilatation of an entire arterial segment greater than 1.5 times its normal size and involving the VA, BA, or both with superimposed dilatation of a portion of the involved arterial segment. Symptoms most commonly result from mass effect on surrounding structures, cerebral infarction or transient ischaemic attack and subarachnoid hemorrhage. The Dolichoectasia very rarely requires a neurosurgical/neuroendovascular treatment. The transitional type exhibits the highest propensity to enlarge and to be symptomatic. The annual prospective risk of hemorrhage from a vertebralbasilar NIA in the Mayo Clinic series is 0.9 % overall, but can be as high as 2.3 % per year in patient with transitional and fusiform type of aneurysm; the majority of patients with hemorrhage had previously demonstrated symptoms due to mass effect or cerebral compression. The high mortality rate in patients with aneurysms growth (56 % at 5 years) makes a choice of treatment mandatory, but vertebralbasilar dolichoectatic aneurysms represent a formidable challenge to neurosurgeon and interventional neuroradiologists. Most often patients are treated medically with antiplatelet or anticoagulant agents because stroke recurrences are the leading causes of morbidity and death. When patients have recurrent symptoms surgical or endovascular options should be considered. Surgical options include vertebralbasilar deconstruction with unilateral or bilateral vertebral artery sacrifice, extracranial-intracranial anastomosis, aneurysms trapping or wrapping and aneurysmorraphy with or without trombectomy and clip recapture. Despite remarkable results in a few selected surgical series coming from highly experienced cerebrovascular centers, attempted open surgical treatment is typically associated with high rates of periprocedural morbidity and mortality. Endovascular parent vessel occlusion or bilateral vertebral artery occlusion to elicit flow reversal, represents a strategy with significant risk and unpredictable efficacy. Moreover, this deconstructive strategy eliminates any future access for endovascular therapy. With the advent of the new generation of intracranial stents, Pipeline embolization device (PED) (Chestnut Medical Technologies, Inc., Menlo Park, CA) and Silk (BALT) a stand-alone endovascular reconstructive is now feasible. The rationale of the sole stenting technique in the dolichoectatic aneurysm is to lead to aneurysms thrombosis while maintaining the integrity of the parent arteries. The vertebrobasilar Dolichoectatic and fusiform aneurysms were treated at the Division of Neurosurgery and Neuroradiology, Bellaria-Maggiore Hospitals. Three patients underwent a sole stenting treatment with a Flow-Dir- verter (Silk,BALT) and the others two patients were treated medically with anticoagulation therapy. The absence of prospective databases on the natural history and modalities of treatment of these lesions make their management frustrating and often ineffective. Our objective is the constitution of a Prospective Italian Register on natural history, neuroimaging diagnosis, potential modalities of treatment, clinical and neuroradiological follow-up of the Vertebralbasilar Dolichoectatic and Fusiform Aneurysms

PRET - A Randomized Trial Comparing Platinum and Hydrogel-Coated Coils in Patients Prone to Recurrence after Endovascular Treatment

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Centre Hospitalier de L’université de Montréal - Département de Radiologie; Montreal, Canada
Background: Endovascular treatment with platinum coils is safe and effective in preventing bleeding or re-bleeding of intracranial aneurysms. Unfortunately, endovascular treatment is frequently incomplete and may lead to angiographic recurrences in 10 to 20% of patients. This problem becomes significant in two circumstances that we label Aneurysms with a high Propensity for Recurrence after Endovascular Treatment (PRET): 1) patients with large aneurysms; 2) patients in whom platinum coil embolization has already been followed by an angiographic recurrence. In both cases recurrences with platinum is frequent (50% or more). New coils have been designed to preserve the safety of coil embolization while improving on long-term efficacy. In hydrogel coils, a polymer layer is designed to expand after exposure to blood, resulting in a mechanical stabilization of the coil mass. Unfortunately, there is still no scientific evidence that these new coils improve the angiographic or clinical outcome of patients treated by endovascular means.

Objective: The PRET trial aims at comparing hydrogel coils to standard platinum coils in patients with large aneurysms (≥10mm; PRET-1 patients) or in patients with a major recurrence after previous coiling (PRET-2 patients). The primary hypothesis is that the use of hydrogel coils decreases the recurrence rate from 50% to 30% (range: 40-50% to 21-30%) at 18 months. A total of 500 participants equally divided between the two treatment arms will be enrolled and followed for 18 months. PRET is designed as 2 parallel trials; thus PRET-1 (250) and PRET-2 cases (250) will be randomized separately. Adjudication of angiographic results and clinical outcomes will be done by independent committees blinded to treatment allocation. The duration of the study is five years, three years for patient recruitment plus 18 months of follow-up. The study will be conducted in 23-40 centers.

Interventions: The interventions will consist in: a/ standard platinum (any type) coil embolization, using standard or adjunct techniques, without the use of hydrogel coils, or b/ the substitution, as much as possible, of platinum by hydrogel coils, all other aspects of endovascular treatment remaining unchanged.

Outcome measures and analysis: The primary endpoint is recurrence rate defined as 1) a radiographic recurrence of the lesion or the presence of a residual aneurysm at last follow-up or 2) an intracranial bleeding episode or 3) retreatment of the same lesion by endovascular or surgical means during the follow-up period or 4) occurrence or progression of a mass effect in relation to the treated aneurysm. The secondary endpoints include procedural complications, clinical outcome, safety of hydrogel coiling and overall morbidity and mortality. A sample size of 250 patients for PRET-1 and 250 patients for PRET-2 equivalent to 125 patients in each treatment arm (platinum vs hydrogel) is sufficient to detect a decrease in the recurrence rate from 50 to 30% (range from 50-40% to 30-21%) with an alpha error of 2.5% and a beta error of 20% for each of the PRET subgroups (odd ratio 0.58). The primary outcome, recurrence rates, will be compared with a z-test for independent proportions at 6 months and 18 months. In order to describe how and when recurrences occur, Kaplan-Meier analysis of the recurrences will be done and the survival functions will be compared graphically and using a log-rank statistic. Secondary outcomes and safety data will be compared between groups through independent t-tests (quantitative variables) or chi-square statistics (categorical data).

Some preliminary results: By January 2010, 115 PRET subjects had been randomized by 22 registered PRET sites in Canada, the US, France, the UK, Japan and Chile. PRET cases were equally distributed among PRET-1 (49%) and PRET-2 (51%). Baseline characteristics of PRET subjects were as follows (averages given as mean (SD)). Age was 59 (11) years; 68% had only one aneurysm identified at baseline angiography; 15% presented with acute rupture of their aneurysm; for PRET-1 cases, the target aneurysm size was 15(5) mm and in 55% of cases located in the anterior circulation, whereas for PRET-2 cases those parameters were 12(8) mm and 58% respectively. A total of 31 Adverse Events were recorded, but only 9 qualified as Severe (7 PRET-2 vs 2 PRET-1).
AVFs I

Chairs: S. Kominami, R. Anxionnat
14.30-14.45

Spinal Vascular Malformations -
AVMs Experience

N. Mishra, S.B. Gaikwad, A. Garg,
S. Kumar
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Neurosciences Centre, Dept. of
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Seventy spinal vascular malformations
investigated and treated at our
institution in the last ten years were
analyzed to characterize their clinical
and imaging features and treatment
modalities instituted. Majority of
cases presented with gradually
progressive symptoms (>70%) and the
rest with acute or subacute symptoms.
The spinal subpial AVFs and true cord
AVMs predominated in our group,
mmost presenting in 1st to 4th decade of
life. The dural AVMs were observed
in later age groups-4th to 8th decade.
There were also metameric malformations
with intradural shunts. Generally
patients presented with a combination
of symptoms referable to cord or
cranial nerves, such as pain, paresis,
dysesthesias, bladder & bowel distur-
bances or impotence. Majority of the
malformations were located in the
dorso-lumbar area, though a few were
in cervical and sacral canal. Few were
associated with other abnormalities
such as hypermobile joint syndrome,
Klippel Trenaunay syndrome and re-
nal aneurysms. We did not encounter
any of our case to be associated with
obvious pulmonary malformations. All
patients were offered either surgical
or endovascular treatment depending
upon the characteristic of each
malformation with satisfactory outcomes
in most cases. The overall results in
relation to the type of malformation and
extent of neural deficit will be dis-
cussed.

14.45-15.00

Mechanism of the Formation of
Sural Arteriovenous Fistula
The Role of Emissary Vein

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Dural arteriovenous fistula (DAVF)
is acquired and progressive arterio-
enous shunts on or between the dura
matters. It is located not in the all cra-
nium but in the very specific parts, and
is separated two types; DAVF draining
through affected sinus (sinus type)
and direct reflux to cortical vein (non-
sinus type). However, even the sinus
type of DAVF ultimately changes to
the isolated sinus with cortical reflux
alone due to the progressive sinus oc-
cclusion, similar to the non-sinus type.
Such seemingly separated and complex
pathogenesis of DAVF is mysterious.
We tried to clarify the question of the
formation and development of DAVF
based on the hypothesis focusing the
emissary vein.

There are some consensus as the fol-
lowing background; 1) the distribution
of emissary vein definitely corresponds
to those of the location of DAVF, 2)
the isolated sinus with cortical reflux
which partially form the congenital
arteriovenous fistula, 3) affected sinus
often occludes in the process of the de-
velopment of DAVF. Based on this in-
formation the initiation of this disease
should be considered to focus to the
emissary vein. First, the inflammation
occurs at the penetrating point on the
dura due to the idiopathic causes like
allergy and thrombosis, or second-
ary to trauma and infection (Figures 1A,
2A). Local inflammatory reaction
induces vessel dilatation and neovas-
cularization (Figures 1B, 2B). Subse-
quently, the arteriovenous connections
are created on the arteriole level via
existing AV channels (Figures 1C, 2C).
Although emissary veins communicat-
ing the dural arteries might play a role
as one of the draining routes at first,
they become to occlude or degenerate
due to the compression of enlarged
emissary arteries or the hemodynamic
shift to the less resistance pathway
via big drainers. Following the dissap-
pearance of draining to emissary veins
main drainers into the sinus or cortical
veins may develop resulting in the
formation of initial figure of clinically
encountered DAVF (Figure 1D). AV
shunt expands to surrounding dura as-
sociated with the recruitment of feed-
ers from distant sites and drainers be-
come to dilate (Figure 2D). Such devel-
oment of arterial side may be caused
by the expansion of the inflammatory
reaction induced by cytokines, neo-
vascularization due to the expression
of angiogenic factors and the shift of
hemodynamic balance. As the second-
ary change of the drainer side in sinus
type sinus is progressively compart-
tmentalized and finally occludes due
to the thrombogenesis with activated
cogaulopathy or hemodynamic hyper-
trophy of sinus wall resulting in the
matured or final stage of DAVF with
drainage impairments, so called ag-
gressive type (Fig. 1E). Previous recog-
nition about the etiology of DAVF has
directed to the sinus hypertension and
sinus thrombosis, which is difficult to
explain the pathogenesis of non-sinus
type of DAVF. This unique theory
based on the initial change with the
inflammation and occlusion of emis-
sary vein may enable to understand
the common etiology of both (sinus &
non-sinus) types of DAVF.

Parallel Dura Sinus Dural
Arteriovenous Fistula: Diagnosis
and Treatment

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National Taiwan University Hospital,
Neuroradiology, Taipei, Taiwan

Purpose: To reveal the diagnosis and
and treatment of parallel dura sinus dural
AVF that is a special type of lesion lo-
cated at the wall of the sinus in our in-
stitute in the last 3 years.

Materials and Methods: Among the
120 cases of dural AVF diagnosis at
our institute between January 2007 to May 2010, we found 12 cases of parallel dural sinus dural AVF. They were 53.2 years (standard deviation = 12.8) in average, and half of them were males. Their medical records, imaging findings, treatment, and outcome were reviewed.

**Results:** Seven of the 12 patients presented with pulsatile tinnitus, 4 with focal neurological deficits, 1 with progressive dementia. Eight were located at transverse-sigmoid sinus and 4 of them were in superior sagittal sinus. Sinus occlusion was found in 3 of them. Complete obliteration of the lesions were found in 8 of them and partial treatment in 4. With the help of hybrid CTA technique, we can diagnose all the cases but the extent was usually underestimated. However, the hybrid CTA definitely can provide the treatment planning in most of the cases. We treated most of the cases with transvenous (n=7), mixed transvenous and transarterial coiling (n=2), and combination of transvenous coiling and transarterial NBCA embolization(n=3). The clinical outcome was good in 9 patients, stationary in 3.

**Conclusion:** Parallel dural sinus dural AVF is not uncommon, but it is important to make the right diagnosis to avoid dangerous and unnecessary sinus occlusion.

**AVFs 2**

**Chairs:** D.C. Suh, A. Tournade

**15:30-15:45**

**Introductory Lecture**

**Cavernous Sinus Dural Arteriovenous Shunts; Angioarchitect and Endovascular Treatment**

I.S. Choi

Lahey Clinic Medical Center, Burlington, VT, USA

**Introduction:** Dural arteriovenous shunts of the cavernous sinuses have been called as “indirect” or “slow flow” carotid-cavernous fistulas. Among cavernous sinus dural AVs, some are exclusively draining to ophthalmic veins and some to ophthalmic veins as well as inferior petrosal sinuses and pial veins. Arterial feeders are also variable. It is attempted to analyze details of angioarchitect, clinical presentations and their endovascular treatment.

**Material and Method:** All cases of dural arteriovenous shunts, treated in last 15 years by the author were retrospectively analyzed. Patients who didn’t undergo endovascular treatment were excluded. The location of actual AV shunts was defined as the earliest points of venous filling and it was divided to anterior-inferior compartment and superior-posterior compartment of the cavernous sinus and arterial feeders were categorized to ipsilateral, contralateral ICA and ECA. Drainage to ipsilateral and contralateral cavernous sinuses was separated and on other AV shunt side it was individually analyzed. Endovascular treatment was done via transarterial or transvenous route. For transvenous treatment, the inferior petrosal sinus was the first choice to reach the cavernous sinus. In cases the inferior petrosal sinus approach was failed, the ophthalmic vein or pterygoid venous plexus was selected. Results of treatment were assessed by the post-embolization control angiogram and clinical follow up.

**Results:** 31 patients who were confirmed to have dural AVs in the cavernous sinus by selected 24/28 underwent endovascular treatments. 12 patients were male and 20 were female. Only 1 patient had AV shunts bilaterally. There were two distinctive locations. In 4 cases, AV shunts located at the anterior-inferior(A-I) compartment of the cavernous sinus and in 28 cases including bilateral lesions, shunts were observed in the posterior-superior compartment. During the A-I compartment were fed only by ipsilateral ICA and/or ECA. The posterior compartment was not opacified in these cases. Venous drainage was only to the ipsilateral ophthalmic vein. None of A-I compartment Dural AVs is drained to cortical veins. Contrary, dural AVs of the posterior-superior compartment mostly had arterial supply. All P-S compartment cases had feeders from ipsilateral ICA and ECA. 26 out of 28 lesions had additionally supplied by contralateral internal carotid artery branch and 25 had contralateral external carotid artery supply. Venous drainages were also complex than A-I lesions. Constant venous outflow was ipsilateral ophthalmic vein except one case. 12/28(43%) had drainage to the inferior petrosal sinus. 39% of these drained additionally to cortical vein, either to the middle cerebral vein via sphenoparietal sinus or the mesencephalic vein via superior petrosal sinus. 9 lesions even drained to the contralateral cavernous sinus. Interestingly, one lesion drained only to the contralateral ophthalmic vein, causing symptoms on the opposite eye. Treatment; All patients were treated by endovascular technique. For 4 cases of the A-I compartment, one was treated by cavernous sinus packing, going through the occluded inferior petrosal sinus. In one case of unusual a high flow single hole AV fistula, the cavernous sinus was reached through the distal branch of the arterial feeder. One patient was
cured by inadvertent ligation of the draining ophthalmic vein. Transarterial embolization was done in one patient, since it was not possible to reach the cavernous sinus via venous route. For cases of P-S compartment, primary choice of approach was transvenous packing of the involved cavernous sinus. 12 lesions showed venous drainage to the inferior petrosal sinus on initial angiogram. It was rather uncomplicated procedure to reach the cavernous sinus. For remaining cases, 2 cases were treated initially by arterial embolization. It was attempted to go through the occluded inferior petrosal sinus in 14, but successful only in 7 occasions. For 7 failed patients, 2 treated successfully via ophthalmic vein, 1 through pterygoid venous plexus and 4 by arterial embolization. All patients who underwent transvenous treatment were confirmed cured by final control angiogram. Among 6 arterial embolization cases, 2 cases showed no residual shunt on angiograms. But, there were persistent filling of the involved cavernous sinus in 4 patients. On clinical follow up, all ocular symptoms resolved subsequently. These patients didn’t have any pial venous drainage.

**Conclusion:** cavernous Sinus dural Arteriovenous shunts have two distinctive divisions, one in the anterior-inferior and one in the posterior-superior compartment. The A-I lesions have unilateral arterial supply and unilateral venous drainage. Contrary, The P-S lesions have bilateral arterial supply and multiple venous outflow including the contralateral cavernous sinus.

**15.45-16.00 10’**

**Traumatic Trigeminal Cavernous Fistula Caused by Persistent Trigeminal Artery Variant Pseudo-Aneurysm: Endovascular Treatment**

S. Meckel\(^1\), W. McAuliffe\(^2\)

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We report a case of a 59-year-old male patient presenting with a post-traumatic trigeminal-cavernous fistula that underwent spontaneous occlusion. A pseudo-aneurysm located on a rare PTA variant, an anomalous anterior inferior cerebellar artery (AICA) originating from the internal carotid artery (ICA), was unmasked as the cause of the fistula. This pseudo-aneurysm was successfully treated with coil embolization. The anatomical variants of the trigeminal artery and potential implications for endovascular treatment of trigeminal artery aneurysms are discussed.

**16.00-16.15 10’**

**A Case of Primitive Trigeminal Artery-cavernous Fistula: Embolization, Complication and Strategy**

Q. Zeng, Y. Chen, X. He, Y. Li

Department of Interventional Therapy, Nanfang Hospital, Southern Medical University, Guangzhou, China

One 22-year-old man who suffered from primitive trigeminal artery-cavernous fistula was admitted to our hospital. Embolization with Guglielmi Detachable Coil and microcoils was attempted on the fistula from the internal carotid artery. The last microcoil was incorrectly released to basilar artery through primitive trigeminal artery. The misplaced microcoil was eventually retrieved by goose neck snare. There was no related complication in the follow-up period.
Fistula Occlusion (techni-

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Wednesday, 6 October

16.15-16.30 10'

Hydrocoil Occlusion for Treatment of Traumatic Carotid-cavernous Fistula

Z. Wang
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Key words : carotid-cavernous fistula; occlusion; HydroCoil

Objective To summarize our primary experiences regarding HydroCoil occlusion for the treatment of carotid-cavernous fistula (CCF), and to evaluate the effectiveness of this treatment.

Methods: From January 2006 to June 2007, 15 patients with traumatic CCF who were treated using HydroCoil occlusion were included in this study. All the patients presented with symptoms such as intracranial pulsatile noise, bulbar conjunctival hyperemia, and pulsatile exophthalmia. Cerebral angiography revealed that the fistula was located in the right carotid cavernous segment in 6 cases, in the left carotid cavernous segment in 8 cases, and on both sides in 1 case. Results: After CCF surgery, in 15 patients, the fistula was no longer visualized, the internal carotid artery on the affected side remained patent, and intracranial noise disappeared immediately. The preoperative symptoms exophthalmia, bulbar conjunctival hyperemia, etc., returned to normal 1 week after the operation. Vision recovered to varying extents. In the 9 patients who underwent 1-3 months of follow-up cerebral angiography, CCF recurrences and neurological complications were not observed. Conclusion: In the case of failure of detachable balloon embolization because the patient cannot tolerate the procedure or internal carotid artery occlusion on the affected side is contraindicated, HydroCoil occlusion is a safe and effective though expensive alternative and a stable method of maintaining high carotid artery patency.

16.30-16.45 10'

Complex Cerebral Arteriovenous Fistula; Endovascular Treatment Using Trans Venous and Trans Arterial Approach

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1 Americas Clinic / Incare, Medellin, Colombia, 2 HUSVP / Americas Clinic / Incare, Medellin, Colombia, 3 HUSVP, Medellin, Colombia

Background and Purpose: Endovascular treatment is an accepted choice for intracranial Pial and dural Arteriovenous Fistulas (PAVF/DAVF). We assessed the technical feasibility, safety and efficacy of the endovascular approach as monotherapy for difficult and, complex cases.

Methods: Since June 2006 to Dec 2009, of 68 patients with cerebral AVM’s treated, 20 cases were DAVF and 6 PAVF. 10 cases presented with hemorrhage, 2 cases with seizures, 8 cases with headache and, six cases truly incidental. 16 cases were treated with trans arterial strategy, while 7 lesions were treated for trans venous approach (retrograde technique). Clinical and radiological outcome were assessed and mid-term follow up is presented. Special consideration was take account about anatomical tips and, adverse events.

Results: Fistula Occlusion (technical success) of 97%. Undesired distal embolization was registered in one case. In two cases we had microcatheter retention. One case of recurrence after occlusion. None case presented re-bleeding during FU.

Conclusion: Current Microsystems can be safely maneuvered through severely tortuous arterials and venous vessels, although technically demanding to advance while a “retrograde” technique its carry out. The combined strategy was associated with high rates of occlusion. Although immediate and mid-term angiographic results are promising, long-term angiographic and clinical follow-up is essential to determine occlusion stability and clinical outcome.

Embolization of Carotid Cavernous Fistulae by Transvenous Approach through the Facial Vein

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Purpose: Endovascular embolization of carotid-cavernous fistulas (CCF) via transarterial and/or transvenous routes is an optimal treatment with promising results. Transvenous access through internal jugular vein and the inferior petrosal sinus (IPS) to the cavernous sinus (CS) is not always successful because of occlusion, stenosis or difficult anatomy of the IPS. To increase the successful occlusion of the fistulae, we present our experiences of trans-facial vein (FV) to embolize CCFs by using detachable coils.

Method: Over a 6-year period, a total of 72 CCFs were referred to our institute for transvascular embolization. Among these, 12 patients (male/female: 5/7, mean age: 43) with 13 CCFs (direct: 3, indirect: 10) were treated by trans-FV access. In 3 patients with direct CCFs, recurrent fistulae were found after transarterial treatment. Trans-FV access was selected because of occlusion (n=8), stenosis (n=2) or coil occlusion (n=2) of the IPS. Trans-FV access via superficial facial vein was performed in 11, while 2 through retromandibular vein. Detachable coils were selected to embolize in all CCFs.

Results: The variation of the termination of FV into external jugular vein was found in 7; while 6 terminate to usual internal jugular vein. All CCFs were successfully accessed by trans-FV catheterization; the fistulae were successful occluded by detachable coils on immediate angiography. One direct CCF had a recurrence and was managed by direct puncture of CS with coil and liquid adhesive embolization. Two had temporary third cranial nerve palsies. There was no significant peri-procedure complication or other recurrent or residual fistulae in an average of 9-month follow up.
Conclusion: The long and tortuous FV and superior ophthalmic vein may make catheterization difficult, particular in those CCFs with FV termination in the external jugular vein. However, trans-FV catheterization is a feasible and effective approach and provides a convenient alternative pathway for transvenous embolization of CCFs when failure to access the fistulae via the IPS; and catheterization of the CS via the FV is usually successful in our case study.

Unusual Carotid Cavernous Sinus Fistula
A. Karapurkar
SIR H N Hospital; Mumbai, India

Carotid Cavernous Fistula has been classified by Barrow into Type A (Between ICA and Cavernous sinus), Type B (between branches of ICA and cavernous sinus), Type C (between branches of ECA and cavernous sinus), Type D (between branches of ICA and ECAand cavernous sinus). A series of unusual cases of CCF have been seen and treated over the last 25 years. Three of these were due to spontaneous rupture of aneurysm two of which had been previously diagnosed. There was 1 Type A Post-traumatic fistula with separate post-traumatic aneurysm. One patient had a post-traumatic aneurysm of the cavernous ICA which several days later presented with intractable epistaxis and CCF. There was rupture of aneurysm on persistent trigeminal artery resulting in Type A CCF. There was Type A CCF with separate aneurysm following septic infection of the cavernous sinus. There was patient with bilateral CCF, Type A on one side and Type D on the other with congenital co-arctation of aorta. One side sub-sided after correction of the coarctation. A patient was shot in the neck and had post-traumatic CCF. One patient had an aneurysm on an unusual cavernous branch of the ICA with CCF. One patient had an AVF of the middle fossa and another of the petrosal vein. One had proptosis of the side opposite to the CCF due to occlusion of the draining cavernous sinus.

Unusual Carotid Cavernous Sinus Fistula: Therapeutic Options
F. Tsai
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Carotid cavernous fistula (CCF) is the result of severe injury or nontraumatic occlusion of venous drainages. The clinical symptoms are generally slowly worsen as increasing arterial shunting and venous pressure. Acute complication has been rarely reported. We like to present 8 patients with these rarely acute complications to define the mechanism and methods of embolization.

Materials and Methods: We have collected 8 unusual acute complication of CCF of more than 2400 angiographic cases from August 2000 to June of 2009. The emrgent embolization were performed with stent or coils.

Result and Discussion: One of these 8 patients who died with complication of increasing cerebral hematoma from delay in diagnosis and treatment.

The rest 7 of 8 patients who were diagnosed and treated emergently recovered well without significant deficit. Three of these 7 patients had increasing subarachnoid hemorrhage (SAH). One who had orbital hemorrhage from global rupture was from acute thrombosis of proximal jugular vein. The thrombosed jugular vein was thrombolysed to open facial vein to perform coiling. One patient who had enlarging sigmoid sinus arteriovenous fistula (AVF) had improved after embolization of CCF. One patient who suffered massive subarachnoid hemorrhages (SAH) from ruptured cavernous varix treated with covered stent. Another patient who had previous ligation of proximal common carotid artery of CCF at other country transferred to our hospital.

The embolization had to go through superficial temporal vein due to stenosis or occlusion of facial vein, inferior petrosal sinus and anterior communi- cating artery.

Arterial shunting from CCF induce venous hypertension, venous outlet obstruction will exaggerate venous pressure more. These 8 cases illustrated various examples of acute complication of CCF from acute venous congestion. These acute complication should be recognized and treated properly to avoid fatality.
**N-Acetylaspartate (NAA) A Biomarker for Disease Activity in NPSLE Patients**

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**Introduction:** SLE is an autoimmune disease with an annual incidence of 2.0-7.6 per 100,000. Neuropsychiatric systemic lupus (NPSLE) occurs in 25-70% of patients with lupus and is associated with increased morbidity and mortality. The clinical manifestations of NPSLE include: headache, stroke or stroke like symptoms, psychosis, seizures and cognitive dysfunction among others. Although clinical assessment is the cornerstone of the NPSLE diagnosis, this diagnosis can be difficult to make and is frequently presumptive. Other MR techniques like MR spectroscopy has shown to be another useful tool in the work up of SLE and NPSLE patients.

**Purpose:** The purpose of this study was to investigate if differences in metabolic ratios exist between patients with SLE and healthy control as well as between SLE patients without and those with neurological symptoms in three specific brain regions. The second aim was to investigate if changes in any of the metabolites or metabolic ratios are correlated to disease activity and other clinical parameters.

**Material Methods:** Subjects: 20 SLE patients with no neurological symptoms (18 females, 2 men, aged range 21.0-61.0, mean 39.4), 20 NPSLE (20 females, aged range 25.2-67.3, mean 41.5), and 20 (HC) (17 females, 3 men, aged range 18.8-61.0, mean 40.7).

**Methods:** All subjects had conventional MRI of the brain, and SWS MR Spectroscopy (PRESS, TR 2000ms, TE 30 ms, 2x2x2 cm voxel size) performed at baseline. The volumes were placed in the following regions of interest: frontal white matter (FWM), right insula (RI), and in occipital gray matter (OGM). All subjects had a clinical work-up including laboratory testing for SLE activity, SLEDAI score, mini mental testing, questionnaire about fatigue, depression, pain, and other symptoms. The conventional MR images were evaluated for any signal abnormalities, haemorrhage, acute ischemic events, old infarcts, focal lesions, and focal or general atrophy.

**Results:** A One-Way ANOVA revealed that the GPC/Cr ratio within the frontal white matter was significantly different across groups (mean±SD); HC: 0.31±0.09; SLE: 0.22±0.13; NPSLE: 0.30±0.09; p=0.04). Post hoc analyses indicated that this finding was due primarily to the SLE patients because this group had significantly reduced GPC/Cr as compared to HC (p=0.02) and NPSLE patients (p=0.04). No other metabolites in the frontal white matter showed differences across groups. Within the right insula NAA/Cr differed across groups (mean±SD); HC: 1.12±0.78; SLE: 1.12±0.17; NPSLE: 0.98±0.12; p=0.002. Post hoc analyses indicated that this finding was due primarily to the NPSLE patients because this group had significantly reduced NAA/Cr as compared to HC (p=0.002) and SLE (p=0.002) patients. No other metabolites in the insula or the occipital gray matter regions showed differences across groups.

When the SLE and NPSLE groups were combined, the NAA/Cr ratio in the right insula was significantly negatively correlated with the SLEDAI score (r=-0.45; p=0.005). Patients with lower NAA/Cr ratios had higher SLEDAI scores. This relationship was due in large part to neurobiological symptoms since patients with SLEDAI scores reflecting high neurobiological involvement had lower NAA/Cr (mean±SD): non-neuro 1.10±0.17; neuro: 0.98±0.14; p=0.04).

Furthermore when SLE and NPSLE groups were analyzed on the basis of active SLE symptoms, patients with active symptoms had lower NAA/Cr ratios (mean±SD): inactive 1.12±0.15; active: 0.90±0.15; p=0.01). No significant relationships were found between the frontal white matter GPC/Cr ratio and disease symptoms.

**Discussion and Conclusion:** The present data supports our and others previous findings of a reduction in NAA. This decline of NAA, which serves as a marker for normal healthy neuronal tissue, suggest that there is a reduction or destruction of neurons in patients with SLE even maybe more so in the NPSLE patients as seen by the significant decrease in the NAA/Cr ratio in the insular region. These findings again support the role of MR spectroscopy that together with conventional MRI aid in the work-up of SLE and NPSLE patients. Especially, these data as well as similar findings previously indicate that the NAA/Cr ratio may be an additional biomarker for disease activity specifically in NPSLE patients.
Results: There were 28 patients and 47 controls (mean age 40 years, 88% female). There is an increasing NAA/cho ratio in the anteroposterior direction along the longitudinal axis of the hippocampus in both patients and controls. The NAA/cho ratios in the hippocampal voxels were significantly lower in patients than in controls.

Conclusion: Our preliminary findings show that hippocampal NAA/cho ratios are lower in stable lupus patients than those in controls. Statistical correlation with the clinical data is still underway.

15:00-15:15

Hippocampal Activation Associated with Successful External Source Monitoring

S. Mugikura 1, N. Abe 1, M. Suzuki 3, A. Ueno 3, S. Higano 3, S. Takahashi 3, T. Fuji 2
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Studies demonstrating hippocampal activation associated with memories for persons from whom information is acquired (external source monitoring) are lacking. In this study, we used functional magnetic resonance imaging (fMRI) to investigate whether the medial temporal lobe (MTL), especially the hippocampus, is activated during the retrieval of external source information as well as during the retrieval of the items themselves. Before the fMRI, subjects intentionally studied photographs with names that were presented by either a woman or a man in a videotape. During the fMRI, subjects were asked to judge whether each photograph was new or old and, if they judged it as old, to indicate which person had presented the photograph during the study phase according to a confidence rating (high or low).

The results showed that successful retrieval of a source with high confidence was associated with increased activity in the hippocampus and that correct item recognition with failed source retrieval and low confidence for a source (i.e., item-only hits) was associated with decreased activity in the perirhinal cortex. Further analysis revealed that the hippocampus was also associated with familiarity/novelty distinction for the items themselves. The present study is the first to provide evidence that hippocampal activation is associated with external source monitoring. The results also support existing models suggesting that the hippocampus is associated with recollection-based recognition and the perirhinal cortex with familiarity-based recognition, with the possibility that the hippocampus plays roles in both recognition processes.

15:15-15:30

Plasma Levels of 3-Methoxy-4-Hydroxyphenylglycol Are Associated with Microstructural Changes within the Cerebellum in Early Stage of First-Episode Schizophrenia-A Longitudinal Voxel-Based Study

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Purpose: The plasma homovanillic acid (HVA) and 3-methoxy-4-hydroxyphenylglycol (MHPG) levels, which are peripheral catecholaminergic measures, have been good predictors of the response to antipsychotic treatment of schizophrenia. Although determining whether neural changes continue during the course of the illness is important for understanding its neurobiological features, we know of no voxel-wise correlation/regression analysis to explore the relationship between brain microstructures in schizophrenia and peripheral catecholaminergic measures such as HVA or MHPG. The aims of this study are to determine how the interval changes of the brain structures in early stage of first-episode schizophrenia may relate to interval changes of the clinical data including clinical symptoms of schizophrenia and catecholaminergic measures (MHPG and HVA).

Materials and Methods: A total of 22 patients, who fulfilled the DSM-IV-TR criteria for schizophrenia (SCH), were recruited for the study and all patients underwent the baseline MRI. Three-dimensional spoiled gradient recalled acquisition with steady state (3D-SPGR) and diffusion tensor imaging (DTI) were performed at 3T MR system. After a 6-month follow-up, a diagnosis of schizophrenia was established in 20 of the 23 patients. One of the 20 patients was excluded from the study, because the image quality was impaired by severe artifacts from dental materials. After a 6-month follow-up, these 19 patients were invited for a repeat MRI and 16 of the 19 patients had two MR scans of adequate quality on the same MR system using the same imaging protocol. Therefore, 16 patients (8 males, 8 females; mean age 29.0±11.6) were finally enrolled in the study as having been in the early stage of first-episode schizophrenia at the time of the baseline MRI. In 16 of the 19 patients, we measured a regional brain volume, fractional anisotropy (FA), and mean diffusivity (MD). At the time of baseline and follow-up MRI, all 16 patients underwent an extensive evaluation, which includes a psychopathological assessment (Positive and Negative Syndrome Scale: PANSS) and peripheral catecholaminergic measures (plasma MHPG or plasma HVA). Image processing for voxel-based analysis, a fully automatic technique for a computational analysis of differences in regional brain structure, was performed. The voxel-based analysis was performed as a series of single regression correlations in SPM5, with the interval changes in clinical data or peripheral catecholaminergic measures as the covariate.

Results: In the correlation/regression analysis, a positive correlation between the FA and MHPG was observed in the right cerebellar vermis, whereas an inverse correlation was found in any brain region. No significant correlations between any of the brain volume or MD and any laboratory data (MHPG and HVA) were also found. There were no significant correlations between any MR data and PANSS.

Discussion: Many regions of the brain are supplied by the noradrenergic system using the same imaging protocol.
ergic systems. The principal centers for noradrenergic neurons are the locus coeruleus and the caudal raphe nuclei. The ascending nerves of the locus coeruleus project to the frontal cortex, thalamus, hypothalamus and limbic system. The noradrenaline is also transmitted from the locus coeruleus to the cerebellum. Our positive correlation between frontal F changes and noradrenergic systems may reflect these functional connections in the cerebel- lum as noradrenergic systems. In addition, our finding may suggest that the microstructural changes within the cerebellum in patients with first-episode schizophrenia are present during 6-month follow-up. This also may be consistent with theoretical accounts of schizophrenia as a disorder of functional integration, and with the cognitive dysmetria hypothesis, which posits a disconnection within the cor- tico-cerebellum-thalamo-cortical circuit (CCTCC) as a fundamental abnormal- ity in schizophrenia.

Conclusion: We found evidence that patients in early stage of first-episode schizophrenia exhibit the positive correlation between the FA changes and MHPG change in the cerebellar vermis, which may reflect the both ana- tomical and functional connections within the cerebellum to the pre- frontal cortex, the subcortical limbic structures and monoamine-producing brainstem nuclei.

15:30-15:45
10' fMRI Study of Body Image Distortion in Anorexia Nervosa

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The body image distortion is a core symptom of Eating Disorders (Eds), and is defined as “a disturbance in the way in which one’s body weight or shape is experienced” (American Psychiatric Association, 1994). Recently, functional magnetic resonance imaging (fMRI) has been used to study cerebral reactions to distorted own or other female bodies in adolescent patients with Anorexia Nervosa (AN). The present study aimed at the investigation of the neural circuitry activated by the recognition of the body image in Anorexia Nervosa patients, by examining the cerebral response to their own body pictures (normal and distorted), evaluated through functional magnetic resonance imaging (fMRI) and compared with normal controls. The study was carried out at the unit of Psychiatric and of Neuro- radiology of the Florence University School of Medicine. The fMRI study was performed on a consecutive series of 30 subjects with a diagnosis of Ano- rexia Nervosa Restricting Type, and 24 healthy control subjects. The inclusion criteria was a current diagnosis of Anorexia Nervosa Restricting Type (AN-R) according to DSM IV criteria, evaluated through Structured Clinical Interview for DSM-IV (SCID) for Axis I mental disorders. The age of onset was 15 ± 3.3 years. The mean dura- tion of illness was 7.6 ±4.3 years. The exclusion criteria were as follows: previous Eating Disorder other than AN-R, evaluated through SCID for Axis I mental disorders, illiteracy, mental retardation, any known neurological disease, claustrophobia, metallic im- plants, prior psychotherapeutical and/or psychopharmacological treatment for Eds, current use of any psychoactive medi- cations. Photographs of their own body (normal, undersize, oversize) were contrasted to meaningful objects photographs (houses). The contrast between body and house conditions attempts to identify the neural sub- strate of body perception. Contrasts between bodies of different sizes are designed to show the processes related to body size perception and evaluation.

The probands dressed in a black bikini, stays against a neutral back- ground without any reference points on clothes or background. The sub- ject’s image was taken by a camera and modified by means of Power Point Format Picture Size with a progressive size reduction (from 95% up to 65%) and size increase (from 110% up to 175%), taking height as fixed. The task consists on three im- age sequences (three minutes per se- quence). Each image was shown for 2 sec, followed by a blank screen for 1 sec. Each sequence was composed by ten body pictures (“on”condition) fol- lowed by ten house-control (“off” condition). Each sequence was repeated three times for each type of stimuli. The sequences were as follows: 1) the first sequence based on normal size body photos; 2) the second based on increased size body photos; 3) the third sequence based on reduced size body photos. The main findings of the present study are:

1) general hyperactivation (all con- ditions) in right Inferior and Superior Parietal Gyrus in AN compared to healthy controls; 2) higher activation in limbic and paralimbic structures (right amygdala and parahippocam- pus) among AN patients, upon per- forming the oversize distorted-image task; 3) general hyperactivation (all conditions) in right and left Prefron- tal area (medial and superior orbitofrontal cortex), among AN patients. The main finding of this study is the higher activation in right amygdala and parahippocampus among AN pa- tients compared with healthy controls when they are confronted with their own distorted oversized body image. The amygdala activation in AN pa- tients study viewing one’s own overs- sized body image suggests that the distortion of their own body size could has been interpreted as a serious fear- ful information. As for patients with anxiety disorders, amygdala activa- tion has been interpreted as being caused by aversive or threat-related events and by a potential recall of aversive memories. To our knowledge this is the first study which found a significant difference between AN pa- tients and healthy subjects in terms of prefrONTAL activation in response to viewing one’s own body image. Overall the main results of the present study suggest that AN patients show a different pattern of cerebral activa- tion in response to their body image, characterized by a greater selective attention to the body perception, a higher response in limbic/paralimbic system, and a reduced functionality of emotional processing and modulation. If our knowledge this is the first study which found a significant difference between AN pa- tients and healthy subjects in terms of prefrontal activation in response to viewing one’s own body image. Over- all the main results of the present study suggest that AN patients show a different pattern of cerebral activa- tion in response to their body image, characterized by a greater selective attention to the body perception, a higher response in limbic/paralimbic system, and a reduced functionality of emotional processing and modulation.}

15:45-16:00
10' Cortical Representation of Taste in the Human Brain: A fMRI and DTI Study

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Purpose: In the human brain taste is represented in the primary gusta- tory area (GI), between the frontal operculum and the insula. The study aimed to highlight a topographi-
cal organization of the BOLD effect elicited by four taste stimuli (salty, sweet, sour, and bitter) and by a neutral stimulus (distilled water) in the ipsilateral and contralateral area GI using Functional Magnetic Resonance Imaging (fMRI) and Diffusion Tensor Imaging (DTI). We also sought to establish the contribution of the corpus callosum (CC) to the bilateral representation of unilateral taste stimulation in area GI. Materials & Methods: The cortical representation of the gustatory and chemiotopic organization of area GI were studied in 15 healthy subjects (10 women; 5 men) by applying 5 taste stimuli (salty, sweet, sour, bitter, neutral) to either side of the tongue (2-5 stimuli/subject). The contribution of the CC to bilateral taste representation was explored in 6 patients with callosal resection performed to treat severe epilepsy, by applying a salty stimulus to either side of the tongue. All studies used a 5-min fMRI block design protocol, approved by the local Ethics Committee, envisaging alternate periods of rest and stimulation.

Results: In all subjects unilateral taste stimulation with different tastants, including water, evoked bilateral activation in area GI. The ipsilateral foci were generally larger and the signal increases greater. The mean Talairach coordinates of the foci evoked by the different tastants were slightly but not significantly different (p>0.05), with broad overlap between the cortical areas activated by each type of stimulus. In addition, activations exhibited considerable interindividual variability. In 5 patients (2 with total, 1 with partial anterior and 2 with partial posterior resection), unilateral salty stimulation evoked activation of area GI bilaterally. In the remaining patient with total callosotomy, left hemispheric stimulation activated ipsilateral GI, while right stimulation activated GI in both hemispheres. Salty stimulation also evoked significant activation in a ventromedial thalamic nucleus, likely the ventropostero-medial nucleus, parvicellular portion (VPMpc), and in a pontine region both in controls and in patients. DTI allows virtual reconstruction of axonal fibres via analysis of the diffusion of water molecules along different directions. Diffusion tensor tractography showed that in control subjects and in patient with posterior resection, the fibres connecting areas GI in the two hemispheres crossed through the anterior CC. In patients with anterior and total resection, areas GI were connected through subcortical structures, likely the pontine parabrachial nucleus.

Conclusion: This study confirmed previous neuropsychological findings suggesting that gustatory pathways from tongue to cortex are bilaterally distributed, with an ipsilateral predominance. It can be hypothesized that the gustatory stimulus reaches ipsilateral area GI via the solitary tract nucleus, then projects to ipsilateral area GI via the thalamic relay, i.e., VPMpc, and then to contralateral area GI through the CC. In control subjects, bilateral activation of area GI thus appears to be mediated, at least in part, by the anterior portion of the CC. The bilateral activation of area GI seen in patients lacking the anterior part of the CC could be subserved by a subcortical pathway originating in the pontine parabrachial nucleus, projecting to the VPMpc nuclei of both hemispheres and then to area GI of the same side. Although distinct GI zones were activated by the different taste stimuli, a clear topographical organization of the cortical areas activated by specific taste stimuli (chemiotopy) could not be recognized. A possible explanation for these findings is that the fMRI technique is unable to resolve fine topographical arrangements. On the other hand, the discriminative role of area GI for the different tastants could be subserved by a non-spatial mechanism. Both explanations may also apply. Finally, the considerable inter-individual variability of activation, likely depending on individual cerebral functional anatomy, is in line with the notion that tastes are perceived differently by different subjects.

fMRI

Chair: SK. Lee, S. Wattjes

16.00–16.15

10’

3T MR Spectroscopy in Drug-Resistant Temporal Lobe Epilepsy with Hippocampal Abnormalities

S. Battaglia1, A.F. Mariani1, L. Albini Riccioli2, V. Clementi1, G. Rubboli1, F. Agati1, R. Agati1
1 Neurology Department, Bellaria Hospital, Bologna, Italy; 2 Department of Statistics, University of Bologna, Italy

Introduction: 3T MR systems allow more accurate anatomical investigations and more precise MRS studies. Proton magnetic resonance spectroscopy (1H-MRS) of hippocampal regions might provide lateralizing informations in the presurgical evaluation of patients with drug-resistant temporal lobe epilepsy (TLE).

Methods: From December 2005 to May 2008 we performed 3T 1H-MRS (Signa Excite system, GE) on bilateral hippocampal regions in 20 patients (9 males -11 females, mean age 39±7) suffering from intractable TLE associated with mesial temporal sclerosis (MTS). All patients underwent total surgery; pathological examination of surgical specimens demonstrated MTS in all cases, with associated cortical dysplasia in some. 1H-MRS spectra were obtained by a PRESS sequence with TE 35 ms, TR 2000 ms. Data postprocessing was performed using LCModel. The tNAA/Cr, tNAA/Cho, tCr/Cr, mI/Cr, Gd/Cr ratio were calculated and compared with data collected from 12 healthy volunteers. Data from patients versus normal subjects, and data from the affected hippocampus versus the contralateral healthy, one were compared and statistically evaluated (test di Mann-Whitney). We are now checking in the same way the same patients surgical treated to assess whether there are changes of metabolites in the not removed hippocampus.

Results: Our preliminary analysis shows: a) a statistically significant (p<0.01) bilateral reduction of tNAA/Cr in hippocampal regions in patients as compared to normal subjects, overall on the pathological hippocampus; b) in all patients a statistically significant increase (p<0.01) of the mI/Cr ratio in the affected hippocampus as compared to the contralateral one.

Conclusion: Our study demonstrates concordant patters of increased hippocampal mI/Cr ratio and pathological hippocampus; an additional interesting finding was the bilateral reduction of hippocampal NAA/Cr ratio as compared to normals, suggesting metabolic abnormalities in both hippocampi. This bilateral metabolic abnormalities may be reversible in not removed hippocampus.

Radiological Assessment of White Matter Pathway Involvement after Temporal Lobe Epilepsy Surgery - FA Maps versus Tractography

A. Kaneider1, G. Kasprian1, C. Mitter1, Th. Czech1, M. Weber1, D. Prayer1
1 Univ. Clinic of Radiodiagnostics; Vienna, Austria; 2 Unic Clinic of Neurosurgery; Vienna, Austria

Purpose: Diffusion tensor imaging (DTI) based tractography is increasingly used in clinical practice to non-invasively study cerebral structure and its alterations. Due to the time-
of these abnormalities by surface visualization could help in the diagnosis of dysplastic lesions that are not vis

Sulcal Abnormalities Associated with Focal Cortical Dysplasia

C. Mellerio, C. Oppenheim, C. Rodriguez, R. Souillard, O. Nagmara, S. Rodrigo, B. Devaux, F. Chassoux, JF. Meder

Purpose: To evaluate the MR aspects in a group of patients with drug resistant partial epilepsy (DRPE) who had surgery with neuropathological confirmation of Focal Cortical Dysplasia of Palmini type II A & B, and search for possible differential MR features in the two subgroups.

Materials and Methods: We studied 30 consecutive histologically proven Taylor-type FCD (23 frontal, 6 parietal, 1 temporal) associated with typical MRI features (FLAIR hyper-intensity, blurring of the grey–white matter interface and cortical thickening). Comparison with 13 healthy subjects without neurological history was done. MR images were acquired on a 1.5 T Signa Hdx (GE Health Care, Milwaukee) using a 3D T1-fast field echo sequence. We analysed sulcal morphology using automated sulcal extraction and morphometry (Anatomist / Brainvisa 3.1, CEA, Orsay, France).

Result: 25 out of 30 patients showed sulcal abnormalities near the dysplastic lesion. These abnormalities consisted in atypical morphology (shape, number of intersection) or increased sulcal depth within the FCD neighbourhood. All patients with central FCD (n = 20) had an unusual ramus of the central sulcus, that was observed in only 6 out of 13 controls. Moreover, this ramus exhibited an atypical pattern (location, morphology, depth), not observed in healthy subjects.

Conclusion: FCD are often associated with atypical sulci. The detection of these abnormalities by surface visualization could help in the diagnosis of dysplastic lesions that are not vis

16.45-17.00 10'

MRI Aspects in 100 Focal Cortical Dysplasias of Palmini Type II Proven by Neuropathology

N. Colombo, L. Tassi, A. Citterio, F. Cardinale, G. Lorusso, R. Spreatco

1 Ospedale Niguarda, Department of Neuroradiology, Milan, Italy.
2 Ospedale Niguarda, Centro di Chirurgia dell’Epilessia Claudio Munari, Milan, Italy.
3 Istituto Nazionale Neurologico Carlo Besta, Department of Experimental Neurophysiology and Epileptology, Milan, Italy

Aim: Our purpose is to study the relationship between focal cortical dysplasia (FCD) and brain sulcal abnormalities using surface visualization.

Materials and Methods: We studied 30 consecutive histologically proven Taylor-type FCD (23 frontal, 6 parietal, 1 temporal) associated with typical MRI features (FLAIR hyperintensity, blurring of the grey–white matter interface and cortical thickening). Comparison with 13 healthy subjects without neurological history was done. MR images were acquired on a 1.5 T Signa Hdx (GE Health Care, Milwaukee) using a 3D T1-fast field echo sequence. We analysed sulcal morphology using automated sulcal extraction and morphometry (Anatomist / Brainvisa 3.1, CEA, Orsay, France).

Result: 25 out of 30 patients showed sulcal abnormalities near the dysplastic lesion. These abnormalities consisted in atypical morphology (shape, number of intersection) or increased sulcal depth within the FCD neighbourhood. All patients with central FCD (n = 20) had an unusual ramus of the central sulcus, that was observed in only 6 out of 13 controls. Moreover, this ramus exhibited an atypical pattern (location, morphology, depth), not observed in healthy subjects.

Conclusion: FCD are often associated with atypical sulci. The detection of these abnormalities by surface visualization could help in the diagnosis of dysplastic lesions that are not vis

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brain suspected as the EZ based on electroclinical data. All patients underwent 3D volume FFE-T1W images utilized for multiplanar reconstructions (MPR).

MR examinations were retrospectively reviewed by two experienced neuroradiologists (N.C, A.C) involved in the epilepsy program.

The most electroclinical features were individually evaluated on each sequence and in different planes: cortical thickness, blurring of gray matter/white matter junction, hypersignal on T2WI and hyposignal on T1WI of the subcortical white matter (WM), tapering of the WM signal changes toward the ventricle, hypersignal on T2WI of the cortex, gyration anomalies. According to their extension the dysplasias were subdivides as focal, sub-lobar, lobar & multilobar.

Results: MR was positive in pts 78% and negative in 22 pts (22%). In the group of positive MR the diagnosis was: FCD Palmini type II in 67 cases (85%), FCD Palmini type I in 9 case, low grade tumor in 2 cases. Among the 67 cases correctly diagnosed by MRI as FCD Palmini type II, 55 case (82%) were proven at neuropathology as having balloon cells (BC) (Palmini type II B) and 12 (18%) without BC (Palmini type II A). Of the 9 cases diagnosed on MRI as FCD Palmini type I, 6 were proven without BC and 3 with BC at neuropathological examination. Statistical analysis of the MRI data was performed in search for statistical significance of each MRI sign. Definitive results and discussion will be presented.

17.00-17.15 10' Does Electroconvulsive Therapy (ECT) Affect White Matter Integrity? A Longitudinal Diffusion Tensor Imaging Study of Patients with Depression

E. Larsson1, E. Steffensen2, P. Nordanskog3, U. Dahlstrand1, M. Larsson1, L. Knutsson1, A. Johanson3
1 Uppsala University, Sweden; 2 Aarhus University, Aalborg, Denmark; 3 Lund University, Lund, Sweden

Background: Depression is a major cause of morbidity, disability, and mortality throughout the world but its pathophysiology is not yet fully understood.

The most effective antidepressant treatment is electroconvulsive therapy (ECT), which is used especially in severe melancholic and suicidal cases. The mechanism of action of ECT still remains elusive and the knowledge of the potential effect on cerebral white matter integrity is scarce.
Corpus Callosum Abnormalities Associated with Antiepileptic Drugs in Temporal Lobe Epilepsies. Evaluation by Diffusion Tensor Imaging

H. Gunbey1, K. Ercan1, A. Findikoglu2
1Ataturk Education and Research Hospital; Ankara, Turkey; 2Taksim Education and Research Hospital, Istanbul, Turkey

Purpose: Epilepsy is more than a grey-matter disorder that affects large white matter connections of brain while seizure generation and propagation. The mechanism for such changes remains unclear. Recent studies using diffusion tensor imaging (DTI) have advanced our knowledge of temporal and extratemporal white matter abnormalities in temporal lobe epilepsy (TLE). The purpose of this study was to investigate the microstructural changes of corpus callosum in TLE patients and whether these abnormalities are related to antiepileptic drug (AED) therapy.

Methods: Ten TLE patients who receive AED therapy, ten TLE patients with any therapy and ten controls included in the study. The regions of interest in the corpus callosum were outlined to each Witelson region (WR). Fractional anisotrophy (FA), apparent diffusion coefficient (ADC) and three main diffusivity values ($\varepsilon_1$, $\varepsilon_2$, $\varepsilon_3$) were acquired from each WR. Fiber tractography was also performed in the course of each WR. DTI indices of these tracts and each WR were compared between three subject groups and correlates examined with clinical variables that included duration of epilepsy, gender, AED type and AED therapy exposure.

Results: In TLE subjects with receiving AED therapy significant ($p<0.05$) decreased FA and increased ADC values of corpus callosum were obtained when compared to other groups. There was no significant relationship between AED type and DTI indices. Analysis of eigen values in splenium of corpus callosum (WR7) $\varepsilon_1$ values were significantly decreased related with AED medication time ($p<0.05$). FA values of rostrum and corpus showed reduction with duration of epilepsy.

Conclusion: TLE is associated with abnormal integrity of corpus callosum white matter tracts. AED therapy may cause additional damage on secondary degeneration and medication time effects especially splenium of corpus callosum.

MRI Changes in Status Epilepticus: A Systematic Review in a Tertiary Center

N. Bargalló Alabart, T. Lema, M. Carreño, A. Donaire, X. Aparicio, I. Maestro
Hospital Clinic i Provincial de Barcelona, Spain

Objective: The objective of our work was to study MRI changes during episodes of status epilepticus (SE) and associated clinical and EEG features.

Material and Methods: We retrospectively reviewed 112 patients who were discharged with diagnosis of SE during the years 2000-2007. Only patients with MRI exams were included. Only 24 patients fulfilled the inclusion criteria. Mean time between MR exam and status onset was 5 days (range 1-17). RMI exams included T1WI, T2WI, FLAIR and DWI. In some patients T1WI alter contrast enhancement and MRS were also performed. EEG data and seizure semiology were also reviewed. Descriptive statistical analysis was performed.

Results: MRI changes were found in 10 patients. Most patients (6) in this group had complex partial SE. All patients had MRI changes involving cortical gray matter; additional changes were found in hippocampus, amygdala, cerebellum and bilateral thalamus. Correlation between the location of the MRI changes and the discharges in the EEG was found in 5 patients. All the patients showed changes in FLAIR sequence. Eight patients showed diffusion restriction in DWI, and one patient showed increased diffusion. In the two patients that MRS was performed lactate was increased. In 7 cases follow-up studies were performed and resolutions of the findings or atrophic changes were observed in 6 patients.

Conclusion: A significant percentage (41.66%) of all episodes of SE display signal changes in MRI. These seem to be more frequent in complex partial status epilepticus. The most common pattern of involvement is cortical although gray and matter subcortical structures may also display signal changes.
By contrast, there is now considerable evidence from the fields of epidemiology, pharmacology, neuroimaging, clinical medicine, microscopic anatomy, and molecular biology indicating that non-genetic AD is a vascular disorder whose underlying cause is impaired blood flow to the brain in the advanced stage of aging. This evidence can be summarized as follows: 1) numerous epidemiologic studies link AD risk factors such as stroke, heart disease, hypertension and atherosclerosis to reduced cerebral blood flow, 2) evidence that AD and vascular dementia (VaD), an acknowledged vascular disorder, share practically all risk factors and may benefit from the same treatments, 3) drug therapy reported to improve AD symptoms (including prescriptive drugs now available for AD) all increase blood flow to the brain, 4) people who are likely to develop AD but do not yet show dementia symptoms can be identified by using brain blood flow measurements and brain PET scans, 5) the clinical symptoms are very similar in most AD and VaD patients, 6) parallel abnormalities occur in brain vessels and brain tissue including Abeta laden plaques in AD and VaD patients, 7) low levels of brain blood flow in aged humans and animals can lead to abnormal cell metabolism, tissue damage and memory problems, independent of Abeta, 8) mild cognitive impairment can convert equally to AD or VaD, and 9) small vessel damage (including the subcellular organelles such as mitochondria) is present in the majority of AD brains after death. For this reasons, it is suggested that AD be re-classified as a oxidative stress-induced vascular disorder and described as a “vasocogno-pathy” with the mitochondrial failure. The term aptly describes the origin of the disease (vaso: vessel blood flow), its primary effect on a system (-cogno: relating to mental ability) and its clinical course (-pathy: disorder). Re-classification of AD from a neurodegenerative to a vascular and/or mitochondrial disorder would contribute to the development of truly beneficial treatments or a cure, improve patient management, provide earlier diagnosis, and reduce the number of AD cases in the future by aggressively treating the risk factors that can turn on this dementia. In conclusion, a bare-bones examination of the literature reveals no compelling evidence that Abeta deposition causes AD or that it results in significant damage to brain cells. By contrast, the findings that support AD as a primary oxidative stress induced mitochondrial failure (e.g., which induces the cellular and subcellular hyperfusion) and vascular disorder appear substantially more convincing.

Finally aging-related changes involving mitochondrial dysfunction are critical to our understanding of Alzheimer pathobiology and energy homeostasis. With age and diabetes, antioxidant enzymes are reduced and this is an initial stage of future pathological processes. Understanding the attenuation or loss of these critical defense mechanisms will help in our fight against this devastating disease.

We introduce a new approach to AD prevention and treatment through enhancing these defense systems through nutritional and antioxidant approaches as part of an early intervention and prevention strategy.

The finding of amyloid-beta (Abeta) deposition in AD brains in autopsy studies led to formulation of the so-called "amyloid hypothesis". For over a decade, the amyloid hypothesis has effected such influence and guided research in the field of Alzheimer's dementia to such an extent that many consider it as the gold standard in scientific investigation. We have made an extensive review of the literature which claims that AD is caused by the deposition of Abeta within structures called senile plaques that invade AD brains and that such plaque formation then leads to further abnormalities within the nerve cells, eventually killing them. We have found little evidence to support this statement and ample evidence to question it. For example, the amyloid hypothesis has been criticized because its research findings up to now have not generated any benefits in the clinical management and treatment of AD patients nor to an understanding of why the disorder affects mainly elderly patients. The three main flaws of the amyloid hypothesis appear to be that: 1) Abeta deposition has not been found to be toxic or cause damage and death of nerve cells in the human or animal brain, 2) the brains of many cognitively normal aged individuals show abundant Abeta containing senile plaques but no clinical signs of Alzheimer’s disease, 3) and since there is general agreement that senile plaques containing Abeta are the products of degenerating neurons, they cannot be the cause, since it is axiomatic that a product is the result not the cause of a particular activity. By contrast, there is now considerable and still growing evidence from the fields of epidemiology, pharmacology, neuroimaging, clinical medicine, microscopic anatomy, and molecular biology indicating that non-genetic AD is a vascular disorder whose underlying cause is impaired blood flow to the brain in the advanced stage of aging. This evidence can be summarized as follows: 1) numerous epidemiologic studies link AD risk factors such as stroke, heart disease, hypertension and atherosclerosis to reduced cerebral blood flow, 2) evidence that AD and vascular dementia (VaD), an acknowledged vascular disorder, share practically all risk factors and may benefit from the same treatments, 3) drug therapy reported to improve AD symptoms (including prescriptive drugs now available for AD) all increase blood flow to the brain, 4) people who are likely to develop AD but do not yet show dementia symptoms can be identified by using brain blood flow measurements and brain PET scans, 5) the clinical symptoms are very similar in most AD and VaD patients, 6) parallel abnormalities occur in brain vessels and brain tissue including Abeta laden plaques in AD and VaD patients, 7) low levels of brain blood flow in aged humans and animals can lead to abnormal cell metabolism, tissue damage and memory problems independent of Abeta, 8) mild cognitive impairment can convert equally to AD or VaD, and 9) small vessel damage (including the subcellular organelles such as mitochondria) is present in the majority of AD brains after death. For this reasons, it is suggested that AD be re-classified as a oxidative stress-induced vascular disorder and described as a “vasocogno-pathy” with the mitochondrial failure. The term aptly describes the origin of the disease (vaso: vessel blood flow), its primary effect on a system (-cogno: relating to mental ability) and its clinical course (-pathy: disorder). Re-classification of AD from a neurodegenerative to a vascular and/or mitochondrial disorder would contribute to the development of truly beneficial treatments or a cure, improve patient management, provide earlier diagnosis, and reduce the number of AD cases in the future by aggressively treating the risk factors that can turn on this dementia. In conclusion, a bare-bones examination of the literature reveals no compelling evidence that Abeta deposition causes AD or that it results in significant damage to brain cells. By contrast, the findings that support AD as a primary oxidative stress induced mitochondrial failure (e.g., which induces the cellular and subcellular hyperfusion) and vascular disorder appear substantially more convincing.

Finally aging-related changes involving mitochondrial dysfunction are critical to our understanding of Alzheimer pathobiology and energy homeostasis. With age and diabetes, antioxidant enzymes are reduced and this is an initial stage of future pathological processes. Understanding the attenuation or loss of these critical defense mechanisms will help in our fight against this devastating disease.

We introduce a new approach to AD prevention and treatment through enhancing these defense systems through nutritional and antioxidant approaches as part of an early intervention and prevention strategy.
Aph-1b and Pen-2 proteins. Alpha-secretase proteolysis leads to the formation of a soluble form of a physiological amyloid protein consisting of 40 amino acids (Abeta40). However, proteolysis catalysed by beta and gamma secretases initiates sequestration of insoluble aggregating amyloid 42 aminoacid protein (Abeta42). Abeta42 is the microscopic conversion of senile plaques (SP) which also consist of many other proteins and degenerated neural and glial cells. Apart from SP other pathomorphological markers of AD include neurofibrillary tangles (NFT) formed from paired helical filaments (PHF). It is still necessary to elucidate whether the aggregation of amyloid is the primary pathomechanism of AD as Abeta has also been found to accumulate in people with advanced age not suffering from dementia. There have also been reports suggesting that the disturbed process of protein degradation through ubiquitin-proteasome pathway is the primary event in AD progression. Other phenomena such as oxidative stress, prolonged inflammatory response, formation of pathological ion channels and altered neurotransmission may be regarded as secondary in AD. Another important cause of neuronal death in AD is the phosphorylation of tau protein leading to neurofibrillary degeneration. Pathological tau is hyperphosphorylated and aggregates into neurofibrillary tangles. In addition to these factors glycation, as an other posttranslational modification by miRNA. One miRNA molecule can interact with even 1000 different genes leading to the disturbed process transcription by miRNA. One miRNA molecule can interact with even 1000 different genes leading to the disturbed process transcription and DNA repair.

The multigenetic and multifactorial character of AD entails a novel approach to its pathogenesis. Sporadic AD is a systemic gene deregulation, as searching for single hot spot mutations (PHF) formed from paired helical filaments (PHF). In 2007 Maes et al. published the results of expression profiling study and found significant changes in gene activity in sporadic AD individuals as compared to aged-matched normal elderly controls. Different groups of genes showed a significant decrease in expression in AD subjects; mainly genes responsible for cytoskeletal maintenance, cellular trafficking, stress response, redox homeostasis, transcription, and DNA repair.

The multigenetic and multifactorial character of AD entails a novel approach to its pathogenesis. Sporadic AD is a systemic gene deregulation, as searching for single hot spot mutations in sporadic AD individuals as compared to aged-matched normal elderly controls. Different groups of genes showed a significant decrease in expression in AD subjects; mainly genes responsible for cytoskeletal maintenance, cellular trafficking, stress response, redox homeostasis, transcription, and DNA repair. The discovery of new genetic mechanisms in human AD pathology opens a new area in searching for genetic etiology of Alzheimer disease.

Proton MR Spectroscopy (1h MRS) in Patients with Mild Cognitive Impairment (MCI)

J. Walecki
Medical Research Centre, Polish Academy of Science; Warsaw, Poland

Aging of the society leads to senile diseases, including the Alzheimer disease (AD) as well as mild cognitive impairment (MCI) which become a serious medical and socioeconomic problem. Therefore, progress in early diagnosis as well as in its successful treatment is necessary, especially in an early stage of disease. Most patients advanced in age suffer from physiological memory disorders that require a careful clinical assessment as it is extremely difficult to mark out the line between physiological and pathology. Thus, when the disorders of memory and other cognitive functions go beyond the standards of age and educational level but have not reached the standards of dementia yet, we diagnose mild cognitive impairment (MCI).

Currently, base on criteria established by Mayo Clinic Group, MCI is define as a transitional state between normal aging and a phase of degenerative disease in which memory impairment is greater than expected for age, but general cognitive function and daily living activities are preserved. Among a wide range of imaging modalities which can be applied in MCI diagnosis, 1H MRS and PET(amyloid imaging) seem to be the most sensitive methods. Other commonly known techniques such as the visual inspection of hypocampal formation (MRI), volumetric method (including longitudinal studies) and perfusion techniques (SPECT, MR perfusion, CT perfusion) are not sufficient in such an early stage of Alzheimer disease. People suffering from MCI, especially amnestic form (aMCI), are subject to the risk of developing dementia, particularly Alzheimer's disease (AD). According to various reports the percentage of conversion from aMCI into AD ranges from 1 to 25% per year, usually the mean time of dementia development and the regeneration after therapy. However, no treatment is currently available. The risk factors are not well defined. Therefore, the decreasing of NAA concentration means the loss of neurons, while the increasing of mI peak means the glial reaction. These two mechanisms are typical of degenerative process. There have appeared a great variety of valuable papers which present the usefulness of spectroscopy in the diagnosis of MCI and AD.

Contrary to aging in MCI and AD the above mentioned features of spectroscopy are typical. There are several reports on AD or MCA dysfunctions among the limbic system in patients with Alzheimer’s disease A relatively small number of spectroscopic examinations have carried out on patients with MCI. Some of them were presented by Catani et al. located voxels in the white matter at the ventricular triangle level and Kantarci et al. examined the posterior part of cingulate gyrus in patients with MCI as well as with AD.

Contrary to aging in MCI the above mentioned features of spectroscopy are typical. Many give up on spectroscopic examinations of hippocampal structures in order to their technical limitations, such as the size of examined structures and topographical relations of the surrounding area. The problems mentioned most often are difficulties with field homogeneity, artifacts from cranial base area and...
a disqualifying weakening of the signal to noise ratio, along with necessity of reducing the volume of interest (VOI). However, there are certain literature reports on technical capacities of such examinations in various brain diseases. According to available references, only few papers concerning of 1H MRS spectroscopy of external and mesial temporal lobes and also frontal lobes have been published so far. The aim of my presentation was an attempt evaluation of regional metabolic disorders using 1H MRS within the frontal lobes also external and medial temporal lobes in patients with MCI, as predictor of clinical deterioration to dementia base on clinical follow-up.

In our study examination was performed on a group of 31 randomly chosen (19 female and 12 male), MCI diagnosed subjects under care of Department of Neurodegenerative Disorders, Medical Research Centre, Polish Academy of Science. All subjects underwent neurological and psychiatric tests, routine laboratory investigations and standard neuropsychological examinations.

Based on our results and literature data we concluded that 1H MRS seems to be very sensitive method proving biochemical information using in vivo approach in patients with initial MCI who in significant number developed disease progression and/or convert to AD. It means that 1H MRS can identified subjects with prodromal phase of AD.

**Cerebral Amyloid Angiopathy-Related Inflammation: an Emerging Disease**


**Background**

In 2002, the trial for treatment of Alzheimer disease with active ß-amyloid 42 (Aß42) immunization was terminated because of cases of meningoencephalitis. In 2004, Eng et al. (Ann Neurol), in reviewing cases with biopsy-proven cerebral amyloid angiopathy (CAA), identified patients with multiple, predominantly white
matter (WM) lesions, often responding to immunosuppressive treatment, and coined the term CAA-related inflammation (CAA-ri). We wish to present 3 cases with this disease, observed in the last year.

Patients: there were 2 males and 1 female, aged 76, 67, 68, respectively, with different clinical presentations. Patient (Pt.) 1 was an elderly, female, aged 76, with severe, non-contrast enhancement on CT and MRI. Pt. 1 had an acute onset of speech difficulties and a single, left, posterior temporal lesion on CT and MRI, initially considered as an area of probable ischemia. Course of the disease: Pt. 1: in the differential diagnosis of multiple WM lesions in an elderly patient, the neuroradiologist initially considered that the abnormalities were consistent with vasogenic edema; they had low perfusion, without post-contrast enhancement. Only Gradient Echo (GE) images demonstrated multiple, scattered microhemorrhages consistent with CAA. Steroid treatment led to near disappearance of the lesions. Apolipoprotein E (APOE) genotyping demonstrated the e4/e4 genotype. Pt. 2: severe, progressive neurological involvement led to frontal WM stereotactic biopsy which was not diagnostic of CAA. Steroid treatment was initiated, with rapid, remarkable improvement. Repeat MRI with GE images revealed very numerous microhemorrhages scattered in the cerebral cortex. Genetic testing demonstrated the e4/e4 genotype. Pt. 3: clinical observation and various examinations excluded ischemic, infectious, and tumor etiologies for the single left posterior lesion that rapidly regressed on steroid treatment, with normalization also of the neurological examination. Susceptibility weighted (SW) MR images at 3T showed a group of about 15-20 microhemorrhages scattered in the region of the previous WM lesion. Genetic testing is pending.

Comment: In order to make a rapid diagnosis, the neuroradiologist must be aware of the existence of this disease. The essential step is to recognize CAA, that, when history of previous bleeding or obvious intracerebral hematomas are absent, often requires GE or SW images to demonstrate microhemorrhages. They are typically cortical or subcortical, with sparing of the basal ganglia that are instead preferentially involved in hypertensive hemorrhages of arteriosclerotic patients. Obtaining a T2*-weighted images more frequently than usual done will unquestionably lead to harvesting a greater number of hemorrhagic lesions.

Evidence supporting the diagnosis of CAA-ri may be given by genetic analysis of APOE, more than 80 percent of patients with CAA-ri have e4/e4 genotype, whereas patients with CAA without inflammation carry this genotype in only 5 percent of the cases. Therefore, when possible inflammatory lesions are seen in an elderly patient, GE sequences should be obtained. If probable CAA is demonstrated, finding e4/e4 genotype is in favour of CAA-ri. Good response to steroid treatment might also indicate the presence of an inflammatory condition. Brain biopsy, until recently considered necessary for diagnosis of CAA, is no longer required in the appropriate clinical setting, the MRI findings described of T2-hyperintense WM lesions and cortical/subcortical microbleeds may be sufficient for the diagnosis of CAA-ri (Kase et al., Arch Neurol, 2007). It is worth noting that pathological examination, usually considered as the diagnostic gold standard, failed to recognize the disease in Pt. 2. This failure was probably due to the deep WM target, without examination, therefore, of cortex and meninges.

Finally, in our cases, post-contrast enhancement, often reported in severe cases along with hemorrhages, was not observed. When the inflammation is severe and extensively involves the wall of the vessels, the term angiitis has been used (CAA-related angiitis; Scolding et al., Brain, 2005). The spectrum of inflammatory reactions to Aa is probably broader than previously thought. Our pt. 1 probably represents the mildest clinical involvement that may be observed and demonstrates that only a high degree of suspicion and prompt MR examination with appropriate sequences may lead to a rapid diagnosis and treatment.

In order to make a rapid diagnosis, the neuroradiologist must be aware of the existence of this disease. The essential step is to recognize CAA, that, when history of previous bleeding or obvious intracerebral hematomas are absent, often requires GE or SW images to demonstrate microhemorrhages. They are typically cortical or subcortical, with sparing of the basal ganglia that are instead preferentially involved in hypertensive hemorrhages of arteriosclerotic patients. Obtaining a T2*-weighted images more frequently than usual done will unquestionably lead to harvesting a greater number of hemorrhagic lesions.

Evidence supporting the diagnosis of CAA-ri may be given by genetic analysis of APOE, more than 80 percent of patients with CAA-ri have e4/e4 genotype, whereas patients with CAA without inflammation carry this genotype in only 5 percent of the cases. Therefore, when possible inflammatory lesions are seen in an elderly patient, GE sequences should be obtained. If probable CAA is demonstrated, finding e4/e4 genotype is in favour of CAA-ri. Good response to steroid treatment might also indicate the presence of an inflammatory condition. Brain biopsy, until recently considered necessary for diagnosis of CAA, is no longer required in the appropriate clinical setting, the MRI findings described of T2-hyperintense WM lesions and cortical/subcortical microbleeds may be sufficient for the diagnosis of CAA-ri (Kase et al., Arch Neurol, 2007). It is worth noting that pathological examination, usually considered as the diagnostic gold standard, failed to recognize the disease in Pt. 2. This failure was probably due to the deep WM target, without examination, therefore, of cortex and meninges.

Finally, in our cases, post-contrast enhancement, often reported in severe cases along with hemorrhages, was not observed. When the inflammation is severe and extensively involves the wall of the vessels, the term angiitis has been used (CAA-related angiitis; Scolding et al., Brain, 2005). The spectrum of inflammatory reactions to Aa is probably broader than previously thought. Our pt. 1 probably represents the mildest clinical involvement that may be observed and demonstrates that only a high degree of suspicion and prompt MR examination with appropriate sequences may lead to a rapid diagnosis and treatment.

Multi-voxel MR Spectroscopic Study of Cingulate Gyrus in Patients with Mild Cognitive Impairment

R. Wu, Z. Yang
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Objective: The objective of this pilot study was to assess brain metabolites in the cingulate gyrus of patients with mild cognitive impairment (MCI) using multi-voxel MR spectroscopy.

Methods: Cognitive ability of the subjects were firstly assessed by Unified Alzheimer Disease Rating Scale (UADRS) in the department of Neurology. 5 MCI patients and 3 control subjects matched in age and education, were performed in the experiment. All data were acquired on a 1.5T GE signa HDx MR scanner, and then were processed using the SAGE analysis package on the ADW4.3 workstation. The peaks area and ratios to creatine (Cr) of N-acetyl aspartate (NAA), myoinositol (MI), and choline-compound (Cho) were measured in the cingulate gyrus.

Results: In MCI patients, NAA and NAA/Cr were decreased, and MI/Cr, Cho/Cr were increased. The value of metabolites in MCI group vs control group were as follows: NAA: 9973.60 ± 795.64 vs 27533.33
± 11696.77 (p < 0.05), MI: 5804.00 ± 3773.98 vs 34540.00 ± 5544.92 (p < 0.05), NAA/Cr: 1.42 ± 0.40 vs 2.25 ± 0.42 (p < 0.05), MI/Cr: 0.53 ± 0.01 vs 0.66 ± 0.20 (p < 0.05 ) and Cho/Cr: 0.66 ± 0.20 Vs 0.85 ± 0.50 (p > 0.05).

Conclusion: The variation of the metabolites in the cingulate gyrus of patients with MCI were able to be detected in NAA, NAA/Cr and an increase in mi/Cr and may be observed in the early stages of dementia. Ratio measurements of these metabolites are contributed to MCI diagnosis.

Alzheimer

**Chairs:** K. Tsuchiya, T. Stosic Opincal

16.15-16.30 10’

**Neuroimaging and Clinical Spectrum of Hippocampal Sclerosis Dementia**

M. Musacchio1, F. Sellai1; F. Blanc3, J-M. Michel1, J-L. Dietemann2, 1Neuroimaging - Hôpitaux Civils de Colmar, France; 2Neurology - Hôpitaux Civils de Colmar, France; 3Neurology - Hôpital de Hautpierre; Strasbourg, France; Geriatry - Hôpitaux Civils de Colmar, France; 4Neuroimaging - Hôpital de Hautpierre; Strasbourg, France

**Introduction:** Hippocampal sclerosis (HS) is a relatively common pathological finding in elderly, characterized by severe neuronal loss and gliosis in the CA-1 region of the hippocampus and the subiculum. Sometimes it is pure and dementia associated to HS (HSD) has been said to resemble AD (Alzheimer desease). How-frontotemporal dementia (FTD) more HS (HSD) has been said to resemble the initial diagnosis during follow-up. SPECT perfusion showed the typical AD bipartial pattern only in one of the two patients who kept a final diagnosis of AD. In other patients hypoperfusion was observed in the external and internal parts of the temporal lobe, either bilaterally or unilaterally, and sometimes extended in the frontal lobes, a pattern which fits with the temporal forms of FTLD.

**Conclusion:** Hippocampal amnesia with HS on MRI is rare. From a clinical point of view the differential diagnosis seems to be HS and AD. From a pathological study, HSD can be separated from the temporal forms of FTLD, as it has been suggested by pathological studies.

**Results:** Nine patients fulfilled MRI criteria for HS. HS relatively preserved the posterior hippocampus. Four patients had an asymmetrical atrophy of hippocampi. For 3 of them, a diagnosis of AD was suspected at the first consultation and it was clinically confirmed at the more recent consultation for 2 of them. The third patient was clinically diagnosed as HSD. Three patients had an initial diagnosis of amnestic MCI (aMCI) and one of focal atrophy. They all developed significant behavioural disorders, so that a final diagnosis of AD was established in 4/4, according to Neary criteria. The two last patients were classified as a temporal form of Frontotemporal Lobe Degeneration (FTLD) and this diagnosis was confirmed at the last consultation of follow-up. SPECT perfusion showed the typical AD bipartial pattern only in one of the two patients who kept a final diagnosis of AD. In other patients hypoperfusion was observed in both hemispheres and a pattern which fits with the temporal forms of FTLD.

**Conclusion:** Hippocampal amnesia with HS on MRI is rare. From a clinical point of view the differential diagnosis seems to be HS and AD. From a pathological study, HSD can be separated from the temporal forms of FTLD, as it has been suggested by pathological studies.

16.30-16.45 10’

**fMRI Episodic Memory Study. A Longitudinal Study in 31 Patients Presenting with Early Memory Complain**

F. Gelbert 1, C Baclet-Roussel 2, C Belin 3, A.M Ergis 4, J Ankri 2, R Palau 1, C Moroni 4, C Noche 4, J.L Sarrazin 1

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**Introduction:** Early in the course of AD, deficits are found in Episodic memory. fMRI studies suggest that patients with mild AD often show memory related activity increases in the prefrontal cortex, relative to healthy controls. This has been interpreted as a functional compensatory response, related to the increased effort needed by patients with AD to perform the tasks. Early detection of early stage of Alzheimer is challenging regarding new therapeutic approaches and the goal of this goal of our study was to evaluate along a 3 years follow-up brain activation, using fMRI in patients with probable AD, MCI, and controls while performing an episodic memory task.

**Material and Methods:** 31 patients underwent a fMRI study while performing a visual and verbal Episodic Memory tasks. Functional images were obtained using a T2 gradient echo-planar imaging (EPI/GE with paradigms consisting of eight blocks of rest and stimulation periods alternatively). Anatomical images were acquired after fMRI runs with a 3D spoiled gradient echo sequence (SPGR). 2 fMRI experiments were made for each patient. Before scanning, subjects were asked to review 28 pictures and decide whether these pictures contained three colors or more, or less than three colors. No functional sequence was recorded at this time. This task is actually the distracting encoding phase of the DMS48 neuropsychological test. Then the patients were submitted to a fluency test. They were asked to retrieve as many words as possible starting with a particular letter (P, R, S and T) during a visual instruction slide. The second task was the recognition phase of the DMS 48 test and the patients were instructed just before. The task was completed with a set of 28 distractors. Each target was shown simultaneously with a distractor, presented in equal proportion on either the left or the right side of the screen, and the subject was asked to identify the target silently.

fMRI data were preprocessed and analyzed using statistical parametric mapping with SPM99 and B.A.R. (Brain Activity Research software developed in HIA Val de Grâce). After data collection, images were processed by generating individual T-test maps comparing rest and experimental conditions on a voxel-by-voxel basis.

**Results:** 31 subjects entered the protocol study, 10 were normal control, 19 had MCI and 2 had early AD. Because of their clinical condition, 5 subjects could not perform 2 runs (1 per...

Materials and Methods: Ninety-five subjects (51 apoE4-carriers, 44 non-carriers) from the AD Neuroimaging Initiative (ADNI) database with documented MCI-to-AD conversion and stable MCI were divided into apoE4 carriers and non-carriers. Brain MRIs obtained one year before conversion from MCI to AD, at conversion and after twelve months were available for stable MCI patients. We used voxel-based morphometry, a whole-brain analysis technique.

Results: There were no differences in cognitive profile between apoE4-positive and apoE4-negative subjects in each group. ApoE4 carriers who converted from MCI to AD showed significant GM volume loss in the hippocampus, temporal neocortex, parietal lobes, caudate nuclei, and insulae. In apoE4 carriers with stable MCI GM volume loss was observed in the bilateral frontal and temporal lobes. There were no significant changes in GM volume in noncarriers of the apoE4 allele in each group.

Conclusion: ApoE4-carriers with cognitive decline undergo faster GM atrophy than noncarriers. The involvement of apoE4 in the progression of hippocampal / neocortical atrophy has potential important implications for therapeutic approaches in AD and should be taken into consideration in clinical trials.


References

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Diffusion Abnormality of Corpus Callosum in Alzheimer’s Disease

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Key words: Alzheimer’s disease; diffusion tensor MRI; corpus callosum; fractional anisotropy

Purpose: The purpose of this study was to investigate diffusion abnormalities in the parts of corpus callosum (CC) of patients with Alzheimer’s disease (AD) using diffusion tensor magnetic resonance imaging (DT-MRI).

Materials and Methods: Twenty-one patients with AD and 20 healthy volunteers participated in the study. MRI was performed with a 1.5 T system. Conventional MR images and diffusion tensor images were obtained for all participants. We divided corpus callosum in 3 part as rostrum, body and splenium. The mean diffusivity (MD) and fractional anisotropy (FA) were measured in all parts.

Results: The fractional anisotropy values for the corpus callosum were lower in AD patients than the values of controls. In patients with AD, the lowest values were found in the rostrum of the corpus callosum and also corpus callosum body’s FA values were lower than the splenium. But the difference did not reach statistical significance.

Conclusion: Diffusion tensor imaging is a promising technique to investigate microstructural changes in white matter regions in AD. Early detection of the disease has been increasingly studied in AD. Further studies with larger populations are needed to confirm the role of diffusion tensor imaging in the evaluation of memory impairment.

17.00-17.15 10'
uncinate fasciculus and compared the values between AD cases, MCI cases and control subjects, and evaluated statistical difference of these values by ANOVA.

**Results:** Figure shows tractographies of uncinate fascicles with four different FA thresholds. There was a tendency that lower threshold brought larger number of tract lines, and higher threshold brought small in number and concentrated tracts.

The measurements showed that higher FA threshold bring lower value of ADC and higher value of FA along the uncinate fasciculus. For FA values, statistically significant differences among the severity of AD were shown in all four sets of data obtained under four different FA thresholds. Also for ADC values, statistically significant differences among severities of AD were shown in the results, FA threshold of 0.10 and 0.25 showed less discrimination between discrete groups of different severity of AD. Also in ADC, orders of measured value according to the severity of AD were not influenced by FA threshold. FA threshold of 0.15 and 0.2 showed better discrimination between mean ADC values of discrete groups of different severity of AD.

**Discussion:** On the measurement of diffusion tensor parameter along uncinate fascicles, higher FA threshold brought lower value of ADC and higher value of FA along the uncinate fasciculus. Important point in the result of the current study may be the fact that there are no FA thresholds in which the relationship between different groups differs to the others. In every FA thresholds, mean FA value is higher in normal and lower in severe AD cases, and mean ADC values are lower in normal. This means that as far as using constant FA threshold, the essence of the result is not influenced. However, as shown in the results, FA threshold of 0.10 and 0.25 showed less discrimination between discrete groups of different severity of AD. For uncinate fascicles, FA threshold between 0.15 and 0.20 may be optimal for evaluation of diffusion tensor parameters.

**Conclusion:** On the measurement of diffusion tensor parameter along uncinate fascicles, higher FA threshold brought lower value of ADC and higher value of FA along the uncinate fasciculus. This result suggests the distribution of the FA of given fiber bundle is concentric manner with higher FA in the center. Although as far as using constant FA threshold, the essence of the result is not influenced, selection of optimal FA threshold is important for tract based analysis of white matter tract.
Palazzo della Cultura e dei Congressi - Violet Hall  
Wednesday, 6 October - 14.30-17.30

COMMUNICATIONS

Epilepsy 1

Chair: P.M. Trulzì, F. Menetti

14.30-15.00  
Introductory Lecture

Radiological Aspects of Genetic Disorders with Adult-Onset CNS Symptoms

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Genetic disorders affecting the central nervous system have been most often described in children. However, some of those diseases have also adult forms and, in addition, there are genetic disorders only giving symptoms in adulthood. Symptoms may be neurological or psychiatric including early dementia. It is important to try to recognize such diseases because the right diagnosis may have influence on the patient’s treatment. Radiological examinations also provide further knowledge about these diseases and help us in understanding pathophysiology. Examples of some genetic diseases with adult-onset will be presented.

Mitochondrial disorders are often pediatric diseases but may give first symptoms so late as in the sixth decade. Episodes of exacerbation are typical. MELAS and POLG-associated encephalopathy syndromes are examples of such diseases. In both syndromes, stroke-like episodes occur and stroke-like lesions are found on MRI. In POLG-associated syndromes, the changes often are cortical (but rarely temporal) and thalamic. These patients often have ataxia, epilepsy and liver disease. Valproate should be avoided in epilepsy therapy of these patients because it may cause severe liver damage.

Patients with hepatolenticular degeneration (Wilson’s disease) have a defect in copper metabolism and may represent hepatic (in particular in children) or neurologic symptoms or dementia. They have T1 and T2 signal changes characteristically in the basal ganglia, thalami, and mesencephalon but may also have white matter changes which may be asymmetric. Polycystic lipomembranous osteodysplasia and sclerosing leukoencephalopathy (PLOS/L, Nasu-Hakola disease) is an example of the disease which first affects the bones but later leads to dementia. Atrophy and calcium deposits of the basal ganglia are typical radiological findings.

Leukodystrophies mostly often begins in infants and children but there are also adult forms. Adult-onset metachromatic leukodystrophy typically begins in young adults and with psychiatric symptoms. There are also adult-onset forms of Alexander disease and Krabbe disease (globoid cell leukodystrophy). Their radiological findings are different from those seen in infantile or childhood types. Patients with adult-onset autosomal dominant leukodystrophy (ADLD) with autonomic symptoms represent first clinical symptoms in the fifth decade but MRI is pathological in much younger symptomless relatives. All these three leukodystrophies also affect the spinal cord causing substance loss and, some of them, also signal intensity changes. Some disorders primarily affect blood vessels. One example is cerebral autosomal dominant arteriopathy with subcortical infarcts and leukoencephalopathy (CADASIL). Characteristically, the temporal white matter - which often is the best reserved part of the brain in vascular white matter diseases - is affected. Lacunar infarcts and microbleeds are typical. Microbleeds are also seen in cerebral amyloid angiopathy but in that disease most of them are situated more peripheral.

Microbleeds and cavernomas type IV may have an identical appearance. There is a familiar form of multiple cavernomas and they can be found both in the brain and spinal cord.

There is a lot of genetic disorders in which there may be more or less typical findings. One disease is presented as an example hereditary spastic paraparesis and thin corpus callosum (HSP-TCC) with mutations in SPG11 gene. These patients have progressive brain substance loss with general enlargement of the lateral and third ventricles and locally variable peripheral atrophy. Cerebral T2 signal intensity is increased, mostly in central areas. These are very non-specific changes. As curiosity, all the patients, even before other pathologic findings, had a very thin corpus callosum and small T2 hyperintense bundles anterior to the frontal horns.

A thorough and systematic analysis of the atrophic and signal intensity changes may help to find a specific diagnosis or at least to rule out diseases with the same clinical symptomatology. Collaboration with geneticians is a way to develop specificity of radiological diagnosis. One should also remember that radiological abnormalities may precede clinical symptoms and can be found in asymptomatic individuals.

15.00-15.15  
Hippocampal MR Volumetric Studies in Paediatric Control and Epilepsy Group

Salimah J. Win Mar, A. Noorfizura, A. Mohd Shafie, A.H. Ahmad Helmy, A.R. Salmi

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Objectives: The aim of this study is (1) to determine the hippocampal volume in children with epilepsy; (2) to determine the hippocampal volume in children from the control group; (3) to determine and compare the hippocampal volume in children with epilepsy and the control group; (4) to compare the mean of right and left hippocampal volume in control subjects. This study was carried out in USM from January 2008 - June 2009.

Material and Methods: This is a cross sectional study of 40 children with epilepsy and 40 children of the age-matched control volunteer group. MRI of brain and temporal lobe series were performed using a Signa Horizon LX 1.0 Tesla from the General Electric Company. Oblique coronal sections perpendicular to the axis of temporal lobe were done with 4mm
slice thickness and 1 mm gap. T1, T2, FLAIR and SPGR series were done. Anatomical hippocampal boundaries for this study was based on protocol of Obenaus et al., 2001. The whole hippocampal volume was measured. Volumetry was done manually by using Osirix workstation (v 3.5.1-64 bit). Each slices were measured thrice and the average value was taken. Data were analyzed by paired t-test and independent t-test for univariante data and repeated measures ANOVA for multivariate data.

Results: The mean hippocampal volume in the control group were 2.81 cm^3 (SD=0.38) and 2.65 cm^3 (SD=0.41) for right and left hippocampus respectively. The mean hippocampal volume in epilepsy patients were 2.47 cm^3 (SD=0.52) and 2.39 cm^3 (SD=0.44) for right and left respectively. There is statistically significant difference between hippocampal volume in epileptic and normal children in both the right and the left hippocampus. In control group, the right hippocampus volume is much greater than the left, with p < 0.001.

Conclusion: The data of this study provides a useful reference for the study of hippocampal volume in Malayan paediatric population. It is useful in determining the side affected and also serves as part of the study to establish the whole age-related hippocampal growth.

15.15-15.30 10’

Cerebral MR-Volumetric Examinations in Juvenile Myoclonic Epilepsy

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Objectives: Juvenile myoclonic epilepsy (JME) is an idiopathic generalized epilepsy (IGE) syndrome with age-related onset of seizures (typically with myoclonic jerks, tonic-clonic seizures and less frequently by typical absences). Prevalence is 5-10% among adult and adolescent epileptic patients. JME is defined by electrophysiological features indicating involvement of both cerebral hemispheres. There are no specific abnormalities seen on MRI of patients with JME. We correlated data obtained from quantitative volumetric analysis of MRI scans with the clinical diagnosis of JME.

Methods: 6 JME patients, clinically diagnosed, and 17 healthy controls were examined with a standard MRI epilepsy protocol containing axial TSE T2, 3D-MPRAGE, and coronal FLAIR and T2 weighted sequences with thin slices perpendicular to the hippocampi on a 3 T MR scanner (Phillips, Achieva). Patients’ average age was 29±5 years at examination without any structural cerebral abnormality according to the MRI scans. Controls were healthy medical students in the second year (20-21 year old). Quantitative volumetric analysis was performed on the 3D-MPRAGE images using SPM5; it consisted of brain normalization, segmentation, grey matter parcellation according to the AAL template (116 regions), and volumetric normalization to total grey matter. Group-wise comparisons were performed on the data.

Results: We found many anatomic structures with significantly bigger volumes in JME patients than in controls. The amygdala, several cerebellar and the olfactory regions show the strongest significance (p<0.000000). We got similar results with the Heschl, cingulate gyri, pallidum, hippocampus and vermis (P<0.00008).

Conclusion: Our method shows the volume increases in brain regions in JME patients compared to controls. These results are similar to previous studies mentioning that the mesial falkal lobe is affected in this kind of epilepsy. Our results give the possibility of exactly measuring the volume of the 116 regions contained in the AAL template. MR volumetric analysis may prove to be helpful in the diagnostics and understanding of JME.

15.30-15.45 10’

On the Feasibility of Passive Range-of-Motion Functional MRI Paradigms in the Diagnostic Workup of Childhood Epilepsies

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Introduction: Functional magnetic resonance imaging (fMRI) examinations became an integral part of epilepsy surgery workup. Most fMRI examinations require patient cooperation which poses serious difficulty in childhood epilepsy: partly because of their mental retardation or paresis. As most pediatric MR examinations are carried out in intravenous sedation there is a need for paradigms requiring no patient cooperation. Passive range-of-motion (ROM) paradigms were suggested for motor cortex mapping in this population [Souweidane et al., 1999; Ogg et al., 2009]. Here we present a retrospective analysis of our passive movement (MI) paradigm and examined the utility of the method in the pediatric epilepsy population.

Patients and Methods: Five children (mean age 9, range 3-14, 4 boys) were investigated with fMRI at 3T (Phillips Achieva 3T, Philips Healthcare, Best, The Netherlands) in the MR Research Center, Semmelweis University. Three of our patients were investigated in sedation with the administration of intravenous propofol using passive ROM paradigms: Case#1 (7yo male) had hemispheric cortical dysgenesis (pachygyria), was scanned pre- and postoperatively; Case#2 (8yo male) had hemispheric cortical dysgenesis, was scanned postoperatively; Case#3 (3yo male) had benign tumor, was scanned preoperatively. One patient, Case#4 (14yo male) had porencephalic cyst in the arteria cerberi media (ACM) distribution, was scanned preoperatively both awake and in general anesthesia with fMRI examination. The other patient was investigated awake with active and passive ROM paradigms: Case#5 (13yo female) had porencephalic cyst in the ACM distribution, was scanned preoperatively.

Results: We were able to collect meaningful results with passive ROM fMRI in all cases. Case#1 posed a challenge for fMRI as the patient was entered to a state of electric status epilepticus in sleep during anesthesia in the preoperative scanning session; however, with the co-administration of clonazepam the fMRI examination became possible. Cases #1 and #2 showed clear-cut reorganization of the sensorymotor cortex to the healthy hemisphere. The clinical picture of these cases was compatible with the fMRI results, as both patients had less severe hemiparesis after surgery than that would have been expected without fMRI. Cases #5 showed partial reorganization between hemispheres, and Cases #3 and #4 showed no reorganization. We found somewhat different distribution of activations in Cases#4 for the awake vs. anesthetized comparison and in Case#5 for the active vs. passive movement comparison.

Conclusions: Passive movement (MI) paradigms are useful for the evaluation of sensorymotor cortex in pediatric epilepsy patients. Moreover, our results show that these paradigms are able to describe cortical reorganization, thus they have clear prognostic value in a pre-operative setting.
Purpose: The aim of this study is to report the unusual neuroimaging findings of focal leptomeningeal enhancement in association with corticopial calcification, underlying a parietal meningeal lipoma in two pediatric epileptic patients. A review of the literature and a discussion regarding their possible classification is also provided.

Methods: Two pediatric patients aged 11 and 15 years with normal psychomotor development, unremarkable cutaneous and ocular findings, and recent onset of epilepsy were studied with computed tomography (CT) and Magnetic Resonance Imaging (MRI). CT was performed in sequential mode with pediatric dose reduction protocol. MRI studies where obtained on a 1.5 Tesla system and included pre and post contrast fat saturated T1 weighted images, T2 and T2* weighted images, diffusion weighted imaging (DWI), MR angiography and venography.

Results: In both patients, CT demonstrated unilateral corticopial calcifications with a gyriform distribution limited to the parietal lobes adjacent to the convexity. These findings are suggestive of adenopoeisis characteristic of adipose tissue. On MRI, unenhanced T1 weighted images depicted the presence of lipomas in both patients, one characterized by a tubulonodular shape (patient 1) and the other curvilinear. Post contrast images demonstrated focal leptomeningeal enhancement, thought to represent leptomeningeal angiomatosis, underlying the lipoma. As additional findings, patient 1 presented mild limited cortical atrophy with enlargement of subarachnoid spaces whereas patient 2 had extensive linear calcification of the falx cerebri. No other neuroimaging abnormalities were found within the brain.

Discussion: To our knowledge, the association of focal leptomeningeal enhancement and corticopial calcifications underlying a meningeal lipoma of the convexity has not been reported in literature, and may represent an extremely rare spectrum of MRI findings. Leptomeningeal enhancement (pial angioma) and cortical calcifications are distinctive features of Sturge-Weber syndrome (SWS), a well-known neurological disorder characterized by the association of facial, ocular, and cerebral vascular malformations. In rare instances, facial angiomas are thoroughly absent (so-called SWS type 3, ie exclusive leptomeningeal angiomatoses). We found only one case report describing a patient affected by SWS in association with a lipoma located on the temporal mesial region, far from the leptomeningeal angioma. Intracranial lipomas, leptomeningeal angiomatosis and corticopial calcifications are also known findings of neurocutaneous cutaneous lipomatous lipomatosis (ECCL), a rare neurocutaneous syndrome that may share some neuroimaging characteristics with SWS. Nevertheless, affected patients typically present peculiar cutaneous, ocular, cerebral and spinal stigmata, significantly different from SWS and from our cases too. Corticopial calcifications and a gyriform-enhancing pattern secondary to the meningeal abnormality have been described in meningioangiomatosis, a rare focal disorder characterized by meningovascular proliferation; however, meningioangiomatosis generally appears as a mass lesion within the cortex and may present vasogenic edema. Very few cases of intracranial lipomas of the cerebral hemispheric surface have been reported, representing an extremely rare lesion. They are often located in the sylvian fissure or in anomalous fissures surrounded by polymicrogyric cortex. A variety of vascular abnormalities have been described in association with hemispheric lipomas including arteriovenous defects and aneurysms. To our knowledge, there is only one description of a patient with convexity lipoma and normal contrast enhancement of the meninges, however associated to intracranial hypotension. The presence of calcifications contiguous to lipomas has also been reported. On the basis of Verga’s hypothesis and Truwit and Barkovich analysis, lipomas are thought to be a congenital malformation resulting from abnormal persistence and maldevelopment of meninx primitiva, the mesenchymal precursor of the leptomeninges. This early meningeal dysplasia may presumably interract with the development of the brain, but the mechanism is uncertain. In our cases, lipomas were located on the parietal convexity and the underlying cortex was not dysplastic.

In conclusion, the MRI pattern presented here does not fit properly either SWS type 3 or ECCL criteria, and the diagnostic classification as a possible forma frusta of these entities remain speculative. Probably, these findings could be considered an exclusive and extremely rare meningeal maldevelopment complex resulting from focal abnormal persistence and maldevelopment of the meninx primitiva along the parietal convexity, associated with calcific depositions and abnormalities of the primitive sinusoidal vascular channels. This MRI spectrum might be named: calcific meningeal lipangiomatosis.
mm/s, and even lower 1.09*10−3 mm/s, respectively. Significant differences of ADC values are observed in different regions of the GM. In neonates of the NG the highest ADC are observed in the cortex and in the head of caudate nucleus (1.34*10−3 mm/s). In thalamus and in nucleus lentiformis the lower ADC values are observed: 1.21*10−3 mm/s. From the results suggests that in children of the NG during first 3 years of life water diffusion is highly dependent on subjects age and decreases by approximately one-third to one-half. During first 3 years of life ADC values varies markedly with the brain regions. In the NG in children older 3 years in subcortical WM the mean ADC values are 0.75*10−3 mm/s, as in normal adult brain. The temporal ADC changes during first 3 years of life reflect the reduction of water content, cellular maturation, and WM myelination. In the PG in the epileptic focus ADC values decrease during the first 1-3 hours after the onset of seizures and after 24-48 hours normalized or even increase. The development of anisotropy is reflected in the FA values: FA is high sensitive to small differences among white matter tracts when anisotropy is low (as in neonates and infants) and we use FA in studies of the brain in neonates and infants. Figure 1 represents dependence in studies of the brain in neonates and infants) and we use FA small differences among white matter regions of the GM. In neonates of the NG during development in the NG, children with seizure disorders, and children with seizure disorders, teach their clinical manifestations and genetic causes, and elucidate their underlying pathogenesis and pathology.

Conclusion: MRS and DWI data may have long-term prognostic value.

**Round Table: Epilepsy and Malformations of the Cerebrum**

**Chair:** A.J. Barkovich

**A. Barkovich  
University of California AT  
San Francisco - Department of Radiology and Biomedical Imaging:  
San Francisco, CA, USA;**

Epilepsy is a common disorder that can have devastating effects upon affected people. Although most cases of epilepsy can be controlled by medical therapy, some cases are refractory to medication; a high proportion of these are related to malformations of cortical development (MCDs). Indeed, several studies have shown that MCDs are the cause of 23-26% of medically refractory epilepsy in children and young adults and 15% of lesions selected for intractable epilepsy.

As a result of the frequency of these lesions, the severe effect of both epilepsy and anti-epileptic medication on development, and the effect of both epilepsy and developmental disorder upon the lives of affected adults, many epileptologists now recommend early surgical resection for amenable MCDs in children and young adults. The purpose of this session is to increase the understanding on the best imaging techniques to diagnose these disorders, teach their clinical manifestations and genetic causes, and elucidate their underlying pathogenesis and pathology.

This session will also serve as an example of how radiologists, neurologists, geneticists, neuroscientists, and pathologists work together as clinicians and researchers. Prof. Barkovich will discuss the optimal imaging techniques and imaging findings in malformations of cortical development. MRI is the optimal tool, supplemented by Positron Emission Tomography (PET), magnetoencephalography (MEG), electroencephalography (EEG), and videotelemetry, as needed. The imager must always know as much as possible about the suspected epileptogenic region in order to optimally image it.

Thin section volumetric images with optimized contrast between cortex and white matter, using both T1 and T2 contrast, increases the likeli-
hood to detecting the malformation. PET and MEG data should be co-registered with the MRI, as they will direct the interpreting physicians to the affected regions of the brain.

In addition, a strong knowledge of the underlying pathologic characteristics and pathophysiology of the malformations helps in their identification.

A special focus will be made on Focal Cortical Dysplasias, which are common causes of medically refractory epilepsy and are the most difficult to identify with imaging techniques.

Prof. Guerrini will discuss the clinical characteristics of affected patients and how the epileptologist uses the clinical characteristics (semiology) of the seizures in order to direct the imaging studies to certain regions of the brain. He will also explain how certain genetic mutations result in MCD, and how taking a good clinical history helps to determine which patients will benefit from medical therapy and which will require surgery.

Prof. Spreafico will discuss the pathological substrate of MCDs; these are not random aggregations of neurons in ectopic locations, but well-connected accumulations of axons and neurons that are usually connected to other regions of the brain. He will also explain the pathophysiology of the epilepsy; how dysplastic cells can generate large action potentials that spread aberrant electrical activity in the brain to generate both partial and generalized seizures.

16.40-17.05

Neuropathology and Pathophysiology of Malformations of Cortical Development (MCDs) and Related Epilepsies

R. Spreafico
Epilepsy Clinic and Experimental Neurophysiology Unit Fondazione IRCCS Istituto Neurologico “C. Besta”; Milano, Italy

The term Malformations of Cortical Development (MCDs) include all developmental abnormalities, representing a broad spectrum of histopathological findings encountered in clinical practice and assigned to different pathogenetic mechanisms and to different periods of the embryonic stages. The cortical malformations represent focal or diffuse anatomical abnormalities largely dependent on the timing of the defect in the developmental processes as well as on its cause. Over the past decade, molecular biologic and genetic studies have greatly expanded our knowledge of the normal and abnormal brain’s development and several disorders of cortical development have been recognized, with the identification for some of them of specific causative genetic defects.

However the aetiology of many malformative disorders is often uncertain and the mechanisms by which they generate epilepsy are not completely understood. Although the basic cellular mechanisms of epilepsy have a common functional output (reflected in an abrupt, excessive, and synchronous discharge of a certain neuronal population - i.e., a seizure), different types of MCD may determine abnormal discharge through different mechanisms.

The advent of high-resolution imaging techniques, particularly magnetic resonance imaging (MRI), made it possible to diagnose MCD in vivo and, several types of partial epilepsies previously defined as cryptogenic are now recognized as secondary to cortical lesions. As a consequence, the last decade has seen an increasing number of epileptic patients been successfully admitted to epilepsy surgery programs, with a parallel increase in the availability of surgical specimens for neuropathological analysis.

Three questions appear fundamental to our understanding of MCD-related epilepsies:

1. How do malformations develop?
2. Why, in the majority of cases, do they generate epileptic activity?
3. Do the different types of malformations have the same mechanisms for generating epilepsy? in other words, do the different clinical types of malformations have the same pathophysiological mechanism for epileptogenesis?

In order to answer these issues an integrated, interdisciplinary network must be achieved among epileptologist, neuroradiologist, neuropathologist and neurophysiologist.

New neuropathological techniques such as immunocytochemistry, and in situ hybridization using several mRNA probes can be fruitfully applied on human tissue not only for a correct neuropathological diagnosis but also to elucidate the pathomechanisms underlying MCD and related epilepsies.

Based on these assumptions the present talk will be mainly focused on Focal Cortical Dysplasia (FCD) in order to give insights, through a multi-disciplinary approach, on the possible pathogenetic mechanisms of these malformations and on the genesis and spread of the epileptic discharge.

The present work has been made possible thanks to the active collaboration within Lombardy Dipartimento di Diagnostica Pre-Chirurgica (DDPC) and in particular with the “C. Munari” Epilepsy Surgery Centre. Part of the work was supported by Italian Ministry of Health, Associazione “Paolo Zorzi” and European Community (LSH-CT-2006-037319 EPICURE).

17.05-17.30

Eletroclinical Findings and Genetic Basis

R. Guerrini
Children’s Hospital A. Meyer, University of Florence, Medical School; Firenze, Italy

Prof. Guerrini will discuss the clinical characteristics of affected patients and how the epileptologist uses the clinical characteristics (semiology) of the seizures in order to direct the imaging studies to certain regions of the brain. He will also explain how certain genetic mutations result in MCD, and how taking a good clinical history and understanding the genetic nature of certain MCDs, in addition to the initial response to medical therapy, helps to determine which patients will benefit from medical therapy and which will require surgery.
Brain Tumors 3

**Introductory Lecture**

**Tissue Characteristics and Reorganization of Peri-Lesional Components in the Brain on MRI**

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In many CNS disorders, the tissue contents of peri-lesional tissues as well as the lesions per se are not involved. They, however, may contain different components and need different therapeutic strategy. For example, on MRI peri-lesional signal abnormality (PSA) of brain tumors contains varieties of tissues, namely vasogenic edema, gliosis, and tumor infiltration. Clinically, T2-weighted MR images are used to identify PSA for patients with tumors. However, PSA can hardly be distinguished effectively. Diffusion tensor imaging (DTI) was applied to differentiate the complex contents of PSA and showed its power in the application. Imaging-wise, reversible PSA (signal abnormalities that normalized after tumor removal) contain mainly vasogenic edema. They will re-organized toward normal structures. Contrary to the tissues infiltrated by tumors, they should not be included in treatment target. The reversibility is predictable by mean FA ratios on DTI. For tumor per se, the mean FA ratios of meningiomas are significant higher than gliomas. However, both gliomas and meningiomas contain reversible and irreversible PSA. The mean FA ratios of irreversible PSA of meningiomas and gliomas and the mean FA ratio of reversible PSA of meningiomas and gliomas do not show difference. The b-value used in DTI may also influence the illustration of PSA. A higher b-value (3000 s/mm2) DTI showed more fiber numbers than the lower b-value (1000 s/mm2) DTI in reversible PSA. Consequently, higher b-valued DTI might better show the tissue characteristics of peri-tumoral tissues. Similar scenario are reflected in cases received radiation therapy. PSA may occur in brain tumors and vascular malformations after radiation therapy. Radiation damage to the brain tissues intervening or around the lesions with BBB breakdown and vasogenic edema are considered as the key mechanism being behind these PSA. Their clinical significance depends on the severity and anatomical location of the lesions. Nevertheless, they may cause local or remote metabolic and functional impairments with different reversibility. In conclusion, the advanced imaging allows us to explore microenvironment of not only lesions but also peri-lesional components. The improvement in tissue characteristics extends our knowledge of tissue specificity and consequently helps in optimizing our therapeutic strategy.

**Consecutive Acquisition of Time-Resolved Contrast-Enhanced MRA and Perfusion MR Imaging of Brain Tumors with a Contrast Dose of 16 ml**

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**Purpose:** To assess the feasibility and value of consecutive acquisition of time-resolved contrast-enhanced MRA (TCMRA) and perfusion MR imaging (PWI) in patients with brain tumor in one session using a small dose (16 mL) of Gd-based contrast material.

**Materials and Methods:** Our patient group comprised 28 patients with brain tumor (one with low-grade glioma, seven with high-grade glioma, five with metastasis, four with meningioma, two with lymphoma, two with others, and seven with unproven tumor; 14 males and 14 females; age range, 28 to 82 years; and average body weight, 58.9 kg). In addition to conventional MR imaging, we performed TCMRA followed by PWI on a 1.5-T system. TCMRA was carried out using a 3D fast gradient-echo sequence in combination with parallel imaging and an efficient k-space filling method (0.8 sec/frame), while ten sections of PWI were obtained using a gradient-echo planar sequence. For both TCMRA and PWI, we injected 8 mL of Gd-based contrast material (ProHance, Bracco, Milan, Italy) and 22 mL of flush saline at a rate of 3 mL/sec. We visually evaluated TCMRA images as well as perfusion maps (rCBF, rCBV, and MTT) with respect to contrast of a lesion with normal brain using a three-point grading scale. Information additionally obtained by these techniques was also assessed comparing with the final diagnosis.

**Results:** In all patients, we could obtain TCMRA images and perfusion maps that allowed assessment of tumor hemodynamics. In 13 of 20 patients with pathologically or clinically established diagnosis, TCMRA and PWI findings corresponded with conventional MR findings and supported our diagnosis. Meanwhile, in four of the remaining seven patients, TCMRA and/or PWI added information to conventional MR findings that were difficult to interpret. Among these patients, TCMRA and/or PWI findings were valuable in the differential diagnosis among high-grade glioma, metastasis and atypically located meningioma in three patients and in glioma grading in one patient.

**Conclusion:** It is possible to consecutively perform TCMRA and PWI in this order using 8 mL of Gd-based contrast material each. They can provide images that facilitate the differential diagnosis of brain tumors.

**Metabolic Mapping of Human Gliomas: Assessment with Simultaneous PET/MR Imaging for Preoperative "Hot-Spot" Imaging of Suspected Anaplastic Gliomas**

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University of Tübingen - Department of Neurosurgery; Tübingen, Germany;
1 University of Tübingen - Department of Radiology; Tübingen, Germany

Purpose: To evaluate the simultaneous PET/MR imaging using a newly launched integrated PET/MR system for metabolic mapping in patients with suspected anaplastic gliomas.

Materials and Methods: Simultaneous acquisition of 3C-Methionine (MET)-PET, contrast-enhanced T1-weighted-MR (T2FLAIR), and 1H-MRS (3-dimensional chemical shift imaging technique, echo time: 135 ms) exams were performed in 18 consecutive patients with newly diagnosed intracerebral lesions indistinguishable of being low-grade or anaplastic gliomas. The integrated PET/MR system consisted of a PET-compatible PET scanner (1.25 mm axial spatial resolution in a 3T PET MR unit). To measure lesion to brain ratios of MET uptake, the signal intensity was normalized with abnormal T2FLAIR lesion. The PET/MR imaging findings were analyzed using commercially-available software (Tissue 4D®), based on a modified Tofts-Kermode model with arterial input function, for the calculation of the transfer constant (Ktrans), which was supposed to be positive (Ktrans>0) in anaplastic gliomas. Metabolic maps of Choline/N-acetyl-aspartate (Cho/NAA) ratios >3 were considered suggestive of anaplastic gliomas. The tumor “hot-spots” of each modality were correlated with the histological analysis of the subsequent stereotactic guided biopsies.

Results: All patients underwent the integrated PET/MR imaging without complications. All acquired images were of diagnostic quality. The MET-PET images demonstrated 24 positive lesions, the Ktrans maps indicated 14 lesions with abnormal permeability, and the Cho/NAA maps showed 26 localizations with anaplastic characteristics. A spatial discrepancy between MET and Cho/NAA “hot-spots” was evident in 10 patients (see image where A: axial MET-PET fused with anatomical FLAIR image, B: Cho/NAA ratio based on MR spectroscopy, and C: Ktrans map based on MR perfusion). There was no spatial discrepancy regarding positive findings between MET and perfusion maps. Sensitivity/specificity (%) of MET, perfusion and spectroscopy were 75/100, 70/100, and 85/84. In discrepant cases, the biopsy of both MET- and Cho/NAA “hot-spots” led to a 100% sensitivity and specificity.

Conclusion: In patients with suspected anaplastic gliomas, simultaneous acquisition of PET/MR imaging is feasible and markedly improves the diagnostic efficacy of the targeted biopsies. The histological analysis of the subseque...
intensity of the tumor on T2WI, lesion distribution, and normalized max rCBV were significantly associated with differentiation between PCNSLs and glioblastomas (odds ratio [OR] = 0.29 [p = 0.01], [OR] = 3.21 [p = 0.02], and [OR] = 0.42 [p = 0.0004] respectively). By multivariate analysis, normalized max rCBV was significantly associated with differentiation between PCNSLs and glioblastomas (OR=0.42, p = 0.002).

Conclusion: Normalized max rCBV was the most useful MR imaging factor to differentiate PCNSLs from glioblastomas.

Perifocal MR Perfusion and Diffusion Values in Gliomas

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Background and Purpose: Evaluation of primary brain tumors has been revolutionized by diffusion and, especially, perfusion MR imaging. Relative cerebral blood volume (rCBV) has been shown to provide important prognostic information. Processing of perfusion data, however, differs significantly among vendors, with most packages being deficient in various aspects. Our hypotheses are: 1) that dedicated MR perfusion processing software is superior to the packages provided by the vendors, and 2) that values of rCBV and water diffusivity (apparent diffusion coefficient, ADC) within perifocal bands adjacent to the primary brain tumors, as visualized on MR imaging, provide additional information, which may improve our understanding of the disease and prognosis.

Materials and Methods: This ongoing retrospective study includes adult patients diagnosed with cerebral glioma at our institution. Initially, dynamic susceptibility contrast enhanced T2* perfusion data were acquired on two 1.5T MR scanners from different vendors and processed by the proprietary vendor’s software to obtain rCBV. The software from one vendor performs completely automatic calculation, without any ability for user modification; it also offers quantitative data. The software from the other vendor requires the user to select the input information; measurements and quantification are, however, not possible. The data from 10 MR studies in 5 patients were then analyzed off-line using the Java Image software package (www.xinapse.com). The obtained images and their quality were then compared to the images processed on the scanners in consensus by two neuroradiologists, in a random manner, using a 3-point scale (superior, equal, inferior). Data from patients with stable disease for at least 2 years (S) and disease progression within 6 months (P) were then overlaid on the parametric ADC and rCBV maps. In addition to the mean values from within the lesion ROI, values were also obtained from incrementally dilated regions outside the central region, defined automatically using MRlcron. Four bands of dilated regions were considered in 3D ranges away from the lesion in steps of 0-4mm, 5-9mm, 10-14mm, and 15-19mm. Dilution was constrained to be within the ipsilateral hemisphere of the lesion and excluding the lateral ventricles. A manually defined ROI was defined on the contralateral normal-appearing cerebral hemisphere ‘mirroring’ the lesion, to provide an estimate of more normal values. The study is ongoing, and the data currently available are from a very limited number of patients.

Results: The rCBV images processed by the Java Image software package were considered superior to the ones provided by the vendors in 6 cases and equal in 4 cases. Average absolute ADC tumor values in the P and S were similar (1.309 and 1257 10-6 mm²/s), with slightly lower relative ADC values in the rapid progression group (1.56 compared to 1.81). Average ADC values from the dilated perifocal regions showed an outward decreasing trend in both groups. As expected, there was a striking difference in rCBV values between the P and S (91.0 versus 26.1). The rCBV values from the perifocal bands showed continuous outward decrease in P, remaining slightly higher than the contralateral ROI (1.07) at 15-19mm (30.1); the values were, on the contrary, steadily slightly increasing toward the periphery in S to reach values similar to P at 15-19mm (29.0), higher than the contralateral ROI (1.08).

Conclusion: Java Image software package is a reliable tool for brain MR perfusion analysis. MRlcron is a potentially powerful tool for evaluation of brain tumors. Relatively increased rCBV in the outer perifocal region may suggest a more favorable prognosis.

15:45-16:00 107

Glioblastoma Multiform: MRI Findings of the Brain and DWI Analysis

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Learning Objectives: The aim of this study is to describe the MR features of Glioblastoma Multiform, investigate them with DWI and calculate the apparent diffusion coefficient values (ADC).

Background: Brain tumors exhibit various imaging findings on MR due to their internal tissue characteristics and factors influencing the microscopic diffusion of water are responsible for the difference in DWI. We retrospectively analyzed 16 patients (range 26-58y.o.), with histologically proven glioblastomas, seen in our department during the last year. In addition to conventional sequences of routine tumor protocol, the cystic-necrotic components and the solid parts of the tumors were evaluated on the DWI and the ADC values were calculated. Imaging findings: 13 patients showed a heterogeneous mass with cystic-necrotic components of variable size and extension, and a patchy, nodular or ring enhancement. In 3 patients multiple lesions were depicted. All tumors exhibited hypointensity on T1 sequences and areas of high signal intensity on T2, PD and flair sequences with adjacent surrounding edema. In 5 cases hemorrhage was seen within the mass or the tumor margins. DWI showed areas of slightly increased signal intensity in all cases. In 10 patients the cystic-necrotic component of the lesions, demonstrated signal suppression in DWI and high ADC values. In 3 cases apparent high signal intensity in DWI and low ADC values were interpreted.

Conclusion: In most cases of glioblastomas, cystic components do not
exhibit restricted diffusion in DWI, but some of them display homogeneous or heterogeneous high signal intensity and decrease of ADC values.

Brain Surface Motion Imaging for Prediction of Adhesions between Meningiomas and the Brain Surface

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Department of Radiology, Nara Medical University; Kashihara, Japan

Purpose: The presence of adhesions between the brain and the meningioma is one of the major causes of difficulty in clear prediction of tumor at the surgical resection, and pre-surgical prediction of adhesions between the brain and the meningioma would be advantageous for surgical planning. In order to evaluate tumor-brain adhesion including location of adhesion, we developed a novel imaging technique named “Brain surface motion imaging (BSMI)”, which is a method in which subtractions of images in systolic and diastolic phases of CSF/brain pulsatile motion are made. We used single shot spin echo sequence with reduced echo space in order to get a motion-freezing effect. The purpose of this study is to evaluate the feasibility of this imaging method for providing pre-surgical information about adhesion between meningioma and brain surface.

Materials and Methods: Subject of the current study was consecutive 18 cases (34 y.o. to 75 y.o, 14 female and 4 male) with surgically resected meningioma, in which BSMI was obtained preoperatively. The location of the tumor were failx in 3 cases, parasagittal in 6 cases, convexity in 3 cases, frontal base in 4 cases and posterior fossa in 2 cases. BSMI consisted of 2 sets of pulse gated 3D heavily-T2-weighted images (TR=2RR, TE=49, ETL=143 with SPACE). Images of the systolic phase and the diastolic phase were obtained, and subtraction was performed with 3D motion correction. We hypothesized that locations with tumor-brain surface adhesions have no discrepancy in the pulsatile motion between the tumor and the brain surface, so that a band-like texture cannot be observed at the interface of the tumor and the surface of the brain. On the other hand, the presence of black or white band-like texture surrounding the tumor indicates independent motion of the tumor and the brain, indicating the absence of adhesions. The presence of white or black band-like texture surrounding the meningioma was taken as an indicator of discrepancy in pulsatile motion, thus indicating no adhesion. The degree of tumor-brain surface adhesion was classified as follows: “no motion discrepancy”, no band-like texture on the surface of the tumor, taken as indicating diffuse adhesions; “partial motion discrepancy”, a band-like texture in some part of the tumor and not in other parts, taken as indicating the presence of partial adhesions; and “total motion discrepancy”, a band-like texture throughout the surface of the tumor, taken as indicating no adhesions (Figure).

Results: On presurgical BSMI, 8 cases were judged as “no motion discrepancy” suggesting diffuse adhesion, 6 cases were judged as “partial motion discrepancy” suggesting partial adhesion, and 4 cases were judged as “total motion discrepancy” suggesting no adhesion. These presurgical predictions about adhesion and surgical finding agreed in 13 cases (72.2%), including 6 diffuse adhesion, 5 partial adhesion and 2 no adhesion. Disagreements were seen in 5 cases. Two of them were judged as “no motion discrepancy” on BSMI suggesting diffuse adhesion, while no adhesion was found at the surgery. The other disagreements included a case judged as “partial adhesion” on BSMI while no adhesion was found at the surgery, and a case judged as “no adhesion” suggesting no adhesion on BSMI while diffuse adhesion was found at the surgery. There were six cases judged as “partial motion discrepancy” suggesting partial adhesion on BSMIs. Within those six cases, location of the partial adhesion agreed in five cases with partial adhesion.

Discussion: The prediction of brain and meningioma adhesion by BSMI agreed with the surgical findings in most of the cases. This result suggests the feasibility of this method for prediction of adhesions between tumors and the brain surface. One of the major advantages of this method is that it can predict adhesion location. In the current study, the location of the adhesions showed good agreement with the surgical findings, and the accuracy of this method in predicting the adhesion location was proven. Adhesion location is important information for surgical planning, in that tumor removal can be made safer when cleavage of the tumor is started where there is no or less severe adhesion.

Conclusion: In the current study, BSMI could predict brain and meningioma adhesions correctly in 72.2% of cases, and adhesion location could also be predicted. This imaging method appears to provide presurgical information about brain/ meningoia adhesions.

Brain Tumors 4

Chairs: M. Essig, F. Briganti

Preoperative Embolization of Meningioma with Dural Branch of Internal Carotid Artery

M. Hirohata1, Y. Takeuchi1, K. Orito2, T. Abe2

1Department of Neurosurgery, Kurume University; Kurume, Japan;
2Department of Radiology, Kurume University; Kurume, Japan

Purpose: One of the most important issues in the surgical treatment of large hypervascular meningiomas is the securing and coagulation of feeding arteries. However, securing the feeding artery prior to actual tumor resection might be difficult in tumors with a feeding artery arising from the deep surface of the operative field. For such cases, we performed selective feeder embolization before tumor resection. This study evaluated the clinical usefulness of preoperative embolization of the dural branch of the internal carotid artery (ICA) for brain tumor. Clinical Material: Subjects comprised 21 consecutive patients with large hypervascular meningioma fed by ICA dural branches. (Meningohypophysyal A:14, Infero-lateral trunk: 9, Ethmoidal A:1) Feeder embolizations were performed under local anesthesia 1 day before tumor resection. 2 or 1.7 P microcatheter and hydrophilic shapable micro guide
Preoperative Embolisation of the Intra-Cranial Meningiomas via the Ophtalmic Artery

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Objectives: the arterial supply by the internal carotid artery to meningiomas relies to a large extent on preoperative embolisation. Meningiomas of the olfactory groove and those of the greater sphenoidal wing are often supplied by branches of the ophtalmic artery. Our objective is to report our experience in the embolisation of meningiomas vascularised by branches of the ophtalmic artery by using the Onyx 18 as embolic agent.

Patients and Methods: 4 patients, carriers of intracranial meningiomas (3 olfactory meningiomas and 1 meningiom of the external edge of the greater sphenoidal wing), mainly supplied by branches of the ophtalmic artery. All the procedures were realized under general anaesthesia. After supra-selective catheterization as distally as possible of the ophtalmic arteries via the ophtalmic artery, the embolic agent was injected. The rate of tumoral devascularisation was estimated by the angiographic control realized at the end of procedure, the observations of the neurosurgeon during the intervention and the macroscopic study of the various tumoral samples.

Results: in every case it was obtained a good intra-tumoral penetration of Onyx. No patient presented visual complications. A patient presented a unilateral paralysis of the third cranial nerve because of a small peritumoral bleeding which completely regressed after surgical removal of the tumor. In any case it was necessary a post-operative transfusion. The macroscopic analyses of the surgical samples showed a significant intratumoral necrosis.

Conclusion: the preoperative embolisation of meningiomas vascularised by branches of the ophtalmic artery is possible without increase of the ophtalmic regional risks. The tumoral necrosis relative to the intrasalenital penetration of the embolic agent opens the opportunity of single embolisation of these tumors in case of minor symptoms.

Therapeutic Embolization of Meningiomas with Glue: A Potential Alternative to Surgery?

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1Hôpital Foch, Department of Neuroangiography; Suresnes, France; 2Hôpital Foch, Department of Neurosurgery, Suresnes, France

Introduction: Meningiomas are the most frequent intracranial benign tumors and their treatment is considered surgical. When needed, embolization in meningiomas is most often performed with particles as a presurgical procedure. To be effective and induce tumoral necrosis, these particles have to reach the capillary bed of the tumor and not occlude the feeding vessel proximally. Sometimes cases have been reported in the literature of shrinkage of the tumor, reduction of its size and even disappearance after particle embolization. However no follow up on these cases is available and it is not known if these meningiomas regrow secondarily, particles being a transient material. In our institution, embolization is performed whenever possible with acrylic glue deposed after distal superselective catheterization into the lesion itself. Glue is used because of its characteristics and because it is known to be a stable and definite material. The glue has penetrated in most of the cases very deeply in the tumor and has created extensive tissue necrosis, allowing the neurosurgical team to operate in improved conditions. This technique has also allowed to avoid surgical resection in certain types of meningiomas because of tumoral shrinkage and disappearance, even at long term follow up. We assess the indications, safety and efficacy of such a procedure, emphasizing the stability of the results at mid and long term follow up.

Material and Methods: 98 meningiomas have been selectively embolized with glue (Histoacryl® or Glubran®) between 2002 and 2008. Among them, 9 tumors shrunk and / or disappeared, and were consequently not operated (9,2 %). The localization of these latter lesions, their clinical symptoms, their angioarchitecture, their therapeutic management and the results obtained have been analyzed.

Emboloization of Vascularized Vertebral Tumours Using Particles and Glue. Injection Technique, Advantages and Limits of Each of These Materials. Our Experience

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The radical resection of highly vascularised spine tumors (primitive or secondary) is to be considered a high-blood-loss surgery. In our experience, the pre-surgical embolization of these lesions offers the possibility to highly reduce the blood loss during surgery and in some cases (i.e. vertebral aneurysmatic cysts) could be considered a real therapeutic opportunity. This topic is rarely reported and discussed in the literature. The aim of this paper is to share our experience: indications, materials, technique and results in more than 300 patients.
COMMUNICATIONS

Head & Neck 1

Chair: W.Y. Guo, G. Meli

09.15-09.30

Dural Branches of Proximal Anterior Cerebral Artery: Radiological and Intraoperative Description of a Rare Anatomic Variant

F. Signorelli 1, F. Scholtes 2, N. McLaughlin 3, M.W. Bojanowski 1

Background: The comprehension of vascular anatomy is crucial for the planification of anterior skull base surgery. We describe the occurrence of rarely reported bilateral A1 branches supplying the dura of planum sphenoidale, depicted by angioCT and seen intraoperatively.

Methods: Case report and review of the literature.

Results: During surgery for an olfactory groove meningioma, an artery branching from the anterior aspect of each A1 segment was identified. Both arteries were supplying the dura of planum sphenoidale. Review of the literature demonstrated that proximal ACA dural branches are under-studied and have not been well described. CT angiogram revealed the course of those inframillimetric arterial branches.

Conclusions: The possible existence of dural branches of the A1 segment supplying the anterior skull base must be recognized. CT angiography depicts these minute vascular variants.

09.30-09.45

Compressed Print of the Cranial Nerves Observed on Multislice Motion-Sensitized Driven-Equilibrium (MSDE) in Patients with Neurovascular Compression

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Background and Purposes: The cranial nerve compressed by blood vessels causes the neurovascular compression (NVC), and causes a variety of persistent neurological symptoms such as hemifacial spasm, trigeminal neuralgia, and so on. There are many preoperative imaging methods delineating NVC: such as Gd-T1FFE, MR cisternography (MRC), and so on. However, it has been difficult to show the compressed print of the cranial nerve so far. Multislice Motion-Sensitized Driven-Equilibrium (MSDE) is a novel MRI technique similar to acquisition of diffusion weighted image. It causes phase dispersion of blood by using magnetic field gradient and suppresses blood flow signal. Therefore, MSDE can clearly show the cranial nerves without vascular signal because the complete flow void is obtained. Our purpose is to demonstrate the deformity of the cranial nerves by arterial compression using MSDE.

Materials and Methods: We used a 3.0 Tesla MRI unit (Intera Achieva Philips, Netherlands). Imaging parameters were as following: TR/TE, 7.6/3.4 ms; FOV, 290 mm; b-factor, 10; Matrix, 256x256; Slice thickness, 0.8 mm; Flip angle, 20 degrees; Coil, SENSE-Head-8ch; Scan time, 5 min 17 sec. The subjects were 3 patients with trigeminal neuralgia and 2 patients with hemifacial spasm (male: female = 1:4; average, 74.0 years old). Gd-T1FFE, MRC and MSDE were performed for all patients. MSDE is the volume data of 0.8mm. After we confirmed arterial compression by both Gd-T1FFE and MRC, we observed the existence and portion of the compressed print of the nerves in detail by MSDE.

Results: Compressing blood vessels were superior cerebellar artery (SCA) in one patient, posterior inferior cerebellar artery (PICA) in one patient, anterior inferior cerebellar artery (AICA) in two patients and AICA and vein in one patient. All compressing blood vessels could be correctly diagnosed in preoperative evaluation. of all 5 patients, 4 patients (2 with trigeminal neuralgia and 2 with hemifacial spasm) showed the compressed print of the cranial nerves, which was consistent with operative findings. In postoperative evaluation, their neurological symptoms improved quickly and their compressed prints disappeared promptly. One patient with trigeminal neuralgia did not show the compressed print of the trigeminal nerve on MSDE. In operative observation, also the compressed print was not observed.

Conclusions: We can demonstrate the compressed print of the cranial nerves in patients with NVC using MSDE, findings of which were well consistent with the operative findings. The compressed prints were disappeared promptly after operation.

09.45-10.00

Quantification of the Facial Nerve Motion during Cardiac Cycle Using Phase Contrast MRI. Preliminary Results for a Better Understanding of Neurovascular Conflicts

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Introduction: Hemifacial spasm is generally caused by pulsatile neurovascular contact at the root entry zone of the facial nerve, which divides it between a central nervous system segment and a peripheral one. More often offending vessels are the anterior inferior cerebellar artery and the posterior inferior cerebellar artery, and less frequently the vertebral artery. During the cardiac cycle, the vessels localized in the cerebello pontine angle, the brain stem and cranial nerves move according to the pulse wave. Understanding
the genesis of these neurovascular conflicts imply that the motions of these vessels and the facial nerve are well known. Concerning the nerve motion, there’s no available data in literature. The purpose of this study is to measure facial nerve motion during cardiac cycle. Phase contrast magnetic resonance imaging (PCMRI) is a non invasive technique allowing investigations of the variations of cerebrospinal fluid (CSF) flow dynamics, but also of brain tissue. CSF flow quantification is a routine procedure for certain pathologies such as hydrocephalus. The purpose of this study is to measure facial nerve motion during the cardiac cycle.

**Methods**: A phase contrast sequence was set up and tested on two volunteers. Each was scanned at the level of the right internal acoustic-facial bundle, on a SIGMA 3T HDxt (GE Healthcare, Waukesha, WI). A 3D Fiesta sequence (bSSFP, TE/TR: 1.8 / 4.5 ms) was initially used as localizer to precisely select the anatomical level of the right facial nerve. Then, flow images were acquired with a two-dimensional fast cine PCMRI pulse sequence (TE/TR 8.5-10/13-20 ms), perpendicular to the measured direction of the flow in the two longitudinal and the one perpendicular plane, relative to the nerve bundle. The selected interval (ie the systole and the diastole) were precisely known, and then carry over the cardiac cycle. The study of the motion of cranial nerves could lead to a better global modelling of motion of all components in the posterior cranial fossa, and thus may help understanding certain pathologies such as neurovascular compression syndromes or neurovascular conflicts.

**Results**: Measured axial and coronal motions in (mm) of the facial nerves and the pons for volunteer n°1 is shown in figure 1, 2 and 3. Maximum displacement of the cisternal part of the facial nerve was 0.45 - 0.5 mm over the cardiac cycle, and was three times larger than in the mesial part. This was observed both in axial and coronal planes. This is consistent with the anatomy: the facial nerve is firmly fixed at the bottom of the internal acoustic meatus. Displacement of the pons was of the same order of magnitude between axial and coronal planes (axial: 0.15 mm; coronal: 0.04 mm), but significantly less than motion of the cisternal part of the facial nerve. Values of motion of the pons over the cardiac cycle are consistent with those found in literature (4), but as for the facial nerve motion, we have not found any relevant literature value.

**Conclusions**: The PCMRI sequence can provide cranial nerve motion in longitudinal and perpendicular planes of the facial nerves. More volunteers are needed to validate this preliminary study. It should be improved as well if the several phases of the cardiac cycle (ie the systole and the diastole) were precisely known, and then carry over the cardiac cycle. The study of the motion of cranial nerves could lead to a better global modelling of motion of all components in the posterior cranial fossa, and thus may help understanding certain pathologies such as neurovascular compression syndromes or neurovascular conflicts.

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**Background and Purpose**: The cochlea and the carotid artery presents possible surgical risk during increasingly popular cochlear implant surgery. The purpose of this study was to determine the normal range of the this region termed the cochlear-carotid interval (CCI), by 64-lice multi-detector computed tomography (MDCT) in population.

**Methods**: The study consisted of 510 males and 595 females, total1105 patients who had undergone a temporal MDCT between September 2008 and March 2010.Two bony interval among the basal turn of cochlea and petrous part of internal carotid artery measured by 2 observers independently with electronic calipers on PACS station. The 0.5 mm of axial corona images with confirming from axial and sagittal planes from planar computar reformat images acquired and a specific attention was paid to internal acoustic canals for being on the same plane. The Mann Whitney U test and Spearman correlation test were used to assess differences between readers, sides and gentles.

**Results**: Among 1105 patients and 2210 temporal sides CCI ranged from 0.0 mm unilateraly in eight (0.7%) and bilateraly in two patients (0.1%) with a score of ten in total population (0.9%). The right CCI ranged from 0.0 to 6.0 mm in females (mean 1.0 ± 0.8; median 1.0) and 0.0 to 5.8 mm in males (mean 1.0 ± 0.8; median 0.7). The left CCI ranged from 0.1 to 5.4 mm in males (mean 1.0 ± 0.8; median 1.0) and 0.0 to 5.9 mm in females (mean 1.0 ± 0.8; median 0.9). Total scores ranged to 0.0 to 6 mm for right CCI (mean 0.9 ± 0.8; median 0.7) and 0.0 to 5.9 mm for left CCI(mean 1.0 ± 0.8; median 1.0). The CCI showed no significant relationship with subject gentle (P= .969) and there were no significant differences between readers (P=.457 and sides (P=.879). A positive correlation (r=0.741) found between right and left CCI.

**Conclusion**: The present study demonstrated that the CCI varies considerably between 0.0 mm to 6 mm independently from gentle in population. The close relationship between cochlea and internal carotid artery can be associated with sensorineural hearing loss as well. Understanding the importance of CCI
and preoperative knowledge of thin or absent bone allows the radiologist to play a crucial role in alerting the surgeon to prevent penetration of the carotid canal during cochlear implant surgery.

10.15-10.30 10

Imaging of the Ear. Particular Findings

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The temporal bone is known as an area of difficult anatomy. Subtle bony structures, small canals and fine su-
tures cause sometimes problems in the differentiation between normal and abnormal. Moreover, anatomical variants should not be confused with pathological structures. Precise and complete imaging of the ear is neces-
sary not only to give an indication of the eventual aesthetic and audiological therapy, but also to plan sur-
gical treatment and avoid iatrogenic lesions. CT represents the imaging technique of choice for showing exter-
nal and middle-ear anatomy; CT and MR are complementary in the study of the inner ear.

The aim of this paper is to remind some ear radiological findings which can imply problems of differential di-
agnosis or, on the other hand, which should be described for justify the symptoms or alert the surgeon. Con-
cerning the middle ear, the normal condition at birth should not mis-
taken for congenital malformations. At birth there is still a remnant of unresorbed embryonal tissue that fills the tympanic cavity. Mesenchyme oc-
cupies 20% of the middle ear at birth and disappears by 1 year of age. On the other hand, in middle ears with congenital anomalies, mesenchyme occupies about 30% of the middle ear at birth and does not resolve until 3 years of age. Mesenchyme is found most frequently in the mesotym-
num, followed by epitympanum, adi-
tus ad antrum and mastoid antrum. Amniotic fluid can be also detected in the middle ear of newborns. Ossi-
ification of the ossicles seems to occur steadily throughout fetal life and af-
ter birth. Bone marrow was observed in both the malleus and incus in chil-
dren until 25 months of age, whilst after the age of 25 months, no bone marrow tissue was present in either of the ossicles. So, on CT examination performed before 25 months of age, hypodensities of the osseous chain should not be misinterpreted as con-
genital abnormalities or acquired le-
sions. Moving on the inner ear, peri-
 cochlear hypodensity on CT is often detected in childhood; it can be due to incomplete ossification of the otic capsule, with persistence of cartilagi-
neous remnants. Without clinical cor-
relation, the significance of this CT sign, commonly described in associa-
tion with pericochlear otosclerosis and the pericochlear form of osteogenesis imperfecta, requires prudence of inter-
pretation. In case of dehiscence of the jugular bulb with a vestibular aqueduct, jugu-
lar venous pulsations could be trans-
mitted to the vestibular aqueduct and the endolympathic sac; it could cause aberrant transmitted signals to the vestibular and cochlear nerve, thereby producing dizziness or hearing loss. Displacement of the 7th cranial nerve and lack of a bony cover are two con-
titions that place the facial nerve at risk of being injured by the unwary surgeon. In general, paediatric otorhi-
nolaryngologists should be cautious when exploring patients with ear malformations because associated fa-
cial nerve anomalies may be present.

Abnormalities of the vertical portion of the facial nerve coexist very often with external and middle-ear malfor-
mations. In the case of EAC atresia, tympanic membrane and masta-
doid hypoplasia, coronal CT images show precisely anterior dislocation of the mastoid segment of the nerve, which runs obliquely, medial to lat-
eral, in the frontal plane. The mastoid segment of the facial nerve has been described as being 3 mm more anteri-
orly displaced in patients with 2° and 3° grade microtia than in those with 1° grade microtia. Duplication of the facial nerve or its dehiscence in jugu-
lar fossa should alert the surgeon. In conclusion, the knowledge of anatomical variants and of up-to-date embryolog-
ical concepts enables the production of a radiological report, which is not only descriptive but also interpretative, suggesting clinical correlations, surgi-
cal cautions, further investigations or genetic counselling.

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Head & Neck

Chairs: D. Goldsher, F. Calzolari
10.30-10.45 10’

TMJ Pain and Neuropathic Pain in Patients with Temporomandibular Joint Disorders

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Subjects with “Temporomandibular Joint Disorders (TMJ-D)” may be af-
fected with joint dysfunction and ad-
ditional oro-facial complaints. Among the various symptoms described by the patients, pain is surely one of the most frequent 1. It was reported that in patients with TMJ-D, pain may be located in the proximity of the tempo-
romandibular joint (TMJ) or may in-
volve greater portions of the oro-facial region. In the first case, pain is called as TMJ pain; in the latter case pain is instead labeled as “TMJ-neuropathic pain” because it could be consequence of nerve fiber damage. “TMJ pain” may be mild or severe, is generally dull and may occasionally or continuously present in association with jaw move-
ments. “TMJ-neuropathic pain” is, in-
stead, associated with the onset of sen-
sory deficits of the head (mostly in the area of distribution of the trigeminal nerve) such as facial paresthesia, dys-
esthesia or hypesthesia, headaches, toothache, and ear sounds. The causes of the presence of one of those two dif-
ferent features of pain in patients with TMJ-D is not well known yet. Never-
theless, in the last years, MR imaging has been able to demonstrate that “TMJ pain” could be correlated to the presence of internal derangement, ef-
fusion, osteoarthrosis, and bone mar-
row edema within the TMJ (Figures 1 a-d), whereas “TMJ neuropathic pain” could be associated to the presence of a mechanical impingement of the TMJ disc on the mandibular nerve fibers (Figures 2 a-b) 1,2,6.

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Figure 1 a-d Sagittal MR image of the TMJ in patients with TMJ-D: a. Internal derangement of TMJ with anterior displacement of the articular disc; b. Effusion of the TMJ; c. Osteoarthrosis with erosion of the condyle; d. Bone Marrow edema.

Figure 2 a-b Paracoronal MR image of the TMJ joint at the maximal open-mouth position:a. MR image shows the normal TMJ arrangement of TMJ with anterior displacement and no effusion in healthy people; b. In this patient with TMJ-D and neuropathic pain, the dis- arrangement of TMJ with anterior displacement of the articular disc is still visible, but the condyle is eroded. The condyle is no longer seen in healthy people.

Diagnostic Value of MRI Performed after Intratympanic Gadolinium Administration in Patients with Ménière Disease

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Objective: To evaluate the diagnostic efficiency of magnetic resonance imaging (MRI), performed after intra-tympanic gadolinium administration, in defining endolymphatic hydrops (EH) in Ménière’s disease (MD) and correlate images with the outcomes of a number of diagnostic parameters.

Patients: Sixteen patients (13 males and 3 females, ages 25 to 78 years, median age 59 years) with definite MD and 11 subjects suffering from various unilateral non-MD disorders of the inner ear.

Intervention: A 0.6 ml solution of Gadobutrol (1mmol/ml) diluted 1:7 in saline, was injected through the inferior-posterior quadrant of the tympanic membrane, using a 22 gauge spinal needle. The patient was kept with the head rotated 45° contralaterally for 30 min after the injection. Twenty-four hours later, three-dimensional fluid-at-tenuated inversion recovery MRI using a 3 Tesla unit was performed.

Main outcome measure: The diagnostic efficiency of MRI identifying EH in MD was evaluated and the correlation between imaging outcomes and a series of otoneurological parameters was investigated. Modification of hydrops after successful treatment with intra-tympanic gentamicin was also studied in four MD patients.

Results: All patients showed impaired enhancement of the inner ear of variable degree, with the vestibular portion of the labyrinth more frequently involved than the cochlea. No subject with inner ear disorder different from MD showed enhancement defects at any site of the inner ear. Abnormal vestibular evoked myogenic potentials and stage of the disease were significantly correlated to the number of inner ear sites involved. Duration of the disease yielded probability values very close to significance. Four patients re-evaluated with MRI after successful intratympanic gentamicin administration per-lymphatic enhancement corresponding exactly to the pre-treatment values.

Conclusions: Modern imaging makes possible the identification of the endolymphatic and perilymphatic spaces of the inner ear in humans, allowing the certain diagnosis of MD in a living subject. This may have practical implications in the management of the disease favouring appropriateness in the prescription of medical and surgical treatments.

The Large Vestibular Aqueduct Syndrome in Adults. An Almost Underestimated Realm

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The large vestibular aqueduct syndrome (LVAS) is well known as a rare congenital settled anomaly of the inner ear predisposing the patients to an acquired and progressive sensorineural hearing loss (SNHL). With development in technique and clinically driven awareness there is likely an entity of adult patients with progressive sensorineural hearing loss as well with tinnitus having their only explanation in sometimes subtle changes in the vestibular aqueduct system (VAS). Another group consists of patients with assumable changes in the VAS developing over time. At time of clinical presentation there are signs of erosion of the bony wall of the endolymphatic duct or of the jugular bulb. Furthermore, in the last years otoneurologists likely see adult patients whose symptoms are comparable of those with a LVAS. Thus they are more and more asking for Magna comparative to LVAS in adult, even elderly patients. With ongoing technical improvements likely there is more and more evidence that subtle changes may be responsible for SNHL. In principle there are three groups of signs which will be demonstrated and discussed. First, the slightly widened endolymphatic sac and duct. Second, the lately, in adult or even adolescent age, enlarging vestibular aqueduct. One cause may be the so called diverticul of the jugular bulb or high rising jugular bulb. The latter term expresses that there is (almost evidence for) a dynamic process in an increasing high position of the jugular bulb which will reach the inner ear, most likely the VAS, sometimes the posterior semicircular canal-finally. Other causes are tumors of the posterior fossa, obviously. Third, dehiscence of the superior but also the posterior semicircular canal, being called the third window, being now also more and more recognized. The question arises is if there is no or very complex relationship. Reviewing the experience in two dutch university hospitals with some focus on inner ear pathology, the numbers of reported cases are small, even in review articles. The results are very variable and almost anything but conclusive. The question arises is if there is no or very complex relationship. Reviewing the experience in two dutch university hospitals with some focus on inner ear pathology, the numbers of reported cases are small, even in review articles. The results are very variable and almost anything but conclusive. The question arises is if there is no or very complex relationship. Reviewing the experience in two dutch university hospitals with some focus on inner ear pathology, the numbers of reported cases are small, even in review articles. The results are very variable and almost anything but conclusive. The question arises is if there is no or very complex relationship. Reviewing the experience in two dutch university hospitals with some focus on inner ear pathology, the numbers of reported cases are small, even in review articles. The results are very variable and almost anything but conclusive. The question arises is if there is no or very complex relationship. Reviewing the experience in two dutch university hospitals with some focus on inner ear pathology, the numbers of reported cases are small, even in review articles. The results are very variable and almost anything but conclusive.
operant training in real-time functional magnetic resonance imaging (rtfMRI) neurofeedback allows voluntary modification of specific circumscribed neuronal activations. Combining these observations, we investigated whether patients suffering from tinnitus can (1) learn to voluntarily reduce activation of the auditory system by rtfMRI neurofeedback and whether (2) successful learning improves tinnitus symptoms.

Methods: Six participants with chronic tinnitus were included. First, location of the individual auditory cortex was determined in a standard MRI auditory block-design localization. Then, participants were trained to voluntarily reduce the auditory activation (rtfMRI) with visual biofeedback of the current auditory activation.

Results: Auditory activation significantly decreased after rtfMRI neurofeedback. This reduced the subjective tinnitus in two of six participants.

Conclusion: These preliminary results suggest that tinnitus patients learn to voluntarily reduce spatially specific auditory activations by rtfMRI neurofeedback and that this may reduce tinnitus symptoms. Optimized training protocols (frequency, duration, etc.) may further improve the results.

Advanced CT Studies 1

Chairs: T. Mori, J. Shankar

14.10-14.45 10’

Analysis of CT Perfusion Parameters in Normal Control Patients to Assess the Normal Variations of Major Vascular Territories and the Effects of Using Different Arterial Input Functions

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Introduction: Recent advances in CT Perfusion imaging technology may now provide potential physiologic information during acute strokes, with the potential to risk-stratify patients into a multitude of potential interventions independent of traditional time windows. The purpose of this study was to assess the variability in perfusion parameters based on varying arterial input functions in a normal control population.

There were two specific goals in this study. The first was to obtain average values for CBF, CBV, MTT, and TTP for 19 different regions of interest (ROIs) throughout the brain. These regions contained both all gray and white matter. They were also selected in order to include parts of the brain that were supplied by each of the AIFs. The second goal was to determine whether or not the values for CBF, CBV, MTT and TTP differed within the same ROI based on the AIF used.

Materials and Methods: We performed a single-center retrospective study at the SUNY Downstate University Hospital of Brooklyn. From the period of May 23, 2006 to October 12, 2009, 157 unique patients were found to have undergone a CT Perfusion study of the brain. From this group, 6 patients were selected on the basis of having high quality CTP images, a high number of the arterial input functions (AIFs) of interest were present, and other imaging modalities were also available to confirm absence of pathology. A Philips workstation (Philips Extended Brilliance Workshop 3.5.0.2254, Philips Medical Systems Nederland B.V., The Netherlands) was used to process the data. For the venous output function (VOF), the superior sagittal sinus was used in all cases. For the AIF, all six major cerebral arteries of the Circle of Willis were used. These were the left anterior cerebral (LACA), right anterior cerebral (RACA), left middle cerebral (LMCA), right middle cerebral (RMCA), left posterior cerebral (LPCA) and right posterior cerebral (RPCA) arteries. The parameters obtained using these varying AIFs and single VOF were cerebral blood volume (CBV), cerebral blood flow (CBF), mean transit time (MTT) and time to peak (TTP).

In order to obtain the average values for the four parameters of interest and to compare them with respect to AIF, the non-contrast CT images were coregistered with CTP maps using MATLAB (MATLAB R2006b, The Mathworks Inc., USA). The data taken from the CTP was collected at eight contiguous levels in the brain, each separated by five millimeters. These slices were coregistered for all of the patients, a graphic-user interface (GUI) designed by the research team was used to select the ROIs on the actual CTP images themselves. An analysis of variance (ANOVA) was performed to find the average CBV, CBF, MTT and TTP with respect to each of the AIFs used. The averages for each of the AIFs with respect to the ROIs could then be compared to see if they were significantly different from each other.

Results: A two-way ANOVA was performed with the AIF and the ROI as the two independent variables. The CBF, CBV and MTT were all significantly different for varying ROIs (p<.001), as was CBF and MTT for varying AIF (p<.001) when the variables were considered separately. (Figures 1-3 and Table 1) This data suggests that there may be significant variation of normal values in the commonly measured perfusion parameters (CBF, CBV, MTT) for different vascular territories (ACA vs MCA vs PCA) as well as for gray vs white matter. A confounding technical factor, is the significant variability in these calculated perfusion parameters (specifically MTT and CBF) when different AIFs are utilized (with consistent VOF) (Table 1). CBV was not significantly affected, however, this may be secondary to the method of calculating CBV based on Philips deconvolution algorithms being more dependent on VOF, which was not altered in this study or the limited number of patients assessed in this preliminary evaluation. Further analysis of additional patients is ongoing.

Conclusion: Our study suggests that commonly measured CT perfusion parameters vary significantly between normal patients for different vascular AIFs and for gray vs white matter. Secondly, that varying AIF selection can significantly change the calculated values of these parameters within an individual patient and between normal patients. These results suggest that further refinement and validation of the techniques of calculating these physiologic parameters needs to be performed to produce consistent, precise, and potentially accurate measurements. In addition, thresholds of normal values may vary significantly for different arterial vascular territories as well as for gray and white matter within these territories. The clinical relevance of these differences needs to be further studied within the different normal and pathologic populations commonly evaluated using this potentially useful new imaging strategy.

14.45-15.00 10’

The Effect of Using 80 kVp versus 120 kVp on Temporal Resolution and Parametric MAP Generation in Perfusion CT

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Introduction: Perfusion CT imaging studies are increasingly being utilized in attempts to assess brain tissue
for potential viability during acute ischemic stroke. These studies, which generate parametric maps of regional cerebral blood flow (rCBF), cerebral blood volume (rCBV), and mean transit time (MTT), involve sequential acquisition of cerebral CT sections during IV contrast administration. These studies have been reported to be acquired at both 80 kVp and 120 kVp. However, the lower kVp may result in noisier images. In this study we investigate the affect of noise on the temporal resolution. Ultimately, it is the temporal resolution that determines the arterial, venous, and parenchymal input functions that are used in the deconvolution technique. In one method, used to calculate MTT, CBV, and CBF, a gamma-variate function is used to fit the concentration-time curves. We hypothesize that having more noise in the temporal domain may increase error in curve fitting, resulting in less accurate representations of the parametric maps.

Materials & Methods: To further evaluate how noise in the temporal domain may increase error in curve fitting, we performed a retrospective comparison of CT perfusion imaging for the evaluation of acute stroke at 80 kVp and 120 kVp. All CTP studies were performed at both 80 kVp and 120 kVp detector helical scanner (Brilliance 64, Philips Medical Systems) and standard protocol. The protocol entailed a 60-second cine series, using 40 mL of iotinated contrast at 4 mL/s, a fixed 200 mAs, and a 1.5 second rotation time. From this data 8 contiguous 5 mm thick reformatted sections were generated, resulting in 40 images per section. All patients had CT perfusion studies done at SUNY Downstate University Hospital between 5/23/06 and 12/26/2010. Our initial brain perfusion protocol utilized 120 kVp, however, based on concerns to reduce dose and potential early evidence suggesting adequate spatial resolution, we rediced our studies to 80 kVp, maintaining all other parameters constant starting in August, 2009. Ten normal patients (without evidence of vascular stenosis or occlusion, and with no prior cerebral vascular accident) were chosen based on the completeness and subjective quality of their studies. Half of these patients had received the standard 120 kVp dose and half had received the 80 kVp dose. The data were analyzed using MATLAB R2006b (Mathworks Inc., USA) The arterial and venous concentration curves were obtained by averaging the weighted average of the nearest neighbors of the pixel with the maximal intensity in an area chosen by the user. The parenchymal concentration curves were obtained by averaging the weighted average of the nearest neighbors of the pixel of interest of 75 pixels, also selected by the user. Two white matter ROIs were chosen, three basal ganglia gray matter ROIs, and two cortical gray matter ROIs. For each patient, the temporal data sets were analyzed for goodness-of-fit of the standard gamma-variate function to the aforementioned arterial input, venous output, and the parenchymal concentration functions. (Figure 2) The standard error for each fit curve was calculated and compared between the 80 kVp and 120 kVp groups. A unilateral unpaired t-test was used to compare the errors between the two groups.

Results: For the arterial input function, venous output function, and all parenchymal regions of interest, the mean error was higher for patients imaged at 80 kVp. (Table 1) However, it was only statistically significant for the venous output function (p value = 0.016). This may be a limitation of the initially small sample size of 5 studies in each group evaluated in this pilot study. Imaging at a lower kVp appeared to have a greater effect on the white matter (approaching statistical significance) than gray matter, (p-value 0.051 [WM] vs 0.380 [GM] and 0.445 [BG]). As white matter tends to have lower blood flow and a lower peak concentration, the tissue concentration map may be subject to a higher signal to noise ratio and may be more sensitive to the increased noise when the study is done at 80 kVp.

Conclusion: It appears that using 80 kVp on CT perfusion studies demonstrates a trend towards increasing error in gamma variate curve fitting. In our study this increase in error was most notable when fitting a curve to the venous output function and white matter. Our study is limited by a small number of pilot patients, but ongoing evaluation of a larger sample may provide us with even stronger evidence of any potential impact of varying kVp. In addition, ongoing studies in our lab are planned to demonstrate how these errors may propagate into the parametric maps and what, if any, is their clinical relevance and significance.

CTA-SI Are Flow not Volume Weighted

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Background: CT Angiography Source Images (CTA-SI) were correlated closely with cerebral blood volume, however this no longer appears true with new faster scanning protocols. We aim to correlate CTA-SI and post-Contrast CT (PCCT) hypodensity with CTP perfusion (CTP) flow and volume abnormalities. We hypothesized that CTA-SI correlate more closely with CTP flow than volume abnormality.

Methods: Anonymized random order of CTA-SI and PCCT images of 64 patients with anterior circulation stroke were reviewed by a reader, blinded to all other data, who manually traced and calculated volumes of abnormality. Spearman correlation performed with CBF and CBV CTP lesion volumes calculated independently by another blinded reviewer. PCCT and CBV volumes normalized by log transformation. Linear regression analysis performed to look for factors associated with flow or volume weighting.

Results: Median (IQR) CTA-SI, PCCT, CBF and CBV volumes of abnormality were 81.84 (47.74-124.06) cm³, 35.3 (15.21-46.47) cm³, 93.15 (55.37-133.08) cm³, 37.52 (7.57-40.96) cm³ respectively. Strong positive correlation was found between CTA with CBF (r = 0.89; p < 0.0001) and between PCCT and CBV (r = 0.78; p < 0.0001), with poorer CTA to CBV (r=0.5) and PCCT to CBF (r=0.52) correlation. Comparisons of baseline demographics between residual values divergent from expected abnormality, considered outliers, and expected values for CTA/CBF correlation confirmed that outliers were more likely to have higher NIHSS (p=0.01), lower ASPECTS (p=0.01), larger baseline CTA(118±51cm³ vs 78±42 cm³; p=0.002) and final infarct(177±105cm³ vs 86±89 cm³; p=0.09) volumes than non outliers.

Conclusion: Our results indicate that currently acquired CTA-SI are blood flow- rather than blood volume weighted.
Materials and Methods: The study includes 22 patients who underwent PCT prior to surgery or stereotactic biopsy in presence of a newly diagnosed intracranial solitary mass. The final diagnoses were 10 Glioblastomas (GBM), 5 non-anaplastic meningiomas, 2 lymphomas, 4 abscesses and 1 metastasis from testicular choriocarcinoma. For CT a 4-slice multidetector scanner was utilized. PCT was carried out during pre-operative CECT studies. ANECT head scan had been preliminarily performed to locate the 2 cm thick coverage area of PCT, which corresponded to the level of the largest lesional diameters. For PCT 40ml of non-ionic iodinated contrast material (370 mg/ml) was injected through a 18-gauge intravenous line at a rate of 4ml/sec. At 8 seconds into the injection, a dynamic scan started with the following parameters: 80kVp, 108 mA, 1 sec per rotation for a total scan time of 45 seconds. The exams were completed by a CECT scan of the whole brain. Cerebral Blood Volume (CBV) and Permeability Surface Area Product (PS) maps were generated from PCT data by using a two-compartmental model (Patlak algorithm). Time to Peak (TTP) and Mean Transit Time (MTT) maps were generated by using a maximum-slope model. The absolute CBV, PS and MTT measurements were normalized to the contralateral normal-appearing white matter (NAWM) and the maximal relative CBV, PS and MTT (rCBV, rPS and rMTT) values were considered for comparative analysis. For TTP, the absolute difference in seconds between the TTP values of the mass and the mean of the contralateral normal-appearing cerebral parenchyma was considered. Receiver operating characteristics (ROC) analyses were done to compute the area under the curve (AUC) for each parameter in the differential diagnoses between biologically aggressive neoplasms (BAN: GBM, Lymphomas, Metastases) versus slow-growing tumors (grade I-II neoplasms) and non-neoplastic conditions (abscesses). ROC analyses were furthermore performed to assess which PCT parameters had the highest predictive value for GBM, meningioma, abscess and lymphoma.

Results: TTP and rMTT were the best predictors for BAN (TTP: AUC 0.842, <=2.4 sec sensitivity 76.92%, specificity 88.89%; rMTT: AUC 0.821, <=1.17 sec sensitivity 84.62%, specificity 66.67%) and for GBM (TTP: AUC 0.904, <=2.4 sec sensitivity 90%, specificity 83.33%; rMTT: AUC 0.817, <=1.07 sec sensitivity 80%, specificity 91.66%). The rCBV of PE had good predictive value for GBM (AUC 0.812, >0.91 sensitivity 90%, specificity 75%), meningioma (AUC 0.912, <=0.88 sensitivity 80%, specificity 82.35%) and lymphoma (AUC 0.857, <=0.81 sensitivity 100%, specificity 85%). Lesional rCBV had high predictive values for meningioma (AUC 0.976, <=7.13 sensitivity 100%, specificity 92.4%), lymphoma (AUC 0.967, <=3.14 sensitivity 100%, specificity 75%) and abscess (AUC 0.806, <=2.29 sensitivity 75%, specificity 88.89%). Lesional rPS best predicted meningioma (AUC 0.988, >24.97 sensitivity 100%, specificity 94.12%). Lesional rCBV did not have good predictive values for BAN (AUC 0.658 and GBM (AUC 0.583), while lesional rPS performed a little better (AUC 0.692 for BAN, AUC 0.708 for GBM). When excluding meningiomas, the predictability of rCBV improved (AUC: for BAN 0.732, for GBM 0.719). Moreover, a decrease of the predictive value of lesional rPS (AUC 0.673 and 0.5 respectively) was found.

Conclusion: PCT is useful in the differential diagnosis of intracranial masses with PE. The temporal parameters (TTP and rMTT) were the best predictors for BAN and GBM, whereas lesional rCBV and rPS were not good predictors. Lesional rPS best predicted meningiomas. We found high predictive values of lesional rCBV for meningioma, lymphoma and abscesses, while PE rCBV was a good predictor for GBM, meningioma and lymphoma. The main limitation of the study is the lack of some malignant neoplasms such as low-grade gliomas, metastases and anaplastic meningiomas. Furthermore, there were only 2 lymphomas in our series.
Deep white matter tracts at the junction of the brainstem, cerebellum, and cerebrum play a major yet poorly understood role in complex cerebral processes. Better knowledge of their anatomy is requisite to understanding the clinical correlates of their lesions and developing targeted treatments. By coupling high-resolution diffusion tensor imaging with neuroanatomical data from the end of the nineteenth century, we mapped white matter tracts at the diencephalic-mesencephalic junction for the first time in vivo.

DTI acquisition used single-shot spin echo-echo planar sequence with diffusion gradients applied in 32 non-collinear directions (six healthy adult subjects; SENSE head coil, 3.0-T wholebody MR scanner).

The signal-to-noise ratio was improved using five identical datasets per subject.

The anatomic study was performed (1) by transposition in 3D of the anatomic knowledge, (2) fiber tracking by a continuous tracking method and (3) embedding tracts in the volume-rendered brain coupled with triplanar multi-imaging display.

We describe and discuss the anatomic course and relations of the following tracts: subthalamic fibers (brachium conjunctivum, Wernicke’s commissure, medial longitudinal fasciculus, central tegmental tract, basal forebrain bundle, Forel’s decussation, oblongato-lenticularis, lemnisci and mammillothalamic fasciculus), fibers related to deep brain nuclei (red nucleus, subthalamic nucleus, substantia nigra, pedunculopontine nucleus and substance Q), internal capsule (projection fibers, ansa lenticularis, Turck’s bundle, fasciculus of Arnold, pontine fibers, superior thalamic radiations, optic radiations and connections with longitudinal pathways), telencephalic longitudinal pathways (inferior fronto-occipital, uncinate, tempo-occipital and arcuate fasciculi), commissural tracts (forceps of corpus callosum, tapetum, anterior and posterior commissures, fornix, commissure of Forel and suprapoetic commissure), and radiate fibers. In addition to visualizing these complex tracts in vivo, we clarify the anatomical course of these pathways in normal and pathological conditions and developing highly targeted treatments.

Mapping of the deepest white matter bundles within a clinically acceptable time paves the way for understanding the roles these pathways play in normal and pathological conditions and developing highly targeted treatments.

Results: The SNRs of diffusion tensor MR imaging and diffusion-weighted MR imaging were 21.7 ± 7.2 (mean ± SD) and 26.3 ± 17.5, respectively, which resulted in no significant difference (p=0.118). In terms of LNRs, diffusion tensor MR imaging showed higher value (1.8 ± 0.4) than diffusion-weighted MR imaging (2.2 ± 0.5) (p<0.0001). ROC analysis revealed that the area under the curve of diffusion tensor MR imaging (0.973) was significantly higher than diffusion-weighted MR imaging (0.865) (p=0.014). Sensitivities and positive predictive values were 95 % and 100 % for diffusion tensor MR imaging, and 73 % and 100 % for diffusion-weighted MR imaging, respectively.

Conclusion: We concluded that diffusion tensor MR imaging has higher LNR than diffusion-weighted MR imaging and thus can prove higher lesion detection rate than diffusion-weighted MR imaging for acute stroke lesion delineation.

Clinical relevance: Diffusion tensor MR imaging is more useful for the detection of tiny embolic infarction than diffusion-weighted MR imaging.

**Brain Lesions: Can 3D FLAIR Imaging Replace 2D FLAIR at 3T?**

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2Kumamoto University School of Medicine; Kumamoto, Japan

Purpose: To compare diffusion tensor magnetic resonance (MR) imaging with single-shot echo-planar diffusion-weighted MR imaging for image quality and visualization of acute cerebral infarction.

Materials and Methods: Forty-two subjects (25 men, 17 women; mean age, 53 years ± 20 [SD]) who were suspected of having acute cerebral infarction (symptom duration, 3.5 days ± 2.4) underwent diffusion tensor MR imaging (six encoding directions) and echo-planar diffusion-weighted MR imaging (b = 1,000 sec/mm2). Two neuroradiologists performed a quantitative analysis of the estimated signal-to-noise ratio (SNR) and the lesion to normal ratio (LNR) by consensus between them. Diffusion tensor MR imaging and diffusion-weighted MR imaging analysis for the evaluation of the presence of acute infarction was performed by two radiologists without clinical information. Receiver operating characteristic analysis was performed to compare the diagnostic values of diffusion tensor MR imaging and diffusion-weighted MR imaging, and sensitivities and positive predictive values were calculated.

Results: The SNRs of diffusion tensor MR imaging and diffusion-weighted MR imaging were 21.7 ± 7.2 (mean ± SD) and 26.3 ± 17.5, respectively, which resulted in no significant difference (p=0.118). In terms of LNRs, diffusion tensor MR imaging showed higher value (1.8 ± 0.4) than diffusion-weighted MR imaging (2.2 ± 0.5) (p<0.0001). ROC analysis revealed that the area under the curve of diffusion tensor MR imaging (0.973) was significantly higher than diffusion-weighted MR imaging (0.865) (p=0.014). Sensitivities and positive predictive values were 95 % and 100 % for diffusion tensor MR imaging, and 73 % and 100 % for diffusion-weighted MR imaging, respectively.

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Clinical relevance: Diffusion tensor MR imaging is more useful for the detection of tiny embolic infarction than diffusion-weighted MR imaging.
could replace 2D FLAIR in routine MR examinations.

Materials and Methods: Before clinical study, three healthy volunteers underwent an MRI varying the TR and TE to investigate the effects of these parameters on the gray-to-white matter contrast with the 3D FLAIR sequence. We performed the visual assessment and lesion tumor (considering the gray-to-white matter contrast between 2D and 3D FLAIR images. In the prospective clinical study, 97 patients suspected of having brain lesions on the basis of clinical history or neurologic findings underwent MR imaging at 3T with 2D and 3D FLAIR pulse sequences. 3D FLAIR sequence was determined based on the results of optimization of TR and TE. 2D FLAIR images were compared with 3D images qualitatively and quantitatively. Qualitative analyses were performed by two radiologists using the following three-point grading system for the lesion conspicuity and lesion detection: +1, 3D FLAIR were superior to 2D FLAIR; 0, 3D and 2D FLAIR were equal; -1, 3D FLAIR were inferior to 2D FLAIR. When the answers of the radiologists were scored as +1 or -1, the radiologists were asked to provide a possible reason. 2D and 3D FLAIR were also compared quantitatively. In 15 (19%) of 81 lesions, as equal (+1), 3D FLAIR images received an overall score of +0.17 ± 0.41 (mean ± SD), [A1] and they were rated as significantly superior to 2D FLAIR images (P<0.01). Of the 15 lesions rated as (+1), 8 lesions were located in the brain stem, 3 were small lesions in patients with brain trauma, and 2 were the extraxial cerebello-pontine angle tumors. One lesion rated as (+1) was the extraaxial cerebello-pontine angle tumor. For two extraaxial tumors, one subarachnoid hemorrhage, the lesion detection and lesion conspicuity on 3D FLAIR images were superior to those on 2D FLAIR images due to the increased sensitivity of the 3D FLAIR sequence. The CSF signal eliminating cerebrospinal fluid pulsation artifacts. The quantitative evaluation demonstrated that, for all lesions, the mean contrast ratios of lesion-gray matter and lesion-white matter were higher on 3D FLAIR than on 2D FLAIR, and there were significant differences between two sequences in ischemic lesions or infarction and brain tumor and white matter lesion (P<0.05).

Discussion: Our clinical study demonstrated that the more small lesions such as brain trauma or lacunar infarction were detected with 3D FLAIR images than with 2D FLAIR images. This improved detection of the small lesions is largely due to the resolution with 3D FLAIR sequence. Otherwise due to the thiner slice thickness, which reduces the partial volume effects. The spatial resolution with 3D FLAIR sequence is approximately 1.0 x 1.0 x 1.2-mm resolution, whereas that of the 2D FLAIR sequence is approximately 0.9 x 1.1 x 5-mm resolution. For the lesion detection and conspicuity in the brain stem, the 3D FLAIR images were superior to 2D FLAIR images. One possible explanation is the suppression of CSF pulsation artifacts with 3D FLAIR sequence compared to 2D FLAIR sequence. Previous study has reported that 2D FLAIR images failed to demonstrate MS lesions located in the brain stem, and the presence of CSF pulsation artifacts surrounding the brain stem contributed to the insufficient contrast.

Conclusion: A 3D FLAIR sequence is equal or superior to a standard 2D FLAIR in the conspicuity of brain lesion and can replace 2D FLAIR images in most cases.

Evaluation of Different MR Measurement and Postprocessing Techniques for Perfusion

Parameters Using a New Phantom as Gold Standard

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Purpose: Measurement of cerebral perfusion parameters like Regional Cerebral Blood Flow (rCBF) gains increasing importance in treatment of acute stroke. So far however, existing phantoms used for validation of these techniques are far from reality or suffer from low reproducibility of measurements. In this study, a new type of phantom is presented based on the dialysator principle. Because perfusion within the phantom can be measured mechanically and has proven to be homogenous and stable, the phantom can be used as a gold standard to evaluate and quantify MR perfusion measurements and data postprocessing software systems.

Methods: The phantom is presented based on a dialysator containing capillary-like polysulfone membranes of a median diameter of 200 μm. The internal volume of these capillaries and the volume of the surrounding space can be quantified exactly. The inflow into the phantom is pulsatile, can be varied and is measured by an independent mechanical flow meter. The phantom contains a port for repeated injection of contrast medium. All parts can be exchanged easily and are free of metal. Encasement into a water bath reduces surface-induced artefacts in magnetic resonance imaging (MRI).

Multiple measurement of perfusion inside the phantom as well as inflow and outflow was performed in a Siemens 3T Trio scanner mainly using a T1W sequence (TE 1.26 ms, TR 323 ms), but also a T2-W sequence (TE 32 ms, TR 1000 ms) for evaluation of different, mostly commercially available software systems. For this purpose, flow parameter maps were calculated by the systems from data sets of phantom flow measurements of 6 different flow velocities and were compared to the independently measured flow inside the phantom.

Results: During repeated measurements, flow values were stable showing a variability (quotient between standard deviation and mean value) of only 2-5%, which was highest in the inflow zone. Increasing velocity of flow however, induced a signal elevation of up to 10%, and application of a different kind of contrast medium (Magnevist® vs. Magnegit®, same molar concentra- tion) elevated the signal up to 30%. The perfusion values calculated by the postprocessing system, showed differences to the phantom capillary flow between 9% (IB Neuro for OsiriX and Siemens Perfusion (MR), 28% StokeTool and 380% (DPTools), usually being above gold standard.

Conclusion: The newly developed capillary-based phantom can be regarded as a gold standard for perfusion measurements with a sufficiently high similarity to intracerebral flow and can be used for evaluation of postprocessing systems to calculate flow parameter maps from MR data. Further details will be given on the symposium including flow measurement by arterial spin labeling which at present is work in progress.
Restless Legs Syndrome Patients

Introduction: Restless legs syndrome (RLS) is a common sensorimotor disorder wherein sensory unaiseens evokes motor restlessness of the lower limbs. The symptoms, following a circadian pattern, aggravate during quiet wakefulness or in the late night hours and lead to insomnia and daytime fatigue. RLS encompasses an early onset subtype which is mainly idiopathic and a late onset that is a secondary form. Early onset RLS affects mainly younger patients (<45 years) with a positive family history. Sparse bibliographic data describe T2 relaxometry metrics of iron content in early onset RLS patients. Conventional MRI has yielded normal findings in RLS patients. Further studies have been performed to evaluate brain volume by using Voxel Based Morphometry (VBM) but the results were controversial. Functional MRI (fMRI) detects local neuronal firing based on the paramagnetic properties of deoxyhemoglobin-containing blood. Previous fMRI in RLS have been conducted in patients with either defined disease onset or in patients with late disease onset. In the present study early onset RLS patients were assessed with MRI and optimized VBM and voxel-based relaxometry (VBR) techniques were used to analyze brain volume and T2 relaxation rate. fMRI paradigm was event-related and was performed in night hours during exacerbation of symptoms.

Materials and Methods: Eleven right-handed patients with idiopathic RLS who had never been treated with dopaminergic agents (9 women, 2 men; age range 48-70 years; mean age 55.3 +/- 8.4; mean disease duration 17.5 +/- 14.05) were assessed with MRI. All patients had early disease onset and four of them reported positive family history. The severity of symptoms assessed with the International Restless Legs Severity Scale (IRLS) resulted in 18.4 +/- 4.8. MRI data were acquired using a 1.5-Tesla scanner (INTERA, Philips Medical Systems, Best, The Netherlands). The imaging protocol consisted of 1) a T1- weighted high-resolution (0.86 _ 0.86 _ 1 mm) three dimensional spoiled gradient echo sequence (repetition time [TR]/echo time [TE], 25 msec/4.6 msec), which was used for structural imaging; 2) a multislice echo T2-weighted sequence (TR, 2,200 msec; TE, 16 values between 32 and 112 msec; slice thickness, 5 mm; gap, 0.5 mm), which was used for T2 relaxometry; and 3) a single-shot multislice gradient echo planar imaging (EPI), which was used for blood oxygenation level-dependent contrast (BOLD) functional images (TR/TE, 3,000 msec/50 msec; flip angle, 40°; matrix, 64 _ 64; slice thickness, 5 mm; gap, 0 mm). VBM, VBR and fMRI data pre-processing and analysis was implemented using statistical parametric mapping software (SPM5) running in MATLAB 7.6. fMRI paradigm consisted of periodic limb movements (PLM) that were made to relieve sensory leg discomfort (900 D) exerted during the examination. The movements were recorded.

Results: Optimized VBM depicted normal brain volume of either grey or white matter structure as compared with MRI and EEG findings. MRI and fMRI activation during Pronounced PLM(p=0.006). Multiple regression analysis revealed that early-onset patients with less disease duration showed activation of the motor and the premotor cortex, the primary and the association somatosensory cortex, the caudate body, the supramarginal gyrus, the dorsolateral prefrontal cortex on the left hemisphere, activation of the temporal lobe, dorsal cingulum and the pars opercularis on the right hemisphere. fMRI activation of the cerebellum, the midbrain, the pons and the pulvinar of the above mentioned areas which were statistically significant at the cluster level (p corrected<0.05) was the cerebellum (Right), the pulvinar (Left), the pons, the primary somatosensory cortex, the dorsal cingulum, the pars opercularis of the inferior frontal gyrus and the supramarginal gyrus. Correlation analysis revealed that early-onset patients with less disease duration activated significantly greater the pars opercularis in extent(p=0.02) and intensity(p=0.008). Additionally, patients with longer disease duration had greater latency (time from the beginning of the fMRI till the first PLM)(p=0.006). Multiple regression analysis with covariates the age and the duration of the patients, controlling for the duration resulted in bilateral activation of the pulvinar.

Discussion: Voxel-based techniques depicted that the early-onset subtype, the merely idiopathic form does not correlate with brain volumetric alterations nor with abnormal iron distribution and may correlate with abnormal functional pathways. MRI activation of motor, premotor cortex, midbrain, caudate body, pons and pars opercularis was attributed to the motor paradigm. Cerebellum and somatosensory cortex activation was due to the sensory symptoms the patients had during the exam. Cingulum activity was linked to the attention to the somatosensory stimuli. 

Magnetic Resonance Spectroscopy (MRS) of the Hippocampus

Purpose: Our objective was to find the proper protocol, to detect metabolite changes and to define the level of abnormality in the hippocampus involved by hippocampal sclerosis (HS) even if structural lesion was not seen on MRI. Magnetic resonance spectroscopy (MRS) provides molecular analy- sis of tissues in vivo in a non invasive way. Metabolite and neurotransmitter contents have diagnostic value in several diseases like brain tumors, neurodegenerative diseases and epilepsy. Hippocampus is a structure difficult to examine by MRS and only 70% of HS can be detected with MRI. HS is present in 65% of temporal lobe epilepsy (TLE) and though it is not clear if it is the cause or the effect of ongoing seizures, it seems to correlate with poor response to therapy.

Method: Single voxel MRS was performed on 18 TLE patients (10 women, mean age 41+/-10 years), using PRESS (point resolved spin echo sequence) with short (35 ms) and long (288 ms) echo time, on a 3T MR scanner. According to previous MRS examinations, 13 patients had unilateral (left, right) HS and 5 patients had no visible abnormality. Elongated (30 x 8 x 6mm, 1440 mm³) volume of interest (VOL) was used, tilted to include most of the hippocampus and to exclude adjacent cerebrospinal fluid and to minimize inhomogeneity effects caused by nearby skull base structures. Metabolite ratios were calculated using peak area measurements of N-acetyl-aspartate (NAA), cholin (Cho) and creatin (Cr). Lateralization was made by calculating asymmetry coefficient (Ca), comparing to contralateral side. Results were then compared with MRI and EEG findings. We found lower NAA/Cr and NAA/Cho and higher Cho/Cr ratios on the affected side. According to most of the
Utilization of Cine MRI Technique in Central Nervous System, Head and Neck and beyond in Fetuses and Children

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**Purpose**: To illustrate the utility of real-time cine-MRI in the functional evaluation of various pathologic entities causing alteration of cerebro-spinal fluid (CSF) flow. The potential for evaluation of coordination of swallowing, and dynamic airway evaluation is demonstrated.

**Materials and Methods**: Real-time MR techniques, such as Cine and CSF flow imaging, are applied for the following pathologies in pediatric patients: obstructive hydrocephalus; status post third ventricle ventriculostomy/endoscopic arachnoid cyst fenestration; unexplained headache; suspected tethered cord, and Chiari1 malformation.

True FISP cine and cine phase contrast with low velocity encoding parameters sequences are utilized for assessment of the target structures, with the acquisition plane depending on the particular expected orientation of the CSF flow being evaluated or the target organ. The method is also utilized in the setting of head and neck masses to decide upon management with fetal (Ex-Utero Intrapartum Treatment) EXIT procedure.

**Results**: Real-time cine MRI techniques are equally feasible in evaluation of normal and impaired CSF flow at the cervico medullary junction; through the foramen of Monro and cerebral aqueduct. Presence of CSF flow through the endoscopically approached third ventriculostomy or fenestration along the wall of arachnoid cyst is demonstrated. Decreased motion of the distal lumbar nerve roots is demonstrated in cases of tethered spinal cord. Evaluation of swallowing movements and its coordination, and airway dynamics are illustrated.

**Conclusion**: Cine-MRI methods are technically feasible, fast sequences, which can potentially be valuable and add useful information to assessment of intracranial CSF flow dynamics and evaluation of effectiveness of endoscopic neurosurgical procedures performed to divert CSF flow. There is also potential useful information which can be revealed by Cine-MRI for respiratory and gastrointestinal diseases.
OZONE SESSION

Introductory Lecture
Decade Review of Ozone Therapy in China

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It has been ten years since ozone therapy was performed in 2000 in China. In the past decade, ozone therapy got great achievement. It was only used for lumbar disc herniation initially, but now it could be used to treat various pains, osteoarthritis, gynecological inflammation, ulcers, viral hepatitis, cerebral infarction and so on. Currently, hundreds of hospitals have already undertaken the program of the ozone therapy, and according to incomplete statistics, hundreds of thousands of patient received this therapy each year. Patients with cervical and lumbar disc herniation reached over 50,000 patients each year, with more than 80% excellent rate. In China, HBV prevalence in the population is very high, and the efficiency of clot formation therapy is equivalents to that of oral antiviral drugs, thus for patients with drug resistance, ozone autohemotherapy is the best choice. Currently, many hospitals in the domestic use ozone therapy for cerebral infarction in clinical research, and had rapid development. The preliminary study outcomes show that ozone therapy can reduce cerebral edema and promote brain tissue repair, which has been the new topic in the last two years. Ozone therapy for tumor still in its infancy, but it has been seen some good signs. In September 2008, with the strong support of the President of China Chapter of the World Medical Association Pain, Prof. Ni JiaXiang, the China Federation of Ozone Therapy (CFOT) was established, with Prof. He Xiaofeng as director, liver specialist Prof. Guo Yabing, orthopedic specialist Prof. Yu Bin, neurological expert Peng Kairun as core strength of the federation. In February 2009, the book called “The clinical application of ozone therapy” edited by the He Xiaodong was officially published. It is the first professional book about ozone therapy in China, collecting the latest researches in various fields. The first and second annual conferences have been successfully held since the establishment of Federation, with more than 300 participants at each session and 288 memberships. And about 30 hospital or medical units have been granted “Demonstration Unit Ozone Therapy” or “Standardized Unit of Ozone Therapy”. Meanwhile, with the financial support of Germany Humares Company, a “Nanfang Hospital-Humares clinical training center of ozone therapy” was established, which specialized in systematic training the physician who are fresh on ozone therapy. Training contents include ozone therapy for the disc herniation, liver disease, cerebrovascular disease, osteoarthritis, as well as animal experiment practice. We believe that in the near future, ozone therapy can benefit more and more patients like other treatments.

Introductory Lecture
The Evolution in the Treatment of Spinal Degenerative Pathologies: From Demolitive, to Conservative or Regenerative Procedures

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Introduction: In face of spinal degenerative processes involving ligamentous, discal and bony mechanical and metabolic functions, enormously wide investigation has modified the therapeutic attitudes of specialists. Enormous effort has been accomplished in improving pain treatments, and each anatomical structure has been studied with the aim of controlling its damage, which can be considered a specific pain generator. Since some years, for regenerative purposes, haemocomponents rich in platelets, have been produced for applications in different clinical sectors and on different lesions of tissue such as skin, bone, tendons and cartilage. Wider and wider is the interest, in different clinical field, in the application for regenerative purpose of haemocomponents produced from peripheral blood. These are mainly made up of concentrated platelets capable of releasing locally growth factor (GF) that stimulates tissue regeneration. Our group has devised a method in order to produce a new leukocyte-platelet haemocomponent enriched in fibrinogen, that integrates the GF stimulus with the presence of cells involved in the regenerative processes: monocytes and stem cells. The use of the cell separator in order to collect these haemocomponents from peripheral blood has allowed us to realize a safe standardized product, with good regenerative potentiality and reasonable costs. This is obtained modifying some parameters of separation, and without cell manipulation. Rationale of treatment: The first answer of an organism to a lesion is the formation of a clot, basically made of fibrin filaments. After the clot formation begins an inflammatory phase triggered by specific signal molecules released by platelets and leukocytes. The result is the recruitment of macrophages in the zone where the tissue has been damaged. This process passes through the creation of a physiological environment that favour the recruitment in the clot of not differentiated cells and orientated them to proliferation. Platelets that are activated locally, other than exercise their haemostatic function, release alfa-granules, a series of GFs, that induce the activation of resident cells, as macrophages and fibroblasts, which play an essential role in tissue reparation. For a complete tissue reparation process three elements are necessary: scaffold extracellular matrix), tissue cells, growth factors. This is the rationale of our intradiscal injection with leukocytes-platelets gel. Matherials and Methods: A total of 12 patients affected by degenerative
disc disease (DDD) have been treated with an intradiscal injection of 1 ml, and a peridiscal injection of 3-4 ml of an autologous leucocyte-platelet haemocomponent enriched in fibrino

gen. Another group of 6 patients affected by severe disco-arthritis associated with foraminal stenosis has been treated with an intradiscal injection of 3 ml, and a peridiscal injection of 3 ml of the same autologous leucocyte-platelet haemocomponent enriched in fibrinogen gel. In both groups of patients the injections have been performed 2 times, with an in-
terval time of 3 months. In the same time lapse we have studied the effects and clinical results of nucleoplasty on contained lumbar disc herni-
tations. The aim was that of applying a method which is not strictly distruc-
tive, but which also stimulates ripara-
tive processes. For what Nucleoplasty is concerned, Methods were: 1390 contained disc herniation patients (consecutive series, 2003 to 2006; 234 in L3-L4; 989 in L4-L5; 167 in L5-
as satisfaction index was 9/10. B) In the other group of 6 patient affected by severe disco-arthritis associated with foraminal stenosis the mean VAS scale improvement was = 3, while the patient satisfaction index was again 9/10. For Nucleoplasty these are the results (v. Table). MRI or CT have been performed 6 months after the procedure, in 498 cases. Bulging was eliminated in 128, significantly reduced in 222 and unvaried in 148 cases. This case distribution anyway is not directly correlated to the qual-
ity of the clinical outcome. Cobloration just perforates the anulus, without disruption of surrounding structures. It provokes a small volume loss en-
tailing a large fall of pressure. The ob-
erved initial decreases in interleukine 1, which has hyperalgesic effects, followed by augmentation in interleukine 8, which may express the re-
paratory response, might correspond to the two-step clinical amelioration, initially due to the rapid discal loss of volume, and later due to the progres-

<table>
<thead>
<tr>
<th>Results of Nucleoplasty</th>
<th>12 months</th>
<th>24 months</th>
<th>36 months</th>
<th>48 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent 70% score improvement</td>
<td>679</td>
<td>51.47%</td>
<td>334</td>
<td>49.2%</td>
</tr>
<tr>
<td>Good 50-70% score improvement</td>
<td>416</td>
<td>31.53%</td>
<td>196</td>
<td>28.9%</td>
</tr>
<tr>
<td>Insufficient &gt;50% score improvement</td>
<td>112</td>
<td>8.49%</td>
<td>88</td>
<td>12.9%</td>
</tr>
</tbody>
</table>

Roland Morris >70% improvement is considered excellent result; 50 to 70% good result.

S1) received ablation of the nucleus pulposus. By posterolateral approach under fluoroscopy through a 17G nee-
dle the SpineWand electrode is intro-
duced and radiofrequency is applied. In these patients Morphological Ind-
dications were contained lumbar disc herniations, intact anulus, and clin-
ical Indications were leg pain with or without back pain; failure of 6 weeks conservative therapy. Results: For haemocomponents rich in platelets, these are the results: A) in the group of 12 patients affected by DDD the improvement in motor performance was significant, as even the pain attenuation, which were 3-7 months lasting. The mean VAS scale improvement was = 4, and the patient

tive discl repair. Byochemical modi-
fication may correspond to the clinical result more than morphological ones. By this minimally invasive procedure patients will not be out of physiotherapy, and out of normal daily activities for more than a few days. In cases of Failed back Surgery Syndrome, pa-
tients were admitted to evaluation on the basis of unselected enrollment because of lumboscliotic pain, in the Division of Neurospatic Pain Treatment in Sant’Angelo Hospital, Lodi. Owing to the clinical diagnosis and to the data from neuroradiological and EMGraphic investigations, in a series of 1920 consecutive Patients, 1027 (53.489 %) were cases of FBSS. Upon enrollment patients have been evalu-
ated and scored by the application of the Roland Morris international dis-
ability scale and of the International Pain Visual Analog Scale (VAS). The same evaluation has been performed upon clinical controls during the follow-up. Failed Back Surgery Syn-
drome is a definition bespeaking the clinical effect of biochemical nerve structure-dysfunction. This dysfunction may be provoked by peridural scarring, by local ischemia because of reduced blood of CSF perfusion on the nerve roots. Several reports have shown that surgical reintervention and physical decompression may not be a solution. This is the general basis for arguing that a biochemical treat-
ment might be useful for controlling the symptoms and allowing a better quality of life without open surgery. In all these patients treatment consisted in a phase of out patient care, and a phase of hospitalization. The outpatient treatment was composed of 10 ses-
sions of paravertebral perianglionar injection of 10 mg O2-O3 gas mixture at 15 micrograms/ml ozone concentra-
tion. During this treatment a second procedure was performed during hos-
pitalization: the peri- and intra-discal injection. The injected volume was 15 ml of oxygen-ozone gas mixture, at 30 micrograms/ml ozone concentration. Injection was started after placing the needle inside the nucleus. In patients in which the anulus was fissured or broken the gas mixture was seen to escape in the peridural area, and the entire injection was performed without moving the needle. In those cases in which the intradiscal tension allowed only 2 or 3 ml of gas to enter the disc, the needle was re-
tracted and gas was injected in the foraminal peridural space. Results: 2 p. (0.194%) did not toler-
are the treatment and stopped imme-
diately. They where eliminated from the study group 30p. (2.92%) had no useful clinical result; 256 p. (24.9%) had moderate result; 441 p. (42.94%) had good result; 298 p. (29.01%) had excellent result; total 1027. Mini-invasive percutaneous peri-
and intra-discal injection was then carried out with the following results at 12 months: a) out of the 30 p. with no result from the outpatient treat-
ments: 10 poor result, insufficient; 15 moderate improvement; 5 good im-
provement. b) the 256 patients with moderate outcome changed as follows: 20 out of 256 (7.8 %) passed to a situ-
aton of excellent result; 64 out of 256 (25 %) passed to a situation of good result; 172 out of 256 (67.18 %) re-
mained with a situation of moderate der. c) the 441 patients with good outcome changed as follows: 105 out of 441 (23.8 %) passed to a situation of excellent result; 314 out of 441 (71.2
Objective: To explore the significance of choosing ozone therapy (percutaneous O2-O3 mixed gas in lumbar discography) or other minimally invasive treatments for lumbar disc annular tear and annular rupture.

Methods: Two hundred and sixty-one patients who were definitely diagnosed as disc degeneration diseases with imaging examinations from July 2008 to June 2010 in our hospital were involved in the study. These patients had the symptoms of low-back pain and sciatica. The patients lied in lateral position and the discharged discs were punctured through posterolateral approach on the inner side of facet. When the needlepoint was positioned at the center of intervertebral space or later 1/3 area, 10 ml O2-O3 mixed gas with the concentration of 30-40 μg/ml ozone were injected into the disc. Then, the needle was withdrawn near the foramina where 10-15ml with 25 μg/ml ozone was injected. Then 14mg Diprosan, 500 μg Vitamin B12 and 5ml 2% Lidocaine were injected there for local anesthesia of nerve root. According to the lumbar discography with mixed gas, the lumbar disc diseases could be classified as follows: 1. 24 cases with annular tear, accounting for 9.20%. 2. 30 cases with annular tear combined with disc herniation, for 11.49%. 3. 48 with annular tear and herniation, for 18.39%. 4. 92 with annular disruption combined with disc herniation, for 35.25%. 5. 45 with annular disruption combined with disc prolapse, for 17.24%. 6. 22 with annular disruption combined with spinal stenosis, for 8.43%. Among the 30 patients who had annular tear combined with disc herniation, 5 out of 263 (1.9%) had a reduction of 1027 = 77.99 %. Three essential refections remain on Ozone Therapy: 1. - the mini-invasive technique involves the patient in nothing more than outpatient treatment during days of life which remains normal. The single admission to hospital for 1 or 2 nights, is for a treatment without consequences that are disabling or limit the patient’s active life either in the short or the medium term; 2 - when the mini-invasive techniques have lost their clinical effectiveness, they can be repeated without harm for the patient at a distance of 1 or 2 years. We are talking of patients currently considered either as untreatable or as needing an invasive major surgical procedure, which has by definition a non-predictable result; 3 - the cost for the health organization is notably very high for surgical revisions and even more for instrumented rigid stabilization, while the costs for mini-invasive techniques are extremely limited.

The Significance of Choosing Ozone Therapy for Lumbar Disc Annular Tear or Annular Disruption

X. He
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Conclusion: For lumbar disc diseases, percutaneous O2-O3 mixed gas injection and nerve root block had significant effect on patients with disc annular disruption, and if IDET was combined, the efficacy could be increased. But for patients with disc annular tear, the short-term effect was poor, but if Dekompressor was also used, the efficacy could be increased, too.
tions. Patients age between 20 to 70 years underwent percutaneous ozonoclealysis. The procedure done under the angiofluoroscopy with full aseptic technique. The ozone generator, essential component placed close to the patients. Simple 23G needle to 22G spinal needle, (quince type point) were used to inject ozone under fluoroscopy. No precautions, such as rate. The appropriate treatment of cervical disc herniation is a challenge. Oxygen Ozone therapy exploits the chemical properties of Ozone like immunomodulating action, analgesic and anti-inflammatory effects. Comparing of our results with those of already published in literature are same level or better. This treatment is useful in patients who have not responded to physical therapy and conventional pain therapy. Most of these patients had no FDA surgical indication. The patients who failed to benefit from ozonucleolysis underwent surgery. In all these cases, the previous O₂-O₃ gas therapy had no negative effects on the surgical procedure. In our experience, Ozone Gas Therapy in treatment of herniated disc has revolutionized the percutaneous approach to nerve root disease making it safer cheaper and easier to repeat than treatments currently in use. So oxygen ozone therapy should be 1st choice of treatment in cervical disc prolapse.

Reference
2 Bonetti M, Valdenassi L: Oxygezozone therapy in percutaneous treatment of disc hernias. In: Atti “Unconventional medicine at the beginning of the third millen-

Lumbar Disc Herniation Treatment by Microdiscectomy Versus Intradiscal Oxygen-Ozone Injections
R. Paradiso, A. Alexandre European Neurosurgical Institute (EU.N.I.); Treviso, Italy

Lumbar disc herniation with both radiculopathy and chronic discogenic pain have been studied by several authors during the past decades to understand pathophysiological mechanisms and to determine the appropriate therapy. Retrospective analysis of the results of microdiscectomy leaded a limitation in indications of this procedure, in a better understanding of short and long term outcome. Oxygezozone (O₂-O₃) discolysis is a minimally-invasive percutaneous treatment that has been more and more applied during the past years mainly for its characteristics of safety and efficacy. Our study is a 5 years clinical follow-up of 300 patients treated with microdiscectomy and another group of 300 patients treated with intradiscal oxygen-ozone injection (discolysis). Results are overall better for percutaneous discolysis in contained herniations, with broken annulus, under or extraligamentosus. On the other hand, results are totally better in cases of big extruded or migrated herniations, particular if pain was intolerable or there were important motor deficits. Except than these considerations results are essentially equivalent with time considering both pain control and management of neurological deficits. Regression of pain, as compared to the level of the herniation, after 1 year (VAS Regression > 4 points) is 143 / 159 (89.9%) in L4-L5 Microdiscectomy, and 150 / 165 (90.90%) L4-L5 discolysis; is 104 / 108 (96.2%) in L5-S1 Microdiscectomy, and 88 / 93 (94.8%) in L5-S1 discolysis. Regression of pain as compared to type of hernia (VAS Regression > 4 points) is 163/197 (82.74%) in Microdiscectomy, and 172/200 (86%) in Discolysis for Contained Herniations, is 85 / 93 (91.30%) in Microdiscectomy, and 76 / 82 (92.6%) in Discolysis for Extruded Herniations and is 9 / 10 (90%) in Microdiscectomy, and 15 / 18 (83.33%) in Discolysis for Migrated Herniations. Regression of pain in intraforaminal localization of the hernia (VAS Regression > 4 points) is in favour of microdiscectomy (91.6% / 84.6%). Regression of motor deficit at 18 months is in favour of Microdiscectomy 95% / 93%. Complications observed in the two series of case records related to the procedure are 4 fistulas of cerebrospinal fluid and 1 bacterial discitis in Microdiscectomy, and 2 chemical discitis in Discolysis.

Discussion

Oxyen-Ozone Therapy for Herniated Disc: Analysys of Complicances
G. Pellicano', M.Bonetti, M.Muto
C.Andreuila, M.Leonardi
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Oxygen/ozone treatment of herniated discs is an effective and extremely safe procedure. Many studies demonstrate good results in terms of pain relief after this procedures after in case of herniated disc both at cervical as well as lumbar level. A metanalysis on twelve studies collecting treatment results for almost 8000 patient from multiple centers, demonstrates a complication rate <0.1%;this is much lower than surgical discectomy with similar pain and function outcomes. In our experience we collect the Italian experience with the analysis of 25000 patients results, treated with oxygenozone intradiscal and/or intrafornial therapy under CT or fluoroscopic guidance. No complications was evident in all cases.Our tool was the FIO Oxygen-ozone therapy Italian Federation (IFIO) web-site, where there is a private area allowing the access to electronic clinical folder where all treatment data and complications were recorded. The intradiscal treatment technique was: 21-22G needle, 3-8 cc of mixture, concentration 15-25 mg/ml. The intraforaminal treatment technique was:21-22G needle, 3-8 cc of mixture, concentration 15-25 mg/ml.No adverse reactions only sporadic vagal crisis, treated without any drugs and in particular no spondilodiscitis cases. Analyzing the literature all the papers published on this therapy complications were not able to demonstrate a correlation with oxygen-ozone therapy.
Spine 3

Chairs: B. Georgy, M. Braun
14.30-14.50

Introductory Lecture

Spinal and Posterior Fossa Endoscopic Anatomy Using Percutaneous Intraspinal Navigation

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2 UT Southwestern Medical Center, Departments of Neurosurgery & Radiology, Dallas, TX, USA;
3 UT Southwestern Medical Center, Mobility Foundation Center; Dallas, TX, USA;
4 Hoyo Cancer Center, Department of Orthopaedic Surgery, Akashi, Japan

Background: Percutaneous Intraspinal Navigation (PIN) involves placement of a catheter, endoscope, or other instrument into the spinal subarachnoid space and the use of that space as a conduit for navigation within the spinal canal and into the cerebral subarachnoid space. We described this technique using a lumbar puncture approach for visualization of the spinal cord and posterior fossa structures 1. We also described the technique for entry into the ventricular system and performance of a 3rd ventricular fenestration procedure 2. Other 3 described navigation to the 3rd ventricle by way of the aqueduct of Sylvius in live human patients using a much smaller fiberoptic device without a working channel or steerable tip. Development of the technique as a clinical tool requires refinement of instrumentation, documentation of applications, and establishment of safety. These also depend on understanding of anatomy. Our work originally utilized human cadaveric materials for technical elaboration. More recently we have developed a live swine model to explore potential risks and their avoidance. This presentation will review the instrumentation used and the results obtained with cadaveric navigation and imaging with our flexible fiberoptic endoscope. The animal model and survival studies involving endoscopic navigation along the spinal cord will be described separately.

Materials and Methods: Multiple human cadavers of random ages and sexes were obtained via the UT Southwestern Willed Body Program. In each, lumbar puncture was performed at varying levels between L2-3 and L5-S1 using fluoroscopic guidance. The technique in each cadaver was essentially as previously described 2 using angiographic-type techniques of needle placement, guidewire advancement through the needle, advancement of a small catheter over the .018” wire, replacement of the small wire with a .035” wire, and placement of a 10-French arterial sheath over that wire. The sheath was then used for advancement of a 2.5-3 mm diameter steerable-tip fiberoptic endoscope (Karl Storz, Inc.-Germany or Olympus, Inc.-Japan). Endoscopic images were captured via recording onto DVD, played back via a Canopus TwinFlash 100 digitizer into an Apple Mac Pro computer and edited using Apple iMovie software. More recently, video was acquired directly from the analog endoscope video processor into iMovie via the Canopus digitizer.

Results: Video images of the medulla, pons, posterior inferior and anterior inferior cerebellar arteries, vertebral arteries, basilar artery, superior and inferior cerebellar arteries, posterior cerebral arteries, lower cranial nerves (9th-11th), 7th-8th cranial nerves, 5th cranial nerve, 3rd cranial nerves bilaterally, pituitary stalk, optic chiasm, optic tract, optic nerves, entry into the 3rd ventricle posterior to the pituitary stalk, and entry into the lateral ventricle via the foramen of Monro were obtained. While application-specific instrumentation is not available, biopsy of the wall of the 3rd ventricle using a “stone-grabber” apparatus developed for urologic application was performed as a demonstration of concept. The cadaveric spinal cords and multiple spinal nerve roots were seen during navigation to the foramen magnum.

Conclusions: PIN is feasible using fiberoptic endoscopes of commercially available sizes and with working channels of 1 mm or slightly larger. Visualization of multiple spinal and cerebral neural structures in cadavers raises the potential for multiple diagnostic applications, as well as interventions. Rigidity of sheaths available for arterial catheterizations increases the trauma during spinal access. Newer access technology is under development.

References

14.50-15.10

CSF Flow in Syringomyelia and Chiari Malformations

K. Stoverud, K. Mardal, H. P. Langtangen, V. Haughton
Center for Biomedical Computing, Simula, Lysaker, Norway, University of Wisconsin; Madison, WI, USA

The pathogenesis of syringomyelia, secondary to a Chiari malformation or idiopathic, remains unclear. Prevailing theories relate syrinx development to abnormal CSF flow. Abnormal CSF flow is a result of an abnormal pressure environment, which creates abnormal stresses acting on the cord. Provided that the inlet and outlet velocities are known, mathematical models provide a quantitative methodology to investigate the
relation between velocities, pressure and stress in a given anatomy. In this presentation, we illustrate the applications of mathematical models to the study of syringomyelia and review existing theories for the pathogenesis of syringomyelia. Models can be used to simulate the pulsatile CSF flow in either patient-specific or idealized geometries and to virtually test the healthiest abnormal human subarachnoid space. Modeling flow in the spinal cord, one may consider the tissue as an elastic porous medium where the neurons, glial cells and vasculature make up the solid phase filled by the extracellular fluid. The fluid in the cord has fluctuating pressures due to the changes in arterial pressure and has shifts in water between the intravascular and extravascular spaces. The surrounding fluid has fluctuating flow and pressure changes representing the cardiac cycle on the CSF. One mechanism theoretically causing syrinx development is increased pressures in the subarachnoid space from the piston action of the tonsils, or from coughing, or from the Valsalva maneuver. Elevated pressure in the SAS may force fluid into the spinal cord along the perivascular spaces displacing the tissue in the spinal cord and eventually causing a cyst. The pressure increase may have a short duration or may have a phase shift with respect to the arterial pressure wave within the cord. The theories implicating elevated CSF pressures suggest mechanisms for the accumulation of fluid in the cord but do not explain the elevated pressures in the syrinx or expansion of the syrinx in face of larger pressures external to it. Another mechanism proposed to cause syrinx development is diminished CSF pressure causing fluid accumulation in the cord. Transient reduction in CSF pressures results in stress on the spinal cord and, according to these theories, an increased flux of fluid from the intravascular to the extravascular space. The accumulation of fluid results in the development of a cyst. Reduced pressures may be the result of stenosis in the foramen magnum or the spinal canal, or of increases in the cross-sectional area of the subarachnoid space. By means of mathematical models, the experimental evidence and PC MR data currently available are examined critically. CFD models, incorporating the cord as a linear elastic porous medium, support decreased CSF pressures as a cause of syrinx in patients with idiopathic syringomyelia or Chiari-related syringomyelia. This presentation illustrates how mathematical modeling is improving our understanding of the effect of CSF flow on the spinal cord.

15.10-15.30 18° Leucocyte-Platelet Haemocomponents for Topical Use: Regenerative Potentiality

A. Alexandre 1, A.M. Alexandre 1, G. Caloprisco 1, A. Borean 2
1 European Neurosurgical Institute (Eu.N.I.), Treviso, Italy; 2 Dipartimento di Immunomeiotologia e Medicina Trasfusionale Ospedale San Martino di Belluno, Italy

Introduction: Since some years, for regenerative purposes, haemocomponents rich in platelets, have been produced for applications in different clinical sectors and on different lesions of tissue such as skin, bone, tendons and cartilage. Wider and wider is the interest, in different clinical field, in the application for regenerative purpose of haemocomponents produced from peripheral blood. These are mainly made up of concentrated platelets capable of releasing locally growth factor (GF) that stimulates tissue regeneration. Our group has devised a method in order to produce a new leucocyte-platelet haemocomponent enriched in fibrinogen, that integrates the GF stimulus with the presence of cells involved in the regenerative processes: monocytes and stem cells. The use of the cell separator in order to collect these haemocomponents from peripheral blood has allowed us to realize a safe standardized product, with good regenerative potentiality and reasonable costs. This is obtained modifying some parameters of separation and, without cell manipulation. Rationale of treatment: The first answer of an organism to a lesion is the formation of a clot, basically made of fibrin filaments. After the clot formation begins an inflammatory phase triggered by specific signal molecules released by platelets and leukocytes. The result is the recruitment of macrophages in the zone where the tissue has been damaged. This process passes through the creation of a physiological environment that favor the recruitment in the clot of not-differentiated cells and orientated them to proliferation. Platelets that are activated locally, other than exercise their haemostatic function, release alfa-granules, a series of Gfs, that induce the activation of resident cells, as macrophages and fibroblasts, which play an essential role in tissue reparation. For a complete tissue repair reparation three elements are necessary: scaffold (extracellular matrix), tissue cells, growth factors. This is the rationale of our intradiscal injection with leukocytes-platelet gel.

15.30-16.00 25° Interpretation of Spine MRI, an Interventionalist Prospective

B. Georgy
University of California; San Diego, CA, USA

Over the last few years, radiologists have developed a growing interest in more minimally invasive procedures of the spine. It is crucial for both diagnostic and interventional radiologists to know each other knowledge of pathologic findings in relation to clinical presentation. Radiologists have a tremendous opportunity to contribute to the understanding and treatment of spine-related pathology due to their core knowledge and access of image guidance and technology. While most spine interventionists perform diagnostic imaging, it is crucial that they share their insights with respect to the need for more diagnostically relevant imaging analysis. This presentation will integrate imaging findings with the clinical presentation in order to improve image analysis, selection and performance of spine interventions.

16.00-16.15 10' Less Studied non Osseous Signs in Painful Lumbar Pathology

J. Théron 1, T. Sola 1, L. Guimaraens 1, A Casasco 1, P Courtheoux 1
16.15-16.30 10’
Pathology: non osseous signs appears critical in
ments. 
studied after percutaneous treat-
gelified ethanol (Discogel) have been
performed (osseous windowing) after
lumbar and/or radicular pain. 
have been studied in detail on regu-
subcutaneous tissues and muscles
intradiscal therapy.

Method: modifications of the skin, subcutaneous tissues and muscles
have been studied in detail on regular T2 MR procedures performed for
lumbar and/or radicular pain. 
performed (osseous windowing) after
intradiscal injection of radiopaque
gelified ethanol (Discogel) have been
studied after percutaneous treat-
ments.

Results: skin and subcutaneous tis-
ues are good indicators of local suffer-
and of shearing forces responsible for
disk hernias. Study of pattern and
orientation of the para-spinal muscles
allows better understanding of their
weakness in active contention of the
lumbar spine. Fat deposits surrounding
the atrophic paraspinous muscles
will be evaluated before therapeu-
tic decision. Intradiscal fissures, not
visualized on MR are well displayed
on the post treatment CT that allows
better understanding of the actual in-
tradiscal lesions.

Conclusion: thorough study of the
non osseous signs appears critical in
full understanding of lumbar painful
pathology

16.30-16.45 10’

Percutaneous Treatment of Cervical Disk Hernias Using
gelified Ethanol

J. Théron, H. Cuéllar, T. Solà, L. Guimaraens, A. Casasco,
P. Courthéoux, 1

1 CHU Côte de Nacre Service de
Neuroradiologie; Caen, France; 
Hospital General de Cataluña, Servicio
Endovascular; Barcelona, Spain; 
Clinica del Rosario, Servicio Endovascular y
Percutanea; Madrid, Spain

Purpose: to demonstrate the effi-
cacy and safety of the percutaneous
treatment of cervical disk hernias us-
ing radiopaque gelified ethanol Disco-
ge
cel 1®.

Methods: from 2004 to 2010, pa-
tients with an intervertebral disk her-
nia at the cervical level in whose con-
ventionl treatment have failed, were
offered percutaneous treatment of the
disk with radiopaque gelified etha-
ol. In most cases a complementary
local steroid injection was performed
around the adjacent articulations in
the course of the same procedure to
accelerate pain relief. A total of 71
consecutive patients were treated in-
cluding 21 men (25%) and 50 women
(75%), ages between 23 and 80.

Results: they were categorized ac-
cording to MacNab scale (Excellent,
Good, Fair, Poor). In 15 cases the re-
sult was excellent (21%), in 48 good
(70.5%), fair in 6 and poor in 2. There
has been no complication.

Conclusions: the use of radiopaque
gelified ethanol (Discogel 1®) for the
treatment of cervical disk hernias is
safe and provides good results, allow-
ing patients with failure to conven-
tional treatments to improve their
symptoms without having to undergo
surgical procedures.

16.45-17.00 10’

Herniated Disk: Treatment
Percutaneous Using Discogel

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L. Guimaraens

Therapeutic Neuroradiography
Service. Hospital General de Cataluña;
Barcelona, Spain

Objectives: To Describe Our Experience
In The Disc Disease Treatment Using
discogel.

Methods: From January 2009 to De-
ce 2009, we treated 46 patients
(17 to 82 years) suffering from disc
disease, through nucleolisis using
Discogel and intrarticular steroid injec-
tion. 5 cases were cervical localization
in 1 case was low dorsal and 40 cases
were lumbar. Every patient had MRI
before to the procedure and MRI after
5 months. In all cases were treated at
the same time the joints adjacent to
the pathological discs. All procedures
have been done under neuroleptanala-
gesia. Neither patient had previously
undergone surgery. We treated a total
of 92 discs. Between 0.8 to 1.2 cc of Dis-
cogel was injected at each level. We did
CT scan immediately to verify Discogel
distribution. All patients continued
NSAID therapy orally for 10 days.

Results: 8 patients required addi-
tional treatment with gabapentin dur-
ing 3 months. 5 patients needed addi-
tional articular infiltration delayed. 1
patient, who suffer cervical disc pro-
lapsed, presented aggravation of neu-
rological symptoms after 5 months, so
he was referred to surgery. Patients
began to play sports on average at
3 months postoperatively. Clinical
improvement was prior to the radio-
graphic improvement. The postopera-
tive CT scan shows the distribution of
disk’s fissures. Symptoms persisted in
2 cases requiring making NSAID.

Conclusions: The treatment of her-
niation disc with Discogel replaces the
surgical treatment. The objective is
that patients return to normal life (in-
cluding the practice of sport) without
having to take anti-inflammatory.

17.00-17.15 10’

Percutaneous Treatment of Lum-
bar Intervertebral Disk Hernias
with Discogel

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C. Bombardieri, A. Giaquinta

Neuroradiology and Neurosurgery
University of Catanzaro, Italy

Purpose: To experience a new tool
in the large arena of disparate techni-
cal approaches.

Methods: This is a preliminary
study where 19 patients affected by intervertebral disc hernias were consecutively treated with radiopaque gelified ethanol (Discogel). In two patients two levels have been treated at the same session. No other techniques have been associated as in the original article of J. Théron, like intrarticular steroids injection, automatized percutaneous diskitectomy and radiofrequency nucleoplasty. All procedures were performed with local anesthesia, in sterile conditions in the angiographic suite under biplane digital fluoroscopy on lateral decubitus opposite to side of the disk herniation. The dose of the product was between 0.4ml and 1.0 ml. A spiral CT was performed following the procedure except in two cases, in which the study was done 10 days later for failure of the machine.

Results: All patients were send home the day after the treatment with anti-inflammatory and antalgic drugs. On the follow-up all patients, according to the classification used by J Theron were on grade very good or good. Only one patients was operated on after 3 week, but the extruded herniation was not found at the operation table. An other patient complained the persistence of the symptoms for one month but he went at work on the following days. In some cases a radicular burning pain was felt at the end of the injection.

Conclusions: It is a technique easy to perform and appears effective and safe. It gives, with the aid of the spiral TC a breathtaking insight on the internal disruption of the disk and therefore on the pathophysiology of the backache. On the preliminary experience the neurosurgeons feel that it can modify the whole surgical approach to the treatment of the disc hernias.

17.15-17.30  

Percutaneous Nucleoplasty for Discoradicular Conflict

A. Alexandre, A.M. Alexandre, L. Corò  
European Neurosurgical Institute (Eu.N.I.); Treviso, Italy

Aim of Investigation: evaluating clinical results of nucleoplasty on contained lumbar disc herniations.

Methods: 1390 contained disc herniation patients (consecutive series, 2003 to 2006; 234 in L3-L4; 989 in L4-L5; 167 in L5-S1) received ablation of the nucleus pulposus. By posterolateral approach under fluoroscopy through a 17G needle the SpineWand electrode is introduced and radiofrequency is applied.

Morphological Indications: contained lumbar disc herniations, intact anulus.

Clinical Indications: leg pain with or without back pain; failure of 6 weeks conservative therapy

We evaluate the results with a 4-years follow-up, as shown:

Results at 12 months on 1319 patients: - Excellent (70%score improvement): 679 (51.47 %) - Good (50-70% score improvement): 416 (31.53 %) - Insufficient (>50% score improvement): - No result (>20% score improvement): 112 (8.49 %) 

Results at 24 months on 678 patients: - Excellent (70%score improvement): 334 (49.2%) - Good (50-70% score improvement): 196 (28.9%) - Insufficient (>50% score improvement): 88 (12.9%) - No result (>20% score improvement): 60 (8.9%) 

Results at 36 months on 201 patients: - Excellent (70%score improvement): 93 (46.2%) - Good (50-70% score improvement): 50 (24.87%) - Insufficient (>50% score improvement): - No result (>20% score improvement): 58 (28.85%) 

Results at 48 months on 80 patients: - Excellent (70%score improvement): 34 (42.5%) - Good (50-70% score improvement): 22 (27.5%) - Insufficient (>50% score improvement): - No result (>20% score improvement): 24 (30%) - (Roland Morris >70% improvement is considered excellent result; 50 to 70% good result).

MRI or CT have been performed 6 months after the procedure, in 498 cases.

Bulging was eliminated in 128, significantly reduced in 222 and unchanged in 148 cases. This case distribution anyway is not directly correlated to the quality of the clinical outcome.

Conclusions: Coblation just perforates the anusul, without disruption of surrounding structures. It provokes a small volume loss entailing a large fall of pressure.

The observed initial decreases in interleukine 1, which has hyperalgesic effects, followed by augmentation in interleukine 8, which may express the reparatory response, might correspond to the two-step clinical improvement. Initially due to the rapid discal loss of volume, and later due to the progressive discal repair. Biochemical modification may correspond to the clinical result more than morphological ones.

By this minimally invasive procedure patients will not be out of physiotherapy, and out of normal daily activities for more than a few days.

Authors have no financial relationship with manufacturer/supplier of the product.
Thursday, 7 October
Oral Sessions
Brain Tumors I

Chairs: P. Parizel, Y. Ono

09.15-09.35

Brain Tumors and MR-Perfusion Imaging: Clinical Applications

P. Due-Tennessen
Radiology Department, Section of Neuroradiology, Oslo University Hospital; Rikshospitalet, Oslo, Norway

Brain tumors represent a significant problem within the population. In Norway the incidence of brain tumors now is twice that of 30-40 years ago, and for children under 15 years of age it represents approximately 30% of all new malignancies and is the most common childhood malignancy. The increased brain tumor incidence has yet to be explained, and while improved diagnostic tools may result in improved tumor detection, this alone constitutes part of the explanation only.

Magnetic Resonance (MR) imaging has for several years been the most important imaging tool in the work-up of brain tumors. Multi planar T1- and T2-weighted MR images will accurately identify tumor location and tumor-related effects upon surrounding structures. However, purely anatomic images do not suffice in the work up of brain tumors. In the past most MR protocols have included T1-weighted images prior to and following intravenous contrast administration to suggest the degree of tumor malignancy. This, however, does not suffice, as for instance as many as 75% of anaplastic astrocytomas fail to enhance on T1-weighted contrast enhanced MR images, while low grade pilocytic astrocytomas fail to enhance on instance as many as 75% of anaplastic astrocytomas. Several MR-perfusion techniques exist, the cases I shall discuss to-day have been performed with so-called Dynamic Susceptibility Contrast perfusion technique. This is a technique we use on a daily basis at my department. MR-perfusion imaging may be used pre-operatively to classify the tumor as high- or low-grade, to identify targets for biopsy, and as part of the usually life long follow-up in these patients. Reference


09.35-09.55

Recent Advent in DTI and Tractography for Neuro-OncoLOGY

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Diffusion-tensor imaging (DTI) and DTI-based tractography are one of the most remarkable advances in the field of neuroimaging in the past decade. This method offers in vivo assessment of the white matter and localization of neuronal fiber tracts, which was not previously possible. The parameters derived from DTI (e.g. FA and mean diffusivity) have been shown to be related with the tumor aggressiveness but there are mixed results on this topic. Tractography has been shown to be a promising tool for assessing the eloquent white matter tracts. The most common target thus far has been the pyramidal tract because of the relative importance of this fiber bundle for activity in daily life. Another important fiber pathway is the optic radiation (OR). Damage to the OR results in visual field defects and therefore, preoperative knowledge about the location of the OR is important. There are, however, areas that are difficult to depict, such as the anterior part of Meyer’s loop, with this technique. A recent study has shown that this problem can be overcome by depicting the uncinate fasciculus (UF), which represents the anterior limits of the optic radiation (Figure). 1

Although tractography has been shown to be a promising tool for assessing the white matter of the brain, the results derived from this technique need to be interpreted with caution to avoid over/under-estimation of the fiber tracts and it still await validation.

References


09.55-10.15

Cerebral Brain Tumors: Role and Limits of Imaging and Comparison with Pathology

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Goals and Objectives:
- Review the use of imaging techniques (including MRI and CT) in the preoperative diagnostic process of intra-axial brain tumors;
- Review and learn the patterns of intra-axial tumors;
- Illustrate the classical imaging finding of intra-axial brain tumors compared to the pathological specimen obtained with resection and/or biopsy;
- Review the role of postoperative imaging to discuss its role and limitations. The diagnostic armamentarium of the preoperative diagnostic of intra-axial brain tumors has expanded tremendously in the past few years including techniques such as Diffusion Imaging (DWI), DTI for fiber tracking, Spectroscopy, MRI Perfusion and CT Perfusion.

The localization capacity and the accuracy of the preoperative imaging (DTI for fiber tracking) in conjunction with the intraoperative navigation techniques and the use of intraoperative MRI have as common aim to assure the complete tumor resection with the least of the post operative neurological deficit. The common goal of all these techniques is to reach a precise diagnosis on the type and grading of the lesion and ultimately the desire to extend patient's life in case of malignant tumors. Unfortunately in spite of all these advances in imaging and sophisticated intra-operative localization techniques the diagnosis of malignant intra-axial brain tumors remains quite bleak and the long term prognosis of these lesions has not really improved in the past two decades.

Patients with high-grade glioma (HGG) have a poor prognosis. Despite multimodality treatment with surgery, radiotherapy, and chemotherapy, mean survival ranges from around 12 months for patients with glioblastoma multiforme to between one and five years for patients with anaplastic astrocytoma, depending on age and performance status at diagnosis. Patients with tumors with oligodendrogial characteristics have a somewhat better prognosis. However, the improved pre-operative assessment and treatment technique since 1970 have certainly lead to improve survival rates for other tumors types (medulloblastoma, oligodendroglioma and low grade astrocytoma). It appears that a sensible better prognosis is possible for these gliomas that undergo complete or almost complete resection (98% or more), hence immediate post-operative imaging is crucial to assess the extent of the resection. We would like to report our experience in the use of pre-operative and post-operative imaging for the assessment of intra-axial brain tumor. Emphasis will be placed in the comparison with the pathological finding in order to improve the knowledge of the semiology of these lesions, therefore obtain a more specific pre-operative diagnosis. The limitations of the different techniques and their optimization will be presented in the light of the literature including the use of automated or semi-automated software for the estimation of the tumor volume resection.

References


10.15-10.35

Brain Tumors: Medical Therapy

A. Brandes
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Glioblastoma (GBM), the most common primary brain tumor in adults worldwide, accounts for approximately 50% of all gliomas. Surgery, the mainstay in GBM treatment, has been followed over the years by ever more aggressive therapeutic approaches (radiotherapy and chemotherapy), which have gradually and anatomical unique to this tumor-type make GBM patients particularly prone to local recurrence after treatment. Over the past 20 years, efforts have therefore been made to establish whether or not adjuvant chemotherapy provides GBM patients with any clinically significant benefit. In 2005, a novel standard of care was defined for patients with newly diagnosed GBM. In a large phase III study by EORTC and NCIC, patients were randomized postoperatively to receive radiotherapy plus temozolomide (TMZ) or radiotherapy (RT) alone. The median survival was 15 months in patients treated with combined TMZ and RT, and 12 months for those treated with RT alone. Moreover, the 2-year survival rate was 28% for the combined modality group and 10%
for the RT group. In the EORTC/NCIC trial, the companion translational research study confirmed the importance of MGMT gene promoter methylation as a predictive and prognostic factor, as well as in other prospective trials. In the analysis of the EORTC/NCIC trial, the overall survival was longer in patients with MGMT promoter methylation irrespective of treatment; it was, however, significantly greater in patients treated with TMZ combined with RT and adjuvant TMZ, these patients having a median survival of 22 months, and a 2-year survival rate of 46%. Despite these improvements in the treatment of GBM patients, disease recurrence is almost unavoidable. Chemotherapy is extensively administered to patients with recurrent glioblastoma, although objective response rates remain unsatisfactory, and time to progression is short (3-6 months). A phase II analysis of eight phase II chemotherapy trials conducted in 225 patients with glioblastoma (partly pre-treated with one or more chemotherapy regimens), reported a PFS-6 of 15% and a median PFS of nine weeks, and represented the benchmark for drug activity in the pre radiotherapy/temozolomide era. Recent advances in the understanding of molecular and cytogene-sis pathways that influence tumor growth, invasion, angiogenesis, and apoptosis have led to the direct targeting of aberrant pathways found in cancer. Data on anti angiogenic treatments appear promising, glioblastomas, lethal cancers, being characterized by florid angiogenesis. Although several molecular mechanisms contribute to tumor angiogenesis, the vascular endothelial growth factor (VEGF) pathway seems particularly important and has been a prominent target in cancer treatment. Recent phase II clinical trials showed that glioma patients might benefit from treatment with a VEGF-neutralizing antibody, bevacizumab (Avastin), administered as single agent or in combination with a topoisomerase-I inhibitor, irinotecan; being the radiographic response rate up to 60%, and the 6-month progression free survival rate about 30-40% for glioblastoma, in view of this encouraging initial data, the FDA approved this drug for the treatment of recurrent GBM in US. However, because VEGF (also known as the vascular permeability factor) regulates vascular permeability, targeting VEGF with bevacizumab may decrease contrast leakage into the tumor thus maximizing a radiographic response, and yielding response assessment particularly difficult. For this reason novel response assessment criteria have been developed in neuro-oncology (RANO criteria), and novel endpoints to better evaluate the effective worth of these agents are under investigation.

References


Brain Tumors II

Chairs: S. De Divitiis, G. Wilms

F. Caluccu
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Pre-Operative and Intra-Operative Imaging of Brain Tumors

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MRI techniques have a continuously evolving role in the development of minimally invasive interventional procedures but also in more traditional, open surgical, MRI-guided procedures. In the last 15 years neuroimaging advanced beyond anatomic imaging and tissue characterization into the realm of neural tissue physiology. All interventional MR systems used in neurosurgery provide basic T1- and T2-weighted capabilities, but high-field systems can also perform MR spectroscopy, MR venography, MR angiography, MR perfusion imaging, brain activation studies, chemical shift imaging, and diffusion weighted imaging. These techniques provide the potential to better answer a large spectrum of relevant neurosurgical questions than structural imaging alone. Over the last years, several examples appeared in the literate demonstrating how the use of these physiological methods leads to more informed planning of surgical procedures, and eventually better patient outcome. For example, combining phase contrast information of MRA with advanced computational modeling allows insight into the blood flow physiology specific to individual patient and mapping of structural forces such as wall shear stress that may contribute to better planning of endovascular treatment but also to understanding the factors contributing to the fragility of intracranial aneurysms. MR perfusion patterns are increasingly used as a surrogate markers of angiogenesis allowing better differential diagnosis, prediction of pathologic tumor grade, estimation of tumor infiltration and guidance for brain biopsies. MR Spectroscopy allows study of equilibrium levels of metabolites such as creatines, cholines, NAA, lactate, glutamate, gamma-aminobutyric acid, alanine, inositol, etc. and is increasingly used to enhance the diagnostic yield of brain biopsies and in determining tissue characterization related to tumor infiltration in the absence of contrast enhancement. Mapping of brain function adjacent to intracranial lesions using f-MRI is used to assess the prognostic risk of therapeutic interventions, to plan endovascular and surgical therapeutic procedures and also to get insight into large-scale plastic changes within primary and non-primary areas contributing to preservation of brain func-
Intraoperative MRI for Precise Resection of the Gliomas and Motor Function

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Purpose: For the maximum amount of resection of the malignant gliomas, maintaining motor and verbal function, effective usage of the preoperative (p)- multimodality-based imaging and the intraoperative MRI (iMRI) and its outstanding advantages introduced for computer-aided neurosurgery. Methods: Review study of the 610cases of gliomas in grade II-III, operated by computer navigation in ten years. 1) The pMRI involving diffusion tensor image (DTI), tractography (TG), functional MRI (fMRI) and 1H-MR spectroscopy (MRS), using 1.5T 3T MR apparatus. In the operative theater, iT2WI, iT1WI, Gd-iT1WI were taken by 0.3T open type MR, just after craniotomy and repeated 2-3 times during the procedure. The motor function was always checked by subcortical stimulation during surgery, and the functional brain mapping was fused on the iMRI. The intraoperative diffusion weighted image (iDWI) was performed in 49 cases for demonstration of the pyramidal tracts. Fusion of the p-T2G and the iT2WI or iT1WI was done in 20 cases. Awake craniotomy was done for the 187 cases with the close location of the tumors to the verbal area, the verbal function was confirmed by speech testing. The fluorescent diagnosis was performed for detection of the residual tumor, by administration of 5-aminolevulinic acid (5ALA). Results: 1) To identify the contrast enhanced tumor in the pMRI, double dosage of contrast material was effective for identification of the tumor margin on iMRI. 2) When the tumor was not enhanced in the pMRI, relation between the tumor and the deformed pyramidal tract was well demonstrated by the iDWI or in the fused images of the pT2G and the iT2WI or iT1WI. 3) The motor area was confirmed by subcortical stimulation during the surgical procedure and compared with the focus on the p-MRI and fused on the deformed iMRI. 4) With awake craniotomy, the verbal function was confirmed by speech testing to be successfully spared. 5) The individual tumor was identified by fluorescent diagnosis. Discussion: The radical resection of gliomas and patient survival have been controversial, in the Brain Tumor Registry of Japan of JNS 2003, more than 95% removal of the gliomas in grade II-III can prolong the five-year survival. On the other hand, quality of the life is highly dependent on motor and verbal function. Therefore precise tumor removal maintaining the motor and verbal function, multi-modality information is necessary for navigation surgery, involving the iMRI to prevent brain shift simultaneously to the operative procedure. Magnetic shielding is important for the equipments and devices for surgery, anesthesia, and iMRI. The open type MR needs less shielding and the open type MR is convenient for maintaining sterility and treatment of the patient. The demerits due to low S/N ratio of the low field MR are compensated by the developed frame to fix the patient, sensitivity of the receiver coils, suitable sequences for the images, fusion techniques of the p-MRI and iMRI, timing of the iMRI which does not remain the same. The deformed brain is demonstrated on iMRI, and the pyramidal tract can be identified on iT2WI, and well demonstrated by the fusion images of the p-TG and iiT2WI. The fusion image of the p-TG by 3T and iMRI is also evaluated in demonstration of the deformed pyramidal tract. The verbal function is confirmed by direct speech testing presenting pictures in awake craniotomy, which is greatly supported by the anesthesiologist to provide adequate analgesia and sedation, maintaining awake and cooperative condition of the patient for neurological testing. Even with careful investigation on iMRI, it is not rare that the margin of the tumor is difficult to be distinguished from surrounding normal and/or edematous brain. The fluorescent photodynamic diagnostic maneuver is important to detect the residual tumor, by oral administration of 5-Aminolevulinic acid (5-ALA), which is used as a fluorescence detection marker for photodiagnosis. The photosensitizer, protoporphyrin IX (PpIX) induced by 5-ALA, presents fluorescent which is malignant tumors under ultra-violet light.
**Boron Neutron Capture Therapy in the Treatment of Brain Tumours**
L. Pelletier
Dept. of Neurosurgery, Sahlgrenska University Hospital; Göteborg, Sweden

The use of Boron Neutron Capture Therapy (BNCT), with boronphenylalanine (BPA) administered by i.v. infusion, for treatment of Glioblastoma Multiforme (GBM) is reviewed. The treatment, which is accomplished in one day only, is well tolerated with only mild side effects and Quality of Life after BNCT remains unaltered until tumour recurrence in most cases. Results obtained in a phase II study on newly diagnosed GBM at Studsvik, Sweden shows that survival after BNCT is longer than that observed with conventional radiotherapy plus concomitant and adjuvant chemotherapy with temozolomide for certain subpopulations of GBM patients. Promising results were also obtained in a pilot study, where 12 patients with recurrent GBM were treated. BNCT should therefore be considered a valid treatment option both for newly diagnosed and for recurrent GBM, as an alternative to conventional therapy, which involves 6 weeks of daily radiotherapy plus adjuvant and concomitant chemotherapy with temozolomide.

The results of the BNCT studies at Studsvik will be presented and the therapeutic potential of BNCT with BPA for GBM and of BNCT with a new boron carrier, now in the preclinical phase for the treatment of GBM and other cancers, will be discussed.

**Nanoparticles for Medical and Surgical Tumor Therapy**
J. Provenzale
Duke University Medical Center, Durham, USA

This presentation will explore the ways in which nanoparticle can be used to treat tumors. Given their capabilities for simultaneous use as both imaging agents and therapeutic agents, radiologists involved in developing this field of medicine may soon find themselves providing patient care in a manner similar to that of radiologists in the first half of the Twentieth Century, i.e., as both an imaging specialist and as a therapist. The presentation will discuss the following topics:
1. Medical Uses of Nanoparticles as:
   A. Imaging agents for tumor detection and monitoring therapy: nanoparticles can be targeted against tumor cell receptors and tumor-related proteins.
   B. Drug-delivery vehicles: nanoparticles are increasingly being used as drug carriers for more effective delivery of chemotherapy, thereby minimizing systemic toxicity and side-effects.
   C. Hyperthermia therapy: laser-induced heating of nanoparticles can provide a means of highly tumor-specific, minimally-invasive therapy.

**Brain Tumor Imaging Analysis and Classification. What Can the Neuroradiologist Really Say?**
A. Osborn
University of Utah, Department of Neuroradiology; UTAH, USA,
Vertebral Artery Orifice Stenosis: Reporting of 43 Cases Stenting and Percutaneous Transluminal Angioplasty

R. Mohammadian, R. Mansourizadeh, M. A. Arami, M. Farhoudi, S. Haririan
Neurological Research Center, Tabriz Medical Faculty, Neuroradiology Unit, Aalinasab Hospital, Tabriz, Iran; Milad Hospital, Tehran, Iran; Neurological Research Center, Tabriz Medical Faculty, Tabriz, Iran

Background: Twenty to thirty percent of all transient ischaemic attacks (TIAs) and ischaemic strokes involve tissue supplied by the vertebral artery (VA) circulation. Stenosis of the vertebral artery can occur in either its extracranial or intracranial portions. Stenotic lesions, particularly at the origin of the vertebral artery, are not uncommon. In contrast to carotid stenosis, there has been little systematic research into the prognosis and the prevention of recurrent vascular events in patients with vertebral artery stenosis. Vertebral artery stenting is relatively safe with a peri-procedural risk of stroke or death ranging from 1.6 to 13.8%.

Methods: We enrolled 43 patients with confirmed vertebrobasilar insufficiency syndrome accompanied by more than 50% stenosis in the vertebral arteries. Posterior circulation stroke was defined by imaging studies and vertebral basilar (VB) circulation. Stenosis of the vertebral artery can occur in either its extracranial or intracranial portions. Stenotic lesions, particularly at the origin of the vertebral artery, are not uncommon. In contrast to carotid stenosis, there has been little systematic research into the prognosis and the prevention of recurrent vascular events in patients with vertebral artery stenosis. Vertebral artery stenting is relatively safe with a peri-procedural risk of stroke or death ranging from 1.6 to 13.8%.

Results: Transluminal angioplasty and stenting was performed in 43 consecutive patients (14 women, 28 men) with vertebral artery orifice stenosis. Mean percentage of stenosis was 68%. In the 36 patients stenosis were in left side (23 men, 12 women), there were 6 cases of left renal artery stenosis that all of them accompanied with left vertebral artery stenosis in male patients. Initial technical success was 100%. No cerebrovascular complications or embolic events occurred. Conclusion: According to our finding angioplasty and stenting of vertebral artery orifice is safe and effective. Left vertebral artery stenosis is more common than right side and most likely especially in the men to be accompany with left vertebral artery stenosis.
female: 91/29) underwent endovascular treatment with undersized predilatation and subsequent Enterprise stent deployment. More treated lesions were located in the posterior circulation (n=70, 58%). The most frequent locations were the basilar artery (n=34), the proximal MCA/M1 (n=36) and the intradural vertebral artery (n=36). All patients received dual platelet antiaggregation (ASA & Clopidogrel) prior to and at least one year after the treatment. Under general anesthesia, the target lesion was visualized using a biplane DSA unit, followed by microwire insertion (X-celerator14), undersized pressure-controlled balloon dilatation (Avion Plus, Invatec; Ryujin, Terumo) and Enterprise stent deployment. Clinical and angiographic follow-up examinations were scheduled 6 and 12 weeks as well as 6 and 12 months later. A total of 285 angiographic follow-up examinations after 5.3 months (median) were available. Data analysis included longitudinal and angiographic follow-up examinations after 5.3 months. Data analysis included the degree of target vessel stenosis before and after treatment and at the follow-up examinations, procedural complications and ischemic events during the follow-up observation. Inflammatory stenoses, dissections, acute stroke treatments and patients with Enterprise deployment without predilatation of oversized Enterprise stents were included. Results: The attempted treatment was possible in all stenoses without any access failure. The average stenosis rate before and after treatment was 65% and 27%, respectively. Procedural complications included symptomatic ischemia (n=9), intracranial reperfusion hemorrhage (n=1) and acute stent thrombosis (n=1). During the angiographic follow-up, a >50% recurrent stenosis was observed in 32 stenoses (27%). Recurrences were equally distributed to anterior and posterior circulation stenoses. Conclusion: The combination of undersized balloon dilatation of intracranial stenoses followed by the deployment of oversized Enterprise stents yields access to very elongated vessels and is highly effective. The follow-up results are better than those achieved with Wingspan or bare metal balloon-expandable stents.

Stenting of Distal Intracranial Vessels in Stroke

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Purpose: To evaluate feasibility and efficacy of endovascular treatment of symptomatic stenosis of distal cerebral arteries by stent angioplasty

Material and Methods: 3 males, aged from 70 to 73 years, with multiple cardiovascular risk factors, were submitted due to acute neurologic deficit. Acute clinical presentation (3-5 hours) was observed in 2 patients, without evidence of acute ischemia or haemorrhage at admission angiographic control. In one case, symptoms evolved progressively during 6 weeks with periods of partial improvement. All patients underwent immediate cerebral angiographic evaluation, and major distal arterial stenosis (left angular artery, right and left insulo-opercular arteries), was diagnosed, topographically congruent with neurologic deficit. Intracranial thrombolytic therapy was attempted in the two patients showing acute clinical presentation, with neither clinical nor morphological improvement. After multidisciplinary discussion, stent angioplasty was decided for all cases. Procedures were performed under neuroleptoanesthesia, IV heparin perfusion and antiplatelet therapy (aspirin + clopidogrel). 2 balloon-expandable (BX Sonic, AVE Inc) and one auto-expandable (Winspan) stents were used. Clinical and radiological follow-up extended from 6 weeks to 13 months, all patients had benefited of a 24-hour angiographic control.

Results: In one case, segmental dissection was detected during angioplasty, which was resolved by stent deployment. In all cases, secondary branches coming from the stented arterial segment not visible in pre-operative angiographic control were detected in post-operative CT scan. One patient presented asymptomatic, non stenotic myo-intimal hyperplasia in 1-year angiographic control.

Conclusion: Endovascular treatment of symptomatic distal arterial stenosis by stent angioplasty is feasible due to development of new material and devices. Immediate segmental dissection and late re-stenosis are major complications directly related to the technique. Long clinical and morphological follow up is mandatory.

Stent Treatment of Intracranial Atherosclerotic Stenoses. Update of the European Intrastent Registry

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Purpose: Stent angioplasty has been increasingly used over the past decades to treat symptomatic lesions which proved to have a poor prognosis on antiplatelet therapy alone. Despite the increasing numbers of procedures, intracranial stenting is still regarded as an „experimental therapy“ since results of randomized trials are not yet available. In 2007 the INTRASTENT registry was founded to serve as a tool for quality control and to gather information on treatment results with the aim to generate hypotheses for further improvement of neurointerventions for intracranial atherosclerotic disease.

Methods: Eighty centers formed the INTRASTENT study group and entered their cases of interventional for symptomatic intracranial stenoses consecutively into the internet based registry. Data collection was done for elective cases excluding emergency treatments for acute vessel occlusion and progressive stroke. We collected baseline data on patient and stenosis characteristics and the type of device used. Acute complication rates were evaluated. A clinical complication was regarded to be significant if the patient’s modified Rankin scale (mRS) deteriorated to be at least 2 at the time of discharge. Clinical follow up was scheduled at three and six month. Decision making on control angiography was left to the discretion of the operator and was based on clinical grounds.

Results: By January 2010 369 patients were registered having been treated for 409 symptomatic intracranial stenoses. Clinically relevant acute strokes occurred in 26 (7%) of all treatments including 8 (2.2%) patient deaths. The rate of procedure related stroke was highest treating middle cerebral artery (9.7%) and anterior cerebral artery (8.6%) lesions but the differences in complication rates did not reach statistical significance between anatomic locations. Self expanding stents did not prove to be superior to balloon mounted devices. A clinical follow up rate of 65.1% was achieved and recurrent ipsilateral stroke was observed in 2% of all patients followed. Control angiography was performed in 22% of treated patients and in this subgroup the rate of restenosis or occlusion was 34.5%.

Conclusion: Data of the INTRASTENT registry showed persistent high clinically relevant procedure related complication rates. Self expanding stents did not improve patient outcome compared to balloon mounted devices. Indication for treatment should remain restricted to subgroups with high risk for recurrent stroke on medical therapy. Clinical and angiographic follow up needs to be improved and neurointerventional departments should put
Stent-Assisted Thrombo-Emolic Revascularization (SATER) for Acute Ischemic Stroke Intervention of Intracranial Artery Occlusion Utilizing Self-Expanding Micro-Stents: A Series of over 30 Consecutive Patients

University of Iowa Hospitals and Clinics; Iowa City, IA, USA


Methods: A prospective database included all patients undergoing SATER for acute stroke from 6/06 to 6/09. The following data was recorded: time of stroke onset, IV t-PA administration, admission NIHSS, lesion location and severity, TICI perfusion pre and post-procedure, time to revascularization, means of revascularization, and NIHSS and mRS at discharge and 3 months. The data was statistically analyzed and compared to historical controls.

Results: Thirty-one consecutive patients underwent SATER for acute stroke utilizing 40 stents. Mean patient age was 58; range (52-83). Mean presenting NIHSS was 14; range (2-26). Nine received IV-tPA with no immediate improvement. All patients demonstrated perfusion abnormality and large vessel occlusion by non-invasive imaging. Mean time to DSA was 541 minutes. All lesions demonstrated pre-procedure TICI 0-1 flow. 27 lesions occurred in the anterior circulation and 4 in the posterior circulation. Technical outcomes-100% achieved TICI 2a-3 revascularization post SAPTA; mean time to revascularization of 752 minutes. One intra-operative hemorrhage occurred following stent deployment requiring ICA sacrifice. One stent occluded postoperatively causing infarct progression. Clinical outcomes- At discharge, 32% of patients had a mRS of 0-2, 45% 3-4, and 23% 5-6. At 3 month follow up, 52% of patients had a mRS of 0-2, 24% 3-4, and 24% 5-6. Patients alive at 3 month flu demonstrated an 8 point reduction in mean NIHSS. Seven deaths occurred, 4 related to hemorrhagic infarct conversion and 3 to infarct progression.

Conclusion: Our single center experience suggests SATER may be an effective alternative means of achieving revascularization in acute ischemic stroke, particularly in cases refractory to other interventions. A randomized controlled trial is necessary to determine true efficacy and safety of this treatment modality.

Results
8 point reduction in mean NIHSS.

Stroke 6
Chairs: I. Szikora, S. Bakke
16.00-16.15

Morphological and Clinical Results of Invasive Intra-Arterial Recanalization in Acute Stroke

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National Institute of Neurosciences, Budapest, Hungary

Background and Purpose: Acute stroke is most frequently treated with intravenous (IV) thrombolysis. However, IV thrombolysis with recombinant tissue plasminogen activator (rtPA) rarely results in recanalization (TICI 2a-3). In our study we evaluated the safety and efficacy of invasive intra-arterial (IA) recanalization therapy alone or in combination with IV rtPA.

Materials and Methods: In case of radiologically confirmed (CT and, or DSA) major arterial occlusion (extracranial internal carotid artery, intracranial carotid artery “T”, proximal and distal middle cerebral artery and basilar artery occlusion), which developed within 6 hours of onset, IA recanalization therapy was performed. Multiple modalities were used including IV, IA thrombolysis, thrombectomy, balloon angioplasty and stent placement. Primary outcome measures were recanalization, 6 months outcome, and safety.

Results: Between January 2007 and May 2009, we performed IA recanalization therapy on 54 consecutive patients. Six months outcome measure was done in 50 of them, with a median pre-treatment National Institutes of Health Stroke Scale score of 19.12±4.6 (7-30). Good outcome (modified Rankin Scale (mRS): 0-2) was found at 6 months in 17 (34%), poor (mRS 3-6) in 33 (66%) cases. Eighteen (36%) patients were died. Intracranial hemorrhage occurred in 20 of 54 (37%) patients, 6 of which were symptomatic bleeding (11%). Mortality and good outcome were related to collateral flow (p=0.021 and p=0.000), successful recanalization /TICI3-2b (p=0.021 and p=0.000), hemorrhagic transformation (p=0.022 and p=0.021), large ischemic lesion on CT after 24 hours (p=0.003 and p=0.000).

Hemorrhagic transformation was correlated with collateral flow (p=0.027), localization /anterior vs. posterior circulation/ (p=0.035), early ischemic sign on acute CT scan (p=0.011).

Conclusions: IA recanalization therapies remarkably improve the chances of recanalization and with this raise the possibility for favorable outcome, without a significant increase in symptomatic hemorrhage. However, no single method can be perfect on its own. For best results, more strategies are needed with an experienced neurorintervention team working full-time.

Postdilation of the Wingspan-Stent Instead of Predilation is Feasible and Safe

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1Department of Neuroradiology, University Clinic; Jena, Germany;
2Department Of Neurology, University Clinic, Jena, Germany

Background: The wingspan-stent system is widely used for the treatment of intracranial stenoses. According to the manufacturer’s recommendation stenoses are first to be predilated with the gateway balloon-system and then stented. Postdilation of the stent is not recommended. This method has the disadvantage of a potential risk of vessel wall rupture or dissection during balloon expansion and there are cases where stenting alone could lead to sufficient treatment of the stenosis, thus making additional balloon dilatation unnecessary. We developed an alternative approach (navigio-balloon) for the predilation and, when necessary, postdilation with the maverick-balloon-system. Aim of this evaluation is to assess feasibility and safety of this procedure.

Methods: Retrospective study. From 02/2008-01/2010 24 consecutive patients (18 male / 6 female; age from 46-80 years, mean 62 years) with symptomatic intracranial stenoses >50% treated with the wingspan stent were evaluated. Indication for endovascular treatment interdisciplinarily with neuroradiologists and a neurologist. Clinical examinations and sonographic follow-up were carried out by the neurologist. We evaluated treatment success, periprocedural complications, restenosis and stent-damage. Results: Stenting was performed in the anterior circulation in 18 patients and in the posterior circulation in 6 patients. The stent could be placed in 100%. In 5 patients (21%) expansion of the stenosis by the stent alone was sufficient, so
that no postdilation was necessary. No damage of a stent was detected. There was 1 major complication in a Patient with stenting of a basilar artery and subacute infarcts who developed new infarcts after the procedure and died after a few days. Minor complications were found in a patient with stenosis of the proximal middle cerebral artery (MCA) with transient impairment of an existing hemiparesis and small new infarctions in MRI. Another patient had a transient mild hyperperfusion syndrome with headache. Restenoses were found in three patients (12.5%). In one patient in-stent restenosis of the MCA occurred during the first 8 weeks. In-stent placement of a drug-eluting stent was performed but again in-stent restenosis occurred over a period of eight months. No new neurologic symptoms were reported. No intracranial bleeding complications occurred in any patient.

**Conclusion:** Postdilation of the wingspan-stent instead of predilation is feasible and shows no increased rate of complications compared with the data of previous studies with the wingspan stent. Especially visually detectable damage to the stents was never found. By placing the stent at first, balloon dilation could be avoided in 21% of the patients. The lumen is not optimized for neurovascular indications but works in the treatment of intracranial arterial stenoses with balloon dilatation and after treatment was 12.5% and 28%, respectively. The lumen loss after DEB re-angioplasty was less than that after primary stent-PTA. Two patients required a second DEB treatment. One patient died from massive reperfusion hemorrhage.

**Conclusion:** Intracranial stenting is notorious for ISR due to intimal hyperplasia. DEB angioplasty seems to be more effective than conventional balloon re-dilatation. The SeQuent Please balloon is not optimized for neurovascular indications but works in the majority of cases. Primary angioplasty with a DEB followed by the deployment of a bare metal stent could be another treatment strategy, which awaits clinical evaluation.

### Material and Methods

**Treatment of Neurovascular In-Stent Re-Stenosis Using a Coronary Paclitaxel Eluting Balloon**

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1 Clinic for Neuroradiology, Klinikum Stuttgart, Germany; 2 Clinic for Neurology, Klinikum Stuttgart, Germany

**Background:** In-stent re-stenosis (ISR) is a frequent phenomenon after the treatment of intracranial arterial stenoses with balloon dilatation and stent deployment. ISR is a major risk factor for cerebral ischemia and should be detected and treated. In addition to conventional balloon angioplasty or deployment of a second stent, drug-eluting balloon (DEB) dilatation became recently available. After very promising results had been reported for coronary interventions, we tried to adopt this technique for neurovascular ISR. The SeQuent Please balloon releases Paclitaxel during a short-lasting exposure (60 sec), which inhibits intimal cell division and proliferation.

**Material and Methods:** Between 3/2009 and 9/2009, 26 patients (median age 64.2 years, male/female: 18/3) were found to carry a high grade ISR and underwent DEB re-angioplasty. The most frequently affected stent was Enterprise (n=15) and the majority of lesions were atherosclerotic (n=17). The locations included the extradural and intradural vertebral artery (n=3), the basilar artery (n=4), the intracranial ICA (n=6) and the proximal MCA (n=8). All patients received dual platelet antiaggregation (ASA & Clopidogrel) prior to and at least one year after the treatment. Clinical and angiographic follow-up examinations were scheduled 6 and 12 weeks as well as 6 and 12 months later. Data analysis included the degree of target vessel stenosis prior to and after initial treatment as well as DEB re-treatment and at the follow-up examinations, procedural complications and ischemic events during the follow-up observation.

**Results:** The attempted treatment failed in 3 stenoses due to the inability to introduce the DEB into the stenotic stent. The average stenosis rate before and after treatment was 84% and 28%, respectively. The lumen loss after DEB re-angioplasty was less than that after primary stent-PTA. Two patients required a second DEB treatment. One patient died from massive reperfusion hemorrhage.

**Conclusion:** Intracranial stenting is notorious for ISR due to intimal hyperplasia. DEB angioplasty seems to be more effective than conventional balloon re-dilatation. The SeQuent Please balloon is not optimized for neurovascular indications but works in the majority of cases. Primary angioplasty with a DEB followed by the deployment of a bare metal stent could be another treatment strategy, which awaits clinical evaluation.

### Material and Methods

**Long-Term Clinical Outcome Following Emergency MR Imaging and Reperfusion Therapy for Acute Middle Cerebral Artery Occlusion**

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**Background and Purpose:** Long-term clinical outcome remains uncertain after emergency MR imaging and reperfusion therapy (eMR-RT). The aim of our retrospective study was to investigate long-term clinical outcome following eMR-RT for acute middle cerebral artery (MCA) occlusion.

**Methods:** Included for retrospective analysis were acute stroke patients who were admitted to our institution during the period from Oct 2005 to Sep 2009, 2) who were admitted within 6 hours from stroke onset, 3) who presented serious neurological symptoms of NIHSS score of 5 or more due to acute MCA occlusion diagnosed by emergency MRA, 4) who underwent emergency MR imaging on admission, and 5) who underwent eMR-RT. Patients who had contraindications of rt-PA or in whom intravenous rt-PA could not be injected within 3 hours from onset, underwent endovascular treatment. Evaluated were age, sex, onset-to-admission hours (OTAH), NIHSS score on admission, long-term survival and modified Rankin scale.

**Results:** During the study period, 601 acute stroke patients were admitted within 6 hours. Among them, 42 patients underwent eMR-RT. Age (mean±SD) is 75.7±10.6 and 74.9±9.3 years old, man is 9(40.9 percent) and 16(80 percent)(p<0.05), OTAH (median) is 2.42 hrs, NIHSS on adm (median) is 12, follow-up period (median) is 115 days, survival probability by Kaplan-Meier method is 76.1%, mRS (median) on the follow-up day is 4, and 14 patients (33.3 percent) had favorable outcome of mRS of 0 to 2. Among 42 patients, 22 patients underwent intravenous rt-PA (E group) and 20 patients did endovascular treatment (E group). In R and E group, age (mean±SD) is 75.7±10.6 and 74.9±9.3 years old, man is 9(40.9 percent) and 16(80 percent)(p<0.05). OTAH (median) is 0.88 and 1.28 hrs(p<0.05), follow-up period (median) is 113 and 117.5 days, survival probability by Kaplan-Meier method is 68.6 and 85.2 percent (p=0.15), and the number of patients who had mRS of 0 to 2 was 5 (22.7 percent) and 9 (45 percent), respectively. Cox proportional hazard model showed that NIHSS score on admission, age, sex and group were significant predictors (p<0.05) for long-term survival.

**Conclusion:** After eMR-RT, long-term survival rate was 76.1 percent and favorable clinical outcome rate was 33.3 percent. Patients who underwent endovascular treatment may be alive longer and have better clinical outcome than intravenous rt-PA.
Background and Purpose: It remains uncertain whether or not emergency reperfusion therapy (ERT) can improve hyperacute stroke patients suffering from basilar artery occlusion (BAO) based on MR imaging. The purpose of our retrospective study was to investigate long-term clinical outcome after emergency reperfusion therapy for acute BAO based on MR imaging.

Methods: Included for retrospective analysis were patients (1) who were admitted to our institution during the period from January 2004 to June 2009, (2) who were admitted within 48 hours from stroke onset, (3) who presented neurological symptoms due to BAO diagnosed by emergency MR imaging, (4) whose NIHSS score on admission was 5 or more, (5) who were candidates for emergency reperfusion therapy. Excluded were patients (1) in whom MRI-DWIs showed extensive high signal intensity area, (2) who presented NIHSS score of less than 5, (3) who were comatose on admission, or (9) who had contraindications for ERT. Some patients underwent ERT (E group) of intravenous rt-PA or endovascular treatment and others did not give written informed consent for ERT (C group). Basic patients' characteristics on admission (age, gender, final diagnosis), NIHSS on admission, NIHSS on discharge, mRS on admission and mRS at 3 months were investigated.

Results: During the study periods, 40 patients were included for analysis. Among them, 25 patients underwent ERT (E group), and 15 patients did not (C group). In E and C groups, a median age was 74 and 77 years (n.s.), man (%) was 68 and 73 (n.s.), cardiogenic (%) was both 40 (n.s.), a median NIHSS on admission was 22 and 14 (p<0.05), a median NIHSS on discharge was 14 and 40 (p<0.05), a median mRS on admission was both 5 (n.s.), a median mRS at 3 months was 4 and 5 (p<0.05), respectively.

Conclusions: Although patients with serious neurological symptoms underwent ERT for acute BAO, ERT improved their 3-month clinical outcome.

17.15-17.30 10'
Endovascular Recanalization for the Internal Carotid Artery or Middle Cerebral Artery Occlusion in a Subacute Stroke Stage in Deteriorating Patients with Internal Border Zone Infarctions
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Background: When neurological symptoms of patients with internal border zone (IBZ) infarctions due to the internal carotid artery (ICA) or middle cerebral artery (MCA) occlusion deteriorate, it is not established how to treat them in a subacute stroke stage and how to improve their clinical outcome. The purpose of our retrospective studies was to investigate the feasibility, safety, and effectiveness of angioplasty and stenting for the ICA or MCA occlusion in a subacute stroke stage in deteriorated patients with IBZ infarctions.

Methods: Included for analysis were patients (1) who were admitted in our institution within 72 hours of onset from August 2004 to August 2008, (2) without extensive high signal intensity on MRI, (3) who were ICA or MCA occlusion, (4) with modified Rankin Scale (mRS) <2 on the onset day, (4) in whom neurological symptoms deteriorated (a >4-point increase on the NIHSS) within 7 days of onset despite full medication, (5) with mRS >4 on the 7th day and (7) who were diagnosed as IBZ infarctions on the 7th days after onset.

Some patients gave written informed consent and underwent angioplasty and/or stenting for the ICA or MCA total occlusion from 7 to 14 days after onset (group E) and others not (group C). NIHSS on admission, 7-day NIHSS after admission, NIHSS on discharge, mRS on discharge and 3-month mRS were investigated in both groups and procedural success rate in group E.

Results: Seventeen patients were included for analysis. Among a total of 6 patients in group E, ICA occlusion in 2 patients was opened successfully by stenting and MCA occlusion in 4 patients successfully by angioplasty too. Among a total of 11 patients in group C, 3 patients had ICA occlusion and 8 patients had MCA occlusion. Although there were no significant differences in NIHSS on admission, 7-day NIHSS after admission, NIHSS on discharge, mRS on discharge and 3-month mRS between groups, 3-month mRS (median) was 2.5 in group E and 5 in group C (p<0.05).

Conclusions: Successful subacute angioplasty and/or stenting for the ICA or MCA total occlusion in deteriorated patients with IBZ infarctions may be effective in improving 3-month clinical outcome.
Aneurysms 5

Chairs: P. Purdy, R. Gasparotti

09.15-09.30 14’

Introductory Lecture

Clinical Predictors of Delayed Cerebral Ischemia after Subarachnoid Hemorrhage: First Experience with Coil Embolization as the First-Line Treatment in the Management of Ruptured Cerebral Aneurysms

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Objective: The purpose of this study was to clarify the clinical predictors of delayed cerebral ischemia (DCI) after subarachnoid hemorrhage (SAH).

Methods: Since 2000, we have treated 92 patients with ruptured cerebral aneurysms (73 by clipping and 19 by coiling). Thirty-five patients were male and 57 were female. The median age was 57.5 years with a range of 31 to 84 years. The Modified Rankin Scale was used to assess functional outcomes 3 months after treatment or at discharge. The associations between potential clinical risk factors and DCI after SAH were assessed using the chi-square test.

Results: Forty-three patients (48.9%) had good outcomes, and 13 patients (14.1%) died despite treatment. DCI was observed in 23 patients. There was no difference in functional outcomes between the two treatment groups (P = 0.23). However, DCI was seen less frequently in the clipping group than in the coiling group (5.3% vs. 31.5%, P = 0.009). The presence of hydrocephalus was significantly associated with occurrence of DCI (P = 0.002). Multivariate logistic regression analysis also showed that the treatment modality and the presence of hydrocephalus were independent risk factors for DCI.

Conclusion: Although there was no difference in the clinical outcomes between the treatment groups, DCI was less frequently observed in the coiling group. The presence of hydrocephalus can predict the occurrence of DCI.

A Novel Force Sensor with an Optical System for Coil Embolization of Intracranial Aneurysms

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Object: In endovascular coil embolization for an intracranial aneurysm, the excessive pressure created during coil insertion into an aneurysm can cause a catastrophic rupture or dislodge a microcatheter tip from the aneurysm dome, resulting in insufficient embolization. Such undue mechanical pressure can only be subjectively detected by the subtle tactile feedback the surgeon experiences. Therefore, the authors of this study developed a new sensor device to measure the coil insertion pressure via an optical system.

Methods: This novel sensor system consists of a hemostatic valve connected to the proximal end of a microcatheter (Y-connector). The sensor principle is based on an optical system composed of a light-emitting diode (LED) and a line sensor. The latter measures how much the coil-delivery wire slightly bends in response to the insertion force by detecting the wire shadow. This information is translated into a given force level. Experimental aneurysm embolization was performed using this optical sensor. A silicone aneurysm model and an in vivo model (porcine aneurysm dome) were used in this study. Several surgeons manually performed the coil insertions. The sensor continuously monitored the mechanical force during the insertions.

Results: The sensor adequately recorded the coil insertion force during embolization. The presence of the sensor did not hinder the embolization procedure in any way. During embolization in the silicone aneurysm model, a sinusoid pattern of force occurred, reflecting actual clinical experience. Similar results were obtained in the in vivo study.

Conclusions: This new sensor device adequately measures coil insertion force. This system provides potentially safer and more reliable aneurysm embolizations.

Mechanism of Catheter Kickback in the Final Stage of Coil Embolization for Aneurysms - Straightening Phenomenon

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Background: On coil embolization for cerebral aneurysm the microcatheter is often kicked back from the aneurismal sac in the last stage of packing. This accident may be an indicator to finish off the embolization, however, occasionally results in the retrieval of the last coil if we fail to reposition the catheter tip into the aneurismal sac. This kickback phenomenon has been believed as the result of no remnant space to insert the last coil or due to the stiff detach
Methods & Results: First, various types of SR coils on the market were inserted into the cylinder or the aneurysmal sac made from silicone tube smaller than the proper space for the prescribed diameter of each coil. All the SR coils showed hardening of coil tail like steel wire is squeezed in the coil end. Shortening SR line into the inadequately narrower space (Figure 2). In this situation the course of SR line was folded in the sac smoothly without kickback phenomenon. Next, 12 times of SR coil model was created to simulate this phenomenon. The first coil loop filament and SR line were made from fishing line. This coil model was formed as the non pre-shaped design and the SR line fixed at the coil tip and tail, and was set in the same length with the coil length. We could realize the straightening of the coil when it was inserted and folded into the narrow square space (Figure 2). In Methods: on the course of SR line in the canal of 1st loops was found to change. Although SR line was positioned in the center of the canal, it became to shift to the outer side in the middle portion, and finally shifted to the inner side instead at the coil tail. We also observed the gap among 1st coil pitches were enlarged on inserting into the narrower space. According to these results, straightening phenomenon at the coil tail on inserting coils into the narrower space may be one of the factors of catheter kickback.

Conclusion: Straightening of the coil tail is caused by the relative shortage of SR line resulting in the squeeze of 1st coil loops. This SR coil-specific phenomenon may be one of the factors of catheter kickback.

Use of 3-D Angiograms for Prediction of Coils Needed to Embolize Small Intracranial Aneurysms

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Purpose: To determine the variables needed to estimate amount of coils necessary to embolize a small intracranial aneurysm (maximum aneurysm diameter < 10.0 mm) for comparison of approximate costs with forthcoming treatment modalities such as flow-diverters.

Methods: We searched the 3-dimensional cerebrovascular database of a single institution to sort out small aneurysms which were treated within 2 years selectively by coiling. All such aneurysms treated with or without balloon or stent assistance were included regardless of their rupture status. Aneurysms were excluded from analysis even if a single hydrogel-coated coil was used during treatment or rupture occurred during treatment. Otherwise all aneurysms treated with any bare or bioactive coils were included. The following 3-dimensional geometric variables were measured by an independent reviewer for these aneurysms: maximum aneurysm dimension (Dmax), height of aneurysm (h: length of the line drawn from the aneurysm dome and intersecting perpendicularly to the parent vessel at the midsegment of the aneurysm orifice), volume of the aneurysm (V). The variables obtained retrospectively from neuroradiography suite logs and patient records included number of coils (bare and bioactive), length of coils and use of stents or balloons. Due to the variation of list prices and actual prices a ‘coil equivalent’ (COE) was defined. Based on the current list prices of bare coils in use, a COE was taken as the average price of a single bare coil, taking into consideration of all bare coils from current vendors. Accordingly, by approximation, Neuroform/Enterprise stents and Hyperflame/Pyrglide balloons were taken as 5 and 1 COEs respectively. Multiple linear regression was used to model both the number of coils and coil length as a function of Dmax, h and V.

Results: 46 aneurysms were included (Dmax: 2.8 to 9.9 mm, v: 10.3 to 467.8 mm3) in the final analysis. There was no significant difference in Dmax, h and V between ruptured and unruptured groups. Coil length was found to be a function of volume (R2 = 0.9). Dmax, by itself was not as reliable as V in predicting the length or number of coils. Still, in 67 % of aneurysms, number of coils used per millimeter of aneurysm diameter (coil/Dmax) was 1.00 or less (range: 0.32-2.13, mean: 0.88, median: 0.73). Mean/median COE for aneurysms treated with bare coils +/- balloon assistance versus those treated with stent assistance was 5.3/5 versus 12.7/12. There was no significant difference in Dmax between these groups.

Conclusions: It may be possible to estimate the amount of coils needed to treat an intracranial aneurysm using geometric data obtained from 3-dimensional angiograms. In our study group, coiling of small aneurysms, especially when no stent assistance was used, appeared more cost effective than the expected costs associated with flow-diverters. Given the proven safety of coiling in small aneurysms, a clinical decision regarding use of stents and flow-diverters in straight-forward and coilable small aneurysms should also include the overall cost estimates based on 3-dimensional geometric data.

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Chairs: P. Lylyk, N.K. Mishra

Endovascular Treatment of Intracranial Baby Aneurysms

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Object: we report the results of endovascular treatment of 98 consecutive baby aneurysms (mean diameter inferior or equal to 3 mm).

Material and Methods: Between 1999 and 2009, 98 baby aneurysms were diagnosed in 96 patients and referred to endovascular treatment. 78
patients presented with subarachnoid hemorrhage and 18 were asymptomatic, 16 of which treated after another aneurysmal rupture. Twelve baby aneurysms were treated with stents, 6 of those without coils associated.

**Results:** One of the 96 endovascular procedures failed, and this patient had conservative treatment and long term follow-up without aneurysmal modification. Of the 97 aneurysms successfully treated by coil embolisation, 74 aneurysms (76.3%) were completely occluded, 18 aneurysms (18.6%) showed a residual neck and 5 aneurysms (5.1%) presented a residual sack. Of 96 patients 68 patients (70 aneurysms) were followed up angiographically at one year: 57 aneurysms (81.4%) were completely excluded, 10 (14.3%) showed residual neck and 3 (4.3%) presented a residual sack. Complications occurred in 10 patients (10.2%) of the 98 embolisations: 6 intra procedural ruptures (6.1%), 3 coil migrations (3%) and 1 thromboembolic event (1%). All of those complications were asymptomatic except for 2 of the rupture patients who died consequently. The 12 procedures in which stents were used presented no complication.

**Conclusion:** In our experience endovascular embolisation of baby aneurysms is not in itself associated with highrates of complication. The stent technique seems to be a good alternative when coil embolisation is difficult.

10.30-10.45 10’

Technical Aspects of Single Coil Embolization of Broad Based, Small Intracranial Aneurysms. Low Case Flow Center Experience

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**Background and Purpose:** Coiling of broad based, small intracranial aneurysms represents a therapeutic challenge because of considerable risk of periprocedural perforation of aneurysms as well as distal migration of the coils. In this paper we describe our experience in endovascular treatment of small aneurysms and discuss technical aspects of procedure that had importance for favorable outcome.

**Material and Methods:** During the period of twelve years (1998-2010) we treated 12 broad based, small aneurysms by single coil embolization. The longest diameter of all aneurysms measured less than 3mm and at list one diameter or neck measured less than 2mm. Back-to-neck ratio was calculated by dividing the largest diameter of the sack with the largest diameter of the neck and was in all patients less than or equal to 1.5. There were 8 males (mean age 46.7 years) and 4 females (mean age 61.5 years). Two patients had concomitant larger aneurysms. One of them was coiled and the other one clipped. Seven aneurysms were occluded with spiral bare coils while the other one were occluded with different types of 3D coils. Balloon assisted coiling was performed four times. We analyzed retrospectively all procedures with stress on technical issues affecting the outcome.

**Results:** Immediately after coiling ten aneurysms were completely occluded while the contrast within the aneurysm was seen in four aneurysms. There were two peroperative perforations of the aneurysms. In one patient the first coil migrated from the aneurysm and was left in edge position distally in a cortical branch. This migration did not cause either identifiable damages of the brain parenchyma or any neurological deficits. There were no morbidity or mortality related to the procedure. One patient died eleven days after coiling because of diffuse and refractory spasm of brain arteries. An elderly patient (73) died shortly after coiling because of general failure. A complete aneurysm occlusion was attained in 35 cases (63.6%), a neck remnant was detected in 19 cases (34.5%), there were no morbidities or mortalities related to the procedure. One patient died seven days after the procedure, both patients with incidental aneurysms had neurological deteriorations. In patients who died consequently. The 12 procedures in which stents were used presented no complication.

**Conclusion:** Successful endovascular treatment of broad based, small intracranial aneurysms can be performed with satisfactory results even in the low case flow institutions. Extremely careful catheterisation of the aneurysms and proper choice of the coil have essential importance for success. Short, spiral coils showed surprising ability to lie stably in the aneurysms and to promote quick trombotization of the aneurysm in spite of discrepancy between the volume of the aneurysm and the volume of the coil. Distal migration of the single, short coils does not seem to compromise the flow in the small, distal arteries. Three D coils and balloons are not always necessary for effective and safe treatment of broad based, small aneurysms.

10.45-11.00 10’

Endovascular Treatment of 55 Posterior Communicating Artery Aneurysms. Overall, Perioperative Results

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**Object:** A series of 55 consecutive patients with a posterior communicating artery aneurysm (PcoA) is presented. The aim in this study was to report the results of endovascular treatment in these patients.

**Methods:** The aneurysms were managed with an endovascular approach in which detachable coils were used. Angiographic and clinical results, including complications, as well as the results of follow-up studies are described. A brief anatomico-physiological description of the posterior communicating artery (PcoA) and its branches is reported.

A review of the surgical and endovascular literature is presented, including the outcome of the III cranial nerve deficit. To our knowledge, this is the first comprehensive report on the endovascular treatment of PcoA.

**Results:** Of the 55 aneurysms, 47 (85.4%) were small, 8 (14.6%) were large. Forty-two (76.3%) had a small neck, whereas 13 (23.7%) had a wide neck. Seventeen (30.9%) were incidental and thirty-eight (69.1%) had presented with a subarachnoid hemorrhage. In all the cases the endovascular treatment was attempted without failure. A complete aneurysm occlusion was attained in 35 cases (63.6%), a neck remnant was detected in 19 cases (34.5%), there were no morbidities or mortalities related to the procedure. One patient died seven days after the procedure, both patients with incidental aneurysms had neurological deteriorations. In patients who died consequently. The 12 procedures in which stents were used presented no complication.

**Conclusion:** Successful endovascular treatment of PcoA is feasible, with good overall clinical and anatomical results. From the data of the literature and from our experience it is possible to infer that the oculomotor nerve deficit may improve with the endovascular treatment. Close post-embolization monitoring (with imaging techniques) is essential, specially in wide-necked lesions.
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Chairs: T. Hyogo, R. Riva

Intracranial Aneurysms Treatment with Hydrocoils: 6 Years Follow-Up in a Single Center Experience

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Purpose: To present and demonstrate the feasibility and effectiveness of intracranial aneurysms could be safely treated by coiling with acceptable outcomes.

Methods: The medical records and radiological studies of 72 consecutive patients with 78 unruptured MCA aneurysms, who underwent coiling, were retrospectively reviewed and evaluated.

Results: Coiling was accomplished in 77 aneurysms, but failed in 1. The aneurysms were treated by using single catheter (n=50), multi-catheter (n=19), balloon-assisted (n=11), stent-assisted (n=13), and combination of multi-catheter and balloon-assisted technique (n=4). One patient died from consequence of subarachnoid hemorrhage (SAH) occurring 9 hours after coiling. One intra-procedural aneurysm rupture occurred, which was controlled by insertion of further coils and left no sequelae. There was one cortical and one basal ganglia infarction, but both recovered completely. Treatment-related permanent morbidity and mortality rates were 0% and 1.5%, respectively. Postembolization control angiography revealed 40 complete, 30 near-complete, and 7 incomplete aneurysm occlusions. Clinical follow-up was available in all surviving patients (mean, 20 months; range, 4-24 months) except for one who was lost to follow-up. There was no SAH, but 1 death from acute myocardial infarction. None of the remaining patients had neurological deterioration. Follow-up angiographies were available in 65 aneurysms at least once at 4-24 months (mean, 11 months). Three major and 6 minor recurrences were detected. All 3 major recurrent aneurysms could be re-treated by coiling without complications.

Conclusions: Using appropriate techniques and devices, most unruptured MCA aneurysms could be safely treated by coiling with acceptable outcomes.

Unruptured Middle Cerebral Artery Aneurysm Coiling, Feasibility and Outcome. Single Center Experience

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Purpose: The purpose of this study is to evaluate the feasibility, clinical and angiographic outcomes of coiling for unruptured middle cerebral artery (MCA) aneurysms.

Methods: The medical records and radiological studies of 72 consecutive patients with 78 unruptured MCA aneurysms, who underwent coiling, were retrospectively reviewed and evaluated.

Results: Coiling was accomplished in 77 aneurysms, but failed in 1. The aneurysms were treated by using single catheter (n=50), multi-catheter (n=19), balloon-assisted (n=11), stent-assisted (n=13), and combination of multi-catheter and balloon-assisted technique (n=4). One patient died from consequence of subarachnoid hemorrhage (SAH) occurring 9 hours after coiling. One intra-procedural aneurysm rupture occurred, which was controlled by insertion of further coils and left no sequelae. There was one cortical and one basal ganglia infarction, but both recovered completely. Treatment-related permanent morbidity and mortality rates were 0% and 1.5%, respectively. Postembolization control angiography revealed 40 complete, 30 near-complete, and 7 incomplete aneurysm occlusions. Clinical follow-up was available in all surviving patients (mean, 20 months; range, 4-24 months) except for one who was lost to follow-up. There was no SAH, but 1 death from acute myocardial infarction. None of the remaining patients had neurological deterioration. Follow-up angiographies were available in 65 aneurysms at least once at 4-24 months (mean, 11 months). Three major and 6 minor recurrences were detected. All 3 major recurrent aneurysms could be re-treated by coiling without complications.

Conclusions: Using appropriate techniques and devices, most unruptured MCA aneurysms could be safely treated by coiling with acceptable outcomes.
Introduction: Treatment of posterior circulation aneurysms has evolved over time from predominantly surgical approach to preferential endovascular approach. The advent of endovascular techniques has made such treatment more feasible. We report our experience with the endovascular management of ruptured posterior circulation aneurysms during the past 10 years.

Methods: A retrospective analysis was performed on all patients with posterior circulation aneurysms undergoing endovascular treatment at PGIMER, Department of Radiodiagnosis, Neurointervention Division between 1999 and June 2009. There were 95 patients who presented with posterior circulation aneurysms. Out of which 75 patients opted for definitive management and were included for the purpose of this study. Details of clinical grade, grade of SAH, treatment opted (surgical Vs. endovascular), procedural complications, post operative course and follow-up were reviewed and analyzed.

Results: of the 75 patients treated, 82% had good Hunt and Hess grading scale (i-iii) and 18% had grade iv. The locations of the posterior circulation aneurysms in all the patients (treated and untreated) included 46.5% in the basilar apex, 14.9% in vertebral artery, 12.9% in PICA, 11.9% at PCA, 5.9% in basilar SCA junction, 1% at basilar-vertebral artery junction and 1% at AICA. The mean age at the time of treatment was 42.8 years (range, 11-70 yr). Of all the patients, 40 were treated with endovascular means and 35 surgically. Majority of the basilar artery aneurysms who were treated (n=60) were managed by coiling (60.7%) with rest (30.3%) being treated surgically by clipping, wrapping or both. 70% of vertebral artery aneurysms were also coiled. As against PICA and PCA aneurysms, where more than 90% of the cases were surgically treated. As regards the outcome out of 75 patients treated with either surgery or endovascularly. In general there were 47 patients with good clinical outcome or moderate disability. Specifically in basilar artery aneurysms 60% of the patients treated with coiling had good clinical outcome as compared with 23.07% of the patients treated surgically. 10 patients treated with either modalities had severe disabilities and 18 patients died out of which 16 patients had basilar apex aneurysms. The most common cause of death was vasospasm induced infarct seen in 10 patients followed by sepsis in 5 patients.

Conclusion: Endovascular coil embolization of posterior circulation aneurysms is an effective treatment especially in the aneurysms located at basilar apex. The mortality in these is related more to the clinical grade of the patient and associated vasospasm than the modality of treatment opted (surgical Vs. non-surgical). There is significantly lesser morbidity when the patient is treated with endovascular means as compared to surgery.

The Technique of Double Catheterization of the Sac in the Treatment of Intra-Cranial Aneurysms

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Objectives: wide neck aneurysms and especially those at an arterial bifurcation are often of particular endovascular management, necessitating the use of a remodelling balloon or the deployment of a stent. This last technique would require an anticoagulant treatment often not recommended in acute phase. According to certain anatomical configurations, the microguide-dependant remodelling balloon modifies the anatomy of the artery and increases the risk of vasospasm or arterial thrombosis. We describe our experience in the treatment of aneurysms by double catheterization of the sac.

Methods: from January 2009 till November 2009, 9 patients benefited from this technique. The anticoagulating protocol was similar to that for the occlusion of an aneurysm by single catheterization. All the aneurysms were asymptomatic. In the only case of aneurysm of the carotid siphon, a remodelling balloon was used as support.

Results: the aneurysm location was pericallosal in 1 case, at the carotid siphon in 1 case and at the MCA bifurcation in 7 cases. The neck to dome ratio varied between 0.35 and 0.82 with an average of 0.55. The angiographic results (classification Raymond) were: A in 7 cases (77.7 %), B in 1 case (11, 1 %) and C in 1 case (11, 1 %). No neurological complication was observed. A single technical event occurred with coil loosing into the artery, without clinical consequence.

Conclusion: in certain particular anatomical situations, the double catheterization could be an alternative to the remodelling and stent assisted techniques.
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Background: Flow diverter technology opened a promising ability for reconstructive treatment of difficult intracranial aneurysms. These devices may be used as stand-alone treatment, with the hope that progressive aneurysm thrombosis and vessel remodeling will follow after treatment.

Materials and Methods: From twelve different worldwide centres thirteen cases of aneurysm rupture after flow diversion treatment were retrospectively analysed. Symptomatology, aneurysm location and morphology, and the time elapsed from treatment till rupture were all assessed.

Results: There were 10 internal carotid, and 3 basilar artery aneurysms. Four lesions were fusiform. The mean diameter of the lesions was 21 mm. Ten cases were symptomatic prior to treatment. One simple flow diverter was used for all saccular aneurysms, whilst fusiform lesions were treated multiple devices in a telescopic fashion. A very loose collaring of the aneurysm was performed in only one case. Ten patients had an early rupture after treatment (mean 16 days, range 2-48), and three patients suffered the rupture 3-5 months after. All aneurysm showed at least partial thrombosis prior to rupture. A possible pathomechanism of this serious event is proposed.

Conclusions: Modified hemodynamics by flow diversion may induce partial intraluminal thrombosis of large aneurysms. The volume and the biological activity of the permanently renewing clot in the aneurysm wall, and may predispose to rupture.

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Chairs: J. Moret, K. Irie

14.30-14.45

Double Lumen Remodelling Balloon: A New Technique for Treatment of MCA Bifurcation Aneurysms

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Objective: The endovascular approach is more and more considered as the first therapeutic option for the treatment of intracranial aneurysms(1,2). Moreover, new devices such as remodelling balloons (3,4) and self-expandable stents(5,6) have enlarged the indications of EVT. Aneurysms arising from the MCA account for 18%-22% of aneurysms and are the third-most common site of aneurismal hemorrhage (7-9). Patients with MCA aneurysms are more likely to have additional aneurysms than patients with aneurysms in other locations (10,11). MCA aneurysms are often wide necked and/or incorporate the origin of arterial branches in the aneurysm base. The middle cerebral artery (MCA) aneurysms remain technically challenging to treat by embolization because of the complex anatomy of the MCA bifurcation. These aneurysms are frequently thought to be candidates for surgical clipping rather than embolization, and little information is available in the literature about their management by endovascular approach. Recently, Vanzin et al. (12) and Iijima et al. (13) retrospectively showed the feasibility and the safety—with good clinical and anatomical results—of EVT in unruptured and ruptured MCA aneurysms. In our case, we present a new technique of remodelling for endovascular treatment of middle cerebral artery bifurcation aneurysms by using a double lumen balloon ASCENT 4 x 7 mm.

Clinical Presentation: A 60-year-old male was presented with disorientation of memory, headache and sensory disturbances. An MRI with 3D sequences was performed showing the presence of white matter supra-tentorial hyperintensities with left middle cerebral artery bifurcation aneurysms measuring nearly 10 mm in its long axis, 7 mm in its axis and transverse collar with about 4 mm. 3D reconstructions confirmed the presence of irregularities in the anatomy of the bag aneurysm. There was a strong family factor of brain vascular disease in this patient, since both parents presented subarachnoid hemorrhage after aneurysm rupture. Angiogram was done revealing the presence of two aneurysmal formations, the first aneurysm was in the left MCA bifurcation measuring 10 mm, the second one was in the right calloso-marginal artery measuring 3 mm. The aneurysm was seemed to be treated by endovascular technique supplemented by remodelling.

Approach: Setting up a balloon, double lumen remodelling ASCENT 4 x 7 mm, which allowed us from one side to protect the aneurysm neck arteries which carry the left middle cerebral bifurcation, and the other side the deployment of coils, through the internal lumen of balloon. It also allows us to use this balloon as a distal round balloon to protect the neck at the sylvian bifurcation. Eighteen coils were placed through the internal lumen of balloon in the aneurysm sac. Final angiogram showed quite satisfactory occlusion of the aneurysm sac, scale Montreal: B.

Conclusion: Endovascular coil embolization of MCA aneurysms is effective and can be performed with acceptable morbidity and mortality in selected patients. Thanks to the development of protecting/bridging neck devices, more and more aneurysms are treatable by endovascular approach with excellent results. Our case shows that EVT of MCA aneurysms is feasible with good results.

14.45-15.00

Safety and Efficacy of the Remodelling Technique in the Treatment of Ruptured and Unruptured Intracranial Aneurysms

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Purpose: To analyze the safety and efficacy of the remodelling technique compared to the standard coil ing technique in two large multicenter series concerning the endovascular treatment of ruptured (CLARITY) and unruptured intracranial aneurysms (ATENA).

Materials and Methods: Both series were large, multicenter, prospective series conducted in France (20 centers in CLARITY, 27 in ATENA). In CLARITY, 768 patients (361 females and 247 males; age: 19-80 years, mean: 51.0 ± 11.1 years) having a total of 768 ruptured aneurysms were treated by coil ing alone in 608 patients (79.2%) and by the remodelling technique in 160 patients (19.8%). In ATENA, 547 patients (383 females and 164 males; age: 22-83 years, mean: 51.0 ± 11.1 years) having a total of 572 aneurysms were treated by coil ing alone in 325 patients, and by

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the remodelling technique in 222 patients in ATENA.

Results: The overall rate of adverse events related to the treatment-regardless of whether they lead to clinical consequences or not - was 17.4% (106/608) for coiling and 16.9% (27/160) for remodelling in ruptured aneurysms, and 10.8% (55/525) for coiling and 11.7% (29/222) for remodelling in unruptured aneurysms. In ruptured and unruptured aneurysms, the rate of thromboembolic events and intraoperative rupture was similar in coiling and remodelling group. The morbimortality related to the treatment was lower (but not significantly) in remodelling group (3.6%) compared to coiling group (5.1%) in ruptured aneurysms. In unruptured aneurysms, morbimortality was not different in both groups (3.1% in coiling group and 3.7% in remodelling group). The rate of adequate occlusion was significantly higher in remodelling group (94.9%) compared to coiling group (88.5%) in ruptured aneurysms, but was similar in both groups in unruptured aneurysms. In two large series dealing with ruptured and unruptured aneurysms, the safety of the remodelling technique is similar in coiling and remodelling groups. In ruptured aneurysms, the remodelling technique was more efficacious than coiling technique regarding the immediate postoperative anatomical results. According to these results, the remodelling technique can be widely used in both ruptured and unruptured aneurysms.

References

Stent-Jail Technique in Endovascular Treatment of Wide-Necked Aneurysms

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Objective: To describe a novel technique for single stent reconstruction of wide-necked aneurysms with a dome-to-neck ratio less than 1.0.

Methods: This technique, named the stent-jail technique, consisted of the aneurismal catheterization before the delivery of a self-expandable stent across the aneurysm neck. Once the stent was deployed, embolization coils were delivered with the microcatheter positioned within the aneurysm dome and wedged between the stent and the vessel wall. The microstents, such as Neuroform, Leo and Wingspan stents, were used in in our series for electively treated aneurysms.

Results: During a 3-year period, 13 patients with wide-necked aneurysms were treated electively with this technique. The aneurysms were located at the internal carotid artery (5), anterior cerebral artery (4), anterior communicating artery (1), vertebral artery (1), middle cerebral artery (1) and middle cerebral artery (1). Thirteen stents (6 Leo stents, 4 Neuroform stents and 3 Wingspan stents) were successfully deployed across the aneurysm neck to support subsequent coil embolization of a wide-necked cerebral aneurysm. None of the patients experienced any periprocedural or delayed neurological complications. This maneuver enabled us to constrain the coil loops within the sac with stabilization of the microcatheter.

Conclusion: Stent-jail technique represents a novel adjuvant technique to support the coilings of selected wide-necked intracranial aneurysms. This technique is particularly useful for wide-necked aneurysms with a dome-to-neck ratio smaller than 1.0.

15:15-15:30 10' Which Factor Increases Procedural Thromboembolic Events in Patients with Unruptured Paracrhoid Internal Carotid Artery Aneurysm Treated by Coil Embolization?

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Purpose: Coil embolization of the paracrhoid internal carotid artery aneurysm is not always easy due to anatomical location or shape of the aneurysm. Neurointerventionalists often worry about the selection of microcatheter, steam-shaping of the microcatheter tip, or the indication of balloon assistance to perform safer and successful embolization. Unfortunately, intracranial stent is not available in our country. The purpose of this study is to analyze factors that influence the procedural thromboembolic events during the coil embolization of the unruptured paracrhoid internal carotid artery aneurysms.

Materials and Methods: Thirteen consecutive unruptured paracrhoid internal carotid artery aneurysms (diameter: 3.4 E8.5mm, mean 5.5mm) were embolized between December 2007 and January 2010. All patients received dual antiplatelet agents preoperatively. Systemic heparinization was also done during the procedure in all cases. Six aneurysms were treated with balloon (Hyperglide) assistance and seven were embolized with only balloon. Achieved volume embolization ratio (VER) of each aneurysm was ranged from 15.6 to 47.8 (mean 28.9%). We needed to exchange the microcatheter during the procedure in four cases. To get a favorable coil packing within the aneurysm, withdrawal of the undetached coil from the aneurysm was necessary in eight cases. In order to assess the procedural thromboembolic events, posttreatment diffusion weighted MR imaging was performed within four days.

Results: Neurologically symptomatic complications did not occur in our series. Silent procedure-related infarction was detected on postoperative diffusion weighted images in five cases. This silent thromboembolic events occurred in 62.5% of cases in which we need to withdraw the undetached coil during the procedure versus 0% in patients without intraprocedural detachment of the coil. Other factors, such as patient's age, sex, size of aneurysm, VER, number of the deployed coils, balloon assistance technique, and exchanging maneuver of microcatheter during the procedure, did not influence the occurrence of silent thromboembolic events.

Conclusion: The use of balloon assistance or exchanging maneuver of the microcatheter during procedure does not increase procedure related silent thromboembolic events. Appropriate coil selection, which may reduce the incidence of coil withdrawal, is important to perform safer embolization of the paracrhoid internal carotid artery aneurysm.

15:30-15:45 10' Local Intra-Arterial Tirofiban for Intraoperative Vessel Thrombosis during Aneurysm Coiling

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Thromboembolism is a recognized complication occurring during endovascular carotid embolization of intracranial aneurysms, and its inci-
Iatrogenic CCF Following Attempted Endovascular Treatment of Intracranial Aneurysm

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This is a report of 2 cases of intracranial aneurysm and CCF treated by placing some more balloons across the neck of the aneurysm with more balloons being deployed showed residual outflow into SOV and cortical veins. The anterior part of the cavernous sinus was obliterated with coils via the superior ophthalmic vein. DSA when no more coils could be deployed showed residual outflow into SOV and cortical veins. The patient was taught intermittent digital compression of the cervical ICA. Despite diligent compression of the ICA the proptosis suddenly enlarged 2 weeks later. DSA now showed large high flow Type A CCF with massive venous outflow into IPS, SOV and intracranial veins. It was decided to occlude the CCV by the venous route. Through the IPS the cavernous sinus was entered but SOV could not be entered. It was decided to pack the cavernous sinus with coils. DSA when no more coils could be deployed showed residual outflow into SOV and cortical veins. The anterior part of the cavernous sinus was obliterated with coils via the superior ophthalmic vein. DSA showed massive retrograde flow into the cortical veins. As there is high risk of intracerebral hemorrhage due to rupture of arterialized cortical veins there was no alternative but to occlude the ICA. This was achieved with some difficulty. The postop. course was uneventful with complete resolution of the proptosis and cranial nerve palsy.
Intravenous Thrombolysis for Acute Cerebral Ischemia Following Endovascular Treatment of Intracranial Aneurysms Using Eptifibatide

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Introduction: Platelet membrane glycoprotein IIb/IIIa (GP) inhibitors are used for the treatment of patients with acute coronary syndrome and the prevention of acute cardiac complications during percutaneous coronary interventions. GP receptors bind to fibrin, which is critical to platelet cross-linking and aggregation. Abciximab has also proved its usefulness in the treatment of acute thromboembolic complication during endovascular treatment (EVT) of intracranial aneurysms. Eptifibatide is a new GP antagonist with comparable clinical efficacy in cardiac ischemia, but its action is rapidly reversible following cessation of the infusion, which could represent a significant advantage regarding the prevention of acute cardiac complications during percutaneous coronary angioplasty and stent placement.

Purpose: To report 2 cases of thromboembolic ischemia following EVT of intracranial aneurysms successfully treated by intravenous thrombolysis (IV-T) using eptifibatide.

First Case: A 25 year-old man presented acute subarachnoid hemorrhage (WFNS I, Fisher 2) due to rupture of a left carotid bifurcation saccular aneurysm. EVT was performed under general anesthesia, without heparin, and saccular exclusion was obtained after 45 minutes. During final angiographic control, distal occlusion of the pre-central branch, with minimal collateral reperfusion through distal branches of the homolateral anterior cerebral artery. No haemorrhagic complication was observed. Cerebral CT scan at 24h showed no ischemic complication. Patient was dismissed 1 week after treatment without neurological deficit.

Conclusion: IV-T with eptifibatide seems to be effective for the treatment of acute cerebral ischemia due to proximal or distal arterial thromboembolism following interventional neuroradiological procedures. However, more experience is required in order to determine indication, risks and benefits of such a therapy.

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Purpose: Aneurysmal coil embolization requires follow up imaging study for its unsteadiness compared to direct surgery. Angiography is rather invasive modality than other modalities as MRA or plane X-ray. However, angiography is still superior to other modalities to evaluate detailed image of embolized aneurysms. For this reason, follow up angiography should be performed with acceptable low complication rate. We evaluated our follow up angiography series retrospectively.

Material & Method: From April 2008 to March 2010, consecutive 128 cases of follow up angiography after aneurysmal coil embolization were performed. Angiography was performed under local anesthesia and trans femoral, trans radial, trans brachial approach. To make ischemic complication minimally, we introduced systemic heparinization and dimer type ionic contrast media in principle. Complications of the series were evaluated prospectively.

Result: Total of 128 studies were performed during the period. Male were 42, Female 86 female. Patients age were from 36 to 80 ys (average age were from 36 to 80 ys)
Intravenous injection of heparin was 2.9ml in average, and aprotonine sul-
fate, to neutralize heparin, was 1.3ml in average. Dose of contrast medium was 22-165ml (average 53.9ml). Ioxaglic acid, dimere type ionic con-
trast media, was used in 115 cases (88.5%). Ioxilan and iohexol, non ionic contrast medium, were used in 13 cases (11.5%). There was no ischemic and hemorrhagic complication. Mi-
nor skin eruption was observed in 6 cases (4.6%), nausea in 2 cases (1.5%), which were all resolved quickly.

Discussion: At the time of follow up angiography, information of access route and allergic reaction to con-
trast medium and others are already known, so previous endovascular sur-
gery. This information might be use-
ful to reduce complications. To reduce ischemic complication, introduction of systemic heparinization and dimere type contrast media might be useful for its anticoagulation effect...

Conclusion: No major complication was observed in our series. Consid-
ing importance of follow up imaging after aneurysmal embolization, follow up angiography for coil embolization seems to be acceptable with low com-
pliation rate.

Very Long Term MRA Follow-Up of Intracranial Aneurysms
Adequately Occluded at 6 Months after Coiling: Lotus Study Results

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Introduction: Intracranial aneu-
rysms are preferably treated by en-
dovascular occlusion with coils, ex-
cluding the aneurysm from the circu-
lation and preventing it from causing a subarachnoid haemorrhage (SAH). Coiling has low morbidity and mor-
tality, but approximately one fifth of coiled aneurysms recur over time and 10% needs retreatment. Various risk factors for aneurysm recurrence have been proposed, such as large aneu-
rysms size and possibly rupture status. Most aneurysm recurrences occur in the first few months, and are diag-
nosed on first angiographic follow-up. Previous studies mostly lack fixed follow-up intervals, making it difficult to assess late aneurysm recurrence rate (> 6 months after coiling). With our study, we aimed to determine an-
eurysm recurrence rate after 4.5-12 years follow-up of adequately occluded (complete or near-complete with a re-
maining small neck remnant) coiled intracranial aneurysms 6 months af-
ter coiling. In addition, we assessed large aneurysm size and rupture sta-
tus as risk factors for late aneurysm recurrence and late retreatment. We aimed to include 400 patients.

Methods: From January 1995-
June 2005, 1808 intracranial aneu-
rysms were treated in 1675 patients by endovascular coiling in 7 medical centres in the Netherlands. Medical ethics committees of all participating centres approved the study protocol. 973 patients were not invited because they had died, had no angiographic follow-up with adequate aneurysm oc-
cclusion, were > 70 years of age or had contra-indications for MRI. All other 702 patients with adequate aneu-
rysm occlusion at 6 month follow-up angiography were invited to undergo long-term follow-up Magnetic Reso-
nance Angiography (MRA) at 3Tesla after > 4.5 years. 128 patients gave no informed consent, 174 patients could not be traced and 400 patients with 436 coiled aneurysms were included in the study. Aneurysm occlusion on MRA was scored by two experienced neuoradiologists in consensus. If aneurysm recurrence was suspected by one of the observers, MRI images were compared to initial and 6 month follow-up imaging and scored as sta-
ble near-complete occlusion, minor re-
currence but still adequate occlusion or major recurrence with incomplete occlusion. Relative risks for late aneu-
rysms recurrence and late retreatment was assessed for large aneurysms (> 10 mm) compared to small aneu-
rysms and ruptured aneurysms com-
pared to unruptured aneurysms.

Results: Up to date, 334 patients with 363 aneurysms have been in-
cluded in the study and 66 more patients are planned. Of the 334 in-
cluded patients, 105 were men (31%). Mean patient age was 54 years (me-
dian 55, range 23-70). Aneurysm size was mean 6.4 mm (median 6.0, range 2.0-20 mm), 286 (79%) coiled an-
ueyrysms were ruptured and 31 aneu-
rysms were large (8.5%). Mean follow-
up duration was 5.7 years (mean 4.9, range 4.5-12.5). 342 of 363 aneurysms (94.2%) remained adequately occluded at very long-term follow-up and 21 (5.8%) showed aneurysm recurrence.

Major recurrence was seen in 12 an-
ueyrysms and minor recurrence in 9 aneurysms. 4 aneurysms with major recurrence were retreated and 4 more are planned to be retreated (2.2%, 95%CI 0.7-3.7%), in 4 retreatment was not possible because of unfavour-
able morphology. Aneurysm rupture was no risk factor for late aneurysm recur-
rence; 17 of 286 ruptured aneurysms and 2 of 77 unruptured aneurysms were retreated or are planned to be retreated, a RR of 0.8 (95%CI 0.2-3.9). Aneurysm size > 10 mm was a risk factor for late aneurysm recurrence; 4 of 31 (12.9%) large aneurysms and 17 of 332 small aneurysms (5.1%) showed recurrence, a RR of 2.5 (95%CI 0.9-7.0), and for late aneurysm retreatment: 2 of 31 (6.5%) large aneurysms and 6 of 355 (1.7%) small aneurysms were re-
treated or are planned to be retreated, a RR of 3.6 (95%CI 0.8-16.9).

Conclusion: Awaiting final results of 400 patients, the first 334 included patients with 363 aneurysms show that the yield of clinically relevant findings of long-term MRA follow-up is low. Large aneurysms are at higher risk for late aneurysm recur-
rence and retreatment. Imaging fol-
low-up of adequately occluded coiled intracranial aneurysms longer than 6 months may not be necessary for most patients. Cost-effectiveness of long-
term screening is yet to be assessed.

Follow-Up of Brain Aneurysms Treated with Bare GDC Coils after 6 Years
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Purpose: To study the clinical and angiographic results beyond 6 years, of the embolization of brain aneu-
rysms.

Material and Methods: The Neu-
rorienterventional Department in Nancy, France has been treating brain aneurysms with detachable GDC coils since 1992. Until the end of 1998, 505 patients were treated. Of those, only 89 had a follow-up longer than 6 years. This patient population had a mean follow-up time of 10.2 years and had a total of 106 brain aneu-
rysms treated with bare GDC with-
out the use of remodelling or stents.
The mean age at the time of treatment was 44.7 years (19 to 74 years), 67.4% were females and 30% had multiple brain aneurysms. Twelve percent of aneurysms were localized in the anterior circulation, 68% presented with subarachnoid hemorrhage, 27.4% were fortuitously discovered and 4.7% were discovered because of neurological symptoms. The anatomical obliteration achieved at the initial treatment was: 43.4% complete obliteration, 49.1% neck remnant and 7.5% partial aneurysm filling.

**Results:** During the initial 5 years of follow-up, 16 patients had a 2nd treatment, 3 patients had a 3rd treatment and 1 patient was operated. After 5 years, with a mean follow-up of 10.2 years 8 (7.5%) major recurrences were recorded. The location of the recurrent aneurysms was: 3 Acom, 2 MCA, 1 Basilar tip, 2 Vertebroartery. The recurrences were managed by further embolization in 6 patients, operation in 1 patient, while 1 patient was follow-up-only. Recurrence beyond the initial 5 years of follow-up was correlated with partial obliteration at 5 years (p<0.001), 2 or more retreatment sessions during the initial 5 years (p<0.001) and a vertebral artery location (p=0.015). No recurrence was worsened when the obliteration was complete at 5 year follow-up.

**Conclusion:** Recurrence beyond the initial 5 years of follow-up was correlated with partial obliteration at 5 years (p<0.001). No recurrence occurred when the obliteration was complete at 5 year follow-up.
Asymmetric Manifestations of Definite Moyamoya Disease: Angiographic Pattern Analysis with Its Pathognomonic Findings

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Purpose: Mmoyamoya disease (MMD) shows the typical angiographic findings of symmetric steno-occlusive changes of both carotid fork regions, however unilateral involvements (overall 20%) are relatively frequently encountered. The exact etiology is not well described in medical literatures, however congenital aspects could be more well accepted considering its typical visualization of embryonic remnant vascular structures and therefore those morphologies also could provide more well depicted anatomic explanations. The target arterial segment of antenatal genetic defects of this disease can be located in proximal middle cerebral artery (MCA) just distal to AChA (anterior choroidal artery) bifurcations during 14-20 mm embryo stage (Stage IV & V by Padget DH). The antenatal occlusive events occurs in early embryonic period, then consequently recruited embryonic anastomosis and annexations develop. As a result, prominent collaterals can be depicted in any periods of symptomatic episodes in MMD patients and the collaterals are adjusted hemodynamic balances of this arterial wall defects of MMD. Therefore, we evaluated the angiographic findings of unilateral MMD considering contralateral side abnormalities of carotid fork changes and also to verify the typical angiographic patterns of remnant embryonic collateral vessels.

Materials and Methods: Among 102 MMD patients, 20 patients (19.6%) of unilateral MMD were angiographically identified. Angiographic findings was evaluated focusing on the identification of contralateral carotid fork abnormalities and embryonic remnant anastomosis patterns. Associated angiographic findings were also evaluated according to embryonic development of cranial arteries in unilateral MMD patients.

Results: Of 102 patients, 20 patients (19.6%) of unilateral MMD were angiographically identified and all of them demonstrated asymmetric carotid fork abnormalities including disproportional vessel caliber changes (2/20, 10%), luminal irregularities with variable degree of stenosis (18/20, 90%). Remnant embryonic vascular changes secondary to prenatal occlusive changes representing as MMD collaterals was visible and classified into (1) primitive olfactory artery with or without ophthalmic rete mirabile (8/19; 42.1%), (2) ophthalmic ethmoidal collaterals (2/19, 10.5%), and (3) callosal artery collaterals (3/19, 15.8%).

Conclusion: The definition of unilateral MMD as previously recognized is inaccurate and asymmetric MMD is more accurate description upon the decision of anatomic configurations. Asymmetric MMD is relatively frequently encountered and associated angiographic findings of typical MMD collaterals representing remnant embryonic anastomosis and annexations, which seem to pathognomonic to understand this disease.
son of derived ratio-percent methods was performed by using Bland-Altman plots and ROC curves were calculated. Correlation coefficients were also calculated by using nonparametric Spearman correlation. A p value < 0.05 was considered to mean statistical significance.

Results: 416 carotid were excluded and in the remaining 1168 ones, a strengthening correlation according to quadratic regression between NASCET and ECST methods was observed (Spearman' rho coefficient = 0.948; p < 0.0001). An inverse correlation according to linear regression was observed between NASCET and direct-mm measurement (Spearman' rho coefficient = -0.972; p < 0.0001); CSI index shows a linear regression with NASCET, a linear regression with ECST and an inverse linear regression with direct mm-measurement (Spearman' rho coefficient = 0.946, 0.932 and -0.9, respectively). Cut-off values for 50% and 70% NASCET stenosis were 2.36 and 1.51, respectively.

Conclusions: Our study results indicate that the direct mm measurement of stenosis, by using appropriate equations, can reliably predict NASCET-type, ECST-type and CSI-type percent stenosis. The use of direct mm measurement may remove the pitfalls and discrepancies deriving from the use of different ratio-percent methods.

Hemodynamics at the Carotid Termi

Calculated by lack of sufficient resolution to visualize the boundary zone, velocity aliasing, especially in areas with stenoses, and difficulty in boundary zone localization. The development of 3-point velocity encoding has made velocity measurements using PC-VIPR possible in patients with stenoses. Also, we have collaborated with researchers at the University of Freiburg in developing a spline interpolation tool that can localize the boundary zone and accurately estimate WSS from cutplanes axial to vessels of interest. Combining these techniques, we can calculate velocity, volume flow rate, and WSS in medium and large-sized arteries with scan times of ~5 minutes.

Conclusion: This study demonstrates that WSS can be calculated quickly and non-invasively with velocity data from MRA and the resulting WSS values are consistent with those found by prior investigators. We are currently performing scans on patients with atherosclerotic stenoses and using derived ratio-percent methods as a baseline for comparison. We anticipate that by combining WSS and velocity measurements with morphologic angiograms acquired using PC-VIPR, patients at risk of atherosclerotic progression, transient ischemic attacks, and ischemic strokes can be identified quickly and non-invasively, a powerful new tool for diagnosing of neurovascular disease.

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Figure 1A Velocity vector map artery as it approaches the carotid terminus.
Evaluation of Balloon Occlusion Test for Giant Brain Aneurysms under Local Anesthesia

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Key words: Giant intracranial aneurysms, parent artery occlusion, BTO, hypotensive challenge.

Objective: To present our experience with balloon test occlusion of the internal carotid or vertebral arteries while dealing with giant intracranial aneurysms.

Study Design: Retrospective study of balloon test occlusion under hypotensive challenge.

Setting: Intravascular Unit of Neurosurgery department, Faculty of Medicine, Alexandria University.

Patients: Twenty patients who underwent balloon test occlusion (BTO) during the year 2008 and 2009.

Interventions: Each patient was subjected to four-vessel angiography along with balloon test occlusion at normotension then at hypotension to assess the efficacy of the collateral circulation.

Results: Only those patients showing evidence of adequate collateral cerebral circulation and absence of any neurological deficits after 20 minutes under normotension then under hypotensive challenge were considered fit i.e. clinically tolerable for operative occlusion of the parent artery. Long-term follow-up after surgery was also based on the development of symptoms and signs of neurovascular compromise. Of 20 Patients, 4 (20%) had deficits at normotension, 2 (10%) had deficits at hypotension and 1 patient with clinical intolerability with hypotensive test occlusion underwent carotid artery sacrifice after STA-MCA bypass without sequelae. None of the 14 (70%) patients who clinically tolerated test occlusion with hypotension and had parent artery sacrifice show any complication. Symptomatic periprocedural complications of the BTO were noted in 2 (10%) patients, which resolved later on. None of our patients showed immediate clinical intolerability during BTO.

Conclusion: There was no mortality in our series related to balloon test occlusion of the internal carotid artery.

Developmental Venous Anomaly (DVA): What Are They Really?

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Introduction/Aim: DVA are thought to be congenital lesions with mature venous walls. They are medullary veins, which converge in a radial fashion to form enlarged transcortical or subependymal collector veins with characteristic Magnetic Resonance Imaging (MRI) and Angiographic sign - Caput Medusae. Most intracerebral hemorrhage associated with DVAs is currently attributed to coexistent, angiographically occult cavernoma. The classical deep and superficial DVAs as described by Lasjaunias and Valavanis are considered to be extreme variation of the transcerebral venous drainage and therefore not pathological and should not be treated. However, cases have now been reported where the symptomaticity have been attributed to changes caused entirely by the DVAs themselves. The aim of this paper is to report on a symptomatic case, review other symptomatic cases in the literature and suggest possible pathophysiological mechanisms for symptomatic DVAs.

Material and Methods and Results: 15 cases of DVA with symptomatic presentation have been described in the literature and should not be treated. However, cases have now been reported where the symptomaticity have been attributed to changes caused entirely by the DVAs themselves. The aim of this paper is to report on a symptomatic case, review other symptomatic cases in the literature and suggest possible pathophysiological mechanisms for symptomatic DVAs.

Discussion: 15 cases of DVA with arterial-venous (AV) shunting have been described and the authors considered these to be true Arteriovenous Malformations (AVM) and that Gamma knife may have a role. Several cases of DVAs associated with thrombosis of the draining veins resulting in ischaemia with and without haemorrhagic conversion have been reported. A case report of a 15 year...
old girl with vertigo and ataxia had signal changes surrounding the cerebellar hemisphere DVA. This was attributed to venous congestion. Rodesch presented 5 cases of symptomatic DVA with capillary staining resulting from sprouting or non-sprouting capillaryogenesis and weak venous disposition leading to venous ischaemia and haemorrhage. He classified DVAs into: Asymptomatic (superficial and deep)-DVAs seen in the majority of cases. Asymptomatic DVAs with capillary stain. Symptomatic DVAs with capillary stain (acute or progressive symptoms). DVAs draining a true AV Shunt. Our patient demonstrated AV shunting. The MRI has no oedema which suggests that there is no significant venous congestion. There was no haemorrhage or infarction. The CT perfusion indicated increased Cerebral Blood Flow (CBF) and Cerebral Blood Volume (CBV) and decreased Mean Transit Time (MTT) which suggested increased cerebral blood flow rather than decreased flow which would have been expected in venous congestion. Thus the mechanism suggested for this case is an arterial steal type phenomenon.

**Conclusion:** DVA can be further classified into: Asymptomatic (superficial and deep)-DVAs seen in the majority of cases. Symptomatic DVAs with capillary stain. Symptomatic DVAs with capillary stain (acute or progressive symptoms). DVAs draining a true AV Shunt. With venous thrombosis / venous congestion. With arterial steal

**References**

**How I Do It Session**

N. Bryan, M. Bilelo

**Small Vessel Ischemic Disease: Pathophysiology, Diagnosis, and Clinical Impact**
Carotids I

**Chairs:** A. Karapurkar, D. Polz

09.15-09.30

Utilization of 3D-RA Cone Beam CTA for CAS Procedure

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**Purpose:** Neuroendovascular therapy requires precise information of the lesion with DSA. Three Dimensional Rotation Angiography (3D-RA) is now essential for neuroendovascular procedure. Development of flat panel technology also enables us to get intraoperative cone beam CT with 3D-RA. Use of contrast medium enables to perform cone beam CT angiography (CTA). We evaluated usefulness of 3D-RA cone beam CTA for carotid artery stenting (CAS) procedure.

**Material and Method:** From December 2007 to September 2009, 3D-RA cone beam CTA (DynaCTA) was performed at various situation of 39 CAS procedures with Axiom artis dBA (Siemens) from December 2007 in our institution. CAS procedure was performed under distal protection with AngioGuard XP (Johnson & Johnson). Image quality of Dyna CTA became better as longer scan time. Scan time for DynaCTA in this study was set to 8 seconds to reduce image processing time. 20% diluted contrast medium was used for DynaCTA study to make accurate contrast resolution of the lesion. DynaCTA was performed at the beginning of the procedure, AngioGuard XP opening and the end of the procedure. Intra vascular ultrasound (IVUS) was also performed at AngioGuard XP opening and the end of the session. Image of DynaCTA, DSA, 3D-CTA and IVUS was evaluated.

**Result:** a) Beginning of procedure: Using DynaCTA, more precise anatomy was visualized and measurement of the vessel was achieved more accurately compared to conventional DSA or 3D-RA. b) AngioGuard XP opening: DynaCTA showed better anatomy of AngioGuard XP and parent vessel compared to DSA. Measurement of lesion was more accurate with DynaCTA than with IVUS. Character of plaque was not visualized with DynaCTA because of its contrast resolution. c) End of procedure: DynaCTA showed more precise relation of parent vessel wall and stent compared to DSA, 3D-RA and IVUS.

**Conclusion:** 3D-RA cone beam CTA showed useful information during CAS procedure, which could not be seen by DSA, 3D-RA and IVUS. 3D-RA cone beam CTA could be essential modality to achieve more accurate and safe CAS procedure. It is also important to avoid unnecessary scan to reduce radiation dose.

09.30-09.45 10’

Evaluation of Soft Plaques by Magnetic Resonance Imaging Can Improve the Outcomes of Carotid Artery Stenting and Carotid Endarterectomy

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**Background:** Carotid artery stenting (CAS) has recently emerged as a potential alternative to carotid endarterectomy (CEA) because of its less invasive procedure. Objective and results in a shorter duration of hospitalization. Soft plaques evaluated by echolucency, that consists lipid pool and intra-plaque hemorrhage is associated with an increased number of emboli after CAS. However, there was no prospective study to predict embolic complications using quantitative cut-offs. A major concern with CAS and CEA is the potential for cerebral embolism particularly in the patients with soft plaques.

**Objectives:** Diffusion-weighted imaging (DWI) is increasingly being used to compare the incidence of new ischemic lesions after both procedures. We analyzed the occurrence of new DWI lesions after CAS or CEA in the patients with soft plaques. Methods: Between June 2007 and September 2008, we performed CAS in 56 patients and CEA in 17 patients with the following carotid stenosis. We performed CEA to the patients with a symptomatic carotid stenosis of > 70% and asymptomatic carotid stenosis of > 60% assessed with angiography, as recommended by the North American Symptomatic Carotid Endarterectomy Trial collaborators. We also performed CAS to the patients with a symptomatic carotid stenosis of > 50% and asymptomatic carotid stenosis of > 80% assessed with angiography, as recommended by the Stenting and Angioplasty with Protection in Patients at High Risk for Endarterectomy Investigators. We also performed quantitative analysis of DWI-MRI to predict cerebral embolic complications using SIR. Soft plaques were defined as the signal intensity ratio (SIR). Soft plaques were defined when the SIR was more than 1.25 with T1 weighted images of BB-MRI according to the criteria and other investigators previously reported. We also performed DWI-MRI of the brain before and after CAS and CEA.

**Results:** The interobserver variability of SIR was 1.2 ± 0.9. The intraobserver variability of SIR was 0.1 ± 0.2. Forty patients were defined as the soft plaque (28 patients before CAS (50%) and 12 patients before CEA (71%)). There were two minor strokes (2.7%) in the patients with soft plaques treated with CAS, whereas there was no minor stroke in the patients with soft plaques treated with CEA. The incidence of new DWI lesions was tend to higher after CAS.
the vessel part subject to investigation proximal side and the distal side of algorithms. We indicated a point at the projections based on proved CAAS algorithms. We performed a semi-automatic diameter (RefD) for lesion definition. Parameters are the minimum luminal diameter and % stenosis before stenting which requires strict luminal recanalization like angioplasty and/or stenting due to anatomic direction.

Results: There were good agreement in intra-observer analysis (k = 0.789). Our data revealed that measurement based on different imaging modalities is compared with WASID criteria. CAAS QCA 3D revealed better results but could not be measured in M1 because M1 could not be measured on lateral view. A semi-automatic 2D QCA contour detection on both projections based on proved CAAS algorithms was most reliable measurement regardless of the analysis group.

Conclusion: Our data revealed that measurement by WASID criteria did not reveal reliable data and can not be used for the exact measurement for stenting procedure. Although CAAS QCA 2D and CAAS QCA 3D showed similar accuracy in intracranial vessels, CAAS QCA 3D had a limitation applying to M1 segment due to anatomical direction.

Accuracy of Preoperative Carotid Artery Stenosis Measurement - Comparison of Magnetic Resonance Angiography (MRA), Digital Subtraction Angiography (DSA) and Histological Specimens

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Purpose of Study: Extend of carotid artery stenosis is one of the most important factor in decision about the method of stenosis treatment (medical, surgical endarterectomy or intravascular carotid artery stenting). The preciseness of carotid artery stenosis measurement based on different imaging modalities is compared with histological specimens obtained by endarterectomy.

Material and Method: 103 patients with carotid artery stenosis were investigated by digital subtraction angiography (DSA) and contrast enhanced magnetic resonance angiography (MRA). Assessment of carotid artery stenosis was performed by both modalities. All patients of this group were operated. During carotid endarterectomy (CEA) the carotid plaque was removed in one piece, preserving walls of the plaque. Specimens were fixed with formaldehyde, transversally and processed by routine paraffin technique. The minimal diameter and the whole plaque diameter were measured. In all 103 cases the above mentioned measurements were obtained. Comparison of preoperative measurements and histological findings was performed.

Results: There are significant differences between preoperative measurements by DSA and MRA and histological measurement: DSA underestimates histological measurement by 14.4 % and MRA by 0.7 %. The results in mild stenoses 30 - 49 % are as follows: DSA measurement underestimates histological measurement by 24.7 % and MRA by 7.6 %. The results in moderate stenoses 50 - 69 % are as follows: DSA measurement underestimates histological measurement by 12.3 % and MRA overestimates by 0.2 %. The results in high grade stenoses 70 % or more, are as follows: DSA measurement underestimates histological measurement by 2.3 % and MRA overestimates by 12.2 %.

Conclusion: Our study confirms that: DSA is most accurate in high grade stenoses (underestimates moderate and mild carotid artery stenosis). MRA is most precise in moderate stenose (slightly underestimates mild and overestimates high grade stenosis). These discrepancies should be aware in decision between medical and surgical/intravascular treatment of carotid artery stenoses.
ditional morphological information beyond that of intravascular ultrasound (IVUS) images. OCT has been shown to detect atheromatous plaques in the human arteries such as coronary artery, but has not yet been applied to the human carotid artery. Here we report of a first series of clinical application of OCT in the carotid artery.

Patients and methods: A total of 14 patients having severe carotid artery stenosis were scheduled for carotid artery stenting (CAS). They were 46 to 83 (ave 70.1) years, and including 2 females. A total of 15 carotid arteries were investigated using OCT (Image Wire, Light-lab Imaging, Goodman, Co, Ltd, Nagoya) and VH-intravascular ultrasound (VH-IVUS) (Eagle-EyeTM, Volcano Therapeutics, Inc., Rancho Cordova, CA, USA) just before vascularization. For OCT examination, occlusion of both the common carotid artery (CCA) and external carotid artery (ECA) and saline infusion were necessary to avoid interference by blood flow. So, a 9-Fr guiding catheter with an occlusion balloon was navigated to the CCA and a guidewire with an occlusion balloon (Guardwire, Medtronic Japan Co., Ltd., Tokyo) was set into the ECA. Then the stenotic site was imaged with OCT using an automatic pull-back device at 1 mm/s under occlusion of both CCA and ECA and saline infusion at a rate of 3ml/sec. Then, CAS was performed under the proximal protection method using the same occlusion system. OCT is now approved only for coronary artery use in Japan, and its use for human carotid artery was approved by our institutional review board (No. 21-108), and the clinical protocol was registered and opened on internet (University hospital medical information network: UMIN 000002808).

Results: OCT examination and CAS were successfully and uneventfully performed in all the procedures in this series. No adverse event was observed relating to OCT imaging. In 6 symptomatic lesions, intraluminal thrombus was demonstrated in 2 (33%) before CAS. Then, in a patient who had large intraluminal thrombus (Fig. 1 A, B), CAS was cancelled and endarterectomy was performed. The specimen obtained during endarterectomy showed soft plaque and intraluminal thrombus, coincided with OCT findings (Fig. 1 C, D). On the other hand, in 10 asymptomatic lesions, no intraluminal thrombus was observed preoperatively by OCT, but postoperative plaque protrusion was detected in 2 of 10 (20%). These findings were well demonstrated by angiography or IVUS.

Discussion: OCT imaging was performed without any adverse effect. Current limitations of OCT are degree of tissue penetration and interference by blood flow. The proximal protection method is required for the application of OCT to the cervical carotid artery. Also, the scan length of OCT is from 3.25 to 3.4 mm, which is smaller than the maximum diameter of normal carotid artery. Therefore, the combined use of OCT and VH-IVUS is a good approach for evaluating total plaque morphology in case of carotid artery.

Carotids 2

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Background and Purpose : Carotid artery stenting (CAS) is considered an effective alternative to carotid endarterectomy in patients with high surgical risk. Because distal embolization is still a major concern with CAS, devices to protect against emboli are usually used during the procedure. We performed carotid black-blood (BB)-MR imaging to diagnose plaque components and assess plaque hardness based on MR signals. We chose from among the following three protective devices, based on our findings : Angioguard XP (filter device), Percusurge Guardwire distal protection, and Parodi method (flow reversal). Method: Three BB-MR images per plaque were obtained from 51 consecutive patients who underwent CAS to generate T1- and T2-weighted images. Regions of interest (ROIs) were placed on the narrowest stenotic image. The ratio of carotid artery stenosis (ROI counts)/sternocleidomastoideus (ROI counts) was calculated as the BB ratio, and a lesion with a BB ratio of 1.5 or more was diagnosed as soft plaque.

Results: Soft plaque (BB ratio of 1.5 or more) was found in 18 patients. Eleven of these patients underwent proximal protection (flow reversal), including the seat-belt and air bag method, and the other 7 patients were treated with the Percusurge Guardwire. Patients with a BB ratio of 1.5 or less underwent distal protection using Angioguard XP. Postoperative diffusion-weighted MRI images in 18 patients with soft plaque showed no evidence of multiple cerebral infarction or procedure-related deficits.

Conclusion: BB-MR imaging can detect plaque components and predict plaque hardness. This procedure provides useful information for the choice of the protective devices to be used for patients undergoing CAS.

Comparison of the Balloon Versus Filter Protection in Carotid Artery Stenting

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Carotid artery stenting (CAS) has emerged as an alternative to carotid endarterectomy (CEA) for patients with high surgical risk. A distal embolic protection device (EPD) is regarded as an essential tool to avoid embolic complications during CAS. Protected CAS using PercuSurge GuardWire, a balloon-type EPD, has been introduced into our hospital since 2002, and AngioGuard XP (filter EPD, has been approved in Japan since 2008. The purpose of this study is to compare clinical results of protected CAS with the use of AngioGuard XP and that with GuardWire. Two hundred and nine patients treated by CAS under distal protection from 2002 to present were included. One hundred and ten patients were treated with GuardWire (the GW group). AngioGuard XP was used in 99 patients (the AG group) from 2007. A self-expandable open-cell-type stent, SMARTeR or PRECISE stent was successfully deployed in all patients. In the GW group, one patient died of intracerebral hemorrhage that developed five days after CAS, and one patient had persistent hemiparesis due to intracerebral hemorrhage that occurred one week after CAS. Another patient died of multiple organ failure after intraoperative abdominal wall hemorrhage. No patients had perioperative ischemic stroke in the GW group. In
the AG group, 2 patients suffered from thromboembolic minor strokes. One patient developed a fatal hematoma in the basal ganglia one hour after the procedure. In conclusion, hemorrhagic complications were causes of disability in our series in the era of GuardWire. Thromboembolic events were more frequently encountered in patients undergoing CAS with the use of Angioguard XP. Appropriate selection of patients and devices may be necessary to achieve more sufficient results.

10'10
Safety & Effectiveness of Carotid Artery Stenting with Protection
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Object: The carotid stenting procedure (CAS) has been proposed as an alternative to carotid endarterectomy (CEA) for carotid artery stenosis. However, data from recent studies & registries favor CEA for its better clinical outcome. Here we are reporting our single-center experience from 2003 to re-evaluate CAS in the treatment of carotid stenosis.

Objects & Materials: From 2003 to 2010/4 total 254 cases of symptomatic or asymptomatic carotid stenosis had been treated with CAS. Protection system has been used in all cases such as distal balloon protection before 2007/12 (116 cases), distal filter or balloon mixed with proximal protection after 2008 (118 cases). Selected cases were evaluated for their plaque property and peri-procedural CBF. Stent was successfully deployed in all cases. Patients improved their narrowed segment less than 20% stenosis. As its complication 10 cases of transient & mild ischemia were experienced. Three cases had post-procedural hemorrhage. Myocardial ischemia was experienced in 2 cases. One patient developed convulsion.

Conclusion: CAS with protection proved to be safe & effective procedure, but there could be several unwanted complications during or after the procedures. These complications can be avoided with proper peri-procedural study & management. Details will be discussed.

10
Prospective Analysis of Carotid Stenting in High Risk Patients in a Larger Referal Single Korean Center Study
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Background and Purpose: Natural history of symptomatic severe carotid stenosis associated with high risk factors has not been known in detail because such high risk patients have been excluded in many randomized controlled studies. Outcome of carotid stenting may depend on definition of patient eligibility especially regarding high risk factors such as operator eligibility. We performed prospective study in a large referral center in Seoul and present to determine factors having an effect on outcome from atherosclerotic risk factors, procedural and clinical features.

Methods: Prospective recanalization study on carotid stenting protocol obtained approval of IRB. Among 342 patients who underwent recanalization from 2007 to 2009, 143 patients with high risk factors were enrolled by intention-to-treat base. Procedures included 135 carotid stenting, 3 angioplasty, 1 thrombectomy and 4 abortions. Based on criteria for high risk factors defined as previously described, we evaluated event rate related to atherosclerotic cardio vascular risk factors, carotid plaques type (apical versus body), procedural factors, residual stenosis, and restenosis rate prospectively analyzed in 111 stable patients by comparing univariate and multivariable logistic regression analysis,

Results: Ipsilateral one month event rate was 3.8% (3 minor & 1 major strokes). There was no mortality. Six month event rate was 4.5% (1 additional minor stroke). Outcome related to atherosclerotic cardiovascular risk factors, carotid plaques type (apical versus body), procedural factors, residual stenosis, and restenosis rate prospectively analyzed in 111 stable patients by comparing univariate and multivariable logistic regression analysis will be presented and discussed. Restenosis rate (1/79, mean 12 month follow-up) was relatively low compared to the reported rate.

Conclusions: Carotid stenting in high risk patients can be performed with relatively low event and restenosis rate. Further outcome analysis will be provided and discussed.

10
Endovascular Revascularization of Complete or Near Occlusion of the Carotid Artery
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Purpose: Complete or near occlusion of the carotid artery is different from carotid artery stenosis. There are some difficulties in revascularization of this disease. Experience with endovascular treatment is presented and discussed.

Materials and Methods: Nine patients with complete occlusion and nineteen with near occlusion were treated with endovascular procedures. External and common carotid arteries were occluded with balloons. Passing through the lesion, distal balloon protection was added. After sequential angioplasty carotid stent or coronary stent was deployed.

Results: Technical success was obtained in 20 of 29 cases with near occlusion and in 13 of 16 cases with complete occlusion. Complication occurred in 2 with near occlusion and in 1 with complete occlusion. No cerebral stroke after treatment was observed in 6-36 months follow-up.

Conclusion: Endovascular treatment is promising for complete or near occlusion of the carotid arteries. Short-term results of this small series are satisfactory. Accumulation of cases and long-term follow-up are necessary to validate this treatment.

10
Primary Carotid Stenting for Severe, Symptomatic Stenosis: A Less-Invasive Approach
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Carotid angioplasty and stenting (CAS) has been a popular alternative to carotid endarterectomy (CEA) for the treatment of carotid atherosclerosis for over 20 years. Many studies have shown it to be a safe, effective treatment for carotid atherosclerosis. Indications for CAS include medical contraindications to surgery, post-radiation stenosis and post-endarterectomy re-stenosis. As large clinical volumes have accumulated, CAS has become more widespread and technologically sophisticated. The indications have broadened and often include asymptomatic patients and symptomatic patients with less than
the 70% stenosis shown by NASCET to benefit the most from intervention. New stents, balloons and protection devices (EPDs) have evolved. Although evidence for the efficacy and safety of expensive devices may be questionable, they are incorporated into standard protocols, increasing the technical complexity, cost and time of the procedure. This stent alone approach is very effective and safer, less invasive and equally as effective as CEA. These impressions are based on large, often single centre series, which include heterogeneous populations of symptomatic and asymptomatic patients with a variety of underlying pathologies. As evidence from randomized controlled studies (RCTs) continues to evolve, questions are being raised as to the safety of CAS vs. CEA, with the largest RCT in North America, the Carotid Revascularization Endarterectomy vs. Stent Trial (CREST) due to announce its results in the spring of 2010. The relationship of CAS to CEA remains uncertain at the present time. In London, Ontario we have adopted a conservative approach to CAS, and we limit the procedure to patients with severe (>70%), symptomatic stenosis who are unable to undergo CEA, usually due to medical comorbidities. We offer CAS to patients with asymptomatic >50% stenosis or re-stenosis after prior CEA. There is ample evidence to suggest that the riskiest part of the CAS procedure, which is most likely to generate distal emboli, is balloon angioplasty of atherosclerotic plaque. There is also evidence that EPDs do not catch all embolic material, and may be associated with their own intrinsic complications. We have shown that a self-expanding stent alone, without the use of balloon angioplasty or EPDs, can successfully dilate atherosclerotic stenoses in approximately 90% of patients with severe, symptomatic lesions. Balloon angioplasty may be required if calcification is prominent. Our complication rates are similar to those found in the literature, although our re-stenosis rates are slightly higher. We have shown that hemodynamic instability is much less common when balloon angioplasty is avoided, and that the stent alone approach is very effective for treating post-CEA restenosis. The complexity, time and cost of CAS using this less-invasive approach are all decreased without an apparent loss of efficacy or safety. Other centres have shown similar findings. This presentation will update our series of almost 200 patients treated with this less-invasive approach over 10 years. Our results will be compared to those in which standard protocols using balloons and EPDs are employed, including CREST. Discussion of the current and future roles of CAS will hopefully ensue.

**Carotid MM-Stenosis: What Is the Threshold That Determines Cerebrovascular Symptoms?**

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**Purpose:** Carotid artery pathology represents the most important cause of cerebral stroke. With the development of CT angiography and, in particular, with the introduction of multi-detector-row CT Angiography (MDCTA), this technique has become a valid method for studying the carotid artery and its pathology. It was recently proposed that MDCTA can reliably evaluate the stenosis of carotid arteries by using millimetres scale. The purpose of this paper was to determine if it is possible to identify a reliable carotid stenosis threshold measured in millimetres, that is associated with cerebrovascular symptoms.

**Methods and Material:** This study is STARD compliant. One-hundred forty-five consecutive patients (males 98; mean age 67 years) were studied for suspected carotid arteries pathology by using a 40-detector-row CT scanner. In each patient, 80 mL of a contrast medium followed by 30 mL of saline flush were injected into a cubital vein, by using a power injector at a flow rate of 4 mL/s and an 18 gauge intravenous catheter. Bolus tracking technique was used to calculate the correct timing of the scanning. In each patient, carotid artery stenosis was quantified by using mm-method. Continuous data were described as the mean value ± Standard Deviation (SD) and they were compared with Student t test. ROC curve was calculated in order to test the hypothesis and identify specific mm-stenosis threshold. Logistic regression analysis was also performed. A p value less than 0.05 was considered to indicate statistical significance. Results: Twenty-two patients were excluded. Of the remaining, seventy-five patients suffered cerebrovascular symptoms (61%). There was a statistically significant difference between patients with symptoms (0.29 mm ± 0.59 mm SD) and without symptoms (1.67 mm ± 0.61 mm SD) in the mm-carotid stenosis (p value = 0.0023). Multiple logistic regression analysis confirmed that symptoms are more frequent in those patients with mm-stenosis (p = 0.004). Moreover, ROC curve (Az = 0.669; ± 0.051 SD; p = 0.0008) indicate that a 1.6 mm stenosis is associated with a sensitivity of 78.5%.

**Conclusions:** Results of our study suggest that mm-method can reliably represent the risk of cerebrovascular symptoms development. Carotid stenosis of 1.6 mm is associated to a sensitivity of 78.5% to have cerebrovascular symptoms.

**Endovascular Repair of In-Tandem Carotid Stenosis**

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In-tandem carotid stenoses (ITCS) is combination of extracranial and intracranial carotid stenoses. This combination may limit open repair. Endovascular treatment of ITCS could be an option. We report 3 cases of ITCS treated by endovascular repair. Each case was discussed in multidisciplinary staff combining surgeons, neuroradiologists and neuro-interventionists. Procedures were performed jointly by a surgeon and a neuro-radiologist, in an interventional room, with a mobile biplane image intensifier (Allura® Phillips), under general anesthesia. Patients received daily clopidogrel (75mg) and aspirin (160mg) 1 week before intervention. Heparin was injected intravenously (100U/kg) during the procedure. Stent remodeling was performed after 1mg atropine intravenous injection. Intracranial stenoses were predilated prior to implant a self expandable stent (Stent Protege RX®, EV3), without cerebral protection. Stent remodeling was performed after 1mg atropine intravenous injection. Intracranial stenoses were treated by primary stenting (Stent Protege RX®, EV3), without cerebral protection. Sten remodeling was performed after 1mg atropine intravenous injection. Intracranial stenoses were predilated prior to implant a self expandable stent (Winspan®, Boston Scientific). Follow-up included physical examination and duplex scan at 1, 6, 12 months, and yearly. CT scan was realized at 6 and 12 months. Patient 1 (48 year-old) presented a symptomatic extracranial carotid stenosis of 70% and a ipsilateral pre-occlusive intracranial carotid stenosis. Patient 2 (57 year-old) presented an asymptomatic extracranial carotid stenosis of 70%, an ipsilateral intracranial carotid stenosis of 70% and a symptomatic occlusion of the controlateral carotid siphon. Patient 3 (64 year-old) presented a symptomatic extracranial carotid stenosis of 70% and a ipsilateral intracranial carotid stenosis of 70%. Technical success rate was 100%.

The mean hospital length of stay was 3.6 days. No patient presented death, stroke or transient ischemic attack during the perioperative period (mean length) or during the follow-up (mean follow-up:14 months). Duplex and CT scans did not reveal additional stroke, thrombosis or in-stent restenosis. In these cases, endovascular treatment of ITCS was safe and effective. Only an larger study may confirm these results.
Timing of stenting of carotid artery after acute TIA or ischemic stroke is important. Mr S S, right hand age 65 years old male patient had sudden onset aphasia and right hemiparesis. MRI showed a fairly large fresh left parietal infarct. MRA showed total occlusion of the right cervical ICA with a very severe focal stenosis of the left ICA. He was treated with LMWH at another hospital. He recovered well but had residual dysphasia and right hemiparesis. He was discharged home. 10 days later he had a second acute attack of aphasia and right hemiplegia. He had a stuttering course over the next 2 days with intermittent improvement and deterioration.

He was referred for acute stenting of the carotid artery. It was explained to the family that we were between the devil and the deep sea. If we did not do the stenting there was high risk of stroke. If we did it there was a high risk of hæmorrhage into the ischemic- infarcted brain. 6 weeks later he had residual right hemiparesis but his speech was normal. As the hemorrhage had resolved, he underwent uneventful stenting of the left carotid artery. The symptomatic severe stenosis of the left subclavian artery was stented 3 weeks later.

**Conclusion:** It is important to do some form of imaging if the patient shows some new clinical signs.

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### Background and Purpose

**Sinus reaction** may be different according to the carotid plaque location. We evaluated incidence of sinus reaction according to the locations of carotid bulb stenosis and to determine the relationship of each location to atherosclerotic risk factors and clinical features.

**Methods:** Prospective study from 2007 to 2009 was analyzed in 97 high risk patients who underwent carotid stenting. We assessed transient (<3hr) and delayed (more than 3hr, less than 24hr) sinus reaction in each type of lesion, angiographic findings, calcification, inflated balloon pressure and size which can also affect carotid body baroreceptor, residual stenosis, and restenosis rate by comparing uni- and multivariable logistic regression analysis.

**Results:** Univariate analysis revealed that apical lesions (n = 56, 58%) (P= 0.011) and longer maximum stenosis from the ICA ostium (P = 0.005) were associated with less transient SR (P < 0.011), whereas body lesions (n = 41, 42%) and shorter maximum stenosis from the ICA ostium were associated with more transient SR, regardless of balloon size, stent length and pressure. Residual stenosis and restenosis rate was not significantly different in two lesion locations. There were no significant differences with stenosis degree (P = 0.051) and calcification (P = 0.069). One month event tended to be more common in apical lesion (4/56) than body lesion (0/41).

**Conclusions:** Sinus reaction in carotid stenting mostly depends on the length of maximum stenosis from the ICA ostium and also on two distinct locations, body and apical. Therefore, differentiation of carotid bulb lesion by location before stenting may be beneficial in controlling the cardiovascular disturbances during procedure, thus leading to more favorable immediate outcomes.

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### Dissections 1

**Chairs:** S. Nemoto, B. Wasserman

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### Introductory Lecture

**Cervical-Cerebral Arterial Dissection; The Disease of Confusing Profile**

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The increasing safety and use of noninvasive imaging in recent years has revealed the surprising frequency of dissection of the carotid and vertebral arteries (either cervical arterial dissection [CAD] or Intracranial arterial dissection [ICAD]) as a cause of ischemic and hemorrhagic stroke. Within the limitations of a nonrandomized study, for determining the proper management strategy for such disease, it will remain a disease of continuing evaluation. An overview of current neuroimaging concepts, available therapeutic and clinical diagnostic pearls of CAD or ICAD will be discussed briefly. Additionally management guidelines which are constantly evolving with new discoveries from neurovascular imaging and medical and surgical management in this area will be disputed.

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### Intracranial Dissections and Dissecting Aneurysms

**A. Bondi**

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Intracranial Dissections and Dissecting Aneurysms are relatively uncommon lesions still difficult to treat. Careful understanding of the underlying pathological mechanisms of dissecting phenomena is mandatory in order to plan the appropriate endovascular treatment. The objectives that we are trying to achieve are the following: 1. To learn the pathological aspects and angiographic features of these lesions especially regarding their clinical presentation and prognosis. 2. To comprehend the management of patients with intracranial dissection and/or dissecting aneurysms and the indications for the endovascular treatment. 3. To know and evaluate the endovascular techniques used in the treatment of these lesions.

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### Advances in Diagnosis and Endovascular Management of Cerebrovascular Dissections

**A. Qureshi**

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**Target Audience:** 1. Neuroradiologists, neurologists, and neurosurgeons and other practitioners involved in the imaging and care of patients with cerebrovascular diseases; 2. Researchers involved in basic or clinical aspects of cerebrovascular diseases; and 3. Trainees with interest in pursuing
a career in cerebrovascular diseases or interventional neuroradiology.

Objectives: 1. Describe natural history and management strategies for acute cerebrovascular dissections and their effectiveness. 2. Review recent developments in diagnostic and interventional modalities for acute and chronic arterial dissections based on etiology including traumatic, iatrogenic. 3. Review recent developments in endovascular treatments of acute and chronic arterial dissections and results of clinical studies.

Abstract of Proposal: Arterial dissection occurs when a tear in the intima allows blood entry within the layers of the vessel wall. Intima exposure and intimal flap lead to thrombogenicity with flow abnormalities. Cervical artery dissection has been implicated as a cause of ischemic stroke accounting for up to 30% of cases of cerebral ischemia in the young population. In the past decade, increased awareness and advances in diagnostic imaging techniques have led to increased detection of cervical arterial dissection with or without associated ischemic events. Even though digital subtraction angiography remains the gold standard, non-invasive imaging tests such as computed tomography angiography (CTA), magnetic resonance angiography (MRA) and Doppler sonography have largely replaced the need for catheter angiogram in most instances. There is limited data that identifies patients at high risk for primary or recurrent ischemic complications after spontaneous dissections. Patients with aneurysmal forms of cervical artery dissection more often have multiple dissections of cervical vessels and arterial redundancy and higher history of migraine and cigarette smoking. At present, there are no randomized controlled studies comparing the use of antplatelet with anticoagulant agents. Both have been used to prevent further ischemic complications, whether there is an arterial occlusion or severe stenosis, and with or without thromboembolic events. No uniformly accepted criteria exist of selecting patients with dissection who should undergo endovascular treatment. Most practitioners advocate recurrent ischemic symptoms despite antplatelet or anticoagulant medications as an indication for endovascular treatment.

Educational Level: Comprehensive

Advanced

Educational Method: Lecture-oral didactic presentation

Name of Director: Adnan I. Qureshi MD

Title/Position: Executive Director; Professor of Neurology, Neurosurgery, and Radiology, University of Minnesota; 12-100 PWB, 516 Delaware St. SE; Minneapolis, MN 55455; Tel 612-626-8221, Fax 612-625-7950.

10' Communications

15.15-15.30

Can Cervical Artery Dissection Be Diagnosed on Routine Brain MRI? Sensitivity and Specificity of Stroke Brain MRI for Diagnosis of Cervical Artery Dissection: A Matched Case Control Study

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Background: The diagnosis of cervical artery dissection (CAD) may be challenging and is frequently delayed. The mural hematoma often extends cranially within the field of view of brain MRI. We therefore hypothesized that a large proportion of carotid (cCAD) and vertebral artery dissection (vCAD) should be detected on brain MRI performed at admission of stroke patients.

Methods: All patients with a final diagnosis of CAD admitted to our stroke unit between January 2002 and December 2007 were reviewed. 110 CAD patients were included. A control group without CAD (n=110), extracted from the same period, was matched for sex, age, NIH Stroke Scale score and stroke incidence. Two observers blinded to the final diagnosis independently reviewed the brain MR sequences of each exam and had to conclude if a CAD was present or not.

Results: Sensitivity, specificity, accuracy, positive and negative likelihood ratio of brain MRI for the diagnosis of CAD were respectively 54% [95%CI: 44-63], 96% [92-99], 78%, 12 [5-28] and 0.5 [0.4-0.6]. The mural hematoma was located in the field of view of brain MRI in 77 patients (70%), as demonstrated on fat-suppressed T1WI sequences. In this subgroup, sensitivity and specificity were respectively 77% [67-86] and 95% [90-100] and was higher for the diagnosis of cCAD than for vCAD (93% [87-100] vs 26% [7-46] and 98% [95-100] vs 84% [68-100], respectively).

Conclusion: Brain MRI performed at admission of stroke patients can allow early detection of carotid artery dissection.

Carotid artery dissection, traumatic or spontaneous, is a significant cause of ischemic stroke in all age groups, but it occurs most frequently in the fifth decade of life and accounts for a much larger percentage of strokes in young patients. Dissection of the internal carotid artery can occur intracranially or, more frequently, extracranially. Internal carotid artery dissection in the young patient can be caused by major or minor trauma, or it can be spontaneous, in which case, genetic, familial, and/or heritable disorders are likely etiologies. Although the cause of internal carotid artery dissection remains elusive, mechanical and underlying arteriopathies alone, or in combination, account for most of the pathophysiology. It is widely accepted that internal carotid artery dissection (CAD) is a multifactorial disease. The annual incidence of symptomatic spontaneous internal carotid artery dissection ranges from 2.5-3 per 100,000. The incidence of carotid artery dissection as a result of blunt injury (mainly high-speed motor vehicle accidents) ranges from less than 1% to 3%. The actual incidence may be higher because some dissections are asymptomatic or cause only minor transient symptoms and remain undiagnosed. Prognosis of internal carotid artery dissection depends on the severity of the initial ischemic injury and the extent of collateral circulation. Overall, the prognosis for spontaneous internal carotid artery dissection is favourable, with about 75% of patients making a good recovery. The mortality rate is about 5%. Patients who have a dissection secondary to trauma have a much higher rate of mortality and neurological deficit on discharge. Recurrence risk is highest in the first month and then about 1% per year for about a decade. Carotid stenting is to be considered a therapeutic choice after anti-coagulant and anti-platelet therapy has failed to control neurological symptoms. In a huge hospital, hosting also a trauma centre, the carotid dissection, represent a relatively frequent pathology. The aim of the paper is to share our experience on diagnostic, follow-up and intravascular treatment of the carotid dissection, both spontaneous or traumatic.
Dissections 2

Chairs: A. Biondi, O. Mansour
15.45-16.00 10’

Stent Placement for Intracranial Internal Carotid Artery Dissection Presenting with Ischemic Stroke

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Objective: Intracranial internal carotid artery (ICA) dissection manifesting as an ischemic stroke is rare and the optimal treatment has not been established. We herein report two cases of this disease treated successfully by stent placement. Clinical Presentation and Intervention: Case 1 was a 28-year-old male who presented with mild left hemiplegia after a sudden headache, and the left hemiplegia was rapidly exacerbated. An MRI diffusion-weighted image (DWI) showed infarcts in the right ICA region, and angiography showed high-grade stenosis and a double lumen in the right suprachindoid ICA. A balloon-expandable coronary stent, MicroDriver (Medtronic, Santa Rosa, CA, USA) was placed 4 hours after onset. Postoperative angiography showed a complete resolution of the stenosis. Follow-up angiography conducted 2 years later showed complete healing of the dissection and the patient’s symptoms include only left upper lumbus headache. Case 2 was a 29-year-old female who presented with left hemiparesis after a sudden headache. MRI-DWI showed infarcts in the right ICA region. Angiography showed a pearl and string sign in the right supragobinoid ICA. Anticoagulant therapy was started and her symptoms disappeared within one day. However, the left hemiparesis occurred 2 days after the initial onset, and MRI revealed new infarcts. Stent placement was performed. Angiography obtained 2 years later shows complete healing of the dissection and the patient’s symptoms include only mild monoparesis of the upper left limb.

Discussion: It has been believed that intracranial ICA dissection presenting with ischemic stroke may lead to an extended cerebral infarction in most cases and the prognosis would be very poor. However, the number of reports in which good prognoses were obtained with only antithrombotic treatment has been increasing in recent years, and the optimal treatment has not been established. One of the reasons that the outcomes are extremely different is the diversity in the mechanisms of cerebral ischemia associated with arterial dissection. Reported cerebral ischemia due to arterial dissection include the following three mechanisms: embolization due to high-grade stenosis or obstruction in the dissection area; embolization with the dissection area as the embolic source; and obstructions of perforators due to the dissection. It is believed that low perfusion is the most strongly associated with poor outcomes. In fact, in cases of intracranial ICA dissection presenting with ischemic stroke and poor outcomes, extended ischemia due to either high-grade stenosis or an obstruction in the dissection area has been reported to be involved in an exacerbation of the symptoms in all of the cases. As a treatment for low perfusion, STA-MCA anastomosis has been recommended in many reports, but there are only two reported cases in which this anastomosis was actually performed. The reasons that STA-MCA anastomosis is hardly performed include difficulties in both selecting appropriate candidate patients for surgery and in determining the optimal timing for performing surgery. On the other hand, stent placement can be performed immediately compared to bypass surgery, so it may be suitable as a revascularization procedure for arterial dissections. But there have been only two reported cases of stent placement for supraclindoid ICA dissection presenting with ischemic stroke, and the long-term prognoses are unknown. We placed balloon-expandable stents in one case in which the ischemic symptoms rapidly deteriorated immediately after the onset and in another case in which acute deterioration occurred a few days after the onset, and we obtained satisfactory results in both cases. The postoperative follow-up durations were 24 months and 28 months, respectively, which are the longest periods of time compared to the previously reported cases, and no restenosis was observed in either case. In particular, Case 1 is a case in which there would have been a high possibility of a poor outcome if revascularization had not been performed during the hyperacute phase. Another advantage of stents is that they can close pseudolumen by closely attaching the dissected intima-media against the vascular wall. This prevents the dissection from extending distally and may be effective in preventing embolization from the dissection area. Because stents for the intracranial arteries are not approved in Japan, we had to use balloon-expandable stents for the coronary arteries. However, it is believed that self-expandable stents for the intracranial arteries are safer as stents to be used for the treatment of intracranial arterial dissection.

Conclusion: The present series indicate that stent placement may be an effective treatment for intracranial ICA dissection presenting with ischemic stroke.

16.00-16.15 10’

Large Cervical Internal Carotid Artery Pseudoaneurysms and their Management. A Case Series

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Pseudoaneurysms of the cervical internal carotid artery (ICA) are uncommon and are commonly due to trauma, infection or sometimes spontaneously. They have the potential of causing life threatening hemorrhage thus there urgent management is necessary. Traditionally these patients were managed surgically with occlusion of the parent artery. However with the development of newer hardware in endovascular techniques, now ICA stenting with a covered stent has emerged as treatment of choice in such cases.

Materials & Methods: We present a series of four cases of large cervical ICA pseudoaneurysms developed secondary to fine needle aspiration cytology (FNAC). All of them presented with pulsatile neck swelling with associated symptoms. One of the patient was managed surgically and rest by endovascular means. In one patient coiling was done and rest two patients underwent covered stent graft. All these patients were doing well on follow-up ranging from 1-2 years.

Conclusion: The present case series suggest that endovascular repair in the form of coiling or placement of covered stent grafts can be accomplished with preservation of anatomic flow in the parent vessel (with stent grafts) in cervical ICA aneurysms. Concerns of long term patency of the stents especially those deployed in the young population are still there and require further studies with long term follow-ups.

16.15-16.30 10’

Endovascular Treatment of a Giant Cranio-Cervical Aneurysm with a New Self Expendable Endoprothesis Silk
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Purpose: To present, assess and demonstrate the effectiveness of Silk self-expandable stents in the treatment of giant cranio-cervical aneurysms.

Material and Method: From May 2008 to October 2009: 3 patients with 4 aneurysms experience EVT using Silk endoprothesis. They were all women; age ranging from 42 to 55 years (48.5 mean age). All patients were symptomatic. One patient with sub-arachnoid hemorrhage and 2 presented clinical signs of cranial nerve palsy. One patient presented with twin aneurysms of an intra-petrous segment of both internal carotid arteries; one with dissecting aneurysm of right M1 segment; the last, with displastic aneurysm situated at the intracavernous segment of the left internal carotid artery. Three 4.5 mm x 30 mm and one 2.5 mm x 12 mm Silk endoprothesis were deployed. All patients underwent pre-operative anti-platelet therapy (Clopidogrel and aspirin) four days before the intervention. Anti-platelet therapy was maintained one year after the procedure.

Results: Full occlusion of the aneurysmal pouch was obtained in all cases, with patency of the arterial lumen. No complications were observed.

Conclusion: In this short experience with four cases and especially with this exceptional twin aneurysms cases we successfully treated these giant displastic and one dissecting aneurysms. In our experience, this kind of device represents a powerful tool of treatment with excellent feasibility and effectiveness with no complication in our series.

Endovascular Treatment of Extra- and Intracranial Dissections Using Self-Expanding Microstents

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Purpose: To determine the feasibility, safety and efficacy of the treatment of neurovascular lesions based on the deployment of self-expanding microstents.

Material and Methods: 48 patients (28 male, 20 female), median age 51 years. Manifestations of dissections: 8 aneurysms, 32 stenoses and/or ischemic lesions, 4 SAH and 2 iatrogenic. Locations of dissections: 18 ICA, 2 MCA, 1 ACA, 25 VA, 2 BA (multiple entries). In every patient, complete vessel reconstruction was the aim of treatment. A total of 76 stents was used (34 Enterprise, 9 Leo, 12 Solitaire, 3 Neuroform, 6 Protege, 9 Coroflex please, 1 coroflex blue, 1 Wallstent, 1 Graft Master).

Results: Vessel reconstruction and full patency were achieved in every patient with ischemic dissection. Telecoiling stent deployment allowed hemodynamic exclusion of all dissecting aneurysms. In 22 patients, more than one stent was required to achieve the goal of treatment. No adverse events were encountered.

Conclusion: Microstents are safe and highly effective devices for the endovascular reconstruction of extra- and intracranial dissections.

Treatment of Spontaneous Intradural Vertebral Artery Dissections

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Spontaneous intradural vertebral artery dissections may cause subarachnoid hemorrhage and such patients often result in devastating damage. Increased use of noninvasive imaging studies has allowed larger numbers of patients to be diagnosed. In addition, intracranial vertebral artery dissection tends to induce multiple lesions affecting both intracranial vertebral arteries recurrently. Although unruptured dissections in this area usually have a benign nature, some authors have reported incidence of rupture from this lesion. If once hemorrhage from dissecting vessel wall occurred, it has to be treated in the acute phase because of the high risk of rebleeding resulted in high morbidity and mortality. From December 2004 to January 2010, we managed 38 patients with spontaneous vertebral artery dissection, 25 patients were ruptured and 13 were unruptured. All patients who suffered from subarachnoid hemorrhage were treated with endovascular procedures. Most of the patients with unruptured dissection received medical therapy, but if the aneurysmal dilatation persisted or grew, surgical interventions were performed. Stenting with or without coils was deployed for 13 patients who were involved the posterior inferior cerebellar artery at the site of dissection and/or were affected in the dominant side. For other ruptured patients, internal coil trappings were performed. Two patients died due to severe initial subarachnoid hemorrhage and one patient, who was underwent stent deployment with coil for the dominant vertebral artery, with bilateral dissection continuing to basilar artery died due to rerupture while the next additional coiling was planning. There were two cases of complications related to intervention. During the follow-up period no bleeding occurred in any of the patients except for the only previously mentioned patient. In conclusion internal coil trapping or stent placement with or without coil was effective in preventing rebleeding of ruptured vertebral artery dissection. In the patient of unruptured dissection, it is necessary to detect the risk of bleeding with careful watching and when progress appears to be made in dissection, patients should be treated promptly. Stent assisted therapy for preserving the patency of parent artery and major branches is a promising treatment for the vertebral artery dissection, even if in the acute stage of subarachnoid hemorrhage.

Endovascular Surgery for Ruptured Vertebral Artery Dissection

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Intracranial dissection may lead to various clinical features such as subarachnoid hemorrhage (SAH), ischemic stroke and isolated headache or neck pain. According to publications, most common affected site of dissection is vertebral artery (VA) as compared with other sites. Here we summarize about the treatment of ruptured VA dissection, especially using endovascular surgery technique. Rerupture is the most significant prognostic factor in SAH dissection presenting with SAH. To prevent a repeated rupture, patients should be treated by open or endovascular surgery as soon as the
diagnosis is made, because rerupture could be frequently seen within first 24-hour after onset. Such being the case may turn to advantage of endovascular surgery that could be shifted by diagnostic angiography in minute. In general, intracranial dissection with ischemic symptoms may be treated with conservative therapy. Natural course of VA dissection with only pain is still unclear.

The sufficient treatment for patients suffering with only the pain has not been established. As a result, the indication of endovascular surgery should be decided cautiously, especially for unruptured cases. Although the results of proximal occlusion, using clips, coils or balloons, are generally excellent, instances of post operative rerupture or enlargement of the site of dissection have been reported. In patients with ruptured VA dissection, trapping of affected site with coils may be more effective than proximal occlusion alone. According to the recent publications, more endovascular surgery, occluding a parent artery including affected sites, has been done rather than open surgery. Patients with VA dissection, which affected site is involving the origin of the posterior inferior cerebellar artery (PICA), may need to be treated with bypass surgery not only with internal trapping. It is also important to consider avoiding an injury to the perforators on the internal trapping. In near future, the stent treatment will be feasible and seems to be an effective modality for the endovascular surgery to intracranial dissection as arterial re-construction.

17.15-17.30 10’

Spontaneous Dissection of Intradural Vertebral and Basilar Arteries. Review of 55 Cases (28 Hemorrhagic and 27 Ischemic) Regarding Multimodality Endovascular Approaches

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Introduction: Spontaneous dissection of intradural vertebral or basilar arteries result from a disruption between the layers of the vessel wall which can be sub intimal, resulting in a ischemic presentation or sub adventitial, with rupture of all layers, resulting in subarachnoid hemorrhage. We review 55 consecutive cases in our service since 1996, that were treated by the same selection of approach.

Objective: report the clinical and angiographic differences between the two groups and our therapeutic approach depending of these features.

Methods: hemorrhagic presentation occurred in 28 cases (18 female and 12 male), age ranging from 33 to 68 years. There is no case of intracerebral hematoma and the Fisher scale for SAH was I and II in 21% of cases and III and IV in 79%. Rebleeding before treatment occurred in 6 patients (in 5 cases in the 2 weeks after initial SAH, 2 of them evolving to death. The other 27 patients had a ischemia (21 cases) or only head or cervical pain (6 cases). The angiographic findings in the hemorrhagic and ischemic group were, respectively: saccular aneurysm 15.7, fusiform dilation 13.11, double lumen 4.2, stenosis 2.9, occlusion 1.5 and thrombus present in the dissection on magnetic resonance images 1.7; more than 1 vessel involved 5.1. Prodromus was present in both groups lasting up to 15 days before the definition of the final clinical presentation; angiographic changes were remarkable in most of patients in the short interval between the diagnostic and the therapeutic examination. In the hemorrhagic group, 20 patients were submitted to an endovascular treatment: proximal vessel occlusion (3), proximal+aneurysm coil occlusion (1), proximal+aneurysm+distal occlusion (7), proximal +distal occlusion (2), stent+coils (7). Two patients were operated and 6 were not treated due anatomic or clinic contra indications (5) or because the family refused treatment. In the ischemic group, 15 patients were treated due the presence of saccular or fusiform aneurysms. We used proximal occlusion (5), proximal+aneurysm occlusion (1), aneurysm occlusion (1), proximal+aneurysm+distal occlusion (1), proximal+distal occlusion (1), stent+coils (5) and stent+Onyx (1).

Results: when we used parent vessel occlusion (13 cases of the hemorrhagic group and 9 in the ischemic one), cure of the lesion occurred in 21 cases. One patient had ischemia of the bulb (proximal occlusion) with permanent deficit and one had a transient deficit (stent+coils), both from the ischemic group. Between the 13 patients treated with stent+coils, there is cure in the follow up in 2, retreatment was necessary in 5, one rebleed and one headache. The other 40 cases died.

Conclusions: intradural dissection of the intradural vertebral and basilar arteries present a period of time with instability, when angiographic changes are present. A prodromus in some patients before definition of the final clinical presentation. Rebleeding is very frequent and devastating, indicating urgent treatment. When a patient enter in the hospital with only neck or head pain, we don’t know if he will develop hemorrhage or not and in the presence of saccular or fusiform aneurysm a urgent treatment should be done. The best treatment to cure the lesion is by deconstructive techniques, that are very efficient in avoid bleeding or rebleeding. Stent+coils doesn’t cure most of the cases, and is indicated when parent vessel occlusion is not possible. Those patients should be followed in short periods of time to disclose recanalization or regrowth of the dissection and retreat them before rebleeding.
Normal CSF Flow Measurements at the Aqueduct Performed at 3T

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Introduction: Quantification of cerebrospinal fluid (CSF) flow through the cerebral aqueduct is of paramount importance in patients with hydrocephalus. The purpose of this study was to evaluate the normal CSF flow measurements at three different anatomical levels of the aqueduct and in the background baseline region, at 3 Tesla.

Materials and Methods: The CSF hydrodynamics in 15 healthy volunteers, aged 15-43 years (mean age, 24.6) were evaluated. Phase-contrast cine MRI was performed on a 3T General Electric MR system (GE Medical Systems, Milwaukee, USA). A cardiac gated, flow compensated, gradient echo sequence with flow encoding of 10 cm/sec was used, and the aqueduct was visualized using a sagittal T1 FLAIR sequence. Velocity maps were acquired perpendicularly to the cerebral aqueduct at three different anatomical levels: the upper, mid and lower part (inlet, ampulla, pars posterior) of the aqueduct. Region-of-interest (ROI) analysis was performed in order to measure the CSF hydrodynamics, including the peak positive velocity and the mean flow, on the phase images. Each CSF flow measurement consisted of one ROI placed exactly at the edge of the aqueduct (ROI 1) and a second one, slightly larger (ROI 2), in order to evaluate user-dependent potential variations in the flow measurements. A background baseline region was set at the level of the midbrain in order to produce a distinct line (zero flow) separating the positive from the negative flow. Flow quantification was performed using GE’s Report Card 3.6 in CSF flow mode. The latest version of this tool does not require a background set in order to calculate flow velocity and therefore, there was no background subtraction performed.

Results: CSF flow velocities were slightly increased at the upper part (inlet) than the lower part (pars posterior) of the aqueduct. However these differences were not statistically significant. The mean peak positive velocity and the mean average flow were calculated for both ROIs. Their values at the level of the ampulla were respectively, for ROI 1, 7.824 ± 2.17 cm/sec and 0.096 ± 0.016 ml/beat, whereas, for ROI 2 were 7.824 ± 2.17 cm/sec and 0.050 ± 0.023.

Conclusions: In order to evaluate normal CSF values through the aqueduct at a 3T, CSF peak positive velocity and mean flow through the aqueduct were calculated in 15 young healthy volunteers. Our measurements do not show significant difference compared to the reported measurements obtained at 1.5T. However, it has to be mentioned that the ROI has to be placed, as accurately as possible, at the margins of the aqueduct, in order to avoid substantial differences in the calculation of the average flow and peak velocities. Slight differences were also observed in the CSF hydrodynamic measurements, depending on the anatomical level of the cerebral aqueduct, however, these measurements do not vary significantly.

Balanced Steady-State Free Precession Sequence in the Study of CSF Dynamic Alterations

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We studied 100 patients referred to our Institution for Cerebral Spinal Fluid (CSF) dynamics alterations (85 Normopressure Hydrocephalus (NPH) 6 Arnold Chiari Malformations, 9 shunt controls after Venticulo-peritoneal derivation not correctly working). In all these patients we perform the CSF dynamic study with Balanced steady-state free precession (bSSFP), compared to the Phase-contrast Gradient-Echo sequences. The bSSFP sequence was implemented with T2 contrast. This sequence is very sensitive to proton movements and moreover to very slow flow. It is mandatory that all protons receive all Rf and gradients impulses to give signal. For this reason the areas of the image where is a protons flow, even if very slow, are characterized by sudden signal loss. So we perform this sequence in the Silvia Aqueduct to detect flow anomalies inside. Using 3D technique we obtained ultramillimetric slices, and then the depiction of Aqueduct is extremely precise. Our sequence parameters were FOV 15 cm matrix192X256 thickness 2mm, Venc= 5cm/sec TE=6.6ms TR 13.2 ms FA=50, 1 NEX total time 1’37”. If in the images obtained with this sequence we don’t detect any flow (hyperintensity signal in the Aqueduct or in other CSF pathways) we don’t perform the PC-GE to obtain the Stroke Volume. The sequence allow to choose the correct Venc for the PC-GE. This sequence however doesn’t allow quantitative signal analysis that depends from user experience. These sequence show an undubitable advantage in the study of CSF dynamics in all our patients allow a more correct calculation of the stroke volume.
Background and Purpose: Differentiate NPH from other types of dementia and select appropriate candidates for surgery, either by endoscopic third ventriculostomy or by CSF shunt, it is still a challenge. Knowledge of basic mechanisms of neuronal injury and recovery in NPH is still undefined but largely due to CSF dynamics abnormalities. More useful in assessing the CSF circulation in NPH, like radioisotope cisternography and CT-metrazamide cisternography, were reported as unreliable. SPECT and Xenon-CT imaging revealed reduced cerebral blood flow (CBF) in patient with NPH and PET showed decrease in cerebral metabolism with 18F-2-fluoro-deoxyglucose. The results were unspecific. On CT and MR studies symmetrical dilatation of ventricles out of proportion to the cerebral sulcal enlargement can arise suspicion of NPH in patient with urinary incontinence, gait apraxia and dementia. Acquedot CSF flow void on MRI can be present but has been found to be nonspecific. Bradley and al.(1989) proposed a un invasive measure of CSF dynamics using cardiac gated phase contrast sequences, and after shunt in NPH patient, indicating a cut off stroke volume value for shunt success. Invasive neurousurgical tools as intracranial pressure measurements and spinal taps are reported to be useful in predicting the response to treatment, but the reliability and reproducibility of these tests are limited. We shown our experience data on radiological diagnosis of NPH and results after surgical treatment.

Methods: After neurologic and neuropsychologic evaluation, the suspected NPH patient is imaged by conventional multiplanar brain MRI (1.5 Tesla) including isotropic diffusion weighted images, temporal lobe T2-IR scans, GRE-T2* and contrast enhanced T1 SE sequence added by phase contrast sequences. The ROI was placed two slices above the periventricular white matter. In some of these patients we also provide proton chemical shift imaging (H1-CSE), looking for increase of lactate peaks at the periventricular and intraventricular level. After treatment follow up has been performed with conventional brain MRI and H1-CSE at 1 month, three months and 1 year or whenever if the clinical status worse.

Results and Conclusion: Radiologic un invasive multimodal approach is still necessary in diagnosing NPH for reach better and longer results after surgical treatment.

Objective: The etiology of normal pressure hydrocephalus (NPH) remains enigmatic. The search for reliable markers of the disease for non invasive diagnostics and for the etiology of the disease is constantly needed. One of the hypotheses for gait impairment in NPH is the affection of periventricular white matter.

Methods: In this study 18 patients were investigated for possible NPH. All patients underwent diagnostic testing including the lumbar infusion test and 5 days of external lumbar drainage for diagnosis of normal pressure hydrocephalus.

Only the patient's with positive diagnostic response were included in the study (n=10), all patients with positive response were treated by venriculoperitoneal shunt. All patients underwent MRI examination including T2W, T1W and DTI sequence of the whole brain in axial sections (EPI, TR/TE = 15,000/80.4 ms, 49 slices with thickness of 2.4 mm, no gap, 128 x 128 matrix, FOV 24 x 24 cm2; along 30 noncollinear gradient directions with b value of 1000 s/mm2, with additional five b = 0 images). Anatomical 3D T1W sequence was also acquired. Eleven healthy individuals were examined with the same technique.

Following parameters were then manually measured: fractional anisotropy (FA) and apparent diffusion coefficient (ADC) in the genu of the internal capsule, and optic radiation. The ROI was placed two slices above the slice where anterior comissure could be detected. A Mann Whitney U test was used for the analysis of the results.

Results: The fractional anisotropy was decreased significantly in the patient group compared to the controls (p<0.01) in fornix, right genu of the capsule interna and left optical radiation (p<0.05), the data showed some trend (p=0.1) in ADC of the left and right optical radiation.

Conclusion: The DTI measurements may reveal the white matter structural impairment in patients with normal pressure hydrocephalus. As a possible non-invasive diagnostic marker it deserves further attention and investigation. Our patients will be also imaged 3 months after the shunting procedure to assess any possible restructurisation.
Abnormalities of the Dura Mater: Are Multiple Clinical Syndromes with Dural Lesions Associated to Abnormal Connective Tissue?

D. Quiñones, J Viaño
Sanatorio del Rosario, Madrid, Spain

The are several clinical and radiological entities with abnormalities of the dura that may be related to each other. Do they all have an underlying common connective tissue disease? Syndrome of spontaneous intracranial hyperten-
sion/ Familial intracranial hypertension. Post-traumatic spine / whiplash injury / hydrops. Anterior dural defects/an-
terior neuroenteric cysts. Spinal cord herniation (through the dura). Sub-
types of dorsal degenerative disc disease, disc clefts. Dorsal herniated disc and ventral ischemia/ infarct /dural AV
Hirayama Disease (juvenile amyotrophy of the distal upper extremity). All the entities listed are associated with dural defects or tears. Some are congenital, some are spontaneous and some seem to be adquired related to microtrauma. Although we are told they are different entities, there are many similarities in their imaging findings. During my everyday practice I have encountered many aspects where they merge. Many so called spontaneous hypertension syndromes are preceded by exthoration. Familial hypertension patients have sometimes a Marphanoid phenotype. Some cases reported of intracranial hyperten-
sion have huge anterior dural defects, or vertebral endplate abnormalities just at the level of the dural tear, are these related by a congenital defect or by de-
generative dorsal disc disease? These large dural defects and vertebral abnor-
malities could have a congenital origin, similar to the neuroenteric cysts where a stalk or cleft may remain connecting to the spinal canal. On the other hand de-
generative disc disease most likely also has an underlying genetic connective tissue predisposition. An interesting group of patients are those with dorsal herniated discs, which may cause local microtrauma and inflammation of the dura locally, and can have intrathecal complications affecting the cord and its vascularization. Patients with scoliosis have a dural sac that slightly rectifies the scoliotic curve and the spinal cord inside the spinal canal seems slightly tethered. The enlarged epidural spaces at the areas of the minimal scoliotic ra-
dius are occupied by fat, venous plexus and connective tissue. In Hirayama dis-
ease the dura thickens with flexion of the spine, separating from the osseous spinal canal and compressing the cord while the extradural space engorges, this is also typical to the venous engorge-
ment and fluid accumulation found in the spinal canal of most hypotension patients. I have occasionally found pa-
ients evaluated by MR for "back pain" that have subdural sac deformities and extradural increased fluid, but I can not continually raise the possibility of intracranial hypotension, specially since most patients are imaged with very little clinical information from re-
ferring physicians. On the other hand sequences that enhance fluid detection such as FLAIR and T2 fat saturation are not routinely obtained in spinal imaging, and they are necessary to evaluate fluid in the extradural space. I propose FLAIR and T2 fat saturation should be included in all routine spine MRI protocols at least in one plane. I encourage neuroradiologists and neurosur-
geons and investigators to search for these dural lesions, and study the dura and connective tissues in these cases to find possible genetic variations related to dural pathology.

Automated Versus Human In Vivo Segmentation of Carotid Plaque MRI

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1 Universite Paris Descartes, Hopital Sainte Anne; Paris, France; 2 Division of Image Processing, Department of Radiology, Leiden University Medical Center; Leiden, The Netherlands; 3 Medis Medical Imaging Systems Bv; Leiden, The Netherlands

Synopsis. On a population of 40 pa-

tients with atherosclerotic carotid ste-

nosis not scheduled for endarterectomy, we compared the automated versus human in vivo segmentation of atherosclerotic carotid plaque MRI using a supervised classifier programmed on an independent training set of 20 manually segmented patients. These analyses were conducted using QPlaqueMR software (Medis medical imaging bv).

Results: For the detection of plaque components, the concordances between the visual and automatic analysis were more strongly correlated for haemorrhage and fibrous tissue (0.80 [0.65 to 0.95]) than for lipids (0.65 [0.43 to 0.80]) and good for calcifications. It confirms results of previous studies that have shown the feasibility of automatic plaque analysis in vivo [2] by comparing the accuracy of the classifiers with that attained by human MRI reader automatic using histology as the standard of reference.

Discussion and Conclusion: This study confirms supervised automatic algorithmic classifiers compare favour-

ament reached 80% for all components. For the quantification in volume, the ICC was high for haemorrhage (0.80 [0.65 to 0.95]) and fibrous tissue (0.80 [0.65 to 0.89]), good for lipid (0.65 [0.43 to 0.80]) and poor for calci

15.45-16.00 10' Abnormalities of the Dura Mater: Are Multiple Clinical Syndromes with Dural Lesions Associated to Abnormal Connective Tissue?
small sample of selected patients with high grade symptomatic carotid stenosis scheduled for endarterectomy. We extend these results to patients included in multicentric trials for whom markers of plaque instability are essential for therapeutic decision i.e. patients with symptomatic moderate stenosis or asymptomatic high grade stenosis. In multicentric trials, computerizing the analysis of the atherosclerotic plaque composition on MRI could avoid time consuming reading sessions and minimize the inter readers variability inherent to the manual plaque segmentation for prognostic purposes.

References

Figure 1 Carotid plaque segmented with O-plaque software. Lipids in yellow. Calcium in orange. Haemorrhage in pink. Fibrous tissue corresponds to the remaining part of the plaque. Lumen outlined in red and outer arterial wall in green.

Idiopathic Intracranial Hypertension: Assessment of the Endovascular Techniques for Treatment
A. Mironov
Creighton University Medical Center, Department of Radiology, Omaha, NE, USA

Background: Idiopathic intracranial hypertension (IIH) has been defined as a condition of raised intracranial pressure without clinical, laboratory, or radiological evidence of intracranial pathology, especially with lack of venous obstructive disease. The typical patient is an obese woman of childbearing age. Pathophysiologic mechanisms remain an ongoing source of debate. The probably higher role of venous outflow obstruction has been suggested, and on contrary, a secondary generation of stenosis due to intracranial pressure elevation like as secondary phenomenon has been hypothesized. Therefore, the debate about the relief of venous outflow obstruction in the etiology of IIH remains controversial. Does sinus angioplasty simply mitigate an effect of raised intracranial pressure on venous outflow or does it address the cause of raised intracranial pressure itself? With reference to this question, we present the evaluation of endovascular manometry and treatment in 12 patients with refractory IIH.

Materials and Methods: All patients (11 female and 1 male; 16 to 34 year-old; all overweight-BMI kg/m2: 20-85) were referred with history of progressive headache and visual disturbance, in 3 cases with initial change of personality. They underwent MR imaging, MRV (7 cases), conventional cerebral angiographies with retrograde venography and manometry of dural sinuses. Pull-back pressure measurements were performed with a standard blood pressure transducer in the sagittal sinus, torcular Herophili, proximal and distal transverse sinus, proximal and distal sigmoid sinus, jugular bulb, proximal and distal jugular vein, and brachiocephalic vein on each side, and additional in superior vena cava. They were analyzed in two ways: first - gradients at central venous pressure elevation, with a standard blood pressure transducer in the sagittal sinus, torcular Herophili, proximal and distal transverse sinus, proximal and distal sigmoid sinus, jugular bulb, proximal and distal jugular vein, and brachiocephalic vein on each side, and additional in superior vena cava. They were analyzed in two ways: first - gradients at central venous pressure elevation, with a standard blood pressure transducer in the sagittal sinus, torcular Herophili, proximal and distal transverse sinus, proximal and distal sigmoid sinus, jugular bulb, proximal and distal jugular vein, and brachiocephalic vein on each side, and additional in superior vena cava.

Results: MR venography demonstrated patent flow of dural sinuses hypoplastic divisions of lateral sinuses. The conventional venous phase showed questionable irregularities of lateral sinuses in all patients. The direct transfemoral dural sinus venography revealed discrete stenotic lesions of lateral sinuses in all. With focus on the gradients across the sinus stenosis the cases were divided in 3 groups: 1. Gradients up to 15 mmHg - 6 cases (4, 6, 7, 8, 9, 12 mm); 2. Gradients up to 30 mmHg - 4 cases (21, 25, 26, 30 mm); 3. Gradients above 30 mmHg - 2 cases (50, 55 mm). Angioplasties for sinus narrowing were performed with compliant balloons (4 and 4.5 mm) for patients in second and third group (6 cases, across gradients 50, 35, 25, 30, 21, 26 mmHg). The clinical course in 4 of them (jugular vein pressure 8, 10, 12, 16 mm Hg) underwent few days later a dramatic improvement with resolving of papilledema & headache over following 6 months. In 2 cases (jugular vein pressure 22 and 24 mmHg) there was clinical improvement for only couple of weeks. The remaining 6 cases (group 1) were considered for medical treatment.

Discussion: The classification of balloon angioplasty is predicated on the notion that venous outflow obstruction plays some part in the etiology of symptoms and signs in patients with IIH. We considered sinus angioplasty for groups 2 and 3 only. These with considerable durable improvement included cases with distinct elevated across gradients (50, 35, 25, 21 mmHg) and moderate elevation of jugular vein pressure (8, 10, 12, 16 mm). These with lack of clinical efficacy included cases with elevated across gradients (26, 30 mmHg), but also with distinct jugular vein pressure (22, 24 mmHg). All of the treated patients had across gradients above 21 mmHg, but only those with jugular vein pressure below 16 mmHg responded extremely well. The patients from group 1 were considered for medical therapy, because across gradients below 15 mmHg are not predictable to contribute to successful resolution. Perhaps some cases of IIH are exacerbated by a coexistent effect of pre-existent anatomic narrowing of the lateral sinuses with elevated across gradients, and perfusion improvement breaks the iterative cycle. The lack of clinical response after angioplasty (or stenting) reflects probably on the both - the lack of exposed across gradients, and the elevation of jugular vein pressure due to central venous pressure elevation. Alternatively, IIH may include two populations; one truly idiopathic (with only central venous pressure elevation, without associated sinus flow obstruction), and the other additional exacerbated by pre-existent venous outflow obstruction. This would have clear implications for clinical management.

Endovascular Stenting of Unilateral Transverse Sinus Stenosis for Treatment of Benign Intracranial Hypertension
W. Mustafa, K. Kadziolka, A. Leautaud, L. Pierot
Department of Radiology, Maison Blanche Hospital; Reims, France

Objective: We present the efficacy of stenting of transverse sinus stenosis as a novel technique for treatment of benign intracranial hypertension.

Material and Methods: Retrospective analysis of 3 consecutive female patients who were presented by manifestations...
Interest of Endovascular Techniques in the Pseudotumor Cerebri Syndrome

P. Courthèoux, S. Saleme, C. Barbier, P. Lacerta
CHU Côte de Nacre - Department of Neuroradiology; Caen, France

Objective: Evaluate the role of transversal sinuses stenting in the treatment of pseudotumor cerebri syndrome (SPTC).

Material and Methods: Ten patients diagnosed with SPTC benefited, after stenosis measurement, from stent placement in the transversal sinuses. Their clinical data (cannigraphy, papilledema), sinus pressure measurement and clinical evolution after treatment were studied.

Results: The ten patients presented stenosis of the transverse sinuses and significant pressure gradient. We have the follow-up of over 6 months for seven of these patients: five have become asymptomatic and two presented a recidive of the syndrome after a few months without symptoms. Phlebography was performed for these two patients and showed the presence of stenosis distally to the stent.

Conclusion: Even though this is a small series, the endovascular technique seems to have a role to relieve the symptoms and to avoid progressive visual loss in patients suffering from SPTC. On the other hand, it doesn’t improve our knowledge as to the real cause of this disease.

Diagnosis and Non-Invasive Follow-Up of Cerebro-Vascular Pathologies (10 Years of CT, D WI and Angio-MR without Contrast Medium)

L. Sabattini
Casa di Cura M.F. Toniolo; Bologna, Italy

16:45-17:00

Clinical Application of Balanced Steady-State Free Precession Technique in Neuroradiology

Y. Lu, S. Wu, J. Lirng, W. Guo, C. Chang
Taipei Veterans General Hospital; Taipei, Taiwan; National Yang-Ming University; Taipei, Taiwan

Balanced steady state free precession (b-SSFP) sequence belongs to the coherent fast gradient-echo (c-FGRE) sequences in which the transverse magnetization is refocused, contributes to steady-state formation and the overall signal intensity and contrast of the images. The main difference between the b-SSFP and other c-FGRE sequences is the addition of a compenste gradient of the same magnitude and opposite polarity for each gradient axis (slice-selection, phase-encoding, and readout) so that the gradient-induced dephasing within each TR is exactly zero. This makes balanced SSFP relatively insensitive to motion and inherently flow-compensated. b-SSFP usually has high signal intensity to noise ratio (S/N) contributed by the total coherent steady-state of the magnetizations. Contrast in b-SSFP depends on the T2/T1 ratio. Thus, there is very high signal intensity for fat and water because of their high T2/T1 ratio. Signal intensity of soft tissues is usually very low due to their low T2/T1 ratio. Contrast among soft tissue is usually not good due to similar T2/T1 ratios. Additional note is that, b-SSFP is not as sensitive to conventional T2*effects as are other GRE (SSFP as is not as sensitive to conventional T2*effects as are other GRE sequences. Additional note is that, b-SSFP is not as sensitive to conventional T2*effects as are other GRE sequences. Additional note is that, b-SSFP is not as sensitive to conventional T2*effects as are other GRE sequences.
Palazzo della Cultura e dei Congressi - Magenta Hall
Thursday, 7 October - 09.15-16.30

COMMUNICATIONS

Infectious Diseases 1

Chairs: L. Lucato, F. Resta
09.15-09.30 14’

Introductory Lecture

The Different Faces of Central Nervous System Tuberculosis: A Pictorial Review

S. Muda 1, Sa Al-Edrus 2, Nr Mohd Zain 3, S Mukari 4, N Mohd Nasir 5, K Abdul Latif 6
1 Universiti Kebangsaan Malaysia; Kuala Lumpur, Malaysia; 2 Universiti Putra Malaysia; Serdang, Malaysia; 3 Hospital Kuala Lumpur, Malaysia

Tuberculosis (TB), an infection caused by Mycobacterium tuberculosis is an infectious disease that continues to be a significant health problem and is responsible for 8 million annual deaths worldwide. The increase in the incidence of Human Immunodeficiency Virus (HIV) infection has resulted in the resurgence of tuberculous infection over the last few decades. Involvement of the central nervous system remains its most severe form and is responsible for a high morbidity and mortality. The clinical features are often non-specific and the disease itself is considered unique, as it is probably the only infection in the central nervous system that has been known to involve any part of the brain and spinal cord and their coverings. The radiological features are therefore remarkably diverse and include calvarial involvement, parenchymal involvement such as tuberculomas and abscesses, ventriculitis, vasculitis causing haemorrhages and infarction, myelitis, pachymeningitis and leptomeningitis. Although diagnosis is often clinical, Magnetic Resonance Imaging is highly sensitive and is routinely used in the diagnosis of central nervous system involvement. We illustrate pictorial features of miliary TB Meningitis with haemorrhages and infarctions. We also illustrate vasculitic changes due to TB Meningitis in MRI series. Among others cases includes two cases of calvarial involvement and two cases of extensive spinal and central canal extension. We want to highlight the advantages of MRI in characterizing the different appearances like miliary and vasculitic changes. The extensive extension into spinal canal and intraspinal exudate collection will be illustrated. We aim to describe the various forms and diversity radiological appearances of central nervous system TB.

09.30-09.45 10’

Military TB Meningitis: MRI Findings in Three Patients

A. Kartikasalwah 1, M. Nazri Ma 2, S. Muda 3
1 Department of Diagnostic Imaging Kuala Lumpur Hospital; Kuala Lumpur, Malaysia; 2 Department of Radiology, Universiti Kebangsaan Malaysia Medical Centre; Kuala Lumpur, Malaysia

Tuberculosis (TB) is a disease caused by bacteria belonging to the Mycobacterium tuberculosis complex. In the current decade, it is becoming an increasingly worrying public health problem. Emergence of multi-drug resistant strains and because of increase in immunodeficiency stated form various cases has be the main contributing factors. Central nervous system (CNS) tuberculosis represents approximately 10% of extra-pulmonary tuberculosis. Imaging manifestations are very variable and can mimic parenchymal cerebral mass lesions or meningeal processes of difference nature. Tuberculous granuloma (tuberculoma) is the most common form of parenchymal lesion. They may be solitary, multiple or miliary in distribution. Although imaging findings are generally non-specific, modern imaging plays a key role in diagnosis. Recognizing this MR imaging pattern in patients with neurological problems, coupled with a high index of suspicion in the appropriate clinical and laboratorial setting may promote rapid diagnosis and institution of therapeutic measures that avoid death or serious neurological consequences. Currently TB meningitis with military pattern are frequently observed in our centre. We present here three cases of military TB meningitis with associated microbleed due to different presentation and discuss the subtle differences and similarities in their MR neuroimaging features.

09.45-10.00 10’

Revisiting the CNS Tuberculosis with Emphasis on Giant Tuberculomas and introducing the Outer RIM Excrescence Sign

D. Kumar, R.K. Sheoran, S.K. Bansal, O.P. Arora
Arora Neuro Centre; Ludhiana, India

Purpose: CNS tuberculosis is a leading cause of morbidity and mortality in developing countries, caused by Mycobacterium tuberculosis. The purpose of our study is:
1. Highlights the characteristic imaging features of CNS tuberculosis.
2. Emphasis on giant tuberculomas and solitary ring enhancing lesion in typical and atypical locations which mimic other pathologies.
3. Introducing a new sign ‘outer rim excrescence sign’ in ring and/or solid enhancing lesions as a differential point.

Material and Methods: This retrospective study includes 21 patients of either surgically or clinically (mainly response to ATT) proven CNS tuberculosis. These patients presented with varied clinical features. There were 15 male and 8 female patients with age range between 9 to 70 years (Mean age: 30 years). Imaging was performed either with MDCT, MRI or both.

Results: Solitary tuberculomas (ring or solid) were seen in seven patients which were located in pons (2), basal ganglia (1), parietal lobe (2), temporal lobes (1) and cord parenchyma (1). Four patients showed presence of 2 to 3 lesions and one of the lesions was categorized as giant tuberculoma. Pure calvarial involvement was noted in one patient only. Total 17 patients showed solitary or multiple ring enhancing lesions. Five patients showed solid enhancing lesions (giant tuberculoma). Outer rim excrescence sign was noted in a total of nine patients. Both brain and spinal tuberculosis was noted in 3 patients. Only two patients presented with meningitis and hydrocephalus.

Discussion: Cases of atypical presentation of CNS tuberculosis clinically and on imaging keeps on increasing in Indian subcontinent which appears to be most serious form of the infection and responsible for high mortality and morbidity. Classical presentation of...
CNS tuberculosis: Majority of patients of CNS tuberculosis show multiple discrete or conglomerate ring enhancing and solid enhancing lesions in almost every region of the brain which is usually associated with enhancing exudates in basal and suprasellar cisterns, hydrocephalous with ventricular ependymal enhancement, focal to diffuse meningeal enhancement, tubercular abscess, focal cerebritis and infarcts. Meningitis. Tuberculous meningitis is the most common manifestation of CNS tuberculosis. Imaging is not always helpful in diagnosis of meningitis. Diagnosis is made by CSF analysis and carefully observed clinical signs and symptoms. Intracranial tuberculosis: Histologically, tuberculomas are categorized as noncaseating, caseating solid and caseating granuloma with central liquefaction. They are commonly encountered without previous or concurrent evidence of an infective focus elsewhere in the body. However, solitary ring enhancing or giant solid enhancing tuberculomas pose major diagnostic challenge in present scenario. Solid giant tuberculomas: Histologically they are composed of solid caseating or non-caseating granuloma. In our study the tuberculoma was considered giant if its size exceeded one cm. It is a unique finding on CT & MRI brain. The same scenario applies also to en- caseous meningitis. Parasitic diseases are not found as part of routine practice. The goal of this lecture is to provide to neuroradiologists of all over the world imaging details of the most characteristic infectious diseases of the central nervous system (CNS) encountered in Latin American countries. First of all we will focus on the fungal infection paracoccidioidomycosis, a systemic granulomatous disease caused by Paracoccidioides brasiliensis, prevalent in Latin America, particularly in Brazil. Its manifestation is usually related to pseudotumoral lesions, and less commonly to meningeal involvement. Parasitic diseases will also be included, especially cysticercosis, characterized by the parasitic involvement of the CNS by the larval stage of the pork tapeworm Taenia solium. Emphasis will be given on advances reached by modern neuroimaging techniques, such as CISS/FIESTA and DWI. Other relevant parasitic diseases include Chagas disease, whose etiologic agent is Trypanosoma cruzi - an important diagnostic possibility in immunocompromised patients and transplant recipients; and schistosomiasis, caused in Latin America by Schistosoma mansoni, usually related to a myelodysplastic syndrome, but less commonly associated to cerebral disease.

References
3 Lucato LT, Guedes MS, Sato JR, et al. The Role of Conventional MR

Tuberculosis Simulating Tumour in Brain
U. Rashid Chaudhry Post Graduate Medical Institute, Lahore, Palau

The purpose of the study is to highlight the varied presentation of Tuberculosis brain simulating tumour. Headache and Seizures are becoming the frequent presenting complaints without any history of tuberculosis. The study comprises of twelve hundred (1200) patients of either sex with age ranged from ten years to sixty years. Electroencephalography (EEG), MRI and CT Scan Brain control and with contrast were the investigations performed on these cases. In some patients cerebral angiography (DSA) and spectroscopy were also achieved. The final diagnosis of tuberculosis was made on the basis of caraniotomiy, stereotactic and burrhole biopsies with histopathology in most of the cases. 40% of the patients were followed up for four months. They were put on anti-tuberculosis treatment with symptomatic and anti-epileptic drugs. The incidence is 544 and 757 per 100,000 in Africa and Indo Pakistan respectively. Male to female ratio is 1:1. Tuberculosis especially with CNS involvement is not only common in immunosuppressed individuals patients in our set up. T.B. has been and still remains and important public health problem in our setup. TB may involve central nervous system either as meneginitis or as parenchymal granulomas or abscesses. Patients with TB brain usually present with fever, multiple cranial nerve involvement and occasional behavioural changes. CSF findings remain non specific in most of the cases. Most common sites are the cerebral hemisphere and basal ganglion in adults and the cerebellum in children. Tuberculosis has unique finding on CT & MRI brain. Cortical and subcortical location are typical whereas brain stem is less common site. Tuberculosis lesions are usually solitary but multiple in 10% to 35% of cases. In spite of all these facts still some cases of Tuberculosis brain needs aggressive neurointervention to reach the final diagnosis of TB brain. The tuberculosis in CNS may manifest in many different ways. So one should always include tuberculosis in differential diagnosis in etiology of delayed onset epilepsy and acute on chronic headache. In case of discrepancy between clinical manifestation and CT/MRI findings, one can always anticipate tuberculous lesion in the brain.


Encephalopathies 4

Chairs: M. Brant-Zawadzki, M. Papathanasiou

10:30-10:45

The Role of Magnetic Resonance Perfusion Imaging in the Assessment of Limbic Encephalitis with Neuronal Potassium Channel Antibody. A Case of Rapidly Progressive Dementia

C. Nunes 1, M. Cordeiro 1, F. Silva 2, I. Santana 2, C. Moura 1, F. Alves 1
1 Serviço de Imagiologia dos H.U.C.; Coimbra, Portugal; 2 Serviço de Neurologia dos H.U.C; Coimbra, Portugal

Purpose: Discuss the importance of brain MRI perfusion imaging in the study of dementia starting from a clinical case of limbic encephalitis with neuronal potassium channel antibodies.

Method and Materials: We report a rare case of dementia, discuss its differential diagnosis and review the literature searching pubmed for dementia+MRI+perfusion restricting it to human studies done in the last 5 years. We summarize the most relevant imaging findings of each known dementia, emphasizing the importance of advanced MRI, namely perfusion imaging.

Results: A 58 years old male presented with depression, cognitive deterioration and right hand clonus. The initial work-up, which involved brain MRI, blood and CSF tests and cancer exclusion, showed only hypoponatremia. Even after taking antiepileptic and antidepressive drugs, the clinical manifestations kept worsening. Brain MRI showed bilateral mesial temporal prolongation of T2 affecting both hippocampus and hypoperfusion of the frontal and temporal lobes. Brain SPECT showed hypoperfusion of left temporal lobe. He was treated with metilprednisolone with very good clinical result. The neuronal voltage dependent potassium channel antibodies were positive in a second work-up. Brain MRI done after treatment showed reduction of the mesial temporal edema. The pubmed search originated 60 articles. We found that in Alzheimer dementia there is parietal and medial temporal cortical brain atrophy especially in hippocampus. There is reduction of the parieto-temporal cortex perfusion as shown by pMRI. Vascular dementia can be subdivided in multi-infarct dementia, dementia caused by a strategically localized sole infarct (eg. in the girus angularis, thalamus or of a major brain vessel), small vessel disease, hypoperfusion dementia and hemorrhagic dementia. In frontotemporal dementia there is anterior frontotemporal atrophy worse in the dominant hemisphere and perfusion deficits predominantly frontal and anterior temporal. Creutzfeld-Jakob, Parkinson disease, amyotrophic lateral sclerosis and Multiple system atrophy were also reviewed and described.

Conclusion: We found a case of the rare and recently described entity limbic encephalitis with neuronal potassium channel antibodies. These should be ased in a dementia work-up.

Clinical Relevance / Application: Brain MRI with perfusion evaluation is important in the work-up of dementia. It correlates with clinical improvement in the case of autoimmune limbic encephalitis.

10:45-11:00

MRI Imaging in Nonneoplastic Limbic Encephalitis

M. Schartizer 1, C. Baumgartner 2, A. Muehlebner 1, D. Prayer 1
1 Department of Radiology, Division of Neuroradiology and Msculoskeletal Radiology; Vienna, Austria; 2 General Hospital Hietzing, Department of Neurology; Vienna, Austria;

Purpose: Chronic limbic encephalitis, usually associated with cancer as a paraneoplastic syndrome, may rarely occur without evidence of underlying malignancy. We present MRI imaging and clinical workup in 11 patients with nonparaneoplastic, nonherpetic limbic encephalitis.

Methods and Materials: Between 1999 and 2009, 11 patients (7 women and 4 men, mean age 41.1 yrs; range 10-63 yrs) presented with symptoms of hippocampal dysfunction (memory deficits, changing mental status, temporal lobe epilepsy). Extensive clinical, laboratory and whole-body imaging work-up did not reveal underlying malignancy.

Results: Increased titers of antibodies to antineuronal antibodies (anti-hu) were detected in 5 of 11 patients (45%), in the other patients these titers were not available. MR imaging (39 investigations, range 2-60 patient), performed on a 1.5 and 3 T superconducting system showed bilateral T1-weighted hypointense and T2-weighted and on the FLAIR sequence hyperintense signals in the hippocampi and amygdalae of all patients. Changes were symmetrical in two and asymmetrical in nine cases. Diffusion-weighted source images (performed in 19 examinations) revealed mild hyperintense areas in the gyrus cinguli in two patients. Postcontrast images showed no significant enhancement of the corresponding areas. Single-voxel spectroscopy (TE=136ms) was performed in 3 patients and demonstrated elevated Choline with respect to Creatine and NAA, reduced NAA/Creatine peak and no lactate peak in all patients. Long-term follow-up MRI in seven patients demonstrated complete resolution of the previous hippocampal T2 signal in nine patients. MR followed by hippocampal atrophy, parietal resolution of abnormalities in three patient and progression in one patient with lethal course.

Conclusion: In patients with clinical symptoms of hippocampal dysfunction without signs of acute illness and MR pattern of limbic involvement, chronic limbic encephalitis must be considered radiologically, even in absence of a malignant disease. The potential clinical improvement with new immunotherapy concepts in these patients emphasizes the importance of a correct diagnosis.

References
2 Tüzün E, Dalmau J. Limbic en-
Missense PANK2-Mutation Without the Tiger’s Eye - MR Findings in a Large Group of Patients with Pantothenate Kinase-Associated Neurodegeneration (PKAN)


PKAN (formerly called Hallervorden-Spatz syndrome) is a rare autosomal recessive disease, typically characterized by dystonia, rigidity and choreoathetosis, retinopathy and intellectual impairment. Probably due to a founder effect, this condition is unusually frequent in the area around the town of Cabral in the southwest of the Dominican Republic. Although the genetic basis for the disease is identical in all cases (homozygous c.680 A>G, p.X227C). There is significant phenotypic heterogeneity. Additionally, there are atypical features, such as a rather late onset between 10 and 14 years of age, no pigmented retinopathy in any of the analysed patients and no or only minor intellectual decline. Here, we report the MR findings of 14 patients in comparison to 16 non-affected first-degree relatives. Examinations were carried out on a 3T Achieva scanner (Philips) and included T2W, T2*W and 3D TIW sequences, T2 time calculation, Diffusion Tensor Imaging (DTI) with gradient application in 32 directions and 1H single voxel spectroscopy of the parieto-occipital white matter. Data postprocessing was mainly performed with scanner-provided software. Results were compared with the clinical findings. The genetic analysis was performed in collaboration (including homozgyosity mapping) with the Dept. for Medical Genetics/Tübingen, Albrecht-Kossel-Institute/Rostock, Section of Neurogenetics/Lübeck and Centogene/Rostock, all in Germany. All patients showed the typical signal reduction within the pallidum and the medial parts of the subthalamic nucleus due to deposits of iron. In comparison to their first-degree relatives, this finding was highly significant in T2*W, but also T2W images (p<0.0001). T2 time was significantly reduced as well, and preliminary estimation revealed an iron content between 51 and 59 mg Fe/100g in one patient (M. Hajek, Prague, personal communication). In addition, we saw an increase of fractional anisotropy in the pallidum, but without an accompanying reduction of the apparent diffusion coefficient (ADC) which might be explained by the severely disturbed susceptibility (Awasthi et al., AJNR 2010, 31: 442-7) due to the highly inhomogeneous iron distribution in our patients. DTI parameters measured inside the thalamus as well as spectroscopic results did not differ significantly between patients and relatives. A surprising finding was the absence of the bright spot (tiger eye) in the medial part of the iron deposit within the pallidum in 6 of our 14 patients. This is known from atypical PKAN cases but has been reported rarely in carriers of typical PANK2 mutations (Zollikofery al., Paediatr Radiol 2006, 36: 1329). Our patients without the bright spot were slightly older (24 vs. 20 years) but there was no obvious difference in onset or clinical expression of the disease. Intellectual function, however, seems to be preserved better in these cases. Subgroup analysis of gene mutations in patients and relatives is underway and will be correlated to the clinical and MR findings.

Rhombencephalitis by Listeria SPP, in Immunocompetent Patient

J. Nunes, B.C. Gomes, M. Shamasna, R.P. Pais, M.T. Garcia

Rhombencephalitis by Listeria SPP is uncommon and in nearly one third of cases there is no identifiable predisposing factor. Some of its most prominent manifestations include bacteremia and Central Nervous System (CNS) involvement where rhombencephalitis is the most common condition in immunocompetent hosts. Case Study: The authors describe a case of a female patient, 18 years old, previously healthy, presenting vomiting, severe frontal headache and fever with one week evolution. She was admitted in the Department of Infectious Diseases. The initial brain CT scan was normal and lumbar puncture revealed elevated proteinorrachy (149 mg / dL) and pleocytosis (128 cells, predominantly mononuclear cells). The patient began empirical treatment with Ceftriaxone and Acyclovir and three days after there were signs of progressive CNS involvement with diplopia, ataxia, right hemiparesis and aphasia. MRI showed areas of hyperintensity on PD (Proton Density), T2 and FLAIR images, involving the posterior fossa structures and nucleus-capsular regions without enhancement after contrast administration. By that time Listeria spp. was isolated in blood cultures. She started Ampicillin and Gentamicin showing progressive clinical improvement with partial recovery of neurological deficits. The CSF (cerebral spinal fluid) microscopical exam and the auto-immune pattern study were normal.

Discussion / Conclusion: The CNS infection by Listeria spp. is rare, mainly in the absence of predisposing factors and ages under 3 or over 45 years. The curse of the illness is usually biphasic with absence of meningal signs in the early phase. Meningoencephalitis is the most common clinical presentation although there can be involvement of brainstem and other brain areas. CSF cultures are positive in only about one third of cases and the imaging techniques are often the guidelines for the diagnosis of cerebral listeriosis.

HIV

Chairs: P. Demaereil, R. Wu

Neuroimaging of Immune Reconstitution Inflammatory Syndrome (IRIS) during HIV Infection

V. Cuvicincic, G. Martin-Blondel, H. Dumas, C. Cognard, B. Marchou, F. Bonneville

Purpose: to describe the imaging features of IRIS cerebral lesions in HIV-infected patients.

Materials & Methods: retrospective analysis of 18 consecutive cerebral opportunistic infections in HIV patients under efficient highly active antiretroviral treatment (HAART). All patients were evaluated clinically, immunologically...
cally and microbiologically. Neuroimaging included CT (15 cases) and/or MRI (17 cases). The diagnosis was confirmed by cerebral biopsy in 4 cases.

**Results**: compatible with the definition of IRIS, the clinical aggravation appeared in all cases during rapid immune reconstitution, proved by increase in CD4 lymphocytes levels and decrease of HIV viral load. The suspected diagnoses were progressive multifocal leukoencephalopathy (PML) in 10 cases, cryptococcosis (5 cases) and toxoplasmosis (3 cases). In 11 cases, IRIS was paradoxical (clinical deterioration of known opportunistic infections). In 7 cases, IRIS revealed a previously unsuspected cerebral infection. In the 8 cases of paradoxical PML IRIS, there was a rapid increase of FLAIR hyperintensity of the white matter, with mass effect (4 cases), apparition of contrast enhancement (3 cases) and peripheral contrast enhancement (2 cases). In the revealing PML IRIS, MRI showed a FLAIR hyper intensity of the white matter compatible with PML, but with peripheral or speckled contrast enhancement. In cryptococcosis, MRI showed multiple leptomeningeal and parenchymal contrast enhancements, particularly perivascular and meningeal. In toxoplasmosis, there were multiple nodular lesions, with peripheral contrast enhancement, sometimes with eccentric target sign. The histological exam showed signs of inflammation, mainly with CD8+ T cells infiltration.

**Conclusion**: MRI shows evidence of cerebral inflammation, supporting the clinical, immunological and histological diagnosis of cerebral IRIS.

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**Material and Methods**: Eighty-six HIV+ subjects were stratified into 3 groups according to their cognitive status using the Memorial Sloan Kettering (MSK) dementia severity score. Twenty one with normal cognitive function (NC) (MSK 0), 31 had mild cognitive impairment (MCI) without dementia (MSK stage = 0.5) and 34 had dementia (HAD) (MSK equal or greater than 1). Using a 3.0T Philips scanner and SENSE head coil, brain MRI and single voxel MRS (TR/TE=2000/45 msec) were acquired from the left frontal white matter (FWM) and the left basal ganglia (BG) with and without water suppression. The voxel size was 2.2x2.2x2.3 mm3. Spectra were analyzed using the LC model (5) and quantified (in mM concentrations) relative to the unsuppressed water signal. Metabolite concentrations and ratios relative to creatine (Cr) were calculated for the 3 groups. Differences between groups were evaluated using ANOVA and post-hoc comparisons. P < 0.05 was considered significant.

**Results**: FWM Glx (combined Glu and Gln) was lower in HAD (8.1±2.1 mM) compared to both MCI (9.17±2.1 mM) and NC group (10.0±1.6 mM), (P = 0.006). FWM ml was higher in HAD (4.15±0.75 mM) compared to both MCI (3.86±0.85 mM) and NC status (3.4±0.67 mM), (P = 0.006). FWM Glx/Creatine (Cr) was lower and FWM myo-inositol (mI)/Cr significantly higher in HAD compared to MCI and NC group (P = 0.01) and (P = 0.004) respectively. BG NAA was lower in the HAD group (6.79±1.53 mM), compared to the MCI (7.5±1.06 mM), and NC groups (7.6±1.01 mM), (P = 0.036). There were significant positive correlation of FWM Glx with Digit symbol test (P= 0.02, 0.002, and 0.02 respectively). There were also significant negative correlations between Glu, Glx, and Glx/Cr with trail-making test B (P= 0.005, 0.0001, and 0.0003 respectively). FWM Glx showed negative correlation with Grooved pegboard non-dominant hand (P= 0.02).

**Discussion and Conclusion**: Several studies performed at 1.5T have previously reported reduced FWM NAA and increased ml/Cr levels in HAD, suggesting neuroaxonal loss or dysfunction, and glial proliferation, respectively. The current study is consistent with these prior reports. In addition, 3T MRS with phased-array head coil reception allows more sensitivity detection of MRS metabolites (in particular compounds such as Glx), and it appears that Glx (consisting of mainly Glu) is abnormal in FWM of patients with HAD. Reduced Glu uptake has previously been demonstrated to occur in vitro in astrocytes exposed to HIV as detected by Northern blot analysis and immunoblotting, and was recently reported in a cohort of 13 HIV positive subjects using TE-averaged MRS at 3T. In the current study, in a large cohort of HAART experienced HIV+ individuals, progressively decreasing levels of FWM Glx were found in patients with normal cognition, MCI, and HAD. FWM Glx decreases were also associated with poorer cognitive function, specifically impaired executive and fine motor functioning in HAD. 3T MRS measurements of Glx may be a useful indicator of neuronal loss or dysfunction in patients with HIV infection.

Acknowledgments: This work was supported in part by NIH grants R01MH71150 and P41RR15241.

References

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**MRI Spectrum of HIV Related Neurological Disorders and Evaluation of the Different MRI Techniques in Diagnosis and Prognostication of Them**

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With the rising incidence of HIV, it has been very essential to exactly diagnose the HIV related various neurological disorders so as to avoid highly invasive tests like biopsy. We in this study evaluated 20 patients who were detected to be HIV positive and presented with various neurological complaints in Jaslok Hospital and Research Centre, Mumbai, India. The scan was done using 3 Tesla Magnetom Trio Tim MRI Scanner. Newer parameters like MRI spectroscopy, Perfusion Imaging, Diffusion Tensor Imaging were included in the evaluation along with the routine con-
Glaucousa and Blindness, an Early Axonal Diagnosis and Prevention by MRI

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Aim: New concept in glaucoma (70 million people in the world), born from a MRI neuro-ophthalmological research undertaken for 16 years, are presented. The modern experimental research is gradually (4 yrs) validating these new horizons.

Material and Methods: Since 1994, 850 adults, male and female, had been addressed at the MR neuro-imaging dept of the CINNO des XV-XX first and then (Sept. 2008) at the CIMN, with 1.5 T then 3T GEHC systems since 2006. The functional visual deficit measurements (tonometry, refractometry, central and peripheral cammetry, manual and automated..) were usually completed by an optic discs and retinal imaging (SLO, OCT,…). MR cerebral sequences and planes (axial NOP, oblique vertical TONOP, NOP perpendicular coronal, sagittal) allow a precise visualisation of the 2nd (intraocular) and 3rd visual neural tracts, exploring the visual pathways “from the optic nerve head to the calcaneous fissure" without partial volume effect.

3T (0MRI and DTMRI were added Results: A T2 hypersignal inside the orbital or cisternal portions of the optic nerve translates the axonal suffering, announcing the axonal death and, consequently, the rarefaction of the tract, a progressive atrophy of the former optical way, detected inIRM. This atrophy begins always behind, in the intracranial portion of the million and half of deutoneurons (from geniculate bodies to the optical tract and chiasma), respecting the 1st intraculcar part of the two optical nerves, their 1 millimeter long "head". It is situated behind the optic disk (papilla), classically visible only with direct ophthalmoscopy. The atrophy is always bilateral, asymmetric, even with a unilateral deficit. In case of acute optical neuropathy with fast visual deterioration (AV, CV) confirm that fact.

Discussion: 1. These results, pathognomonic for us and never denied, lead to discuss the primary role of the intracocular hypertonicity, since the degeneration of the optical way is demonstrated as "retrograde", from back ahead (distant to proximal), and not "anterograde", from the eyeball (papilla) towards the geniculate bodies as in retinal pathologies. 2. Now some axonal transport experiments (mices glaucoma) confirm these facts. 3. It may be supposed that glaucoma belongs to a cephalic neuro-degenerative pathologies, as well as Parkinson’s or Alzheimer’s diseases.

Conclusion: The possibly long period (several years) between a preliminary MRI diagnosis of “glaucomatous axonopathy” and the late evolutive stage (blindness) imposes an evolution to the ophthalmological clinical practice. Trusting in this new axonal MRI diagnosis, the patient and physicians could gain from the most recent neuro-protective therapeutics pushing back the blindness.

References

Parkinson 1

Chairs: Y. Korogi, K. Sator

14.30-14.45

Ultrasonography and RM Imaging in Progressive Supranuclear Palsy (PSP)

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Parkinson’s disease (PD) includes typical motor symptoms and additional non motor symptoms: these are the result of degeneration of dopaminergic nigrostriatal and non dopaminergic neurons as well as dopaminergic pathways. PD is the most common form of progressive neurodegenerative disorder characterized by paucity and slowness of movements, muscular rigidity, unsteadiness, falls, autonomic disfunction, abulia, sleep and cognitive disturbances, and dementia. PD accounts for 75% of all cases of parkinsonism. It is not usually difficult to make clinical diagnosis relying on unilateral or asymmetrical rest tremor, bradychinesia and rigidity. The presence of such symptoms carries a positive predictive value of 92% with a sensitivity of 90%. Misdiagnosed cases are found to have PSP (Progressive Supranuclear Palsy) MSA (Multi-Systemic Atrophy) (APD) and vascular disease. Clinical diagnosis is difficult before the onset of overt symptoms and a critical threshold for their development is reached. Parkinsonian signs are prominent feature of PSP and MSA and the rate of misdiagnosis is much higher at the time of disease onset. Misdiagnosis is clinically important because it determines the treatment and influences the prognosis. Over the last few years, a number of neuroimaging studies have been focused on the identification of possible diagnostic markers of Parkinsonian disease and neurodegenerative disorders in subjects where the loss of the dopaminergic nigrostriatal pathway is only part of a more wide spread degenerative process. A few imaging techniques have been developed to evaluate brain anatomy and function. The main imaging techniques are: positron emission tomography (PET) single photo emission tomography (SPECT), Magnetic Resonance Imaging (MRI) / functional Magnetic Resonance Imaging (fMRI) and TransCranial Sonography (TCS) and ColorDoppler (TCCD). By use of non invasive methods, it is now possible to assess neural activity of brain structures, energy demand and cerebral blood flow. The administration of compounds labelled with radioisotopes allows imaging of dopaminergic system and its pathophysiology: the PET/ SPECT techniques are still not established imaging markers for nigral degeneration that would be suitable for disease monitoring and APD-PD discrimination. Also, these techniques are expensive and risky to subject. For PSP the diagnostic needs context for biomarkers relates to improve diagnostic accuracy in differential diagnosis, to enable early diagnosis and to monitor disease progression. The imaging techniques must be non invasive, cheap and easy accessible. Conventional MRI is a valuable tool for the exclusion of symptomatic brain of Parkinsonism: advances in the de-
Visualization in MRI T2-weighted of the surgical target is done by direct sensorimotor area and ventral medial based on the functional anatomy of the symptoms of Parkinson's disease. The effects of prodromal PD and essential tremor restless legs from PD and could represent an early marker of premotor PD. Nigral hyperechogenicity doesn't correlate with disease duration and progression. The diagnosis is operator dependent, there is subjectivity involved in assessing the threshold for pathologically hyperechogenicity. We will discuss our experience in daily PSP patients discriminating from PS and MSA with MRI/MRI (Philips Intera, 1.5 TESLA) and TCS (HTI DTI Philips) functional imaging and will explain our efforts to obtain an objective evaluation hyperechogenicity mesencephalon.

**Background:** Differentiation of atypical parkinsonian disorders can be difficult when symptoms are mild or uncharacteristic. Abnormal cerebellar fibrillation in atypical parkinsonian disorders resulting in a degeneration of the middle cerebellar peduncles and transverse pontine fibers in patients suffering from multiple system atrophy (MSA) and a degeneration of superior cerebellar peduncles in patients suffering from progressive supranuclear palsy (PSP).

**Purpose:** The purpose of our study was to determine high resolution diffusion tensor imaging (DTI)-based tractography to be a reliable method of diagnosing APD from PD; in contrast to the two radiologists was 90%, which resulted in a cohens kappa coefficient of 0.8214. These results indicate that 80% DTI findings could be assigned to the correct diagnosis. 20% of the cases (2 PSP patients) did not show a reduction of the cerebellar peduncles or the transverse pontine fibers and could not be assigned to the correct diagnosis.

**Conclusion:** These results indicate that MSA-P and PSP patients present with a different pattern of abnormal cerebellar and brainstem connectivity, which can be visualized using high resolution DTI-based tractography. Furthermore, these results suggest that high resolution DTI based tractography is a reliable and feasible tool for differential diagnosis of atypical Parkinsonism.

Correlation of Magnetization Transfer Ratios and Clinical Parameters in Late Parkinson's Disease

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**Purpose:** The aim of this study was to correlate the magnetization transfer ratio (MTR) changes in gray and white matter with clinical parameters, in patients with late Parkinson’s disease (PD).

Materials and Methods: 18 PD patients without dementia, ranging from 2-4 on the Hoehn and Yahr Scale, and 14 healthy volunteers were assessed. The MRI protocol included in axial level proton-density, T2 weighted and T1-weighted spin echo sequences with and without a saturation pulse. Signal intensity measurements were obtained from 14 areas of interest (cerebellar gray matter, dentate nucleus,
substantia nigra, red nucleus, pons, globus pallidus, putamen, caudate nucleus, thalamus, genu and splenium of corpus callosum, periventricular white matter, centrum semiovale, and frontal gray matter). The mean MTR, calculated from the average of the right and left hemisphere values, was used for analysis and was compared between patients and controls.

Results: The most elevated MTR values were found in the corpus callosum and the lowest values were seen in the cerebellar gray matter and caudate nuclei. In the brainstem of PD patients the most significant decrease of MTR was found in the substantia nigra (p<0.001) compared with healthy controls. A significant decrease of MTR was also found in the pons (p<0.01) and red nucleus (p<0.02). Lower MTR values were found in the periventricular white matter of PD patients (p<0.05). The other white and gray matter regions lack significance. No significant differences were also found between the MTR values in the areas measured and both clinical grading and disease duration.

Conclusion: MTR analysis demonstrated differences in PD patients compared to controls. The most significant reduction in MTR was found in substantia nigra in PD patients. There was no correlation between MTR measures and clinical status in patients with late Parkinson's disease.

Diffusion Tensor Imaging and MR-Tractography for Characteristic of Microstructural Integrity of White Matter in Patients with Parkinson's Disease (PD)

Introduction: In recent years, fiber tracing (MR-Tractography) on the basis of Diffusion Tensor Imaging (DTI) has been suggested as one potential in vivo method that could be used concurrent to conventional MRI [1]. DTI makes use of the conventional DWI that is widely used in the clinical environment [2]. We study relation between white matter (WM) integrity, macrostructural changes, such as atrophy of WM, microstructural abnormalities in WM, and cognition dysfunction in patients with PD using MR-Tractography method of visualizing a 3-dimensional structure of cerebral white matter fiber tracts based on volumetric DTI data.

Materials and Methods: Two groups of patients are studied by high resolution anatomical MRI, and DTI methods with 1.5T SIGNA Excite (GE). DTI experiments were performed using a DWI-EPI pulse sequence with following parameters: TR/TE=10000/98 ms, A/A=31/25 ms, b=1000s/mm², 25 diffusion gradient directions. 48 slices with thickness of 3 mm and no interslice gap were acquired covering the whole brain with FoV=25 mm², matrix=128x128. The 1st group includes 14 nondemented patients with PD (PDG). The 2nd group (PDCG) includes 15 patients with PD and cognitive dysfunction. Brain tissue was segmented automatically using the k-nearest neighbor classifier. The Fractional Anisotropy (FA) values and mean apparent diffusivity coefficients (ADC) were measured in cortical WM and in subcortical structures that involved in cognitive dysfunction process. We combined tractography algorithms and visualization methods to trace the pixelated principal direction of a diffusion tensor originating from regions
of interest (ROI) with high fractional anisotropy. Consequently, white matter fiber bundles from the nucleus caudate to frontal cortex via the thalamus were visualized.

Results: We assessed the association of DTI parameters with cognition using linear regression, adjusting for relevant confounders and additionally for cognitively normal appearing WM and WM with appearances of atrophy. From analysis of DTI data for two groups of patients there was a significant reduction of the average FA values in temporal WM (PDG vs PDCG, 392.4±70.3 vs 520.5±64.7) and in parietal WM (268.3±30.3 vs 360.1±31.2). Results of stepwise regression analysis showed the FA values in temporal and parietal WM were associated with the scores of short-term memory and orientation (Table 1). The higher ADC values and lower FA values in WM in subjects of PDG, and PDCG are related to worse performance on tasks assessing memory, executive function, information processing speed, global cognition and motor speed (Table 2).

Conclusions: White matter integrity in temporal and parietal WM is compromised in non-demented patients with PD and in patient with PD and cognitive dysfunction relative to non-demented patients with PD. The feasibility of fiber tractography in patients with PD with DTI may add a new dimension in detection and characterization of WM injuries of patients with cognitive dysfunction.

References

Table 1: FA values for non-demented patients with PD and patients with PD and neuropsychological deficit in various regions of the brain.

<table>
<thead>
<tr>
<th>Region of interest</th>
<th>FA PDG</th>
<th>FA PDCG</th>
<th>p value</th>
<th>FA PDG</th>
<th>FA PDCG</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commissure, right hemisphere</td>
<td>0.44±0.13</td>
<td>0.44±0.11</td>
<td>0.004</td>
<td>0.16±0.08</td>
<td>0.16±0.06</td>
<td>0.406</td>
</tr>
<tr>
<td>Commissure, left hemisphere</td>
<td>0.44±0.13</td>
<td>0.44±0.11</td>
<td>0.004</td>
<td>0.16±0.08</td>
<td>0.16±0.06</td>
<td>0.406</td>
</tr>
<tr>
<td>Frontal lobe, right hemisphere</td>
<td>0.44±0.13</td>
<td>0.44±0.11</td>
<td>0.004</td>
<td>0.16±0.08</td>
<td>0.16±0.06</td>
<td>0.406</td>
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<td>0.16±0.06</td>
<td>0.406</td>
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</table>

Figure 1 ROI localization (a) and 3D reconstruction (b) of fiber tract in SN in non-demented patient with PD (m, 63 y., disease duration 5 y).

Figure 2 3D reconstruction of fiber tract in SN in non-demented patient with PD (m, 70 y., disease duration 8 y).

16.00-16.15 10'

Neuromelanin MR Imaging in Dementia with Lewy Bodies (DLB) at 3T: Comparison with Parkinson’s Disease and Alzheimer Disease

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Purpose: Recent reports have indicated that neuromelanin MR imaging at 3T can visualize and detect the pathological changes of the substantia nigra (SN) and locus ceruleus (LC) in Parkinson’s disease. We evaluated the signal alterations of SN and LC in patients with DLB, Parkinson disease (PD) and Alzheimer disease (AD), and compared them with normal subjects.

Methods and Materials: Neuromelanin MR images (2D fast spin-echo; TE/TR, 10/600 msec; echo train length, 2; FOV, 220 mm; base matrix, 512; 2.5mm slice thickness; number of acquisitions, 5mm; acquisition time, 7min 51sec) were obtained using 3T MR system (MAGNETOM Trio A Tim, Siemens) from 21 patients who were clinically diagnosed with DLB, 60 patients with PD, 9 patients with AD and 17 normal subjects. Signal intensity of SN (SSN), LC (SLC), medial portion of temporal lobe (SMT) and cerebellar vermis (SCV) were measured, and contrast ratio of SN-MT and LC-CV were calculated in each patient. Contrast ratio (CR) of SN-MT and LC-CV were calculated according to the equation: 100*(SSN-SMT)/SMT and 100*(SLC-SCV)/SCV. CR values of SN-MT and LC-CV were compared with each other disease patients and normal subject.

Results: SSN were lower than SMT in DLB patients (CR: -6.2±6.9%) and PD patients (CR: -3.7±7.0%), and were higher than SMT in AD (1.0±8.6%) and normal subjects (5.2±8.6%). SLC were lower than SCV in DLB patients (CR: -3.9±4.6%) and PD patients (CR: -2.8±4.7%), and were higher than SCV in AD patients (CR: 2.0±3.0) and normal subjects (CR: 4.6±4.5%). CR of SN-MT and LC-CV in DLB patients were lower than that of AD patients and normal subjects with statistical significance (P<0.001 or P=0.001). In PD patients, CR of SN-MT were lower than that of normal subjects (P<0.001) and CR of LC-CV were lower than that of AD patients (P=0.003) and normal subjects (P<0.001) with statistical significance. No statistical significance was found between DLB patients and PD patients in CR of SN-MT and LC-CV.

Conclusion: Neuromelanin MR imaging at 3T can depict the signal alteration of the substantia nigra and locus ceruleus which may indicate the alteration of neuromelanin concentration in these nuclei Neuromelanin signal of SN and LC in DLB patients decreased compared with normal subjects and AD patients. Neuromelanin signal intensity in DLB patients decreased to the same degree of PD patients. Neuromelanin imaging is helpful for diagnosis in DLB.
High Field MR Findings in Lower Body Parkinsonism

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Objective: “Lower body parkinsonism” or vascular parkinsonism (VP), is a heterogeneous entity that is often confused with idiopathic parkinsonism (PD) by the generalist.

The role of MR imaging and MR angiography in differentiating VP and PD patients who present with predominant lower body parkinsonism is not clear.

We compared the advanced MRI/A features in subjects who presented with predominant gait problems suggestive of VP and PD with healthy controls, to determine the differentiating imaging characteristics between VP and PD.

Materials & Methods: Patients presenting with predominant lower gait parkinsonism were recruited from a tertiary referral center. A Movement Disorders Specialist divided the patients into possible VP and PD based on their clinical features and levodopa responsiveness.

Age and gender matched healthy controls without gait problems were also recruited.

Each subject was administered a clinical gait and PD rating scale and underwent a standardized 3.0T MR study, with the following sequences: T2-weighted, FLAIR, susceptibility-weighted (SWI) and 3D time of flight MRA.

Results: 18 subjects comprising VP, PD and controls were included with mean age of about 65 years, and equal gender ratio.

The Tinetti gait scores were much worse in VP than PD patients and controls. Vascular risk factors (e.g. hypertension, diabetes, hyperlipidemia and coronary artery disease) were similar in all 3 groups. There were more subcortical and brainstem lacunar infarcts in VP than PD patients and controls. A higher trend of microbleeds was found in VP compared to the other two groups. However, large or medium vessel stenoses on MRA were similar in number between VP, PD and controls. Infarcts on MR were a predictor of VP on multivariate analysis.

Conclusion: Noninvasive MR imaging is useful in differentiating VP from PD and controls. The higher presence of lacunar infarcts and microbleeds suggest small vessel involvement in the pathophysiology of VP.
Collateral Pathways from the Galenic System in Cerebral AV Shunts

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Purpose: Collateral pathways from the Galenic system (CPGS) occurs in the rare situations in the cerebral AV shunts. We reviewed five pediatric patients with CPGS for better understanding of its drainage routes and related pathophysiology.

Method: There were 4 boys and 1 girl, aged 7 months - 9 years (mean 4) with diagnoses of vein of Galen aneurysmal malformation (VGAM) (2), infantile dural AVF (2), and pial AVF (1). Their clinical presentation, angiarchitectue, especially venous drainage routes, and pathophysiology were reviewed. Angiography of VGAM was reviewed after closure of the AV shunts.

Results: Two patients with VGAM presented with hydrocephalus, but after exclusion of the AV shunts, they were neurologically normal. Two patients with infantile dural AVFs presented with cognitive disturbance. After marked reduction of AV shunts, one became normal and the other remained slightly retarded. One AVF patient presented with seizure once and remained neurologically normal.

Communications

Palazzo della Cultura e dei Congressi - Violet Hall
Thursday, 7 October - 09.15-17.30

Paeodiatrics Vascular 1

Chair: K. Yamada, P. Soares Pinto

09.15-09.45 25'

Introductory Lecture

Angioarchitectures, Clinical Manifestations and Endovascular Remodelings of the 24 Galenic Malformations


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Purpose: Galenic malformations are congenital malformations that develop during an early embryonic stage. Although recent reports have shown improved outcome for these patients, the overall outcome is still poor. We present our clinical experience in diagnosis and treatment of 24 Galenic malformations, with an emphasis on morphological classification, symptomatic and treatment of 24 Galenic malformations.

Results: In the 24 VGAM cases, VGAM showed either posterior fossa anomaly or TP was persistent after the completion of treatment. In the ventricular type of VGAD, occlusion at the right sigmoid sinus with cerebellar venous reflux and stenosis at the left sigmoid bulb were demonstrated. Congestion of the transmedullary veins due to sinus hypertension was confirmed in the supra and infratentorial areas in two patients. There was venous reflux into the cerebellar or posterior fossa pial veins in one patient. MRI did not demonstrate either posterior fossa anomaly or TP in the 20 VGAM cases. VGAM showed occlusive angioarchitecture, such as stenosis or occlusion of the draining pathway. Aqueductal occlusion could not be confirmed in any of our patients with either VGAD or VGAM. In our series, twelve out of 20 patients (60%) were successfully treated and neurological development were normal on follow-up after embolization. In this same group of treated patients, four of the 20 (20%) showed improvement, but demonstrated permanent neurological disability. The mortality rate in our series was 20% (four out of 20 patients). These patient were all neonates presenting with severe cardiac failure and pulmonary hypertension, two of the infants presented with hemorrhagic complication before embolization, indicating a score below eight on the neurological evaluation score by the Bicetre team, which would have placed these infants outside the indication. One patient demonstrated technical failure, representing our earlier clinical experience resulted in death.

Conclusion: VGAD should be classified depending on the shunt location, ventricular type, cisternal type, and parenchymal type. In the absence of the brain damage on CT or MRI images, urgent endovascular intervention should be indicated in VGAM with severe congestive heart failure, pulmonary hypertension, evidence of arterial steal and central hypoxia. Severe rapid progressive choroidal type VGAM should be subcategorized as a complex choroidal type.
Drainage routes were classified into three: diencephalic, telencephalic- striatal, and telencephalic-transmedullary. In VGAM cases, there was no drainage to the direct sinus (SS). Their drainage was mainly toward the ventral diencephalic veins and then to bilateral tentorial sinuses nearby. Transmedullary route was also noted in one case. In infantile dural AVFs with bilateral transverse sinus occlusion, predominant drainage was through the unilateral striatal route as well as through bilateral basal vein routes. They further drained to the cavernous sinuses. Venous stagnation in one case was associated with intraparenchymal calcification. In AVF case, predominant Galenic drainage as well as striatal drainage was observed. In most cases, the superficial medullary veins were enhanced in comparison to the deep venous drainage. No falx drainage was noted in any case. In the setting of metabolic derangement and deep cerebral veins, which are variable in number and location. The MV were not seen neither on conventional cross-sectional nor on conventional angiography, unless they were dilated. In our experience, the MV may be normally visualized on EPI sequences performed during fetal imaging, from 18 to 32 wks of gestational age. In the newborn, the MV can be normally seen on 3T MRI, utilizing SWI and usually are not visible on the other sequences. They appear as very symmetric linear fine structures extending from the outer wall of the lateral ventricles. If MV become apparent on conventional T1 and T2 WI and on post contrast imaging, it almost always denotes abnormality of the venous drainage causing pathologic engorgement and/or thrombosis of MV. In our experience, the following conditions can be associated with abnormal appearance of the MV: Primary thrombosis of MV can be seen in: 1. Periventricular hemorrhagic venous infarction in the setting of prematurity and germinal matrix hemorrhage (GM-IVH). It is common belief that the starting event in focal venous infarction is GM hemorrhage, which causes compression and obstruction of the neighboring medullary veins. However, it is still debated and not disproved that the thrombosis of the MV might be the triggering event. 2. Periventricular leukomalacia (PVL) in the setting of severe congenital heart disease, notably, hypoplastic left heart syndrome, Ebstein anomaly, transposition of great vessels; mainly conditions with right to left shunting. It is important to differentiate GM-IVH from bilateral hemorrhagic PVL. These two entities are distinct in their neurodevelopmental outcome, which is more favorable for the GM-IVH and in the imaging features. 3. Pernatal venous infarction of uncertain etiology with Wallerian degeneration of descending corticospinal tracts. This type of injury may be not suspected at birth. It can result from unrecognized fetal venous stroke syndrome. 4. Diffuse symmetric hypoxic-ischemic injury to the deep white matter, best demonstrated on diffusion-weighted imaging and some-what similar as in PVL in the setting of metabolic derangement

Discussion: CPGS occurs in the following situations: 1. Agenesis of the Galenic system, especially agenesis of the straight sinus, 2. Occlusion of the Galenic system, and 3. AV shunts causing CPGS with either retrograde or normograde blood flow through the SS. The first situation includes vein of Galen aneurysmal malformation and holoprosencephaly, anomalous diencephalic and ganglionic drainage to the lateral sinuses are observed. The second situation is caused by sinus thrombosis and tumor compression to the Galenic system. The third situation is associated cerebrovascular lesions with AV shunts. When blood flow in the SS is retrograde, CPGS is apparent, but even with normograde flow in the SS, CPGS may occur when AV shunt flows into the great vein of Galen. Bilateral transverse-sigmoid sinus occlusion enhances retrograde flow in the SS. This situation causes most serious venous hyperten- sion in the deep venous system. In this paper, the first and third situations were focused. Strial and thalamic structures have their own intrinsic col- laterals and drainage routes normally. In thalami, two main outlets, super- ior and inferior thalamic veins, drain to the internal cerebral vein (ICV) and basal vein (BV), respectively. When the thalamic outflow to the ICV is compromised, inferior striate vein predominates (thalamatic route). Similarly, in the cor- pus striatum, superior and inferior outlets are reciprocal. When the superior outlet, superior striatal vein to the ICV, is compromised, inferior striate vein predominates (striatal route). Furthermore, transmedullary veins from the subependymal veins also remain collateral from the deep to superficial cortical drainage when the deep venous system is compromised (medullary route). In addition to these three possible collateral routes, the locations of the final venous outlets to the extracranial venous system play important roles to the collat- eral venous angiogenesis. That, in the case of bilateral sigmoid sinus occlusion, the final outlet should be the cavernous sinuses and/or the internal jugular veins. Cavernous sinus is an important venous collector in these situations, and it gives the venous out- flow to the orbital veins and/or internal jugular veins through the inferior petrosal sinuses. Development of the superficial cortical collateral via the superficial middle cerebral veins to the cavernous sinus (superficial collateral) is the key role for the adaptation of the compromised superficial venous outflow in addition to the CPGS. Conclusion: Understanding of CPGS is important to interpret the venous angiogenesis and pathophysiology of the compromised deep cerebral venous system.

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Purpose: To characterize medullary veins, the smallest cerebral vessels detectable by modern imaging equipment, and to define their role in pathogenesis of numerous pathologic disorders in fetal and pediatric brain.

Introduction: There have been recent reports on the imaging appearance of the deep cerebral medullary veins (MV) on MRI and US, mainly in cases of hemorrhagic venous infarction in the premature infants. A new classification of several subtypes of unilateral periventricular hemorrhagic infarction has been developed, based on precise anatomy of the affected vessels (D. Djudink et al., 2007). This increased awareness of the MV is mostly attributable to markedly improved modern imaging techniques, including the wide use of susceptibility weighted MR sequences(SWI) in fetal and postnatal patients. The MV can be visualized either as a normal structure in fetal brain or can be observed within the spectrum of pathologic entities, which can occur in the fetal or pediatric brain.

Discussion: Cerebral venous blood flow is drained by two major groups of vessels: Superficial cerebral veins, which are variable in number and location and deep cerebral veins, which demonstrate less variation. The MV are the smallest deep cerebral veins (0.05-0.35 mm) which drain periventricu- lar cerebral white matter (WM) and germinal matrix (GM). They then converge on the corners of the lateral ven- tricles in a fan-shaped pattern. This pattern is not random; it has been referred to as being strongly related to em- bryonic path of cells migration. Some rather unique features of MV arrangement may explain the propensity of these vessels for thrombosis. In 1978 the periventricular vessel architecture was first demonstrated by microan- giographic technique (Takashima S, et al). The MV were not seen neither on conventional cross-sectional nor on conventional angiography, unless they were dilated. In our experience, the MV may be normally visualized on EPI sequences performed during fetal imaging, from 18 to 32 wks of gestational age. In the newborn, the MV can be normally seen on 3T MRI, utilizing SWI and usually are not visible on the other sequences. They appear as very symmetric linear fine structures extending from the outer wall of the lateral ventricles. If MV become apparent on conventional T1 and T2 WI and on post contrast imaging, it almost always denotes abnormality of the venous drainage causing pathologic engorgement and/or thrombosis of MV.
Paediatrics Vascular 2

Chairs: K. Ter Brugge, Y. Iizuka

10.15-10.30 10'

Endovascular Management of Pediatric Aneurysms

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Key Words: Pediatric, Intracranial aneurysm, Endovascular, Microsurgery.

Object: Although the general principles of endovascular aneurysm treatment in adults hold true in children, these young patients pose unique challenges: small anatomy, longer life expectancy, associated conditions and morphological characteristics of the aneurysms. Few publications in the literature address the role of endovascular treatment for pediatric aneurysms; including series by Agid et al. (2005) revisiting the Toronto series (Laughlin et al., 1997), Lasjaunias et al. (2005) updating the Bicêtre series (Lasjaunias et al., 1997) and Nader et al presenting the San Francisco series (2006). In their conclusions, the authors of the former two publications favored endovascular treatment over microsurgery. On the other hand, the authors of the latter publication favored microsurgery over endovascular treatment. The authors reviewed Louisiana State University experience regarding endovascular treatment of pediatric aneurysms focusing on outcomes.

Methods: A Retrospective chart review was performed of children under 18, who underwent endovascular treatment for intracranial aneurysms between 2000 and 2009 in our institution. Twelve patients harboring seventeen aneurysms were identified. The patients ranged in age from seven months to seventeen years. Complete aneurysm obliteration following endovascular treatment was around 90%. Our results showed unique features for pediatric aneurysms when compared to adult aneurysms. No intra-operative mortality was recorded. One aneurysm recurred (5% recurrence rate among total number of aneurysms). In this case, six months after treatment, a control angiogram showed that the coils were displaced toward the dome of the aneurysm. This recurrence occurred before the introduction of the hydro coils. One patient died during the post intervention period (8% occurrence rate among total number of patients). The outcome was better in anterior circulation aneurysms than in posterior circulation. We had no mortality, morbidity or disability in the anterior circulation aneurysm group. In the posterior circulation group, there was one recurrence representing 14% of the 9 patients with aneurysms in this group. One recurrence occurred in the posterior circulation group representing 11% of the 9 aneurysms in this group. Follow up of all patients ranged from 2 to 8 years.

Conclusion: Endovascular treatment of pediatric intracranial aneurysm is safe and efficacious. The Endovascular treatment, in many instances, provides less morbidity and mortality for the treatment of pediatric aneurysms than microsurgical clipping. The result of endovascular treatment depends on the location of the aneurysms and the underlying pathology. We advocate a multidisciplinary approach when choosing the therapeutic modality for treatment of pediatric aneurysms.

10.30-10.45 10'

Intracranial Aneurysms and Coarctation of the Aorta: A Magnetic Resonance Angiographic Screening in a Paediatric Population of 61 Patients

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Background and purpose: Intracranial aneurysms have a very low incidence in childhood, the clinical manifestations are usually atypical and the location and size are different from those of adult patients. The pathogenesis of aneurysms in this population is heterogeneous and still debated. It is probably the result of congenital factors, infections, hemodynamic factors or trauma. In literature aortic coarctation has been strictly related to an higher incidence of intracranial aneurysms and, especially if not treated, their rupture. In 2003 the Mayo Clinic published a retrospective Anglo-RM study in 100 adult patients (mean age 41.6 ± 16.5 years) with aortic coarctation where the incidence of intracranial aneurysm was 10%. However, it’s important to notice that only 86 out of 100 were treated for aortic coarctation and 19 of them were retreated, hypertension was present in 63 of them and 41 were smokers. To our knowledge until now no one has value the real incidence of intracranial aneurysms in a big population of children treated for aortic coarctation in paediatric age. Aim of this magnetic resonance angiography study is to determine the incidence of intracranial aneurysms in a population of paediatric patients that were treated in childhood for coarctation of the aorta by chirurgical resection and end-to-end anastomosis, endovascular interposition of a Dacron tube graft or both.

Methods: 61 patients treated for aortic coarctation in childhood have been included until now in this study. MR angiography with time of flight technique, Fast Spoiled Gradient Echo, Maximum Intensity Projection reconstructions, sagittal T1 Spin Echo e axial T2 FS and FLAIR sequence was performed in all children and the images were valuated in blind by two neuroradiologists and one interventional radiologist with international experience in endovascular treatment of intracranial aneurysm.

Results: MR angiography showed no evidence of intracranial aneurysm of the Willis polygon in any of our patient treated for aortic coarctation in childhood.

Discussion: The real incidence of intracranial aneurysms in children is debated. Several case reports in literature show that the association between aortic coarctation and aneurysm was usually present in those patients with concomitant other factors, first of all hypertension. Epidemiological evidence and MR angiography studies made in adult patients with aortic coarctation not treated or treated in adulthood seem to indicate that ‘acquired’ factors such as hypertension are causally related to the formation and rupture of cerebral aneurysms. Our hypothesis is that the association between endovascular aortic coarctation could be strongly related to
the haemodynamic stress due to long lasting hypertension. In our young patients, all treated in childhood for coarctation and with controlled blood pressure, in fact there was no evidence of aneurysm.

**Conclusion:** Preliminary results of our study suggest that the association between aortic coarctation and intracranial aneurysm has to be discussed giving more attention on dynamic stress factors such as hypertension. A reevaluation of this group of patients should be done to confirm the hypothesis that the real association with intracranial aneurysms in this kind of patients is with uncontrolled hypertension and that if they are treated in childhood they have less chance to develop hypertension and therefore intracranial aneurysms.

10.45-11.00

**Brain Artery Stenosis in Neurofibromatosis Type 1 (NF1)**

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**Introduction:** Neurofibromatosis 1 (NF1) is one of the most common genetic conditions affecting the nervous system (1 out of 3000 individuals) caused by a mutation in the NF1 gene on chromosome 17q. In addition to the most frequently encountered abnormalities such as café au lait spots, nerve sheath tumors, low grade gliomas, the protein product of the NF1 gene (neurofibromin) expressed in endothelial and smooth muscle cells, could be responsible for a NF1 associated vasculopathy. Among the cerebrovascular abnormalities found in patients with NF1, the most common is stenosis or occlusion of the cerebral arteries, which may resemble Moyamoya disease. Cerebral aneurysms and arteriovenous fistulae are described as well, although less frequently. The purpose of our study was to review the spectrum of arterial stenosis at MRA/MRA in series of patients with NF1.

**Materials and Methods:** Of the 80 patients included in the study, 63 underwent both conventional brain MRI and MR Angiography (TOF 3D) of the intracranial arteries (61 studies were carried out at 1.5 Tesla, 2 at 0.5 Tesla).

In 17 additional patients where MRA was not available brain MRI studies were accurately reviewed, searching for vessel asymmetries/abnormalities. All patients were asymptomatic for brain ischemia at the time of the examination.

**Results:** No evidence of ischemic brain lesion was found in all cases. Multiple intracranial arterial stenoses were found in 5 patients (Figure 1), respectively located: 1 at the carotid siphon, 2 at the supraclinoid carotid tracts, 2 involving the entire intracranial tract of the ICA, 4 at the MCA, 3 at the ACA, 2 at the PCA, including a typical case of Moyamoya. ICA stenoses were already well evident at MRI, while other stenotic sites were only detectable at MRA. Although all patients were asymptomatic at the time of the examination, a patient with a large fusiform intracranervous aneurysm of the left ICA and a second contralateral smaller aneurysm became symptomatic when he was 21 years old with a sudden left painful ophthalmoplegia caused by aneurysm thrombosis.

**Conclusions:** Our data suggest that cerebrovascular abnormalities and, specifically, arterial stenosis may have a higher incidence compared to data reported so far. In fact cerebrovascular abnormalities in NF1 patients have been reported in about 2.5% of cases, probably underestimating the real incidence, because MR Angiography (MRA) is not routinely carried out in these patients. As also recommended recently by Rea et al1 our findings suggest that routine MRA could be a valuable addition to the brain MR evaluation in NF1 patients.

**References:**


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**New Observation: The Cytotoxic Edema Has a Special Pathogenesis in Case of the Neonatal Hypoxic-Ischemic Encephalopathy**

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**Introduction:** Hypoxic-ischemic encephalopathy (HIE) is the most common disease of the term newborns with the incidence of 1-5 per thousand term deliveries. The most important way of the treatment is therapeutic hypothermia (cooling of the brain). As the clinical picture is not always reliable, amplitude-integrated electroencephalography (aEEG) is used in adjunction to identify infants suitable for hypothermic neuroprotection following severe intrapartum asphyxia. In the last 10 years diffusion weighted imaging (DWI) was believed to improved the accuracy of the diagnosis of the HIE. However, there are still controversies in the literature: (1) there is new evidence suggesting that the correlation between the early aEEG and the short-term adverse outcomes is not too strong; (2) quite often there are no identifiable pathological changes on the DWI during the relatively short therapeutic window of 6 hours after delivery; (3) a wide variety of brain regions have been shown to be affected using DWI; some publications state, that the thalami (Th) are involved, while others show, that the internal capsules (IC) and basal ganglia (BG) are affected, there are reports showing how alterations in the periventricular white matter (WM), periorbital cortex regions (PCR), and corticothalial tracts (CST); (4) in about 20% of the HIE cases the insult happened antepartum, in these cases the hypothermia is unreasonable, but the differential diagnosis between acute and subacute HIE was so far impossible; (5) an optimal evidence-based regime of hypothermic treatment is still lacking. The purpose of this study was to revise the utility of DWI as a diagnostic method in cases of acute HIE. We investigated how DWI can help improving the accuracy of the diagnosis, and the selection of treatment.

**Patients and Methods:** 7 patients with severe HIE had MR examination including DWI 3 times during the first week of life at 3T (Philips Achieva 3T, Philips Healthcare, Best, The Netherlands): the 1st examination happened during the 1st day of life (mean age: 11h); the 2nd during the 2nd-3rd day.

Figure 1 MRA (left) and coronal T2 MRI (right) in a patient with NF1 and optic glioma (arrow) with stenosis of the right PCA (arrow) and left MCA (arrowhead).
Bilateral Basal Ganglia Lesions in Children

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Background: There is a wide range of basal ganglia lesions in children. Knowledge of the different MRI characteristics of these lesions along with the patient’s history can often lead to the correct diagnosis. The basal ganglia consist of (1) the corpus striatum (composed by the caudate nucleus, the putamen, and the ventral striatum); (2) the globus pallidus (composed by the internal and external segments); (3) the substantia nigra (composed by the pars compacta and the pars reticulata); and (4) the subthalamic nucleus. Basal ganglia lesions can occur alone or with other alterations in the CNS.

Imaging Classification: Diseases of the basal ganglia can be classified according to their onset or duration. Acute lesions are usually a result of hypoxic-ischemic injury including near drowning, electrocution, cardiac arrest and non-accidental trauma, and metabolic disorders such as Wernicke encephalopathy. Toxic etiologies including carbon monoxide, and methadone poisoning may be observed in the acute setting. Kernicterus, which is caused by hyperbilirubinemia also results in bilateral basal ganglia lesions. Acute to subacute disease is also caused by infectious etiologies, particularly West Nile and Japanese encephalitis, and by post infectious autoimmune disorders. Chronic lesions are often caused by metabolic diseases and include Leigh’s disease and Hallervorden-Spatz disease and manganese accumulation secondary to liver disease or chronic hyperalimentation, and neurodegenerative and neoplastic etiology.

Imaging Findings: The different disease entities leading to basal ganglia lesions can be differentiated based on their location in the basal ganglia and their T1 and T2 signal characteristics. Even when alteration at the basal ganglia level is present, analyzing other CNS structures for involvement in the disease process is of foremost importance to make the correct diagnosis.

Summary: The aim of this paper is to present an imaging classification of basal ganglia lesions and their underlying pathology, and to familiarize radiologists with the MRI appearance of bilateral basal ganglia disease in children.

Differential Consideration of Bilateral Basal Ganglia Lesions in Children

Paediatrics Brain Tumors

Chairs: E. De Luis, A. Righini
14.30-14.50

Is There Any Relationship between Radiotherapy and MRI-Signal Changes in the Basal Ganglia and/or Dentate Nucleus?

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Background: Brain tumors are the second most common form of childhood cancers. They can be detected by CCT (cranial computer tomography) and/or MRI (magnetic resonance imaging). MRI is helpful for detecting various complications after irradiation, for primary brain tumors - MRI is neuroimaging standard. Twenty percent of all pediatric tumors are pilocytic astrocytoma, 20% are PNET (medulloblastoma) and 5-10% ependymoma. Pilocytic astrocytoma can occur anywhere in the CNS (central nervous system), treatment for this kind of tumor is in 80-100% a complete resection. PNET accounting for 90% of embryonal tumors are cerebellar tumors occurring predominantly males and at a median of 5-7 years. Treatment for PNET and ependymoma involves surgery, chemotherapy and radiation. Sometimes radiation to the brain can have bad side-effects like headache, edema, nausea, vomiting, alopecia and neurological deficits. On MRI radiation-induced vasculopathy and diffuse leukencephalopathy, WMLs
(white matter lesions) or, in some cases signal changes, in the basal ganglia (BG) and/or the dentate nucleus (DN) can be detected in patients who (on an individual basis) underwent radiotherapy of the posterior fossa.

Purpose: To retrospectively evaluate the prevalence of MRI-signal changes in the BG and/or the DN in children with PNET (medulloblastoma), ependymoma or pilocytic astrocytoma who underwent radiotherapy of the posterior fossa between 1982 and 2009 in the Vienna General Hospital, to evaluate possible risk factors for the development of signal changes and to document the neurological clinical presentation of these patients.

Methods and Materials: 79 patients from 1 to 21 years (median 17 years) with PNET (medulloblastoma), ependymoma or pilocytic astrocytoma were retrospectively evaluated. MRI, using a routine tumor protocol, included pre- and post contrast T1-weighted sequences. BG and DN were assessed for hyperintense signals on unenhanced T1-weighted images. Routine therapy protocol consisted of surgery, radiotherapy and/or chemotherapy depending on age at primary diagnosis, tumor type (with or without metastases) and histology (WHO grade).

Results: 45/79 patients who underwent radiotherapy of the posterior fossa after diagnosis of PNET (medulloblastoma), ependymoma or pilocytic astrocytoma were included in this retrospective study. We noted no signal changes in the supratentorial basal ganglia. In the cerebellar dentate nucleus we noted signal changes in 31 cases (69%) post therapeutically. Signs of cerebellar atrophy were seen in 31 cases (69%) post therapeutically. In the cerebellar dentate nucleus (DN) can be detected in patients treated in a single institution. J Clin Oncol 2005; 23: 8863-8869.

Figure 1
Figure 2

Figure 1 axial T1WI-SE without contrast media of a boy with PNET (medulloblastoma). Figure 2 axial T1WI-SE without contrast media in the same boy as in figure 1 show hyerintense signal changes of the dentate nucleus (DN) after radiotherapy (white arrow).

15:05-15:20 10'

Medulloblastoma: Atypical CT & MRI Findings in Children

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Introduction: Medulloblastoma is a highly malignant neuroepithelial tumor of the posterior fossa that is predominantly seen in children. It is the most common malignant central nervous system tumor in children and accounts for up to 38% of all pediatric posterior fossa tumors, representing the most common posterior fossa tumor in this age group. Medulloblastoma most frequently occurs within the first decade of life, with a peak incidence in children between the ages 3 and 7. The cerebellum is by far the most common location (94.4%), with most medulloblastomas (75%) arising in the midline, mainly in the inferior vermis. Imaging features of medulloblastoma reflect its consistency, which is of well-packed small round cells with scarce cytoplasm and reduced free water. On non-contrast computed tomography (CT), the classic appearance is a hypodense mass with variable degree of vasogenic edema. The mass enhances homogeneously following contrast administration. Hydrocephalus is evident in up to 95% of the cases at presentation. On magnetic resonance imaging (MRI), the appearance is typically iso- to hypointense relative to white matter on T1 weighted images (T1WI). The T2 signal is variable and often heterogeneous, ranging from hyperintense to hypointense relative to grey matter. Increased signal on diffusion-weighted images (DWI), with associated decreased apparent diffusion coefficient (ADC), is typical. Enhancement with contrast is usually present, though variable in degree and extent. In the following, we describe uncommon but recognizable imaging features of medulloblastoma.

Foramen Magnum Extension: Extension of medulloblastoma through the foramina of Luschka and Magendie may occur; this should be differentiated from normal enhancement of choroid plexus. Isolated involvement of the cerebellopontine angle (CPA) can be considered as a rare but extreme form of foraminal extension. Those were reported in 4.5% of a mixed pediatric and adult series, and are thought to originate from remnants of the external granular layer, presumable the floculus which faces the CPA. Another speculation is proliferation of residual cells of the lateral medullary velum which may project to the CPA. Hemorrhage: Hemorrhagic brain tumors in children are relatively rare and only a few medulloblastomas and intratumoral bleeding have been described. Differentiating hemorrhage from tumor on CT may be difficult due to the inherent hyperattenuation of the tumor. Standard MRI sequences will usually suffice for this purpose. Spontaneous massive bleeding into medulloblastoma is rare and often fatal; in such scenario, if the hematoma obscure the tumor, other entities causing intracerebral hemorrhage should be considered, namely vascular malformations and hematologic/coagulation abnormalities.

Hemispheric/Eccentric Location: Pediatric medulloblastoma is typically a midline tumor, whereas an eccentric or hemispheric location is considered more typical for adult medulloblastoma. The difference is attributed to the presumed lateral migration of the undifferentiated primitive cells from
their initially central location. Desmoplastic medulloblastoma is a special subtype that is frequently eccentric in location. Another distinct pattern in children is a nodular, “grape-like” appearance that may mimic dysplastic cerebellar gangliocytoma and is frequently eccentric.

Cysts: Despite some reports to the contrary, cysts within medulloblastomas may be found in as many as 80% of cases. Series relating to the size of the cystic components, found that small cysts are more common than solitary large cysts (30-36% and 4-15% respectively).

Enhancement Pattern: Enhancement is almost always present in pediatric medulloblastomas. However, the enhancement pattern can be variable on MRI, ranging from diffuse and homogeneous to focal and patchy. Non-enhancing tumor, however, is atypical, although this pattern has been reported to occur in as many as 7.5% of tumors. The presence or absence of enhancement has no correlation with pathological subtype or prognosis.

Calcifications: Calcifications are present in as many as 20% of cases and are readily visualized with CT. When using MR images alone, calcifications might be overlooked or mistaken for hypointense hemorrhage.

Conclusion: We reviewed the atypical CT and MRI features of pediatric medulloblastoma. Some features that have previously been considered atypical, especially small cysts are in fact frequently seen. Other features, such as grape-like appearance and location in the CPA, are relatively uncommon and not well known to radiologists; however, their imaging appearance is recognizable if once seen. As this review shows, the diagnosis of medulloblastoma should be considered even when atypical features are present.

Patients and Methods: We evaluated 382 MR examinations of 79 LGGs in 74 patients registered to the SIOP-LGG study concerning the amount of contrast enhancement and a change of contrast behaviour over time. Treatment was not considered. Tumor size was measured simultaneously and we compared the relative changes in tumor size with a change of enhancement.

Results: 234 samples showed no change in contrast behaviour, 34 showed a decrease, and 35 an increase of enhancement. As well a decrease and increase of tumor size were found disproportionately frequent in the respective groups.

The mean values for a gain or loss of size correlated well to an increase or decrease of enhancement. However, in each group also a discrepant behavior could be seen in a considerable number of patients. If patients developed a new enhancing lesion (n=14) we also evaluated if the they progressed in the future and found that in the majority new enhancing lesions was seen in tumors (57%) without a significant change in tumor volume (+/-25%) and even in tumors with a decreasing size.

Conclusion: Even if the majority of LGGs conform to an increase or decrease of contrast enhancement shows a relative increase or decrease in tumor size a discrepant behavior is found in a considerable number of tumors and therefore a change in contrast behavior in an LGG must not be taken as a sign of regression or progression if tumor size remains stable. New enhancing lesion did not accompany or predict progression in more than half of the cases. Contrast behavior is variable in LGGs.

Can Malignant Transformation of Pediatric Solid Gliomas Be Predicted with MRS? A Comparison Grading Between Children and Adults

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Objective: To investigate whether morphologic similar glial tumours in adults and children may also show metabolic similarities in proton magnetic resonance spectroscopy (MRS).

Material and Methods: 49 patients with astrocytomas were evaluated retrospectively using normalized measures of total choline (tCho), N-acetyl-aspartate (NAA) and total creatine (tCr). These metabolites were used to differentiate between diffuse, fibrillary astrocytoma (WHO II) and anaplastic astrocytoma (WHO III) in children and adults. Neuropathological grading was performed using WHO criteria. Twelve children (5 Astro II, 7 Astro III) and 37 adults (21 Astro II, 16 Astro III) were included in this study. MRS was performed before treatment in patients with histologically proven astrocytomas. Metabolite concentrations of tCho, NAA and tCr were normalized to contralateral brain tissue. A Mann-Whitney U-Test was performed to evaluate differences within the respective groups.

Results: In both groups, loss of NAA and increase of tCho were more pronounced in WHO III than in WHO II. The best discriminant function to differentiate between low and high grade gliomas was found to be the ratio of NAA/tCho (p<0.01) for the different groups.

Conclusion: Metabolite ratios were more informative than metabolite changes in differentiating low and high grade gliomas in children as well as in adults.

Unusual Giant Spinal Teratoma in an Infant

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1Dept of Neuroradiology Univ. Würzburg Reference Center; Würzburg, Germany; 2Pediatric Clinic; Study Center for the Siop-Lgg; Augsburg, Germany

A 4-month-old girl suffered from progressive lower limb weakness. Physical examination revealed no skin defect or abnormal hair at her back. MRI of spine showed a giant intradural mass lesion of cystic and solid component extended from C7 to S2 level.

Fat component was also noted. Laminectomy with partial tumor removal was done. Pathological examination revealed mature teratoma Neurodevelopmental tumors (dermoid/epidermoid tumors, and teratomas) were the most common type, about 31%, of pediatric spinal tumors. Identification of the fat component was help to make the diagnosis of teratoma. Most cases are mature teratomas and rare in malignant change.

The most common site of pediatric spinal teratoma is in dorsal area of lumbosacral area. In our case, extension to ventral part is because of the giant size. Invasion of the spinal cord may also be noted on MRI, which will cause the difficulty of tumor total removal during operation.

The diagnosis will be definitely made by detection of fat component. (A) pre-contrast T1WI (B) contrast-
Infarction after Surgical Resection in Chiasmatic Low Grade Gliomas (LGG)

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Introduction: Currently in the SIOP/LGG study chiasmatic tumors identified as a low grade glioma (LGG) on the basis of neuroradiological characteristics are allowed to be treated without histological verification. As some tumors especially in very young children do not respond well to treatment the search for histopathological and immunohistochemical markers in these tumors has gained importance for future studies. However, during the reviewing process of these tumors we had the impression of an increased frequency of infarctions after resections in this area of the brain.

Patients and Results: Our patients consisted of 88 children with an operated chiasmatic glioma registered in the data pool of the national reference center for Neuroradiology. Histology was obtained during 104 surgeries by 18 stereotactic, 9 open and 2 endoscopic biopsies and 65 partial/subtotal resections. In 10 patients we had not information on the mode of surgery. At the time of operation median age was 5y 2m. We could identify infarctions following 15 (14.9%) surgical procedures (all resections). Biopsies of whatever modality were not complicated by infarctions. The age of children with infarctions (2y 4m) was considerably younger than the age of the whole group. As a control group served 51 consecutive patients with an LGG of the cerebellum with 66 surgical procedures (2 biopsy, 22 partial/subtotal resections, 42 total resections). Median age at the time of surgery was 7y 4m. Only one resection was followed by an infarction (1.5%).

Conclusion: There is a high risk of infarction linked to resections for chiasmatic LGG especially in the younger children and as complete resection is usually not feasible in this kind of tumor the retrieval of material for diagnosis and scientific evaluation should be performed by biopsy only.
To our knowledge this is only the second case of a pituicytoma presenting with spontaneous haemorrhage. The differential diagnosis of a hemorrhagic suprasellar mass includes: Rathke's cleft cyst, craniopharyngioma, optic-hypothalamic glioma, cavernous angioma, venous angioma, germinoma, meningioma, metastases and aneurysm.

Case Report: A 65-year-old man without any significant previous medical history was brought to our emergency department due to an abrupt decrease of consciousness level. Neurologically he only opened the eyes and made flexion of the limbs in response to painful stimuli, with incomprehensible sounds when stimulated. He had a total Glasgow Coma Score (GCS) of 6. No other focal neurological deficits were seen. Head computed tomography (CT) showed a poorly-demarcated suprasellar acute hemorrhagic mass with 2.7cm of maximum diameter and an extensive tetraventricular haemorrhage with signs of acute hydrocephalus. CT images showed no calcifications, bone destruction or hyperostosis. CT angiography ruled out the hypothesis of aneurysm. External ventricular drainage catheters were placed. In the same day, a Magnetic Resonance Imaging (MRI) showed a 2.4x2.7x2.1cm almost homogeneous suprasellar mass, extending above of the clivus, mainly hyperintense in T2-weighted images (T2WI) and isointense in T1-weighted images (T1WI) with probable haemorrhage inside. There was not any relationship with the pituitary gland but we could not differentiate the pituitary stalk. Prolactin, cortisol and aldosterone levels were within the normal limits and thyroid gland hormones (T3, T4 and TSH) were slightly decreased. In addition, only slight elevation of prolactin and decrease of FSH, LH and testosterone. As pituicytomas are usually not associated with spontaneous haemorrhage, the precise anatomical location and strong con- trast enhancement can be clues to the diagnosis. As pituicytomas are usually highly vascularized and firm tumors, its correct diagnosis can help in the surgical approach, as there is usually a larger role for a craniotomy or to an extended cranial base approach. Preoperative embolization can be a prudent preoperative strategy, not only to reduce the hemorrhagic risk, as well to more accurately depict the vascular feedings of the tumor, in order to try to prevent damage to major vascular branches, as happened in our case.

Discussion: Hemorrhagic suprasellar masses are rare and this kind of presentation in a histologically confirmed pituicytoma is almost unique. Therefore pituicytoma should be considered in the differential diagnosis of a hemorrhagic suprasellar mass. Our first diagnosis in the initial T1 scan was rupture of an aneurism due to location and extensive intraventricular haemorrhage with acute hydrocephalus. As the treatment approach is completely different from a tumor, it was ruled out by CT angiography. Although it is admittedly difficult to identify correctly a preoperative pituicytoma, the precise anatomical location and strong contrast enhancement of the mass give clues to the diagnosis. As pituicytomas are usually highly vascularized and firm tumors, its correct diagnosis can help in the surgical approach, as there is usually a larger role for a craniotomy or to an extended cranial base approach. Preoperative embolization can be a prudent preoperative strategy, not only to reduce the hemorrhagic risk, as well to more accurately depict the vascular feedings of the tumor, in order to try to prevent damage to major vascular branches, as happened in our case.

Results: Both in OVF and in SVG 11 volunteers presented fronto-pa- rietal activations lateralized in the left cerebral hemisphere, while the cerebellar activations were lateralized in the right hemisphere. In one healthy subject where the activations were right lateralized, the cerebel- lar activations were localized in the left hemisphere. In SVG, all subjects presented left fronto-parietal and left temporal activations, while the cerebel- lar activations were lateralized in the right hemisphere. Also a II level study group has been performed on the healthy subjects for all tasks. The random effect analysis gave the localization of the tasks in the right cerebellar hemisphere. The 6 patients pre- sented slightly more bilateral cerebral activations if compared with healthy subjects. Among these, 3 presented bilateral cerebellar activation, 3 more localized activations in the right cerebel- lar hemisphere.

Discussion: Assessment of cerebel- lar fMRI lateralization of language is feasible in children, even with mild cognitive deficits. According to litera- ture, both VF and VG are associated with significant activation in the cerebel- lar hemisphere, contralateral to the dominant cerebral hemisphere. The calculated cerebellar Asymmetry Indexes seem to anti-correlate with the frontal lobe activations: low levels of GFAP helps to rule out pilocytic astrocytoma. The weak cytokeratin immunoreactivity and the apparently benign histologi- cal appearance excluded metastases. The patient recovery slowly from his consciousness level and apart of a visual field loss he was otherwise neurological when discharged home. After 6 months of follow-up, laboratory analysis show only slight elevation of prolactin and decrease in FSH, LH and testosterone. Last MRI shows residual enhancing tumor attached to the pituitary stalk and an old ischemic infarct in the right PCA, probably related with the surgical procedure. No growth of the residual lesion was seen.

Cerebellar fMRI Lateralization of Language in Children after Pilocytic Astrocytoma Resection: Comparison with Healthy Children
F. Ghielemetti, A. Erberta, S. Bulgheroni, F. Vitali, D. Riva, M.G. Brunzone
Fondazione IRCCS Istituto Nazionale Neurologico C. Besta; Milano, Italy

Introduction: Cerebellum is not only involved in motor and articula- tory control but also in higher cogni- tive functions. Studies with functional MRI in right-handed healthy volun- teers show that cerebellar activation during language tasks is mainly localized in the right hemisphere, contralateral to the dominant cerebral hemi- sphere. Our purpose was to evaluate cerebellar lateralization of language by functional MRI in healthy children and to study the functional reorganiza- tion in children after cerebellar pi- locytic astrocytoma resection.

Subjects and methods: We per- formed fMRI studies in 12 healthy right handers children (mean 11.3, range 8-16) and 6 patients (mean 11.6, range 9-17), 5 right handers, 1 left, with surgical resection of vermal (3) and right cerebel- lar hemisphere (3). The tasks chosen for the healthy subjects were: overt verbal fluency (OVF), silent verbal fluency (SVF) and silent verb generation (SVG). Patients underwent OVF and SVG tasks. All subjects were trained outside the scanner before the MRI exam. During the fMRI sessions also morphological T1 and T2 imaging was done for each subject. All acquisitions were performed using a 1.5T Siemens Avanto scanner. Imaging processing and sta- tistical analysis were conducted using the Brain Voyager (Brain Innova- tional Parametric Mapping) software.

Results: In OVF and in SVG 11 volunteers presented fronto-parietal activations lateralized in the left cerebral hemisphere, while the cerebellar activations were lateralized in the right hemisphere. In one healthy subject where the activations were right lateralized, the cerebel- lar activations were localized in the left hemisphere. In SVG, all subjects presented left fronto-parietal and left temporal activations, while the cerebel- lar activations were lateralized in the right hemisphere. Also a II level study group has been performed on the healthy subjects for all tasks. The random effect analysis gave the local- ization of the tasks in the right cere- bellar hemisphere. The 6 patients pre- sented slightly more bilateral cerebral activations if compared with healthy subjects. Among these, 3 presented bilateral cerebellar activation, 3 more localized activations in the right cerebel- lar hemisphere.

Discussion: Assessment of cerebel- lar fMRI lateralization of language is feasible in children, even with mild cognitive deficits. According to litera- ture, both VF and VG are associated with significant activation in the cerebel- lar hemisphere, contralateral to the dominant cerebral hemisphere. The calculated cerebellar Asymmetry Indexes seem to anti-correlate with the frontal lobe activations: low levels of GFAP helps to rule out pilocytic astrocytoma. The weak cytokeratin immunoreactivity and the apparently benign histologi- cal appearance excluded metastases. The patient recovery slowly from his consciousness level and apart of a visual field loss he was otherwise neurological when discharged home. After 6 months of follow-up, laboratory analysis show only slight elevation of prolactin and decrease in FSH, LH and testosterone. Last MRI shows residual enhancing tumor attached to the pituitary stalk and an old ischemic infarct in the right PCA, probably related with the surgical procedure. No growth of the residual lesion was seen.

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Introduction: Cerebellum is not only involved in motor and articula- tory control but also in higher cogni-
eralized for silent tasks, probably due to the bilateral contribution of the mouth movements in overt tasks. Children with right cerebellar resections, especially of the lateral part and for wide lesions, present the most significant language deficits and bilateral cerebellar activations. This activation pattern is likely to be an attempt of compensatory reorganization. However the reorganization takes place also in the right damaged cerebellar hemisphere. Future analysis of correlation between cerebellar lateralization and language performance will disclose if this reorganization is successful to compensate the language deficit. The random effect analysis (study group) conducted on the healthy subjects gave the topology of the cerebellar activations, showing the differences between VF and VG.

References
Brain Tumors 5

Chairs: M.A. Weber, A. Falini

14.30-15.00 25’

Introductory Lecture
Characterization of Glioblastoma and Metastatic Tumor Tissue by Proton Spectroscopy and Diffusional Kurtosis Imaging

P. Raab, E. Bültmann, A. Tabesh, U. Pilatus, E. Hattingen, F.E. Zanella, H. Lantermann, Hannover Medical School; Hannover, Germany; Radiology, New York University; New York, NY, USA; Neuroradiology, JW Goethe University, Frankfurt/Main, Germany

Introduction: Solitary enhancing intracranial neoplasms are often high grade gliomas or metastases. Based on conventional magnetic resonance imaging (MRI) techniques, their radiological appearance can be similar. Non-invasive MRI techniques like diffusion-weighted imaging (DWI), 1H magnetic resonance spectroscopy (MRS) and perfusion-weighted imaging (PWI) can be used to further characterize the tumor tissue, although these techniques showed varying results (Ishimaru, Morikawa et al. 2001). The new technique called diffusional kurtosis imaging has shown its capabilities of better characterizing microstructural tissue changes compared to conventional diffusion tensor imaging (Hui, Cheung et al. 2008; Raab, Hattingen et al. 2010). We found higher mean kurtosis values in the metastasis group of our patients, indicating a higher structural complexity in these non-glial tumors. The higher FA values in the glioblastoma group might be caused by the more infiltrative behavior of these tumor cells. Modern MRI techniques can depict pathophysiological and microstructural differences between glioblastomas and metastases and can help differentiate between these two tumor entities.

Methods: At 1.5 T a standardized spectroscopy analysis was done as described by Falangola et al. (Falangola, Jensen et al. 2008) and Tabesh et al. (Tabesh, Jensen et al. 2010). The tumor groups were compared using the Mann-Whitney test. Results: The spectroscopy analysis included 50 patients with glioblastomas and 15 patients with metastases. The normalized tumor lipids were significantly higher in metastases compared with glioblastomas (p<0.001). Normalized creatine values were higher in glioblastomas compared to metastases. Diffusion analysis included 8 patients with solitary metastases and 13 patients with glioblastomas. The data showed slightly higher FA values in glioblastomas compared to metastases (p<0.04) and higher mean kurtosis in the metastasis group (p<0.045).

Discussion: It can be difficult to discern between a glioblastoma and a metastasis based on conventional MR imaging, if the tumor is a solitary enhancing lesion. Our spectroscopic data showed significantly higher lipid resonances in metastatic disease compared to glioblastomas, which is in accordance with the literature (Ishimaru, Morikawa et al. 2001; Opstad, Murphy et al. 2006). These lipid resonances of metastases are thought to represent intracellular lipid droplets rather than tissue necrosis. Higher creatine concentrations in glioblastomas have been described previously (Ishimaru, Morikawa et al. 2001). The new technique called diffusional kurtosis imaging has shown its capabilities of better characterizing microstructural tissue changes compared to conventional diffusion tensor imaging (Hui, Cheung et al. 2008; Raab, Hattingen et al. 2010). We found higher mean kurtosis values in the metastasis group of our patients, indicating a higher structural complexity in these non-glial tumors. The higher FA values in the glioblastoma group might be caused by the more infiltrative behavior of these tumor cells. Modern MRI techniques can depict pathophysiological and microstructural differences between glioblastomas and metastases and can help differentiate between these two tumor entities.
at eight different timepoints (364ms, 614ms, 864ms, 1114ms, 1364ms, 1614ms, 1864ms, 2114ms) to follow the arrival of the labeled bolus. These timepoints are defined as different “inversion times”, which are determined as the time between labeling and image acquisition. Multivoxel MR-Spectroscopy was used to determine the most malignant part of the tumor related metabolic changes (Cho/NAA and Cho/Cr ratio). These regions are defined as “tumor hotspots” served as the region of interest for ASL signal intensities measurements consequently after the Chemical and Chemical Shift Imaging sequences were coregistrated. The regionally highest tumor perfusion on ASL maps and the highest Cho/NAA ratio in the Chemical Shift Imaging reflecting the most malignant tumor related metabolic changes were correlated. Results were compared with postoperative histology with respect to the degree of malignancy.

Results: All 10 gliomas showed only one region in the brain tumor of highest signal intensity in the ASL sequence (Figure 3) and one Cho/NAA ratio peak in chemical shift imaging (Figure 2), which corresponded with the contrast media enhancement on the T1 weighted images (Figure 1).

In all 10 gliomas there was an accordance between the region of the highest signal intensity in the ASL sequence and the Cho/NAA ratio peak in chemical shift imaging (Figure 4). The figure shows a correlation between the region of the highest signal intensity in the ASL sequence (in the front), which is representing the region of the highest tumor perfusion and the Cho/NAA ratio peak in chemical shift imaging (in the background), which represents the most malignant tumor related metabolic changes. Moreover those voxels with the highest signal intensity in the ASL showed pathologically high Cho/NAA ratios in the multivoxel MR-Spectroscopy, which were characteristic for changes in the most malignant part of brain tumors (Figure 5).

Conclusion: The results indicate that in glial tumors, there is an accordance between tumor perfusion and tumor related metabolic changes, showing the most malignant part of the tumor without any kind of extrinsic tracer or contrast media. This might improve target stereotactic biopsy toward the most malignant part of the tumor and reduce sampling errors for histopathology. Furthermore, there may be a potential of a combination of ASL and MR-Spectroscopy in the differential diagnosis of brain tumors.
Proton Magnetic Resonance Spectroscopy Provides Relevant Prognostic Information in High Grade Astrocytomas

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1 Department of Radiology, IHi Centre Bellvitge, Hu de Bellvitge; Barcelona, Spain; 2 Department of Neurology, Hu de Bellvitge; Barcelona, Spain; 3 Centro de Investigación en Red en Bioingeniería, Biomateriales y Nanomedicina (Ciber-BBN); Cerdanyola del Vallés, Spain; 4 Department of Medical Oncology, Ico Hospital Universitari de Bellvitge; Barcelona, Spain; 5 Department of Biocquímica I Biologia Molecular, Unitat de Bioquimica de Biociències, UA de Barcelona; Cerdanyola del Vallés, Spain

Introduction: Prognosis for patients with High-Grade Astrocytomas (HGA) is poor and survival ranges between a few days and several years. The reasons for this large variability in survival from patient to patient are not fully understood, and can only be partially explained by histopathology, WHO grade, age, extent of surgery an performance status. Functional MR techniques yield metabolic information that could be relevant to predict clinical outcome in these patients. Our purpose was to retrospectively assess the prognostic value of single voxel Proton MR Spectroscopy (1H-MRS) in HGA.

Materials and Methods: This retrospective study was approved by the institutional review board of our hospital with waiver of specific informed patient consent. One hundred and fifty-two patients with pathologically confirmed HGA were retrospectively included in the study. Retained studies had been selected with 1H-MRS prior to any treatment (including surgery) and had available all the clinical information required (age, gender, WHO histology grade, extent of surgery, treatment administered and survival). Single voxel 1H-MRS was performed with a 1.5 T unit. Spectra were acquired with the following parameters: TR, 2000 ms; TE, 30 ms; averages, 96 to 192; VOI between (1.5 cm)3 and (2 cm)3. Spectrum analysis was performed off-line with the use of MRUI software. The intensities of the datapoints of the spectrum included between 0.00ppm and 4.00ppm were measured and normalized to Unit-Length. Each normalized datapoint value was considered a variable for the statistical analysis. The cohort of patients was dichotomized in two groups according to survival better or worse than the median value of survival. These groups were compared with the Mann-Whitney U test for defining the points that showed more significant differences between them. Those datapoints were considered those more relevant and were retained for a prognostic assessment. Threshold values were defined with ROC curves, for stratifying patients into two groups that were hypothesized to represent patients with good and bad prognosis. The predictive potential of these variables about survival was analyzed with the Kaplan-Meier method, with use of log-rank statistics. The Cox proportional hazards model was used with forward stepwise model selection for assessing the spectroscopic variables jointly with other prognostic variables evaluated in the study.

Results: Median survival for high-grade astrocytomas included in the study was 187 days. Average spectra for the two groups defined with this value are shown in Figure 1. Four datapoints were selected with the Mann-Whitney U test: 0.89ppm (p=0.0001); 1.32ppm (p=0.0018); 3.67ppm (p=0.0005) and 3.85ppm (p=0.0112). Four ratios were calculated with permutations of the datapoints. The groups defined with threshold values obtained with ROC curves, showed significant differences in survival (p values between <0.0001 and 0.0008). Four variables were chosen in the multivariate model with forward stepwise selection: extent of surgery, treatment administered, normalized intensity of the datapoint 0.89 ppm, and the ratio between the intensities of the datapoints 3.67ppm and 1.32 ppm. Figure 2 shows the survival curve of patients dichotomized into two groups according to values of the ratio 3.67 ppm/1.32 ppm higher or lower than 0.1723.

Conclusion: 1H-MRS may be considered a major prognostic factor for HGA. The biochemical information brought by 1H-MRS provides a non-invasive insight into the metabolic status of the tumor that may help in specifying the prognosis of patients with high-grade astrocytomas. This information can be obtained by assessing the ratio between the datapoints 3.67ppm and 1.32ppm, a method that does not require additional computation for normalization. We hypothesize that the data point 3.67 ppm could be related to glucose content. On the other hand, the data point 1.32 ppm could be related to mobile lipids, a metabolite that has been associated with tumoral necrosis.
Brain Tumors 6

16.30-16.45

Recurrence of High Grade Gliomas Treated with Bevacizumab (Anti Vascular Endothelial Growth Factor) and Irinotecan: How to Diagnose Tumour Progression on MRI?

S. Condette-Auliac¹, A. Boulin¹, C. Echalier¹, A. Haouzi², S. Aide², S. Guieu¹, F. Deschênes², G. Rodesch¹

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Purpose: The aim of this study is to report the radiological effects of antiangiogenic (antiVEGF) drugs in the treatment of high grade gliomas, and to discuss the MRI evaluation of the response of treatment for these tumours.

Material and methods: Since 2008, 11 patients with recurrent high grade gliomas were treated with second line of chemotherapy and antiangiogenic drugs. We report the radiological effects of antiangiogenic drugs. Parenchymal changes on FLAIR sequences seem to represent an important additional tool to appreciate this tumoral evolution.
Prevalence of Brain White Matter Signal Abnormalities in Acromegalic Patients Undergoing Magnetic Resonance Imaging

V. Citton 1, R. Manara 1, S. Rizzati 1, I. Albano 1, A. Rebellato 1, R. Zanchetta 1, D. D'Avella 1, G. Favezi 1, S. Dal Foss 1, C. Carollo 1, P. Maffei 1, N. Sicolo 1, C. Martinii 1, C. Scarioni 1 1Neuroradiologic Unit; Padua, Italy; 2Endocrinologic Unit; Padua, Italy; 3Third Medical Clinic; Padua, Italy; 4Neurosurgery Department; Padua, Italy

Introduction: Acromegaly is characterized by excessive levels of growth hormone (GH) and insulin-like-growth factor 1 (IGF-1) and is associated with a vast range of complications and comorbidities such as organomegaly, skeletal deformations, diabetes mellitus, arterial hypertension, secondary pituitary deficiency, and neurological complications. Although a higher prevalence of ischaemic heart disease and mortality has been shown, no data are available on cerebrovascular involvement in acromegalic patients.

Purpose: to investigate acromegalic patients by means of brain MRI in order to evaluate the prevalence of white matter signal abnormalities (WMAs).

Material and Methods: patients followed in our centre because of proven acromegaly underwent brain MRI (Philips Achiva 1.5T). Fluid Attenuated inversion Recovery images were used for evaluating semiquantitatively the WMAs burden according to Fazekas scale.

Results: brain MRI of 101 acromegalic patients were evaluated (mean age 53 years, age range 21-79 years). The WMAs burden was scored 0, 1, 2 and 3 in 50, 57, 6 and 8 cases, respectively.

Conclusions: white matter signal abnormalities are very frequent in acromegaly even in young patients. A strict control of concomitant risk factors is warranted in order to prevent severe cerebrovascular events.

Pineal Parenchymal Tumor of Intermediate Origin: Imaging Spectrum of an Unusual Tumor in 11 Cases

S. Komakula 1, M. Warthum-Meta 1, P. Hildenbrand 2, L. Loewner 1, R. Hewlett 1, A. Oshorn 1
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Purpose: Pineal parenchymal tumor of intermediate differentiation (PPTID) has been recognized in the 2007 World Health Organization (WHO) classification as a new primary pineal parenchymal neoplasm, intermediate in malignancy (WHO grade II or III) between pineoblastoma (grade IV) and pineocytoma (grade I). PPTID is characterized by histologic pleomorphism with variable cellularity and nuclear atypia, absence of significant mitotic activity, and strong synaptophysin and GFAP immunoreactivity. Only a limited number of cases have been reported in the pathology literature. This new tumor entity has not been described in the radiology literature. We describe the imaging spectrum in 11 cases and delineate imaging findings that may suggest the preoperative diagnosis of this newly-recognized entity.

Materials & Methods: In this IRB-approved study, teaching files as well as imaging studies and clinical records of patients with typical pineal masses over the last 20 years were reviewed retrospectively.

Results: We identified 9 histologically proven and 2 presumed cases of PPTID. Patient age at presentation ranged from 4.5 to 75 years. Presenting symptoms included headache (7/11), signs of elevated intracranial pressure (6/11), Parinaud syndrome (9/11), other visual symptoms (1/11), seizures (1/11), and focal neurologic deficits (2/11). Imaging studies in nine patients showed aggressive pineal region masses with local brain invasion. Two patients had a well circumscribed mass without signs of regional invasion. Two patients had spinal metastases at presentation. Six patients had CT imaging. Of these, five patients had classic 'exploded' calcifications characteristic for pineal parenchymal tumors. All patients had MRs. The tumor was T1 heterogeneously hypointense and T2 heterogeneously hyperintense in all cases, and showed strong heterogeneous (10/11) or uniform (1/11) enhancement following contrast administration. Cystic foci were identified in 8 cases. Of our two presumed cases, one patient presenting at 15 years age was initially treated for a presumed pineal teratoma. Tumor recurrence with local invasion was later treated with debulking and histopathologic diagnosis of 'pineoblastoma'. The patient expired 21 years after initial diagnosis following multiple recurrences. The autopsy diagnosis was 'Pineoblastoma with transitional features and retinoblastomatous differentiation'. The second presumed case had a pineal tumor diagnosed at age 34 and operated elsewhere, with a histologic diagnosis of 'pineocytoma'. The patient returned 10 years later with an aggressive, locally invasive recurrent tumor and is awaiting surgery at this time. Based on the history and imaging characteristics we suspect a diagnosis of PPTID in both these cases.

Conclusion: PPTIDs may account for at least 20% of all pineal parenchymal tumors. These tumors have highly variable behavior. Local recurrence is common although dissemination is rare. PPTIDs are usually slowly progressive and compatible with long-term survival even with subtotal resection. While no singular neuroradiographic feature is pathognomonic of PPTID, these tumors usually demonstrate local invasion and appear much more heterogeneous than pineocytoma. They present at a later age than pineoblastoma and dissemination is unusual. Based on these features we were able to make the preoperative diagnosis of PPTID in our most recent case. Radiologists should consider the diagnosis of PPTID in an older child or adult with an atypical or aggressive-appearing, locally-invasive pineal region mass. The histopathology of tumors initially diagnosed as ‘pineocytoma versus pineoblastoma’ and ‘atypical pineocytoma’ prior to 2007 should be reviewed as these may be PPTIDs. It is important to consider the diagnosis of PPTID as these tumors have a higher grade and increased potential for recurrence compared to pineocytomas. Shorter follow-up and adjuvant therapy may be indicated in selected cases.
Purpose/Introduction: Extramedullary hematopoiesis (EMH) is the formation and development of blood cells in tissues other than bone marrow. EMH is described as an ectopic production of myeloid, erythroid and megakaryocytic elements. Intracranial EMH is extremely rare.

Subjects and Methods: We present radiologic findings of a young male patient with previously diagnosed and treated as β thalassemia major and complaining of a constant headache and vertiginous symptoms.

Results: Cranial films revealed a characteristic calvarium with wide diploe and thinned plates and hair-on-end outer cortices. Magnetic resonance imaging (MRI) showed subdural masses along the dura and falk cerebri with strong enhancement. There was also a cystic appearance separate from other subdural masses. On FLAIR images it had peripheral hyperintensity consistent with peritumoral edema.

Discussion/Conclusion: Extramedullary hematopoiesis occurs as a compensatory mechanism in response to disease states that inhibit adequate maintenance of bone marrow elements in the peripheral blood. Extramedullary hematopoiesis is most common in patients with hemoglobinopathies such as thalassemia and sickle-cell disease and marrow-replacing disorders such as myelofibrosis. Reported CNS sites of involvement include the choroid plexus and dura mater (over the cerebral convexities, along the falk cerebri, and within the epidural space of the spinal canal). The origin of CNS involvement is thought to be pluripotential stem cells, which occur in tissues of mesenchymal origin. In medical literature, reports of MRI findings have been limited, particularly with respect to intracranial involvement.
Palazzo della Cultura e dei Congressi - White Hall 2
Thursday, 7 October - 09.15-17.15

COMMUNICATIONS

Head & Neck 3
Chairs: W. Dillon, A. Gouliamos
09.15-09.30

Extraskelatal Chondrosarcoma of the Inferior Nasal Concha
I. Demirci, M.D. Aybar, A.Y. Barut, A. Ozturk, I.N. Mutlu
Istanbul Education and Research Hospital; Istanbul, Turkey

Introduction: Chondrosarcoma are slowly growing malignant tumours of cartilaginous tissue. They usually present in the 4th to 6th decade of life. Extraskelatal chondrosarcoma presenting in the head and neck is extremely rare (1,2). Chondrosarcomas may arise in the nasal cavity (septum, floor, lateral wall or cribiform plate), ethmoid sinuses, maxilla and maxillary sinuses and the sphenoid region. At the time of presentation there is frequently extensive involvement of cavities of the nose and adjacent sinuses (3). We report the imaging features of extraskelatal chondrosarcoma originating in the right nasal cavity of a 62-year-old man with the history of right sided nasal obstruction and intermittent right epistaxis.

Case Report: A 62-year old man patient with no significant medical history referred to our hospital complain of right sided epistaxis and nasal obstruction. His physical examination was unremarkable. Unenhanced computed tomography (CT) examination of the paranasal sinuses showed an expansile, polypoid soft tissue mass arising in the right nasal cavity with extension into the right maxillary sinus. Then we performed Magnetic Resonance Imaging (MRI) of the paranasal sinuses. MRI showed multilobulated, heterogenous enhancing tumoral lesion which was originating from right medial-inferior concha level, filling the nasal cavity with extension to the right maxillary sinus wall and narrowing the maxillary sinus lumen with an invagination to the hard palate at inferior. The lesion was hypointense in T1W (figure 1-2), heterogeneous hiperintense in T2W (figure 3) and showed homogeneous but marked enhancing (figure 4-5). After this methods we comment the lesion as a malignant tumoral lesion originating from the nasal cavity. In this patient biopsy findings enabled us to confirm the preoperative diagnosis of low grade chondrosarcoma.

Discussion: Chondrosarcomas are rare malignant neoplasms that can be found anywhere in the body, but are most commonly located in the long bones and the pelvis. Less than 10% originate in the head and neck region. Chondrosarcomas of the sinonasal cavity are slow-growing invasive cartilaginous tumors, and they usually have a high grade of malignancy (4). Chondrosarcoma of nose and paranasal sinus region is a rarely encountered tumour constituting only 4% of nonepithelial tumours of the nasal cavity, paranasal sinuses and nasopharynx (5-6). About 60% of sinonasal chondrosarcomas arise in the anterior alveolar region of the maxilla (7). The tumor most commonly affects patients older than 35 years, and only a few cases have been reported in children and adolescents. Males are more commonly affected than females. The aetiology of this tumour is unknown but like other chondrosarcomas previous accidental or surgical trauma to the nose (4). Patients with sinonasal chondrosarcoma may present with a variety of symptoms, such as nasal obstruction, epistaxis, chronic nasal discharge, loose teeth or dentures, toothache, cheek pain, headache, or toothache, cheek pain, headache, or toothache.

Conclusion: Chondrosarcoma of nose and paranasal sinus is a very rare tumor with malignant potential. Diagnosis is made on the basis of radiological and pathological features. Prognosis depends upon the grade of the tumor and location of primary tumor. The tumor being radio-resistant, widest possible exposure and wide surgical excision are considered the treatment of choice. Post operative follow-up is mandatory as the recurrent disease is more difficult to treat.

09.30-09.45

Meningoencephalocele and Other Septoplasty Complications - In the Context of a Clinical Case
J. Baptista 1, A. Fernandes 1, A. Bráz 1, M. Patrício 1, R. Montemor 2  
1 Centro Hospitalar de Lisboa Central, Neuroradiology Department; Lisbon, Portugal; 2 Centro Hospitalar de Lisboa Central, Otorrinolaringology Department; Lisbon, Portugal

Patients undergoing nasal septoplasty can face many complications. Some of these complications are rare but their results could be life threatening. The occurrence of septoplasty complications can be separated temporally. They may be seen at the start of surgery and extend well beyond the completion of the healing phase. Early complications include hemorrhage and Cerebrospinal Fluid Leak. Bleeding is one of the more common complications of septoplasty, usually occurring during surgery or immediately after surgery. An exceedingly rare complication of septoplasty is CSF leak. It
is caused by a tear of the dura mater surrounding the brain and its supporting structures of the skull base, which therefore produces a leak of fluid through the formed connection between the subarachnoid space and the nasal cavity. Although extremely unusual after septoplasty, it can be a serious and life-threatening complication if not managed appropriately. Nasal surgery is the second most common cause of CSF leakage, second only to traumatic skull base fractures. If a proper diagnosis of CSF leakage is not made, there can be enlargement and remodeling of the bone over time and a dural defect, leading to herniation of the meninges (encephalocele) and brain tissue (encephalocele) through the defect by pulsation of the brain. As with any surgical procedure, postoperative infection is an important complication that can appear. There is a 2.5% chance of infection occurring secondary to septoplasty surgery, most likely to occur immediately after surgery. Septal hematoma and subsequent abscess formation are examples of intermediate complications that should be quickly recognized. Late complications include sensory disturbances as anosmia, palatal sensory, and odynophagia, and even blindness. Anosmia or hyposmia occurs in approximately 1% of patients undergoing septoplasty, with total anosmia on long-term follow-up occurring at a rate of 0.3% to 2.9%. Synechiae, are inflamed bands of adherent mucosa that may cause late postoperative nasal obstruction after septoplasty, commonly occurring between the septum and inferior or middle turbinates. We report a 46-year-old man with history of right nasal fossa obstruction that he noted 4 years after a nasal septoplasty performed ten years before our observation. At otolaryngology examination a blue colored soft non-hemorrhagic formation at the right lateral nasal esphenoidal recess, extending until the head of the right middle turbinate. A paramaxillary computed tomography scan was performed and a defect in the right lateral wall of sphenoid bone and a bicuspid component occupying the right nasal cavity were identified. A magnetic resonance examination was done and showed herniated brain and CSF filled sac through the osseus defect that was interpreted as a meningoencephalocele in the right nasal cavity. We illustrate this case report with CT-scan and MRI images and do a brief review about other septoplasty complications, conservative, endoscopic and transcranial management of CSF leaks and nasal meningoencephalocele are also analyzed.

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Radiological Appearances of Oropharyngeal Soft Tissue Reduction with Bipolar Radio-Frequency Treatment in Sleep Disordered Breathing: A Pilot Study

S. Ghosh-Ray, B. Kotecha, S. Chawda
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Romford, United Kingdom

Aim: To demonstrate and track the changes of bipolar radiofrequency volumetric tissue reduction (BRFVTR) induced lesions of the tongue base and soft palate in the treatment of sleep disordered breathing (SDB) in a pilot study.

Introduction: SDB is a debilitating condition with significant associated morbidity. Aside from the direct effects on sleep duration and quality, there is a growing body of evidence linking obstructive sleep apnoea with an increased risk of acute coronary syndromes[1]. Studies are showing that the volume of the soft tissue structures along the upper airways is greater in subjects with SDB[2]. Tissue reduction treatment using monopolar radiofrequency ablation has been studied widely. BRFVTR treatment allows more accurate delivery of the energy between two electrodes, reducing secondary damage, requires less energy per session and is less time consuming. So far the imaging characteristics of areas treated with BRFVTR has not been studied in human subjects over extended periods post-treatment. This pilot study assesses the magnetic resonance imaging (MRI) characteristics of these areas to understand the post-treatment appearances. This will enable differentiation between normal physiological healing and abnormal appearances following treatment.

Method: The study protocol was reviewed and approved by the local Research & Ethics Committee of Barkingside, Havering and Redbridge Hospitals NHS Trust. Five male patients were treated for SDB with a single session of BRFVTR. Patients had various combinations of treatment to the tongue base, soft palate only and soft palate combined with palatal arches and uvula. One patient had tonsillectomy in addition. MRI scans were performed pre-operatively, one week and six weeks post surgery in all patients. Additional scans were performed at other intervals between day one and week six in some patients to demonstrate sequential changes in lesion appearance. Soft tissue and airway measurements were made on T1 weighted sequence. However, in contrast to T1-weighted imaging, on short tau inversion recovery (STIR) sequence imaging lesions were still evident at Day 42 as small high signal areas in two of the five patients.

Results: The treated area was visible from Day 1 post-procedure. On T1 weighted sequences the lesion demonstrated central hyperintensity (haemorrhage) with surrounding hypointensity (oedema). Lesion size was seen to increase up to Day 3 with mild increase in the central haemorrhagic region. Subjectively, lesion definition improved up to Day 7 while peripheral oedema decreased. After Day 7 lesion size and definition started to diminish. By Day 42 there was no remaining lesion evident subjectively on the T1 weighted sequence. The measurements demonstrated a decrease in uvula length and thickness from the pre-operative stage up to Day 42 post-treatment. The rest of the measurements and volume calculations did not alter greatly. A statistical analysis was not performed given the small number of subjects.

Conclusion: This is a pilot study involving a small caseload of patients undergoing variable treatment patterns using BRFVTR. Overall measurements of anatomical landmarks and volumes did not alter greatly suggesting that these subjective measurements may not prove useful markers to track outcomes. In the immediate post-treatment period up to Day 3, an increase in lesion size and definition appeared to indicate a normal physiological response. Any persistent increase in
lesion size beyond this period may be significant in the relevant clinical context. Clinical evaluation and subjective improvement of symptoms were more important correlates of treatment outcome and success. This pilot study has demonstrated the initial appearances of BRFVT treatment in a small cohort of subjects identifying possible areas of further research. Further work is necessary to confirm the small scale findings of this study, to draw statistically significant conclusions and enable planning of appropriate follow up strategies.

10.45-11.00 10’
Duel Acquisition Extracranial CTA/Enhanced Neck CT for Pre-Transoral Laser Microsurgery Evaluation of Head & Neck Cancer Patients
S. Weindling 1, J. Salassa 2, J. Casler 2, D. Chellini 1
1 Mayo Clinic - Florida; Department of Radiology, Jacksonville, FL, USA; 2 Mayo Clinic - Florida; Department of Otolaryngology, Jacksonville, FL, USA

Background & Purpose: Transoral Laser Microsurgery (TLM) is an alternative surgical technique for endoscopic resection of aerodigestive mucosal based invasive head and neck (H&N) tumors. A carbon dioxide laser is utilized under general anesthesia for endoscopic piecemeal tumor resection, with repeat frozen sections to ensure complete tumor resection with narrow margins. The technique has proven excellent control of primary H&N cancers, and may be used following failure of chemotherapy, radiation or prior conventional open surgery. Compared to open en-bloc resection the TLM procedure’s decreased functional impairment and shorter hospitalization may significantly impact patient quality of life and health care costs. Bleeding from arterial branches along the deep tumor margins remains a significant challenge for the TLM surgeon, with an incidence of TLM primary site post-operative bleeding up to 5–8% reported for tongue based tumors. We describe our preliminary results using a preoperative dual acquisition extracranial CTA-enhanced neck CT (CTA/CT) and image post-processing protocol developed to improve visualization of H&N mucosal tumors and adjacent arterial branches, with the objective of facilitating TLM planning and reducing secondary bleeding complications.

Materials & Methods: 20 patients with known primary H&N cancer (19 Squamous Cell Carcinoma; 1 Adenoid Cystic Carcinoma) for which our Otolaryngologists anticipated TLM resection underwent a protocol for our CTA/CT and image post-processing protocol. Our standard 100 ml dose of non-ionic, iodinated intravenous contrast (Omnipaque, 300mg %) was divided into 2 aliquots of contrast beluses administered at 0 and 40 seconds, and followed by a 30 and 50 ml of normal saline flush respectively. Contrast and flush were injected by power injector at a rate of 4 ml/sec via right antecubital vein. Our CTA/CT protocol included consecutive helical acquisition of extracranial CTA and enhanced neck CT studies on a 64 slice multidetector CT scanner. Extracranial CTA was acquired using a helical technique from aortic arch to skull base with parameters 120 kVp, 240 mAs, 0.6 mm section collimation, 0.37 second rotation and 22cm FOV. Bolus tracking, with a 70 Hounsfield unit trigger, was localized at the aortic arch. The above contrast administration and scan technique resulted in a 10 second CTA acquisition typically commencing between 55 and 60 seconds after contrast injection. Enhanced neck CT, using identical scan parameters to the extracranial CTA, was acquired from external auditory canals to carina beginning 80 seconds after contrast injection. A total patient exposure of 1000 millirads (mR) for our combined CTA/CT protocol is actually less than our routine neck CT technique (1250 mR). In addition to our routine CTA and enhanced neck CT images, we created a series of down the pharynx 3D endoscopic view images from the CTA data to demonstrate the primary tumor - peritumoral vascular relationships for TLM planning. Primary tumor and peritumoral vessel enhancement were compared on matched axial images reconstructed from the CTA and enhanced neck CT acquisition data. Operative reports and clinical notes were retrospectively reviewed to identify patients in whom the TLM surgical approach was altered or changed to conventional open surgery as the result of our pre-surgical CTA/CT exam.

Results: Enhancement of peritumoral vasculature was almost uniformly superior (19 of 20 patients) on the extracranial CTA images as compared to routine enhanced neck CT images. In 30% (6/20) of patients thought to be candidates for TLM, CTA acquisition information resulted in a change in surgical approach intended to improve intraoperative peritumoral vascular control. Our Otolaryngologists judged the CTA/CT protocol as superior to routine enhanced neck CT in facilitating TLM due to improved peritumoral arterial views on CTA images and demonstration of tumor-vascular relationships from an endoscopic view on CTA 3D images. TLM local surgical results were good in this small study. 17 of 19 TLM patients (surgical stages T2; T3; T4) had final surgical margins negative for residual tumor, and there were no instances of TLM post-operative bleeding.

Conclusion: In patients with mucosal based invasive H&N tumors for whom TLM surgery is anticipated our dual acquisition extracranial CTA/enhanced neck CT imaging and post-processing protocol can be readily performed utilizing a standard IV contrast dose with patient radiation exposure less than our routine neck CT. In this small pilot series primary tumor-peritumoral vessel relationships defined with addition of extracranial CTA to our routine pre-operative enhanced neck CT frequently impacted the surgical approach, and was helpful in facilitating TLM planning.
examination, laboratorial and imaging exams are necessary to rule out second-
ary forms. If necessary, the investiga-
tion should be completed with histologi-
cal and electrophysiological techniques. Non invasive management includes the
injection of botulinum toxins, psycho-
otherapy, and pharmacological agents.
Surgical approaches include complete
or partial muscle resection and myo-
suction. In the event of it appearing
alongside other disorders, the correc-
tion of the primary pathology is manda-
tory. In oral communication, a case of a
34-year-old female with hypertrophy of
the temporal muscles is reported and a
review of the relevant literature about
this condition is exposed.

Advanced CT Studies 2

Chairs: P. Maly Sundgren, C. Strother

14.30-14.45

Iterative Reconstruction Algorithm
for Head CT

Z. Rumboldt, S. Tipnis, V. Stampinato, W. Huda, G. Goldsberry, A. Cianfoni
Medical University of South Carolina, Department of Radiology; Charleston, SC, USA

Background and Purpose: The pur-
pose of this study was to compare
image quality in Head CT images re-
constructed using standard filtered
back projection (FBP) with those re-
constructed using a new CT recon-
struction algorithm called Iterative
Reconstruction in Image Space (IRIS).
Our hypotheses are that the images
processed with IRIS will show relative
improvement in detected abnormalities
in Head CT images. Our hypothesis
was that use of NBC increases the con-
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Evaluation of Neuro Best Contrast Filter for Head CT

Z. Rumboldt, V. Stampinato, W. Huda, S. Tipnis
Medical University of South Carolina, Department of Radiology; Charleston, SC, USA

Materials and Methods: We evalu-
ated Head CT images acquired in 10
consecutive adult patients without
detectable abnormalities using NBC
and compared them with Head CT
images reconstructed using stan-
dard filter. Two neuroradiologists
compared 11 sets of images for each pa-
tient at 3 different levels (middle
basal ganglia and centrum semioval; 30
levels in all), evaluating noise and gray/white mat-
ter differentiation, using circular regions of
interest (ROI).

Results: There was no subjective dif-
fERENCE in noise between the images
reconstructed using the standard fil-
ter and NBC. The gray/white matter
contrast was higher in all patients at
all levels with NBC compared to the
standard filter reconstruction. There
were no significant differences between
the two sets of images in the HU for
the CSF, bone, and fat. The mean (SD)
HU measured 39.53 (1.78) with the
standard filter and 36.58 (1.55) with
NBC for the GM, 32.84 (0.89) with
the standard filter and 26.03 (2.40) with
NBC for the WM. The mean difference
in HU between the GM and WM in-
creased from 6.69 using the standard
filter to 10.55 using NBC - the average
increase in contrast between GM and
WM with NBC was 3.86 HU.

Conclusion: NBC filter provides in-
creased contrast between GM and WM
on Head CT scans, which may allow
for a decrease in radiation dose and/or
improved lesion detection.
Impact of Varying Arterial Input Functions in CT Perfusion Studies of the Brain in Pathologic Ischemic Studies

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Introduction: Perfusion Computed Tomography (CTP) is clinically used to distinguish infarcted tissue from the penumbra using three blood flow parameters: cerebral blood volume (CBV), cerebral blood flow (CBF), and mean transit time (MTT). This calculation requires the operator to choose an arterial input function (AIF) that best represents the entry of contrast to the system, however, there have been limited studies that evaluate this selection. This study evaluates the impact of varying this arterial input function in 7 pathologic ischemic patients. Nineteen representative regions of interest were chosen for each study.

Materials and Methods: A retrospective search of the SUNY Downstate University Hospital PACS system for CT Perfusion studies was performed for the period from 5/23/06 to 7/12/2009. 157 unique patients were found, which were then divided into a pathologic group (patients diagnosed with acute occlusive stroke or stenosis) and a normal group (non-pathologic). Seven patients were then divided into subgroups (both in the left internal carotid artery, LICA, and right internal carotid artery, RCA) based on the status of this region for each patient. Ischemic region refers to the status of this region for each patient.

Results/Discussion: A 3-way ANOVA was performed using SPSS (SPSS 14.0, SPSS Inc, USA) using CBF, CBV, and MTT as the dependant variables, and ROI, AIF and Ischemic Status as the independent variables. Our data demonstrated that assessing ischemia may be assessed independent of AIF selection, and needs to be further studied and validated to develop potentially accurate thresholds for clinically relevant evaluations of ischemic penumbra and irreversibly infarcted brain tissue.

Table 1 ANOVA Results

![Figure 1 CBF, CBV, and MTT means for A1 (LMCA region)](image)

Whole Brain CT Perfusion of Arteriovenous Shunting in Arteriovenous Malformations

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Purpose: The altered brain perfusion associated with cerebral arteriovenous malformations(AVMs) has previously been challenging using CT perfusion (CTP) due to limited coverage. Our study was conducted to assess the altered perfusion in brain AVMs using whole brain CTP on a 320 slice volume scanner.

Materials and Methods: Whole brain CTP(Toshiba) was performed in 8 patients with AVM and 3 patients with AVFs. CTP study was performed as part of the time-resolved CT angiograms(TRCTA) performed for clinical reasons. The cerebral blood volume(CBV), cerebral blood flow(CBF), and mean transient for GWD (mean rank 2.06), in 13.3% for DBG (mean rank 2.19) and in 23.7% for GI (mean rank 2.03). HU measurements showed no significant differences between the 3 groups. Mean SD values, as a measure for noise, were almost identical for ND and FLD (2.97 vs. 3.03) and 15% higher for LD (3.43).

Conclusion: The measurements of the noise levels and results from image quality rating indicate that advanced noise filtering with SharpView®CT is capable to improve the image quality in CT examinations of the brain. However this improvement is not sufficient to fully compensate for a dose reduction with 30%.
time (MTT) were assessed. Regions of interest (ROIs) placed over the following AVM target sections were defined as follows: N, AVM nidus; P, immediately posterior to the nidus; A, immediately anterior to the nidus; Ar, anterior remote; Pr, posterior remote; Cbm, cerebellum; BG, basal ganglia for the rest of the brain. Similar ROIs in the contralateral hemisphere (N1, P1, A1, Pr1, Ar1, Cbm1 and BG1) served as internal references. Perfusion parameters were compared to the opposite side. Paired t test was used for statistical analysis. P value less that 0.05 was considered significant.

Results: Three types of perfusion disturbance pattern were observed in cases of AVM. CBF and CBV was very markedly high (p=0.0002 and 0.0026) within the nidus; low (p=0.038 and 0.056) in anterior perilesional parenchyma; and low in the opposite cerebellar hemisphere in 2 patients with hemispheric AVMs. The perfusion parameters were not affected in the 3 cases of AVF.

Conclusion: This study emphasizes the role of whole brain perfusion studies in cases of AVM. Data is now readily available for processing as an adjunctive study to TRCTA.

Study of Computed Tomography Perfusion on Traumatic Cerebral Contusion

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Keywords: traumatic cerebral contusion, CTP, perfusional hypodensity area, oedema

Injury to the brain is the leading factor in morbidity and mortality of traumatic brain injury and this study aimed to determine the perfusion status of pericontusional hypodensity area in traumatic cerebral contusion. Ten patients involved in motor vehicle accidents enrolled in this study and contusion was diagnosed from plain computed tomography (CT) scan of the brain. Subsequent computed tomography perfusion (CTP) was performed to analyse perfusion of pericontusional hypodensity areas which were divided into four region of interest (ROI). Significant positive correlation were found between the perfusion status in pericontusional area nearest to the skull vault (ROI 3) with nearest distance of contusion margin to the skull vault (r=0.698, p=0.025). Two adjacent pericontusional hypodensity area (ROI 4 & ROI 5) also showed significant positive correlation (r=0.667, p=0.035) in perfusion status. Presence of hypodensity in pericontusional area is not just reflecting oedema but it is associated with prediction of perfusion disturbance which appropriate management can be instituted.

CT, CTA, Perfusion CT Guidance of Acute Stroke Intervention Using the Penumbra Device

Hoag Memorial Hospital Presbyterian; Newport Beach, CA, USA

Purpose: Evaluate the role of advanced Multidetector CT scanning (MDCT) in Acute Endovascular Stroke Intervention with the Penumbra Device in a community hospital.

Methods: Retrospective review of medical records was performed in 25 patients who were treated for acute (less than 8 hours) cerebral ischemia with the Penumbra device based on demonstration of large vessel intracranial clot, and salvageable brain parenchyma based on perfusion data from multiparametric MDCT. CT scanning was performed with 64 detector multislice instrument. Non-contrast CT, CT angiographic, and perfusion CT studies were obtained in every case. Percentage of patients with revascularized arterial territory was tallied. Outcomes were measured to 60 days following discharge from hospital. Parameters evaluated included: clot location, degree of collateral supply prior to treatment, non-salvageable brain (blood volume defect), and post-treatment hemorrhage.

Results: 7 carotid T occlusions, 15 middle cerebral occlusions, and 3 vertebral basilar occlusions were treated. Results documented revascularization to TIMI flow 2 or better in 80% of cases treated. Greatest improvement from pre-treatment clinical status occurred in patients with carotid T occlusions. Average improvement in NIH scale in survivors was 80%.

Discussion: Large vessel occlusion has been found angiographically in up to 80% of all individuals presenting to the emergency room with acute ischemic stroke signs. Intravenous thrombolysis has been shown to be beneficial in the first 3 hours of ischemic stroke onset, however, intravenous treatment is relatively ineffective in large vessel occlusions. Previoues trials of intraarterial thrombolysis and mechanical revascularization have demonstrated potential benefit of early intraarterial mechanical revascularization. The Penumbra device was found to achieve revascularization in up to 80% patients with large proximal vessel occlusions, leading to early approval by Food & Drug Administration in the United States. Although the initial trials of intravenous thrombolytic therapy utilized non-contrast CT and clinical status as triage tools for patient enrollment, the location of vessel occlusion and potentially salvageable penumbra were not assessed in those trials. The advantages of modern generation, multi-parametric CT scanning is that the location of the clot, depiction of permanently damaged brain, and salvageable penumbra are achievable within 10 minutes of patient study time. Such capabilities, coupled with new mechanical revascularization devices such as the Penumbra device appear to offer the best chances for better outcomes in treatment for acute ischemic stroke, even in a community hospital setting. Our center’s experience with the use of both tools, and the predictability of good outcomes based on the combination of successful selection and revascularization will be presented.

AdvancedMR Techniques 2

T2 Flair Hyperintense Signal Intensity at the Posterior Limb of the Internal Capsule: Clinical Significance in ALS Patients

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Introduction: Amyotrophic lateral sclerosis (ALS) is characterized by progressive upper and lower motor neuron degeneration. There are several reports of the presence of MRI hyperintensities along the corticospinal tract in patients with confirmed ALS, but the specificity of this finding is under consideration, since it is also identified in healthy controls. Moreover, correlation of this finding with the disease progression has not been established yet. The purpose of our study is...
to evaluate the frequency with which this sign appears in the posterior limb of the internal capsule (PLIC), compare visual with quantitative measurements to correlate these with the progression of the disorder.

**Patients and Methods**: Twenty-four (24) patients are included in our prospective clinical study (14 males, 10 females ages 18-76) and fifty-one (51) normal controls. In the ALS patient group, the diagnosis was established according to the criteria of El Escorial in the revised form of Airlie House. All patients were neurologically examined and underwent intensive diagnostic procedures in order to exclude other diseases, resembling ALS. At the time of the MRI investigation, five patients had been diagnosed with definite ALS, eleven patients with probable ALS, seven patients with possible ALS, and one patient with suspected ALS. Three patients were classified with probable ALS developed definite ALS in the course of the disease. Our patients underwent the initial MRI 6 months to 2 years from the onset of their symptomatology. All ALS patients were clinically examined regarding their symptoms from the upper and lower motor neurons. All 51 controls were healthy volunteers. Follow-up MRI examinations were performed in 9/24 patients in a period of 6 months. MRI examinations were performed on a 3-T unit (HDxT, GE Healthcare, Medical Systems, Milwaukee, USA). Our protocol includes axial T2 weighted images (WI), FLAIR, DWI, DTI and 3D-SPGR images. Intravenous contrast is administered only at the initial MRI scan. Signal changes in the PLIC are visually evaluated on FLAIR images, and are classified as distinct, mild or no signal change. Fractional anisotropy (FA) measurements are performed by placing a region of interest (ROI) in the PLIC bilaterally. Both findings are being compared.

**Results**: In 32/75 subjects (22/51 controls and 10/24 patients), there were no signal changes in the PLIC. Regarding our 10 ALS patients, three had definite, four probable (one with bulbar onset), two possible and one suspected ALS. In 29/51 controls and in 8/24 ALS patients, mild signal changes were visualized in the PLIC. Of these 8 ALS patients, five had possible and three had probable ALS. In the remaining 62/48 ALS patients distinct T2-FLAIR signal changes were visualized in the PLIC. Four of them were classified initially as having probable ALS, which included those who developed definite ALS in the course of the disease, and two were classified as having definite ALS. No distinct signal change was visualized in the PLIC. Moreover, we noticed that this increased T2-FLAIR signal change was more accentuated in all patients that deteriorated or developed definite ALS. Comparing Fractional anisotropy (FA) measurements at the PLIC between controls and patients, we found that FA measurements in patients were lower than in the age matched healthy subjects, but since the number of our patients is very small, we could not establish statistical significance. A decrease in FA measurements was also noticed with disease progression.

**Conclusions**: Our findings indicate that although mild hyperintensity of the PLIC is not pathognomonic for ALS, detection of a distinct PLIC hyperintensity that gradually accentuates might actually be a sign of progressive ALS, reflecting degeneration and neuronal loss. This finding is also supported by the progressively decreasing FA measurements. Larger numbers of patients need to be included and re-evaluated though, in order to obtain statistically significant results.

**The Technique Methods and Progress of MR Imaging**

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In recent years, noninvasive methods to measure regional pH have been developed. A diverse set of pH indicators has been described. Some of them show the character of pH-dependent chemical shift and others show the pH-dependent magnetization transfer as well as the pH-dependent relaxation. These methods based on MR imaging or MR spectroscopy are used to measure intra- or extracellular pH either in vitro or in vivo. This article particularly focuses on the MR-based pH measurement methods. Meanwhile, the technique progress of these methods is reviewed. With technical development, pH imaging will be a useful tool in the tumor mechanism and tumor imaging as well as the approach of image-guided stroke therapy. It has been known that many pathological states are associated with changes in tissue acid-base balance. For example, acidic extracellular pH (pHe) has been proposed to be a feature of tumours. Compared with normal tissue, extracellular pH (pHe) is normally lower in tumors, and intracellular pH (pHe) is often higher. Many years before, the pH of tumors in vivo has been measured using microelectrodes. However, this method is invasive and unfavorable to monitor the extracellular pH variables. In recent years, noninvasive methods to measure regional pH have been developed. These methods based on MR imaging (MRI) or MR spectroscopy (MRS) are used to measure intra- or extracellular pH imaging either in vitro or in vivo. Several 1H-MR and 31P-MR methods for pH measurement have been reported in vitro and in vivo. Intravenous pH measurement approaches has been applied to other NMR nuclei such as fluorine (19F) and carbon (13C). Intraocular pH (pHi) and extracellular pH (pHe) are regulated in a dynamic steady state between H1 entering and leaving cellular space, by the removal of waste products such as lactate, the effect of the internal buffer mechanism as HCO3− and CO2 and reduced perfusion. The method to detect the ion concentration of [H+] or [HCO3−] and [CO2] may provide the chance of direct and absolute measures of pH. Gallagher et al detected the ratio of the signal intensities of hyperpolarized bicarbonate (H13CO3−) and 13CO2 by intravenous injection of hyperpolarized H13CO3− and imaged tissue pH in a mouse tumour model. A disadvantage of these techniques is the need to inject large amounts of the hyperpolarized H13CO3− in order to be able to image pH with acceptable sensitivity and spatial resolution. In many cases such as in tumor, pH and pHe is related with other factors. Recently, a diverse set of pH indicators has been described. Some of them show the character of pH-dependent chemical shift and others show the pH-dependent magnetization transfer as well as the pH-dependent relaxation. MR spectroscopy imaging (MRSI) approaches are generally used in measuring the pH dependent chemical shifts. Both relaxation and Chemical Exchange Saturation Transfer (CEST)-based MRI contrast agents work by mechanisms that involve water or proton exchange which are inherently pH dependent and therefore easily compatible with pH sensing.

**The Comparison among Three Different Reprocessing Technologies for Quantitation and the Influence of Steam and Press Sequence on Metabolic Concentration**

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**Objective**: To study the influence of 3 different kinds of post-processing technologies: LCModel, Functool and SAGE on quantification, and analyze...
metabolic concentration difference in anterior central gyrus acquired with PRESS or STEAM sequences.

Methods: 14 health volunteer were recruited for our study. 1H-MRS examinations were performed on a 1.5 T GE MR scanner with a standard head coil using PRESS and STEAM sequence, respectively. Voxels were placed in left anterior central gyrus. Metabolite ratios to Cr were acquired LCMold, SAGE and Functool with data gained from STEAM sequence. Absolute quantification of All main metabolite was done using LCMold. Multiple Comparison were performed to compare metabolite ratios obtained from LCMold, SAGE and Functool. Sample paired t-test was employed to compare data obtained from PRESS and STEAM sequence.

Results: MI/Cr, Cho/ Cr were significantly different using the three post-processing technologies. Cho/Cr obtained from LCMold was obviously deviated from the reference, NAA/Cr and MI/Cr analyzed by Functool were also deviated from the reference. The concentration translated from the peak areas through a known formula, Cho/Cr and ml/Cr were still deviated from the reference when we analyzed the spectrum by SAGE software. No significant differences detected by Functool. Metabolic concentration was observed between PRESS and STEAM sequences method. But compared with literature, result from STEAM is more close to it.

Conclusion: Compared with Functool and SAGE, LCMold shows an advantage at the quantitation because of simulating the base-line spectrum and handling the systematic error. Compared with PRESS sequence, STEAM is better in simulating line shape and handling baseline which makes the spectrum more stable.

17.00-17.15 10' Comparative Lateralizing Ability of Multimodality MRI in Temporal Lobe Epilepsy
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Purpose: Temporal lobe epilepsy (TLE) with hippocampal sclerosis (HS) is an important cause for focal epilepsy. In this study we explored the comparative lateralizing ability of three quantitative MR (qMRI) modalities and their diagnostic utility to depict changes of hippocampal architecture correlated with clinical manifestations.

Materials and Methods: Fourteen patients with clinical diagnosis of TLE and 15 healthy volunteers were evaluated. Images were acquired using a 1.5 T MR scanner (Achieva, Philips Medical Systems, Best, The Netherlands). Aniso, T2GRE S-channel head coil during a single MRT session. All sequences were acquired orthogonal to hippocampal body axis using a prone orientation of temporal lobes. For hippocampal volumetry and DTI studies coronal planes were positioned parallel to the posterior commissure-obex (PC-OB) line. Single voxel 1-H magnetic resonance spectroscopy (MRS) of hippocampus was acquired in axial plane perpendicular to PC-OB line. All measurements were done for bilateral hippocampi. Special attention was paid to patients for being seizure free for at least 24 hours prior to MRI scan. Standart qualitative imaging protocol for epilepsy patients included an axial and sagittal T1-weighted turbo-spin-echo (TSE) (TR/TE = 450/5, slice thickness (thk): 5 mm), and T2-weighted TSE (TR/TE = 5000/100 ms, thk: 5 mm), and a coronal FLAIR (TR/TE = 2000/1500 ms, thk: 2 mm) sequences. For volumetry, T1-weighted 3D gradient-echo sequence (TR = 7.2 ms, TE = 3.3 ms, NSA = 1, FOV = 256 mm, thk: 1 mm, gap = 0 mm, flip angle = 8°, matrix = 256x256 pixels) through 160 slices of the entire brain was acquired. For single voxel 1-H MRS each hippocampus voxel of interest (VOI, 20x20x20 mm) placed on hippocampus on sagittal, axial and coronal orientations using Point-resolved spectroscopic (PRESS) sequence (TE = 14 ms, TR = 2000 ms). Hippocampal metabolic concentration were measured at 2.0 ppm (NAA), 3.0 ppm (Cre) and 3.2 ppm (Cho). Metabolites were assessed as ratios to Cr (NAA/Cr, Cho/ Cr, and NAA/ (Cho+Cr) and in absolute units. DTI data was acquired using a single-shot spin-echo echo planar image (SE-EPI) sequence. The diffusion sensitizing gradients were applied simultaneously along 6 non-collinear directions (b = 1000s/mm²). All scans were reviewed by two experienced neuroradiologists in consensus. The findings were correlated with electroencephalography and clinical findings.

Results: Individually volumetric measurements on T1-weighted 3D-data set provided accurate lateralization in 85% of the patients, spectroscopy in 57% and DTI in 57%. Higher lateralizing ratios were acquired combining volumetry-spectroscopy (85%), volumetry-DTI (80%) and finally volumetry-DTI (100%). Significant decreased NAA/(Cho+Cr) ratios and increased FA values were obtained ipsilateral to epileptogenic hippocampus. Age at onset and response to antiepileptic drugs did not correlate with any result. Duration of epilepsy and FA values showed a significant positive correlation. Furthermore the history of febrile convulsion was associated with lower hippocampal NAA/Cr values and reduced NAA/(Cho+Cr) ratios the ipsilateral hippocampus.

Conclusion: Volumetry, MRS and DTI studies provides complementary information of hippocampal pathology. For lateralization of epileptogenic focus and pre-operative examination, volumetry-DTI combination represents maximal accuracy.

17.15-17.30 10' DTI in Familiar Tuberous Sclerosis - Comparison of Fractional Anisotropy and Apparent Diffusion Coefficient with Normal Subjects
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Background: Tuberous sclerosis (TS) is a genetically inherited neurocutaneous syndrome characterized by benign hamartomatous lesions in many organs including the brain. Numerous previous studies proved that diffusion tensor imaging (DTI) can detect microstructural changes in different pathological processes.

Objective: To determine the fractional anisotropy (FA) and apparent diffusion coefficient (ADC) values in white-matter lesions (WML) and normal-appearing white matter (NAWM) in a family with TS, and to compare these results with normal age-matched individuals.

Materials and Methods: 5 members of a family (age range 20-62 years, 4 females, 1 male) suffering from TS and three age-matched controls were included. MRI was performed on a 3T Philips Achieva scanner with T1W SE, T2W TSE, FLAIR and DTI sequences. DT images were acquired by using an EPI sequence. Diffusion gradients were applied in 32 directions with a b value of 1000 s/mm². All WML lesions were covered with several single pixel measurements and their merged measurement values were compared to correspondent NAWM in the contralateral hemi.
sphere. Measurements of NAWM were also compared to normal controls.

Results: FA values were significantly lower, and ADC values were significantly higher in WML than in the correspondent contralateral NAWM of patients (FA: 0.279; 0.429; p value <0.0005; ADC: 865.44; 783.09; <0.0005, respectively). The same difference and correlation apply to the NAWM of patients and the WM of controls (FA: 0.279; 0.482; p value <0.0005; ADC: 863.52; 749.64; p value 0.0005, respectively).

Conclusions: Some studies have already shown correlation between the FA and ADC values of NAWM in patients with TS compared to controls, but in our study both values showed significant correlation not only between the abnormal WM and correspondent NAWM of patients with TS, but between NAWM of patients and normal controls. These findings indicate that TS patients have occult damage in NAWM probably due to significant microstructural changes, e.g. myelin/axonal abnormalities or a combination of these.
The Tangled Cauda Equina Sign: Indicator of Significant Spinal Stenosis

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Purpose: To discuss the significance of the tangled cauda equina sign.

Materials and Methods: Correlation of significant tangling of the cauda equina with the severity of spinal stenosis, as assessed on MRI of the lumbar spine.

Results/Discussion: This study correlates significant tangling of the cauda equina at a particular level in the lumbar spine (as seen best on the sagittal T2-MRI sequence) with prominent stenosis in the spinal canal at that particular level or at a level adjacent to this. This is often a consequence of a chronic etiology for spinal stenosis, such as disc disease (i.e., disc extrusion, prominent disc herniation, etc.). This sign, therefore, is one which is important to keep in mind in assessing the lumbar spine, and when noted, close scrutiny for associated significant spinal stenosis needs to be sought on the imaging study. Similarly, when this sign is present, it could alert the physician to the potential significance of the stenosis, and give cause for further clinical evaluation.

Minimally Invasive Lumbar Decompression to Treat Lumbar Spinal Stenosis

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Purpose: More that 1.2 million people are undergoing treatment for lumbar spinal stenosis (LSS) in the United States. Yet, therapeutic options for these patients are limited to either symptomatic treatments or highly invasive surgeries. A new image-guided minimally invasive lumbar decompression (mild®) procedure may offer significant relief for many of these patients by debulking dorsal element hypertrophy while preserving structural stability. The mild® procedure can be performed without general anesthesia and offers a short recovery period.

Materials and Methods: A meta-analysis of nine clinical patient series from multiple institutions in the United States and Canada evaluated > 270 patients for safety and clinical efficacy of the mild® procedure. Clinical efficacy was evaluated with a battery of validated patient reported outcomes (PRO) instruments including the Visual Analog Score (VAS), the Oswestry Disability Index (ODI), SF-12v2® Quality of Life Survey and Zurich Claudication Questionnaire (ZCQ). Outcomes and procedure safety (as determined by the occurrence of adverse events) were compared to the SPORT trial. Clinical follow-up ranged from six weeks to one year for these series.

Results: No serious adverse events (SAEs) have been recorded with the mild® procedure. All outcome metrics demonstrated statistically significant symptomatic improvement over baseline. Initial results compare favorably to open surgery despite slightly higher baseline ODI than the open surgery trial (SPORT) and a much lower complication rate.

Conclusion: The mild® procedure is a safe and efficacious procedure that decompresses LSS in a minimally invasive manner while preserving the structural stability of the spine.

Posterior Vertebral Arch Cement Augmentation to Prevent Fracture of Spinous Processes after Interspinous Spacer Implant

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Introduction: Intermittent neurogenic claudication (INC) is the typical clinical manifestation of lumbo-sacral nerve roots compression, and it is clinically characterized by weakness, pain or altered sensation, radiating to buttocks and lower limbs, initiated by standing or walking, exacerbated by lumbar extension, and improved by lumbar flexion. An FDA multicenter prospective trial demonstrated efficacy of rigid interspinous spacers in treating such condition, since they widen the diameters of the spinal canal and foramina by limiting extension of the stenotic levels. Use of rigid interspinous spacers is contraindicated in patients suffering from osteoporosis, as defined by a T-score of -2.5 or less or prior fragility fracture. Nevertheless INC is more frequent in the elderly, due to age-related degenerative stenosing conditions, and this patients' population is often exposed to the risk of bone fragility, even outside a definite diagnosis of osteoporosis. Use of interspinous spacers in such fragile patients carries the risk of bone failure.

Purpose: Purpose of the study were evaluation of feasibility and safety of posterior arch cement augmentation and preliminary evaluation of the efficacy of the technique in preventing delayed fracture of the posterior arch's elements on which the action of the interspinous device is exerted.

Materials and Methods: From June 2007 to May 2010 we have treated 71 patients complaining of INC at 97 levels using the the Aperius PercLid® System (Medtronic). The Aperius is a titanium cylinder with one round tip (bullet-shaped), implanted using
a percutaneous technique. Six lateral wings prevent the device from migrating laterally out of position, while laminae and intact supraspinous ligament prevent anterior-posterior migration. Among the first 48 consecutive patients, treated at 63 levels, 16 patients, treated at 20 levels, presented a risk factor (age >75 years, or osteopenia, as defined by WHO on a bone scan with a T-score below -1.0). In this latter group, a symptomatic delayed spinous process fracture was diagnosed in 14/16 patients. The fracture was diagnosed at follow-up CT imaging, prompted by abrupt recurrence of INC symptoms. After these observations we decided to strengthen the suspected fragile bone in patients at higher risk for fragility (age-related or osteopenic) injecting verteoplasty cement in the posterior arch in contact with the interspinous devices. The study was IRB-approved, and all the patients were informed of the investigational use of prophylactic posterior arch cement augmentation. Since the beginning of the study 23 patients were treated with interspinaous spacer implant at 54 levels. Among these, 9 patients did not present risk factors, and were treated with interspinous spacer implant only, at 16 levels, while 14 patients presented risk factors, accepted to participate in the study, and were treated with interspinous spacer implant at 18 levels, and with prophylactic posterior arch cement augmentation. For posterior arch augmentation, a 15 G verteoplasty needle is inserted in each spinous process above and below the interspinous spacer, with the tip at the level of the spinolaminar junction. Injection of regular verteoplasty cement is performed with 1-ml syringes. Cement is pushed to fill at least the ventral two thirds of the spinous process and the proximal two thirds of the laminae. Failure of the interspinous spacer, with subsequent recurrence of symptoms, may be related either to bony subsidence directly under the spacer (chronic fatigue fractures, as observed in our cases), where the metallic device comes in contact with the cortex of the spinous process (anterior third of the process), or, less likely, and based on biomechanical studies, at the level where the distraction load is stronger, i.e. the spinolaminar junction. For these reasons, the filling of the posterior arch with cement must include at least the anterior two-thirds of the spinous process and the most proximal (medial) parts of the laminae. Usually between 1 and 2 ml of cement per lamina are sufficient. 10 to 15 minutes are usually required to achieve posterior arch cement injection. Posterior arch augmentation can be done either before or after cement insertion. Results: The technique was eventually used in all patients. Following its introduction, no more posterior arch fractures were observed. Clinical follow-up ranges between 5 and 12 months. Intraprofus cement insertion is easy, relatively inexpensive; it appeared well controllable and consequently safe. The surgical technique is fast, minimally-invasive, performed under local anesthesia, possible also in elderly or fragile patients. Our preliminary experience is so far giving positive results, and could indicate as possible a widening of indications in use of interspinous spacers. Of course larger series and longer follow-ups could be necessary to confirm our data.

Revised Surgery of Internal Fixation. Role of Neuroradiology in 86 Patients Operated

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Background: The Internal Fixation (FI) is a surgical technique widely used, but requires large experience in spinal pathology and careful surgical techniques. This fact may explain the significant percentage of poor results and the necessity of revision of the fixation. Recognizing these failures is relevant. Pathologic or iatrogenic features should be correctly described by Neuroradiology, which is the essential tool.

Material and Method: Analysis of Internal Fixation in 86 patients operated in other institutions and subsequently reopened by the same surgeon (MB) in 7 years between 2000 and 2006 (68 cases-retrospective study) and other 18 cases from 2006 to may 2009 (prospective study). The age varies from 29 to 76, with median age of 59 years. The follow up in the first group varies from 2.5 to 8.5 years. All patients had high invasibility, especially because of intractable pain. 15 cases (18%) took opioids daily. The number of the previous operations was: in 6 cases only 1 operation (7%) (fixation for spondylolisthesis); in 66 cases, 3 or more operations (77%) (discectomy and fusions); in 14 cases, 6 or more operations (16%).

Evaluation of Results. An Index of Satisfaction has been used: a visuoanalogic scale for the evaluation of symptoms, satisfied by the patient himself in relation to 3 independent parameters: autonomy, working efficiency and pain. 3 groups are recognized: 1) satisfied (good result), 2) moderately satisfied (adequate result), 3) unsatisfied (poor result).

Objectives: Analyzing the outcome of revisions and recognizing the reasons of the previous failures on the basis of the neuro-imaging data.

Surgical Technique: A posterior approach has been employed in 84 cases and anterior and posterior in two cases. In order to restore the best possible "Spinal Balance", interbody cages (carbon-titan mesh) filled with autologous bone and pedicle screws with plates/rods have been used.

Surgical Results: No addictive postoperative neurological deficits. The results were: good (satisfied) in 85% (73 cases on 86); adequate (moderately satisfied) in 12% (10 cases on 86); poor (unsatisfied) in 2% (2 cases on 86). The satisfaction of the patients and the efficacy of the surgical revision are very high (97%). Complications: 1 surgical revision for a pseudomeningocele (1%); (3 small asymptomatic pseudomeningocele -RM evidence- did not require reoperation); 16 cases with postoperative fever, treated with antibiotics (12% of operations lasted more than 4 hours).

Discussion: The failure of IF is due to inappropriate surgical strategy and technique, recognizable by Neuroradiology. These are the causes: A) No reconstruction of the anterior column with absence of the intersomatic cages, collapse or malfunction of the discs, pseudoarthrosis, iatrogenic scoliosis, breakage of instrumentation; B) Loss of the segmental or regional lordosis because is not reconstructed or not recreated a solid anterior column and the posterior compression is not applied; C) Lumbar fixation without saccral inclusion or impeding the segmental lordosis and promoting an over load of the disc L5S1, nearly always already compromised; D) Instrumented Fixation with "by pass" of vertebral bodies without fusion, impeding the enhance of lordosis and favouring an overload of the bypassed disc and stress at the junctions; E) "Elastic Fixation" without fusion, hindering the restoring of the lordosis and promoting abnormal painful segmental movements. Other factors are the technique itself, i.e. the incorrect pedicle screws insertion.
and the use of inappropriate implants. These causes contribute to a “spinal istrogenic imbalance”, with segmental overload and impossibility to reach the surgical target: the enhancement of the lordosis and the improvement and restoring of the Economic Balance. 

Conclusion: The results of the revision are highly positive with a high percentage of good (85%) and overall positive results (97%). The indication of revision is the disabling pain for 1) technical faults, with or without breakthrough of the instrumentation, 2) fundamental surgical strategies not applied to restoring an economic balance and a more correct spinal load, 3) when the Spinal Balance (flat back, kyphosis) is definitively decomposed. Recognizing these “faults” is a task of Neuroradiology.

Results: A total of 124 patients with tumours with intraspinal component were investigated. The median age of patients at diagnosis was 57.5 years. There were 96 male and 52 female patients. The median time to diagnosis was 10.5 months (range: 7 days-10.7 years). Most common initial symptoms were back and/or neck pain, pain radiating to one extremity and gait disturbances. There was no distinctive clinical pattern between intradural and extradural and intramedullary tumours regarding initial symptoms. Tumours were extradural in 52 patients. The most common histological type was metastases (29 cases). The mean age was 62.5 years-old. In 6 cases the metastases were located in the cervical segment, 16 cases in the dorsal segment, and 7 in the lumbo-sacral segment. The other histological types were lymphoma (7 cases), multiple myeloma (6 cases), syringoceles (4 cases), angiomyoma (5 cases), neuroblastoma (2 cases), meningocoele (1 case) and osteosarcoma (1 case). In 49 patients the tumours were extradural (31 females and 18 males) with a mean age of 52 years-old. The most common histological type was schwannoma (17 cases). In 8 cases schwannomas were located in the cervical tract, 3 cases in the dorsal tract and 6 in the lumbo-sacral tract. The other histological types were meningoma (16 cases), neurofibroma (5 cases), lipoma (4 cases), arachnoid cysts (3 cases), paraganglioma (1 case), epidermoid cyst (1 case), neurinoma (1 case) and solitary fibrous tumour (1 case). Total removal of the extradural lesions was possible in 47 patients. Tumours were intradural in 23 patients. The most common histological type was ependymoma (17 cases), localized in the filum terminale in 15 cases. The mean age was 48 years-old. The other histological types were astrocytoma (9 cases), glioblastoma multiforme (1 case), hemangioleiomma (1 case) and neurocytoma (1 case).

Conclusion: According to what was expected extradural tumours (42%) were the most common type of spinal tumours found, whereas 39% were intradural extramedullary and 19% were intramedullary. The most common histological type was metastases (23%), followed by schwannomas (14%), meningiomas (13%) and ependymomas (9%). Paraganglioma, neurocytoma, neurinoma, solitary fibrous tumour and glioblastoma multiforme are rare intraspinal tumours. MRI constitutes the ideal diagnostic imaging modality, allowing intraspinal tumours detection and their accurate characterization. Preferred treatment is the microsurgical radical resection. Peri-operative mortality is very low. Determinant predictors of a good outcome after surgery for spinal cord tumours are histological type of lesion, complete removal of the lesion, and a satisfactory neurological status before surgery.

Spine 6

Chairs: P. Courthéoux, R. Izzo

15.45-16.00

10’

Introductory Lecture

Neuromodulation, a New Frontier for Neuroradiologists

B. Georgy

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The clinical use of spinal cord stimulation for treatment of chronic intractable pain has been increasingly successful because of recent technical improvements, particularly the development of multiple-contact electrodes supported by programmable implanted pulse generators. Spinal cord stimulators are used in treatment of various types of back pain, including failed back surgery disease, complex regional pain syndromes, and other neurogenic conditions. The emphasis of this presentation is to present a how-to-approach of the whole clinical scenarios rather than discussing the underlying electrical and neurophysiologic basis. Patient evaluation, indications and contraindications are presented in details. A detailed description using a step-by-step approach for the clinical trial and permanent implantation techniques is presented. Post-operative care and troubleshooting techniques were also discussed as well as expected results.

16.00-16.15

10’

Spinal Cord Stimulators: Normal Positioning and Postsurgical Complications

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Purpose: Spinal cord stimulators (SCS) are one option for pain management in those individuals with chronic low back or radicular pain. The expected positioning of stimulators, types of SCS, and potential complications have not been described in the radiological literature. Our aim was to demonstrate the most common locations and types of SCS electrodes, lead wires and pulse generators. We defined the
appropriated distance of the electrode from the posterior margin of the central spinal canal and identified postsurgical complications.

Methods: A five year search of the radiology information system revealed 24 patients with images of 36 spinal cord stimulators. Those images were reviewed for identifying the locations and types of electrodes and lead wires within the spinal canal. Not all pulse generators were within the radiological field of view. Complications, identified by reviewing the medical records, were correlated with imaging findings. Our Institutional Review Board approved the retrospective review of patient data for this study. Informed consent was waived by the Institutional Review Board, and the study was compliant with the Health Insurance Portability and Accountability Act.

Results: Fourteen different types of electrodes were identified. Most were placed in the thoracic spine but six thoracolumbar and two cervical spine SCS were also present. We measured the position of the electrodes within the spinal canal on 26 CT studies in 24 patients. The electrodes were placed in the epidural space in the posterior 1/3 of the spinal canal on 22/26 CT studies. Complications included misplaced, migrated, broken, and retained electrodes and lead wires, puncture of the thecal sac, infection, and hematoma (Figure 1).

Conclusion: Radiologists should be familiar with the different types and expected locations of SCS employed in the spine to relieve pain. Improper placement of the electrode may lead to ineffective pain relief or other complications.

Coccydynia is often reported after childbirth. The pain is often aggravated by bicycle or bike riding and is a rare cause of dyspareunia. Hyper-excitability of clusters of cells at the termination of parasympathetic chain in Ganglion Impar, located anterior to the Sacrococcygeal disc is implicated in causation of this painful syndrome. Temporary relief of pain is often obtained by blockade of the ganglion using local anesthetic agents. We are describing our experience with treatment of Coccydynia using PRF in 20 patients with lasting benefit.

Material and Methods: Twenty patients suffering from intractable pain of Coccydynia with their age varying from 22 to 72 were treated with fluoroscopic guided pulse radio frequency (PRF) or RF lesions of Ganglion Impar. Procedure was performed in a prone position under conscious sedation. A 18 gauge metal cannula was advanced through the sacro-coccygeal disc into the pre-rectal space with confirmation of positioning using non-ionic contrast. A 20 gauge insulated 5mm bare tip electrode was introduced through the cannula that was then recessed around the insulated electrode. Two lesions at 65 Volts with temperature control at 40 Celsius were made. 3 ml 0.5% bupivacaine and 40 mg depotmedrol were introduced in the epidural space.

Results: 80% percent patients had a successful outcome with a 75% or greater relief. One patient refused a re-intervention for recurrence.

Percutaneous Radiofrequency Neurotomy Is Effective in the Treatment of Lumbar Facet Joint Syndrome

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Purpose: Lumbar medial branch neurotomy has been applied in the treatment of facet joint (zygapophysial) syndrome by means of percutaneous radiofrequency denervation (RFD). The data so far available on its efficacy is still controversial because of differences in patients selection and surgical technique. The aim of this study was to provide new evidence on the clinical outcome of this procedure.

Materials and Methods: 63 patients (mean age 65.3) with chronic low back pain due to facet joint syndrome were selected for RFD. The diagnosis was confirmed by gadolinium MRI and local anesthetic injection close to the zygapophysial symptomatic joints. Electrical stimulation of the medial branch nerve area with measurement of impedance was also performed in order to determine the proper site of intervention and to avoid motor nerve lesion. Clinical evaluation and assessment of pain by means of a Visual Analogue Scale (VAS, 0-10) and a Oswestry Disability Index (ODI, 0-50) test was performed before, one week, one month and twelve months after the RFD procedure. It was also assessed the use of analgesic drugs before and after the procedure.

Results: A total of 140 joints were treated in the 63 patients enrolled in the study. Baseline pain VAS was 9.0, 1 week after RFD 4.92, 1 month after 5.57 and 12 months after 5.88(p<0.0001, Mann-Whitney test); baseline ODI was 30.84, 1 month after procedure 13.31, while 12 months after 15.86(p<0.0001, Mann-Whitney test).

Conclusion: Lumbar medial branch neurotomy by means of RFD is an effective and safe procedure in reducing chronic back pain in patients with facet joint syndrome.

"Regional" Concept of Back Pain and Therapeutic New Proposal

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Purpose: Chronic painful pathology is frequent and multi-factorial. Percutaneous or surgical treatments often consider only one of the anatomical components of the painful pathology which is actually regional. We present our therapeutic concept to solve this problem.

Method: The following tools are used in association or successively according to the result obtained after each therapeutic step: 1) percutaneous treatment of all symptomatic discal levels at discography (this number being frequently of 2 but often also 3 or even 4 levels). The current use of radiopaque gelified ethanol (Disco-gel) has made the percutaneous disk treatments well tolerated and safe 2) bilateral systematic steroids injections in the facet joints at the level of the treated disk 3) systematic consideration of the harmony of the para-spinal muscles and correction by various techniques of stimulation 4)
lumbo sacral percutaneous liposuction to improve the active muscle support of the vertebral column, 5) CT sacroiliac steroid infiltration after clinical determination of its responsibility in the residual symptoms.

Results: Routinely used in the chronic painful lumbar pathology this concept of regional suffering brought numerous and often spectacular good results in majority of the cases.

Conclusion: This new therapeutic concept respects the spine anatomy and is efficient in one of the most frequent human pathologies.

17.00-17.15
Current Experience and New Indications of Liposuction in Spinal Pathology
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Purpose: We have previously proposed a new therapeutic approach to low back pain consisting in a liposuction of the fat surrounding the atrophied lumbosacral paraspinal muscles. This study was originally based upon the observation that paraspinal muscular atrophy with fat deposits occurs near the region of intervertebral disk hernias. Our hypothesis was that reduction in the volume of the fat deposits would allow an expansion of the atrophied muscles and consequently improve the active contention of the lumbo-sacral spine. Since this early experience we did have also used liposuction in other locations and indications such as painful thoracic scoliosis or scars.

Methods: Early results of the technique have been published. We present our current experience on 124 patients. Technique of liposuction has been progressively improved with a better cleaning of the lateral fat components of lumbo-sacral compartment. The technique is in most cases performed on out patients under local anesthetic or light sedation.

Results: There has been no complication. Overall results showed that more than 70% of the patients have been significantly improved by the technique. When performed, repeated liposuction has been beneficial on all the cases. MR follow-up controls regularly showed an expansion of the para-spinal muscles. Liposuction of scars has also showed that most of the patients could be improved by this technique as long as clinical signs have allowed to focus on them.

Conclusion: It is, at our knowledge, the first time that liposuction is used to encourage muscular expansion. This pilot study has demonstrated safety and therapeutic efficiency. Its beneficial mechanism is still unclear but it presumably implies not only a mechanical improvement of the active contention of the spine but also presumably a removal of toxins accumulated in the fat. Its indications are not completely determined but it represents a promising therapeutic tool that could be applied to many types of spinal pathology, alone or in association with percutaneous intradiscal therapies, muscular stimulation and physiotherapy.
Friday, 8 October
Oral Sessions
Interventional Neuroradiology

Chairs: S. Bracard, M. Gallucci

09.15-09.45

Interventional Neuroradiology Is Not Only a Sum of Technicalities, It Is a Medical Work Needing Special Human Approach

J. Moret
Chairman, Department of Interventional Neuroradiology; Beaujon University Hospital; Clichy, France

09.45-10.15

Facing the Emotional Truths of Grief Caused by Complications of Interventional Neuroradiology

K. Goto
Ohta Memorial Hospital; Fukuyama, Japan

There is a famous saying by Doctor Albert Schweitzer: “Everyone has one’s own Lambanéré”. Having ground Zero of Nagasaki as an initial memory of my childhood and finishing career as an interventionist in Hiroshima, I would say that everyone has one’s own Nagasaki and Hiroshima. And also, every interventionist has his her own complications related to the procedure. In modern medicine, it is well known that in areas where treatment results are excellent, the possibility of tragedy is also high. This is very true in our specialty where complications occasionally may not only have a profound neurological effect, but also stress the patient and their families. It was also shown that severe psychic distress tends to occur on both sides of the patient-doctor relationship. The patient and/or families’ grief is so grave that they often desire to die. And observing their grief reminds us of and intensifies our own grief. Therefore, we tend to avoid intimate contact with them and seek support from our colleagues, or estrange ourselves from our surroundings by repeatedly reviewing DSA and MRI and rationalizing the poor results. However, these acts of intellectualization to overcome our sense of loss have great limitations. To face a patient and/or family in the mourning process helps them to grieve thoroughly. It is an important part of a physician’s job to accept the anger and recriminations of the patient and/or family. At the same time, it is necessary to recognize our masked grief and reveal it. The main issue here is “What is the measure of a matured physician?” It could be said that the acquisition of technical skills is only one aspect of growth as a physician. It is obvious that through the grief of a patient and/or family suffering from severe complications and through their own grief, physicians can grow emotionally. Born in Nagasaki shortly before the outbreak of WW II and finishing career as an interventionist in Hiroshima, grief became my major concern increasingly. There are striking similarities between the emotional truths of patient’s and/or family’s grief and atomic bomb survivors’ grief. I would say that those without facing the reality of the disaster and simply transcending grief generated by atomic bomb attack, focusing only on economic activity, produced desolation of our country...

10.50-11.10
Advanced Contrast-Enhanced MRI for Stroke Risk Assessment
B.A. Wasserman
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High-resolution contrast-enhanced MRI has emerged as a powerful tool for characterizing atherosclerotic plaque components, ultimately enabling the identification of anatomic features that are known to predispose to rupture with the consequent clinical event. Re-cently, much attention has focused on the identification by MRI of the thin fibrous cap, large lipid core, and the presence of intraplaque hemorrhage, all of which have been shown to be important determinants of stroke risk when identified in carotid plaque. Intraplaque hemorrhage is of particular interest in that it is thought to lead to the development of the thrombogenic lipid core and contributes to plaque progression. There is growing literature indicating that neovascularization of plaque is also associated with stroke risk and is specifically associated with the development of the thin cap, large core, and macrophage accumulation within plaque. Furthermore, there is evidence that neovascularity can lead to the development of intraplaque hemmorhage because of microvascular incompetence. Preliminary studies by ultrasonic, CT, and dynamic contrast-enhanced MRI have shown our ability to image neovascularity based on contrast-enhancement within the adventitia where novesselles are thought to arise, though the clinical implications of its detection have been unclear. We have shown that high-resolution contrast-enhanced MRI is capable of detecting the anatomic features of plaque vulnerability, including the thin fibrous cap and large lipid core. It can detect intraplaque hemorrhage with high sen-sitivity, specificity and accuracy, and this information can be obtained as part of a routine MRA sequence with out necessitating additional scan time. Finally, we have shown that this tech-nique can categorize the degree of ad-ventitial enhancement as a measure of neovascularity, and this is strongly asso-ciated with having had a recent TIA or stroke independent of intraplaque hemmorhage presence, which is also strongly associated with having had a recent TIA or stroke.

11.10-11.30
DTI for Stroke Imaging
K. Yamada
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Kyoto, Japan

MR tractography based on diffusion tensor imaging (DTI) was first intro-duced to the medical imaging community a decade ago. Since then, it has been successfully applied to a number of neurological conditions. It has been most commonly used for preoperative planning for brain tumors but has also been used in the field of stroke imaging. The technique has been applied to assess the relationship between the elo-quent fiber tracts and small brain infarcts. These clinicoangiographic corre-lation studies have indicated that tractographic results have a fair correlation with clinical symptoms. More recent studies have shown that it may also be used to measure patients’ outcomes after stroke. Assessment of the lan-guage circuits, one of which is known as the arcuate fasciculus, has also been attempted. This fiber tract connects the temporal lobe (primary auditory cortex), Wernicke’s area, and Broca’s area (frontal lobe). This fiber bundle is considered to be an eloquent one when the left hemisphere is considered, and a vascular insult to this circuit can re-sult in conduction aphasia. Studies have shown that the degree of damage to this circuit can predict the patient’s language function in the chronic stage following the vascular event. Tractogra-phy has also been used in the field of pediatric ischemic brain insult. One of these studies has measured the FA of the pyramidal and sensory tracts and has shown that one can predict the occurrence of cerebral palsy using this information. This study also indicated that tract-based analysis (TBA) is su- perior to the manual region of interest (ROI) measurements.

References

Figure A 52-year-old patient with right hemiparesis. (A) T2-weighted image shows a small hyperintense lesion located at the left thalamus/internal capsule. From this T2-weighted image alone, it is difficult to discern whether the internal capsule or thalamus is involved. (B) DWI with superimposed sensory and motor tracts reveals that the lesion directly involves the left motor fibers, a finding that was well correlated with the patient’s motor symptoms.

11.30-11.50
Imaging of Spinal Stroke
S. Kollias
Institute of Neuroradiology, University Hospital of Zurich; Switzerland

Spinal cord infarction is much less frequent than cerebral infarction, accounting for only 1% of all strokes but may cause severe neurological symptoms. The pathogenesis and natural history of spontaneous or nonsurgical spinal cord infarction remain largely unknown. A large study showed that only 9 of 3784 autopsies revealed spinal cord infarction, with a rate of occurrence of 0.23% at death. Its low incidence has contributed to the small diameter and low flow rates of the main arteries supplying the spinal cord as compared with cerebral vessels. The possibility of cardiogenic emboli entering these arteries seems low. Furthermore, there is an extensive collateral network between the main medullary arteries at the level of the spinal cord surface, which nearly always compensates for atherosclerosis i.e., slow occlusion of the large radicular arteries. Spinal cord infarction is probably caused by small emboli gaining access to medullary vessels distal to the ring of collaterals or by sudden occlusion of the radicular arteries. Diagnosis mainly rests on history and clinical symptoms. Acute often painful, rapidly progressive sensorimotor deficits without prior history or clinical signs of an inflammatory disorder are encountered in the initial phase. Relevant differential diagnoses include inflammatory and demyelinating lesions, spinal cord compression due to tumor, spondylodiscitis, disk herniation or hematomas as well as, venous congestion due to pathological arteriovenous shunts. Demyelinating disorders of the medullary cord are rarely painful, and only few neoplastic disorders are as rapidly progressive as medullary cord infarction. However, spinal epidural or subdural hematomas, which may occur spontaneously, have to be excluded by MRI. Clinical presentation in spontaneous cases is suggestive, but no pathognomonic. Cervical cord infarction is dominated by an irreversible flaccid paresis in the affected spinal segments, due to destruction of the motor neurons, and an initially flaccid, later spastic, paraparesis due to damage of the corticospinal tract. The degree of sensory deficits varies according to the size of the affected vascular territories. Most frequently the territory of the anterior spinal artery and the sulco-commissural arteries is affected. This may be due to the large vascular territory of the anterior spinal artery and a larger calibre of theses vessels compared with the posterior spinal artery. Frequent locations of clinically apparent spinal infarctions are the cervical and lumbar enlargements. This may in part be due to the vascular anatomy and in part to the high metabolic demand in these areas with a particularly high concentration of motoneurons. The anterior horns of the gray matter are predominantly affected also due to their high concentration in motoneurons and therefore higher vulnerability to anoxia. This may lead to the typical “snake-eye” or “snake-bite” configuration of medullary infarction with bilateral hyperintensities on T2-w images. T2-w images are not sensitive in the first hours after the onset of the symptoms. Cord lesion is present on sagittal and axial T2-w images in 40-60% of cases. Contrast enhancement may be present in the subacute stage, as well as hemorrhagic transformation, usually recognized as high signal intensity in the peripheral parts of the infarcted area on T1-w images. Intracellular edema, the first initial sign of cytotoxic, i.e., ischemic cell damage, can be demonstrated with DWI. Diffusion abnormality has been observed beginning 4 h after the onset of the symptoms however, most studies were performed much later, between 12-30 hours, all demonstrating a strong diffusion abnormality in the presence of T2-w signal abnormality. A decrease of the calculated ADC values as compared with the normal appearing part of the spinal cord has been demonstrated. Follow-up studies, performed between 5 and 20 days following infarction, have shown an increase in the ADC values compared with the initial examination with normalization in the later stage despite the persistence of the T2-w abnormality. Early diagnosis of acute spinal cord ischemia may contribute to improved patient management and allows earlier application of pharmacological agents that may reduce neuronal apoptosis, and thus, subsequent neurological deficits.

11.50-12.10
Endovascular Stroke Treatment: From Fibrinolysis and Aspiration to Thrombectomy and Stenting
H. Henkes
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12.10-12.30
Penumbra and Extra Corporal Ozone Therapy
G. Wasser
Former Vice President of the German Association for Use of Ozone in Prevention and Therapy

Penumbra or the perifocal edema is the limiting factor in the patient’s restitution after brain stroke. This formation is the culprit for loss of motoric and sensoric function. The depolarized or stunned cells can survive approximately 48 hours. In contrast ozone therapy delivers ATP to the affected cells, restarting metabolism, and shrinking the penumbra. In the end there is minimal loss of function after ischemic brain stroke.
Introduction: Acute ischemic stroke holds a fairly unpredictable prognosis ranging from death to complete inability down to few or none residual deficits. Endovenous (e.v.) administration of tissue plasminogen activator (tPA), within 4.5 hours from symptoms onset, is the only therapy whose efficacy has been demonstrated on several randomized controlled studies. This approach has two important drawbacks: the narrow therapeutic window reduces considerably the pool of potentially treatable patients and the e.v. administration has shown low efficiency in breaking down bigger clots occluding major arteries. Several studies have demonstrated a strict relation between the size of the occluded artery and the clinical score measured with NIHSS (National Institute of Health Stroke Score). Endovascular procedures have been applied to acute stroke treatment in the attempt to re-establish arterial supply using either the administration of fibrinolytic drugs directly on blood clot and/or a combination of different mechanical thrombolytic and angioplastic devices. Critically ill stroke patients suffering from the occlusion of a major arterial vessel and failing to promptly respond to e.v. tPA are now considered for additional endovascular treatment, the so-called “bridging therapy”.

Materials and Methods: In this retrospective study we evaluated the application of bridging therapy in 10 selected patients (8 male, 2 female, aged 47 to 80 median 65) admitted between 2008 and 2009 with an admission NIH stroke score >10 (range 11-32, median 18) and not responding to e.v. thrombolysis by the end of a full dose e.v. infusion (administered according to current guidelines). On admission to hospital patients received a plain CT scan and Angio CT on a multidetector helical scanner (VCT General Electric Healthcare), demonstrating a large vessel arterial obstruction, either a T-shaped internal carotid artery (ICA) occlusion (4/10), a middle cerebral artery (MCA) thrombosis (4/8) or a basilar artery (BA) occlusion (2/10). In 6 cases the NIHSS had remained stable during the e.v. thrombolysis whilst in 4 cases the score had worsened significantly (increase of 4 or more points). These particular cases, before proceeding to the angiographic suite, were studied further with an MRI examination (Philips Intera 1.5 whole body scanner), spin echo planar imaging, gradient T2 imaging and DWI (b = 0 and b = 1000 s/mm²) and two out of these 4 patients were excluded to endovascular procedures as an extensive ischemic core was documented (> 2/3 of middle cerebral artery territory). A total of 8 patients underwent endovascular mechanical thrombectomy as soon as possible after e.v. thrombolysis within 9 hours from symptoms onset (range 3.5 to 9 hours). The femoral artery was punctured by an experienced interventionist, an appropriate size sheath and diagnostic catheter was placed and advanced under fluoroscopic guidance into the symptomatic artery. The mechanical devices and procedures available have been applied on a hierarchical step up approach starting from microcatheter lyse to micro balloon angioplasty and intracranial stenting (TIMI 1, NIHSS 22).

Conclusions: Despite the patients pool is small and heterogenous the initial results seem to support the application of advanced intraluminal mechanical thrombectomy devices in selected patients in order to obtain an efficient re-vascularisation, generally we have experienced better results when vascularisation could be obtained timely. Multimodal therapies have shown to improve considerably patients outcome without increasing morbidity nor mortality, it is although clear that every single patient can respond differently to endovascular treatment and requires a tailored approach able to move to a more sophisticated device when recanalization is not achieved, on the other hand longer lasting procedures expose patient to increasing risks of complications. Our results are currently under revision as new patients are added on a prospective basis.

Mechanical Thrombectomy with the Penumbra Recanalization Device in Acute Ischemic Stroke. A Matched Pair Analysis in Comparison with Intra-Arterial Thrombolysis

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Background and Purpose: The aim of this study was to assess the clinical outcome of patients treated with the Penumbra system (PS) for acute ischemic stroke. A retrospective, monocentric matched-pair analysis in comparison with patients treated by intra-arterial thrombolysis (IAT) with alteplase was designed for this purpose.

Methods: 22 consecutive patients (mean age 62) with acute ischemic stroke and National Institutes of Health Stroke Scale (NIHSS) scores >=7 were
treated with the PS. 20 corresponding patients could be identified, treated with IAT. Matches were sought for initial NIHSS score and target vessels. Thrombolysis in Myocardial Infarction (TIMI) grades, mortality rates, NIHSS upon discharge, and modified Rankin scores (mRS) at 90 days were compared. Results: A total of 32 vessels in 20 patients were treated in either arm of the study. Recanalization to TIMI 2/3 was successful in 25/32 (78%) of target vessels with the PS, and 17/32 (53%) of target vessels in the IAT group. Upon discharge 2/20 patients treated with PS and 7/20 patients treated with IAT had a NIHSS score of 0 to 1 or an improvement >= 10-point on the NIHSS scale. All cause mortality at 90 days was 3/20 patients treated with PS, and 2/20 patients treated with IAT. 3/20 patients treated with PS and 7/20 patients treated with IAT had a mRS of <=2 at 90 days.

Conclusion: The Penumbra system is effective in re-opening occluded major arteries. Our data seems to indicate that patients do not necessarily benefit clinically from improved recanalization of occluded major arteries.

15.00-15.15 10’

Aggressive Mechanical Clot Disruption for Acute Ischemic Stroke with Low Dose Intrararterial Urokinase after Failure of IV Thrombolysis

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Purpose: To evaluate the efficacy, feasibility and safety aggressive mechanical thrombus disruption with low dose intraarterial urokinase after failure of IV thrombolysis in acute ischemic stroke.

Material and Methods: Between August 2007 and September 2009, we analyzed the results of 31 patients with acute infarction treated by endovascular aggressive mechanical thrombus disruption and with/without low dose intra-arterial urokinase. Mean age was 66 years. All patients were initially treated and failed by IV recombinant tissue plasminogen activator. Time to treatment, duration of the procedure, recanalization rate, urokinase dose and rate of symptomatic hemorrhage were analyzed. Clinical outcome measure were assessed, on admission, at discharge and at 3 months follow up (mRS>2).

Results: Average NIHSS score on admission was 16(10-23). Median time from neurologic symptom onset to IV rt-PA was 116 min, and mean time from symptom onset to IA therapy was 195 min. Duration of IA therapy was 61 min in average. Median dose of urokinase was 270,000U (in 5 patients urokinase was not used). No procedure related complications. Recanalization was achieved in all patients except 3 patients (partial recanalization). Early hemorrhagic transformation was noted in 3 patients but symptomatic hemorrhage was at 1 patient. Mean NIHSS score was 4 at discharge. Outcome at 3 month was excellent (mRS0,1) in 16, good in 7 patients and poor in 7 patients. 3 month mortality was only 1 patient (3.2%).

Conclusion: Even after failed IV thrombolysis patients with acute ischemic stroke, combination therapy with aggressive mechanical thrombus disruption with low dose IA urokinase is safe and effective treatment. Excellent clinical outcomes were achieved by relatively high recanalization rate and less symptomatic hemorrhages. Primary use of this this technique may enhance better neurologic recovery.

15.15-15.30 10’

Early Clinical Experiences with a New Generation Flow-Enabler and Clot Retriever (PhenoNet)

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Introduction: The Phenox clot retriever (PCR) and clot retriever cage (CRC) devices have been shown effective for mechanical thrombectomy in acute ischemic stroke. Here we report our first clinical experiences with a new generation combined flow enabler and clot retriever (PhenoBONNetR).

Methods: The Phenox BONNetR consists of a stent-like nitinol tubular structure with the struts bridged and stabilized by microfilaments. The device is introduced into the target vessel through a 0.021- or 0.027-inch microcatheter, deployed over and distally to the thrombus, and pulled back under continuous aspiration via the guiding catheter.

Results: The Phenox BonnetR was employed in 9 patients (5 male 4 female, 58-76 years, mean age 68 years) who had suffered acute ischemic stroke and had no benefit from systemic fibrinolysis and in whom other local strategies failed or were not considered appropriate. There were four carotid-T occlusions, one M1 occlusion, one M2 occlusion, 2 BA occlusions and a P1 occlusion. In all patients thrombus could be removed from the target vessel. There were 6 immediate and complete recanalizations. In three patients the target vessels were successfully re-canalized, but peripheral branches remained occluded.

Conclusion: This early experiences demonstrate that the new Phenox BONNetR device combines the advantage of immediate flow due to its stent-like tubular structure with effective capture and removal of thrombus material. The device is highly flexible and can be employed as peripheral as to the M2 and P1 segments. The impression is that the new BONNetR is a useful and safe product, which expands the armamentary of current devices for endovascular intracranial thrombectomy.

15.30-15.45 10’

The Potential of Stent-Triever: Experience in 180 Acute Ischemic Stroke Treatments

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Mechanical thrombectomy has become a valuable addition to the endovascular treatment for ischemic stroke. However, many of the approved systems do have some limitations. Conventional thrombectomy, reperfusion is achieved only after the entire thrombus has been removed from the occluded segment and thus towards the end of the procedure. A promising alternative is the use of flexible self-expanding stents that can displace the clot and allow for immediate reperfusion of the dependent territory. While permanent stenting requires long term antiplatelet medication that may add to the risk of hemorrhage in the acute and subacute phase of ischemic stroke, temporary stenting is recognized as a reasonable alternative here. In addition to immediate re-establishment of perfusion, self expanding retrievable stent-type implants have proven to hold great potential for mechanical thrombectomy as well. Over the past 20 months, we have treated more than 180 patients with temporary stenting and stentretrieval in two centers with either the Solitaire (ev3) or the TREVO (Concentric). The experience from these treatments was entered into our database of over 350 multimodality stroke treatments. Our analysis has proven Stentriever not only to increase the rate of potentially beneficial TICI 2b and 3 reperfusion above 80% when used as part of a multimodality approach, but also to decrease time to initial TICI 2a/b reperfusion. We will present these results with a special emphasis on potential methodological benefits and limitations and will compare reperfusion results and clinical outcome of stentretrieval to other trials and to our own database.
**In Vivo Evaluation of the First Dedicated Combined Flow Revascularization and Mechanical Thrombectomy Device (Solitaire FR) in a Swine Model of Acute Vessel Occlusion**

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**Background and Purpose**: The purpose of study was to evaluate the efficiency, thrombus-device interaction and potential complications of the stent-like Solitaire FR Revascularization Device for combined immediate restoration and mechanical thrombectomy in-vivo.

**Material and Methods**: The device was evaluated in an established animal model in the swine. Flow restoration effect immediately after deployment (T0), after 5 minutes (T5), 10 minutes (T10), recanalization rate after retrieval, thromboembolic events, and complications were assessed. Radiopaque thrombi (10 mm length) were used for the visualization of thrombus-device interaction during application and retrieval of the device. The Solitaire FR (4 x 20 mm) was assessed in 15 vessel occlusions.

**Results**: Immediate flow restoration after deployment of the Solitaire FR was achieved in 80.0% of vessel occlusions. Mean recanalization rate at T0 was 38.8%, at T5 30.7% and at T10 25.4% of initial vessel diameter. Rec-occlusion occurred in 20.0% between T0 and T5 and in 13.3% between T5 and T10. Complete recanalization (TICI 3) after retrieval was achieved in 86.7%. In two cases (13.3%) partial recanalization was achieved with remaining thrombus in a side branch (TICI 2b). No thromboembolic event was observed during deployment or retrieval. The assessment of thrombus-device interaction illustrated the compression of the thrombus against the vessel wall during deployment leading to partial flow restoration. During retrieval the thrombus was retained by the stent struts even during the passage of vessel curvatures. No vessel perforation, dissection nor fracture of the device was observed.

**Conclusion**: The Solitaire FR is a safe and effective combined flow restoration and thrombectomy device in-vivo. Partial flow restoration is achieved by thrombus compression immediately after deployment but decreases afterwards until final retrieval results in maximal recanalization.

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**Stroke 8**

**Chairs**: M. Sasiadek, A. Biondi

**Temporal Bypass Using Enterprise Stent for Treatment of Acute Proximal Middle Cerebral Artery Thrombosis**

W. Mustafa, K. Kadziolka, A. Leutaund, L. Pierot
Department of Radiology, Maison Blanche Hospital, Reims, France

**Objective and Importance**: We present the efficacy of temporary bypass technique for treatment of proximal middle cerebral artery thrombosis using Enterprise stent. Clinical Presentation: A 19-year-old female was presented to the emergency department approximately 2 hours after the onset of right hemiparesis and aphasia. MRI brain with 3 D sequences was performed showing a thomboaspiration of the M1/ M2 junction with preservation of the collateral branches of the Sylvian artery. A total dose of 4.5 mg of t-PA was administered intravenously before the patient was assessed by the neuroradiology service and intra-arterial therapy was recommended.

**Intervention**: Selective catheterization of the M1 segment using a microcatheter Prowler Select Plus was done followed by injection of 6 mg of Actilyse upstream and downstream of the thrombus with no response. Mechanical thrombectomy was the best therapeutic alternative. Passing using Enterprise stent was deployed for 5 to 70 minutes. Recanalization of the left proximal Sylvian artery was performed by removing the Enterprise system partially open associated with thromboaspiration through a guiding catheter. Controls angiography after the first passage showed satisfactory recovery infusions.

**Conclusion**: The temporary endovascular bypass technique using the Enterprise stent represents a novel strategy to achieve immediate recanalization of an occluded brain artery without the disadvantages and risks associated with permanent stent implantation.

**Stroke 9**

**Chairs**: M. Sasiadek, A. Biondi

**Acute Stroke Treatment with a Self-Expandable, Fully Retrievable Intracranial Stent**

C. Roth¹, P. Papanagiotou¹, S. Behnke², S. Walter³, A. Haass³, W. Reith³
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**Background and Purpose**: The purpose of this study is to demonstrate a new approach to the use of a self-expanding stent in the treatment of acute ischemic stroke.

**Methods**: 22 consecutive patients suffering from acute intracerebral occlusion were treated using a self-expandable intracranial stent, which was withdrawn, in its deployment. For this new technique we used the Solitaire AB (ev3, Calif., USA) that is the only intracranial stent that is fully recoverable. 8 patients had an occlusion of the basilar artery, 14 patients had a middle cerebral artery occlusion, 6 of these had to be treated for acute carotid occlusion first. Recanalization result was assessed by follow-up angiography immediately after the procedure. The neurological status was evaluated before and after the treatment with a follow up of up to 30 days using the NIHSS (National Institutes of Health stroke scale) and mRS (modified ranking scale).

**Results**: Successful recanalization could be achieved in 91.6% (TIMI 2 and 3), a TIMI 3 state could be reached in 18 patients, partial recanalization or slow distal branch filling could be achieved in 4 patients (TIMI 2). In 21/22 cases immediate flow restoration after deployment of the device. The stent was removed in its unfolded state in all patients. The mean time from stroke system onset to recanalization was 265min with a standard deviation of 126min. Mean NIHSS on admission was 17 with a standard deviation of 3. 66.7% of the patients improved more then 10 points on the NIHSS at discharge. 38.3% showed a mRS score of <3 at 30 days (50% mRS <1). Mortality was 16.6%. In one of the cases an asymptomatic ICH was detected on control CT.

**Conclusion**: The withdrawal of an unfolded fully recoverable intracranial stent shows very promising angiographic and clinical results. It combines the advantages of prompt flow restoration and mechanical thrombectomy.

**Carotid Stent Placement in Acute Stroke**

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**Background and Purpose**: Stroke caused by acute occlusion of the origin of the internal carotid artery (ICA) is associated with a significant level of morbidity and mortality. The purpose
of this study is to demonstrate the technical success of recanalization using stent implantation for an acute ICA occlusion as well as the clinical results. Methods: We retrospectively reviewed 17 patients that were treated for an extracranial ICA occlusion within 6 hours of symptom onset. In 14 patients there was an additional occlusion; at the origin of the ICA in 12 patients, and at the level of the middle cerebral artery (MCA) in 12 patients. To treat the intracranial occlusion intraarterial thrombolyis or mechanical recanalization was performed. Recanalization result was assessed by follow-up angiography immediately after the procedure. The neurological status was evaluated before and after the treatment with a follow up of up to 30 days using the NIHSS (National Institutes of Health stroke scale) and mRS (modified ranking scale).

Results: Successful recanalization using acute stent implantation was achieved in 16 patients (94.1%). There was no acute stent thrombosis. There was one procedure related complication. After successful recanalization of the origin of the ICA the intracranial recanalization with TIMI 2/3 flow was achieved in 8 of the 14 patients (57.1%). Mean NIHSS on admission was 17 with a standard deviation of 3. The patients (52.9%) showed an improvement of more than 4 points on the NIHSS at the day of discharge. 8 patients (50%) showed a mRS score of <2 at 90 days (43.7% mRS <2). Mortality was 18.5%.

Conclusion: Recanalisation and stent implantation for an acute extracranial ICA occlusion in selected patients is a relatively safe procedure that can lead to a significant improvement of the clinical symptoms.

16.45-17.00 10' Asymptomatic Occlusion of Both Common Carotid Arteries Missed on MRA
A. Karapurkar, N Aditya
SIR H N Hospital, Mumbai, India

Mr R S C, right handed 45 years old man had multiple episodes of blank spells. They usually occurred whenever he had exerted himself. He used to get fatigued even after the slightest exertion. He also had grand mal convulsions. There was no deficit on examination. MRA was reported to be normal. However when CT angiography was done it showed total occlusion of both common carotid arteries in the neck.DSA confirmed occlusion of both CCAs from about 2 cm beyond the origin. The ECA was reconstituted on both sides by the Vertebral-Occipital anastomosis with retrograde flow into ECA down to the stump of the distal CCA and up into the ICA. In retrospect on the MRA only the upper cervical carotids had been imaged and were reported to be normal. There was also severe stenosis of the left subclavian artery for which uneventful stenting was done.

Conclusion: This case shows the importance of imaging the entire cervical carotid artery.

17.00-17.30 25' Cerebral Hyperperfusion Syndrome Following Intracranial Revascularization: Anatomical and Pathophysiological Considerations
J. Chung
Suncheon Yangphua Hospital, Suncheon, South Korea

Objective: Cerebral hyperperfusion syndrome (CHS) is not uncommon and potentially devastating following cerebral revascularization. The hemorrhagic complications after the revascularization are quite uncommon, but it can be fatal and devastating when it develops. The patho-physiologic mechanisms of the CHS is believed to occur following restoration of blood flow to a brain with impaired autoregulation due to chronic hyperperfusion. Therefore, most of the cerebral revascularized patients show reversible focal neurologic deficits or focal seizures resulting abruptly increased cerebral perfusion. The management of CHS requires aggressive blood pressure control to prevent stroke and intracerebral hemorrhage. We evaluated and tried to understand the imaging findings of CHS especially focusing the cerebrovascular venous anatomy and also to explain the tentative underlying mechanisms of CHS related with chronic hyperperfusion.

Case reports: We present the imaging findings of CHS in two patients of intracranial middle cerebral artery (MCA) M1 segment angioplasty (F/65) and basilar artery stenting (M/56). Both of them showed focal reversible neurologic deficits after the intracranial revascularization procedures. Immediate brain CT scan of MCA angioplasty and stenting procedure showed diffuse sulcal effacement in entire left cortical MCA territory. Follow-up DWI on 3 days showed multifocal small sized ischemic infarctions in left cortical MCA territory. CT perfusion and CT angiography showed symmetric CBV, CBF, and MTT maps with no evidence of re-stenosis or subacute thrombosis. Angiography findings before and after angioplasty demonstrated different cortical venous drainage patterns of partial pseudothrombotic appearances of superior sagittal sinus with prominently dilated and recruited diploe veins draining into sphenopalatine sinus. CT and MRI findings of basilar artery stenting patient showed diffuse edematous changes in pontocerebellar regions with several small sized ischemic changes in both thalami. Post-stent angiography findings show prominent and enlarged lateral and median anterior pontine veins, precentral vein and intercollicular veins along the temporal lobes with recruited venous engorgement. CT perfusion and CT angiography of this patient showed unremarkable findings except reperfusion phenomenon of contrast accumulations in mid pons region due to previously damaged hyperperfused brain tissues.

Discussion and Conclusion: The diagnosis of CHS following intracranial angioplasty and stenting should be confirmed by either imaging studies or neurologic examinations. During the revascularization procedures, we can identify the secondary venous recruitments and redirect venous engorgements related with directly increased cerebral perfusions and blood flows. Those venous structures which were not delineated before the procedures owing to longstanding hyperperfused brain changes or chronic ischemia. Probable patho-physiologic mechanisms of CHS can be related with abruptly increased cerebral perfusion pressures of hypoperfused brain tissues. Those venous recruitments and engorgements could be explained as the potential venous reservoir preventing intracranial hypoperfusions which always occurs after the angioplasty or stenting. Serial angiography exams should be compared with the post-control revascularization angiography findings to verify the exact cause of cerebral hyperperfusions, however we can suggest that venous recruitments could be a one of favorable causative factors, which preventing fatal hemorrhagic complications.
Palazzo della Cultura e dei Congressi - Italy Hall
Friday, 8 October - 14.30-17.30

COMMUNICATIONS

Aneurysms 10

Chair: R. De Blasi, M. Longo

Introductory Lecture
14.30-14.45

Microporous Membrane Covered Flow Diverting Stent for Cerebral Aneurysm Occlusion: Initial European Experience and Mid Term Follow-Up
Clinic of Radiology and Neuroradiology, Klinikum Duisburg, Germany

Key words: aneurysm, cerebral, intracranial, endovascular, wide-neck, giant, fusiform, occlusion, flow diverter, stent, embolization

Summary: The use of flow diverter (FD) devices to reconstruct and treat complex cerebral aneurysms has seen a significant rise in the last two years with the approval of low porosity metal stents in Europe. Recent cases of early aneurysm rupture with these FD devices have been reported and has potentially been related to immediate and short term lack of aneurysm occlusion. The Excalibur Aneurysm Occlusion Device, or AOD (Merlin MD, Singapore) is a new FD that incorporates a novel microporous membrane technology with approximately double the surface area coverage of the clinically available low porosity metal stents. This enables immediate and durable aneurysm occlusion evidenced by preclinical animal studies and our early clinical experience. Furthermore, pre-clinical studies show consistent preservation of perforator and side branch patency, both angiographically and histologically. These results included cases where the perforator emerged directly from the aneurysm sac itself. This paper will present the clinical and angiographic follow up of the first 15 patients successfully implanted with the AOD in the currently on-going safety and efficacy clinical trial in Europe. This initial clinical experience involves only unruptured intracranial internal carotid artery aneurysms, with and without previous endovascular treatment. We will also discuss the challenges and advantages of balloon-expandable versus self-expanding FD technology and the potential implications of surface area coverage on early and late aneurysm rupture. Although more cases are needed to evaluate indications and results at long term follow up, initial post procedure and six-month clinical results indicate that the AOD for the endovascular treatment of intracranial aneurysms is a promising and effective treatment modality.

14.45-15.00

Mid Term Experiences with the Silk Stent - Report of 51 Cases
G. Gál, J. Nepper-Rasmussen
Odense University Hospital; Odense, Denmark

Materials and Methods: Between March 2008-January 2010, 51 patients, with 56 aneurysms were attempted to treat with the SILK flow diverter. Their age was between 12-78 years. The locations of the aneurysms were as follows: 35/40 ICA, 3 MCA, 2 ACA, 3 VA, 7 BA, 1 PCA. 34 of the aneurysms were large or giant, with wide neck. 12 of them were recurrent aneurysms, 5 of them previously treated with stent(s) and coils, 1 was surgically clipped. All patients were preloaded with ASA and Clopidogrel. The treatment was performed under general anesthesia, with the patient fully heparinised. No heparin was administered following the treatment. The Clopidogrel was continued for 2 months, while the ASA for 3. Follow up with DSA and MR was performed between 4 months-1 year after the treatment.

Results: The flow diverter was successfully placed in 48 cases, of which 2 were Leo+ only. In 2 cases the tortuosity generated so much friction during the deployment that it was not possible to reach the target, and in case it was impossible to cross a previously placed stent. 3 cases were treated with Leo+ and SILK, one of them in the same session. In 2 cases we experienced significant shortening of the device, that lost the connection with the proximal vessel wall. These were salvaged with placement of other stents-Leo+ and Enterprise-and coils.

Complications: We experienced the following complications during and after the treatment: 3 transient, in situ thromboembolisms, 2 of which were due to suboptimal inhibition of the platelet aggregation, while the third due to partial non-opening of the device. All of them were salvaged with intravenous ReoPro. 3 patients bled following the treatment. Two of these were fatal SAHs, both from giant, fusiform aneurysms of the basilar artery, one of which was only partially treated with a Leo+, awaiting the scheduled placement of a SILK, and the third was an ICH in the contralateral hemisphere. At the 1 year follow-up in 1 patient we found a significant stent stenosis, that was clinically silent, and we decided not to intervene. Evaluation of the angiographic and clinical results: In January 2010, 11 patients had 1 year follow-up. Of those, 10 aneurysms were totally, and 1 partially occluded, with total regress of the symptoms. 1 giant MCA aneurysm showed progress at 3 and 6 months follow-up. This patient was referred by an other institution to surgery, and a by-pass operation was performed, that, however, caused very severe ischemic complications, due of which the patient subsequently died. We have experienced complete thrombosis of most of the smaller aneurysms with wide neck earlier than the 1 year follow-up was due. According to our experience, the angiographic and the clinical results may be incongruent.

Conclusion: The mid term results with this new tool, in the treatment of a difficult, surgically often inaccessible group of aneurysms are very promising. This treatment modality can replace the combined treatment of aneurysms with stent and coils in the majority of the cases-depending on the cost/benefit ratio. Longer clinical follow-up is necessary to define its role in the field of interventional neuroradiology.

15.00-15.15

Silk Arterial Reconstruction for Intracranial Aneurysms: Multicentric French Study on 51 Consecutive Patients
J. Berge, A. Bonafe, H. Brunel, E. Chabert, J. Gabriellargues, K. Kadziolka, X. Barreau, L. Pierrot, V. Dousset

Aneurysms Treatment Using Intracranial Stent (Large Wide-Necked and Giant Aneurysms)

L. Guimaraes, T. Sola, E. Vivas, A. Casasco, C. Diaz

Service, Hospital General de Catalunya, Barcelona, Spain; Clinica Nuestra Señora del Rosario, Madrid, Spain


Material and Methods: We treated 16 people (12 women and 4 men, their average age was 57.6 years). Clinically, 2 patients showed diplopia, 7 patients suffered from headache, accidental discoveries in 6 patients and 1 patient had prior SAH. 1 patient had previous coils and another patient what a giant aneurysm that had been treated previously using coils and stent (Wingspan).

About location: 5 carotid ophthalmic, 3 para ophthalmic, 1 middle cerebral, 4 supraclinoid, 1 carotid siphon and 2 posterior communicating. About size: 4 small (<10 mm) wide neck, 5 large (10-25 mm) and 7 giant (>25 mm). The stents used: 4 Merlin, 11 Silk and 1 Pipeline. In every case we did prior angiography to get the stent measurements. We did clamping test in patients who suffer from large aneurysm. Six cases were associated with aneurysms in other locations. All patients were treated under systemic heparin therapy and antiplatelet therapy.

Results: One case was not treated because the stent could not be placed (stent Merlin). One case, irregularities and an image of thrombus were detected in the proximal stent (stent Silk) and the carrier artery was sacrificed. The remaining 14 cases the stent was implanted successfully and aneurysm size was reduced immediately. One patient suffered transient toxic encephalopathy, however it was controlled with steroid therapy. Neither aneurysm bled. There were no complications during follow up. All patients are treated with dual antiplatelet therapy.

Conclusion: The closed loop stents implantation as unique treatment is an option for large-necked aneurysms very wide and giant aneurysms. Clamping test is needed before procedure. The stent measures must be accurate. The decrease in aneurysm opacification is immediate. There have been no complications from a distance.

Silk Versus Pipeline for Reconstructive Endovascular Treatment of Intracranial Aneurysms. Technical Differences, Difficulties, Advantages and Disadvantages of Two Types of Flow Diverters

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Objective: During the past 3 years, a new generation of endovascular devices—the flow diverters—has been developed to treat aneurysms through an exclusively endoluminal rather than endosaccular approach. When fully deployed, the implants are designed to provide approximately 30 to 35% metal surface coverage at nominal expansion. The presence of an intravascular stent construct provides several theoretical advantages in addition to physically supporting the introduction of coils into the aneurysm. A direct carotid-cavernous fistula (CCF) is a rare life-threatening disorder where a direct shunt arises between the internal carotid artery (ICA) and the cavernous sinus. Etiologically, most direct CCFs are traumatic, but less commonly they may be spontaneous. We describe a case of direct CCF following treatment of intra-cavernous carotid aneurysm with Silk flow diverter stent alone.
Effect of Flow Modification on Aneurysm Induced Mass Effect

I. Szikora1, Zs. Berentei1, Zs. Kulcsar1, M. Marosfo1i1, I. Gubcz2, P.K. Nelson3, A. Bask1
1National Institute of Neurosciences; Budapest, Hungary; 2State University of New York; NY, USA; 3Chestnut Medical Bv3, Menlo Park; CA, USA

Purpose: to demonstrate the effect of flow modification on mass effect caused by large and giant aneurysms

Methods and Materials: A total of 42 aneurysms were treated with flow modification alone or with a combination of flow diversion and coil packing. All aneurysms had an unfavorable morphology for treatment with coils. Any mass effect related to the aneurysms were identified on contrast enhanced CT scan or spin echo MRI studies prior to treatment. Aneurysms were followed by angiography at 6 months or at 6 and 12 months. Those with mass effect had MRI between 3 and 18 months post treatment.

Results: For flow modification, one or more of the Pipeline Embolic Devices (PED, EV3, Irvin, CA, USA) was used in all cases. Additional coil packing was applied in 9 cases. A total of 37 aneurysms were followed by angiography at 6 months and 18 months post treatment. Three aneurysms were identified as having mass effect. None of them was coiled. Follow up MRI demonstrated collapse of the aneurysm and resolution of the mass effect in 15 of the 16 cases. One aneurysm, that had residual aneurysm filling at 12 months, 1 aneurysm had a persisting neck remnant, and one other were completely occluded. Sixteen aneurysms were identified as having mass effect. None of them was coiled. Follow up MRI demonstrated collapse of the aneurysm and resolution of the mass effect in 15 of the 16 cases. One aneurysm, that had residual partial filling by angiography at 6 months, had persisting mass effect at 18 months by MRI.

Conclusion: Flow diversion is highly effective in producing complete and lasting occlusion of large and giant aneurysms. Complete angiographic occlusion is associated with collapse of the aneurysm and resolution of the mass effect. Incomplete occlusion of such aneurysms, however, does not lead to relief of the mass effect.
Purpose: The endovascular treatment of intracranial aneurysms carries high rate of recanalization (up to 30% in certain series) particularly in case of large neck aneurysms. During the years the endovascular treatment has benefitted from technical advances such as balloon remodeling technique and stent assisted coils. More recently a new generation of stents (flow diversion devices) had been introduced. We like to present our preliminary experience in the first 9 patients treated in our center.

Materials and Methods: A total of 9 patients presenting with intracranial aneurysms were referred to our interventional Neuroradiology service. All patients were female ranging from 45 to 62 years of age harboring broad neck aneurysms 6 in the anterior circulation and 2 fusiform in the basilar artery, and one in the vertebral artery. Six patients were treated using one Silk stents while in 3 cases two Silk stent were introduced. The protocol includes the use of an eight channel phased-array coil and the acquisition of FSE T2-weighted axial sequences, MR angiography with a time-of-flight volume sequence (3D-TOF), T1-weighted 3D IR-FSPGR BRAVO (BRain Volume) sagittal sequences acquired before and after administration of paramagnetic contrast agent (bolus injection of 0.1 mmol/kg, corresponding to 0.2 ml/Kg, of Gd-HP-DO3A, Gadoteriolo-ProHance®, Bracco, Milano, Italy). 3D-TOF and IR-FSPGR BRAVO partitions were subsequently reformatted on a workstation using a Maximum Intensity Projection (MIP) reconstruction algorithm and 2 reconstructions on axial and coronal planes with a thickness of 3.0 x 0.0 mm. Images were assessed by two neuroradiologists with long-standing experience in vascular diseases and in 10 patients a CTA comparison has been achievable.

Results: The stent was deemed “patent” in MR examinations in all 11 patients and was confirmed by CT angiography. Assessment of haemodynamic changes in the aneurysms showed a concordance between MR and CT angiography in 9 out of 10 patients. MR identified complete exclusion of the aneurysmal sac from the circulation in 4 cases and in 3 it had correctly identified progression of aneurysmal thrombosis with residual flow within the lesion. In the remaining 2 patients MR identified the treated aneurysmal dilatation as completely patent to blood flow. In one patient, in whom the stent had been positioned across the neck of a giant aneurysm, already subjected to partial embolization with coils, CT angiography allowed only the assessment of the aneurysm neck, because of the artifacts. By contrast, MR clearly depicted persistent residual flow within the coil mesh, as disclosed by DSA performed during the endovascular procedure. Furthermore MR permitted to relieve in 9 of 10 cases additional findings not shown at CT angiography or depicted less reliably. In the study of the evolution of thrombus formation in the aneurysmal sac sequences taken before and after contrast administration, 9 out of 11 patients agreed in the characterization of the residual flow. Conversely in 2 cases the contrast-enhanced sequences led the observers to change their assessment from “thrombus progression” to pre-contrast examination to “flow exclusion”.

Conclusion: Our MR protocol proved superior to CT angiography in the follow-up of aneurysms treated with flow-diverting stents. MR imaging must be completed by administration of contrast agent when precontrast examination fails to depict complete flow exclusion.
lesions since diminution of ADC in small lesions can be missed on ADC maps because of partial volume effect.

Results: Embolic lesions were noted on the DW images of 50% of patients treated using a Flow Diverter Stent: 1 silent lesion in 37.5% and multiple silent lesions in 12.5% of patients. All lesions were on the aneurysm side except in 1 patient (in whom a balloon test occlusion was performed) with also controlateral lesions to the aneurysm side. Compared to the series of patients with Stent-assisted coil placement, we observed embolic lesions in 50% of patients as well: 1 silent lesion in 25% and multiple silent lesions in 25% of patients.

Conclusion: Silent embolic lesions are frequently detected on high-resolution 3T DW images performed after endovascular treatment of intracranial aneurysms using Flow Diverter Stents. In our series, the results are similar to those obtained after standard stent procedure. In addition, the percentage of patients with multiple silent lesions after a Flow Diverter Stent-assisted procedure remains comparable to the results reported in the literature concerning patients with an intracranial aneurysm treated endovascularly without stenting.
There is mounting evidence that biophysical forces play a central role in the initiation, progression and rupture of cerebral aneurysms. In light of this, a number of morphometric parameters, such as aspect ratio, convexity ratio, bottleneck factor, Fourier amplitudes, etc, have been proposed to augment aneurysm size as risk factors for clinical decision-making. Nevertheless, despite the rise in three-dimensional (3D) imaging over the past decade, whether it be rotational X-ray, CT, or MR angiography, much of the analysis of conventional and novel geometric risk factors still relies on the use of projection or reslicing based on the existing two-dimensional (2D) paradigms. This is understandable, because most of the functionalities available on modern radiological workstations are implicitly based on the conventions of film radiography, which in turn reflect radiologist training paradigms and the available evidence from clinical trials. While robust tools for interacting with and analyzing 3D image datasets are widely used in the technical and entertainment fields, they have resisted translation to routine clinical practice. As just one example, a recent paper by Brinjikji et al. (AJNR 2009;30(4):851-4) highlighted the underestimation of aneurysm aspect ratios using rotational angiography vs. DSA. While some of this had to do with differences in the spatial and temporal resolutions of 3D vs. 2D angiography, another important limitation was the need for digital segmentation of the 3D image, performed in that work using a relatively primitive threshold-based method provided on the 3D workstation available at the investigators’ site. It is well known in the imaging and computer science communities that thresholding, while convenient, is more susceptible to spatial resolution artifacts than, say, more sophisticated edge-finding techniques like level set segmentation. Nevertheless, such techniques are not (yet) routinely deployed on radiological workstations and, even if they were, interaction and measurement of 3D objects remain a challenge when compared to 2D image-based methods using calipers and rulers or their digital analogs. In the past few years we have focused on the development of robust and objective analysis techniques for three-dimensional geometric characterization from medical images (e.g., Lee et al, Stroke 2008;39(8):2314-7; Piccinnelli et al., IEEE Trans Med Imaging 2009;28(8):1141-55). These necessarily rely on a digitized representation (i.e., segmentation) of the 3D lumen from the image volume, and in our approach we use level set methods that hone in on the image edges rather than some ad hoc intensity threshold level. Based on experience with rotational angiography, CTA and MRA datasets, we have found that lumen extraction becomes relatively easy and user-independent in most cases. Once a robust digitization of the lumen is available, any number of geometric analyses can be carried out in an unsupervised or minimally interactive manner. For example, the figure below demonstrates the use of so-called Voronoi diagrams to automatically isolate the aneurysm sac or neck with minimal user interaction. Panel A results from the user simply clicking on the segmented lumen surface somewhere near the ends of each parent artery, and the aneurysm dome; the Voronoi diagram and its associated centerlines are traced automatically. Panel B shows the maximally inscribed sphere at the neck, which, combined with the aneurysm centerline yields a 3D version of aspect ratio. In Panel C the aneurysm sac is delineated automatically. The smoothed aneurysm surface in panel D, resulting from a simple, automated filtering of the Voronoi diagram, captures the essential features of the aneurysm sac shape, and can be compared to the original sac as a measure of 3D surface roughness. A key advantage of this approach is that it takes full advantage of the inherently 3D nature of aneurysm geometry. In relying on edge-based lumen segmentation techniques we avoid the pitfalls of threshold-based segmentation that, as Brinjikji et al. showed, are inferior to manual 2D analysis. By identifying geometric factors that can be extracted automatically, or at least with minimal, and then only high-level, interaction, we restrict the influence of operator variability and uncertainty to the lumen segmentation alone, not the geometric analysis. Having developed open-source frameworks for digitization and sophisticated geometric analyses of 3D datasets, our focus must now be on deploying them in a way that is relatively transparent to the clinician. In so doing, it should become much easier to perform comprehensive geometric surveys of aneurysms in a retrospective or prospective manner, thus attempting to break the vicious cycle whereby the unproven utility of novel geometric risk factors makes it difficult to justify the large-scale studies required to demonstrate their utility.
Results: In all patients, overall image quality was good to excellent at TOF MRV, CE MRV, and MP-RAGE sequences. Venous thrombosis was definitely present in 29 of 45 veins (64.4%) boundary of thrombosis was completely sharp. In venous structures with a completely sharp boundary of thrombosis at CE MRV, boundary could not be seen in 12 of 29 (41.4%) venous structures at TOF MRV, and was unsharp in 6 of 29 (20.7%) venous structures with MP-RAGE sequences. In all 11 venous structures with a completely sharp boundary of thrombosis with MP-RAGE sequences, the boundary was as well completely sharp at CE MRV. The score according to the differentiation of venous thrombosis was higher at CE MRV (MV 3.33) than at MP-RAGE sequences (MV 2.78) followed by TOF MRV (MV 1.9). Conclusions: CE MRV was shown to be superior to TOF MRV and MP-RAGE sequences and MP-RAGE sequences were found to be superior to TOF MRV in visualizing cerebral venous and sinus thrombosis.

Time Resolved Angiography: Can It Be Used as a Venous Triggering Technique for Magnetic Resonance Venography? Falsability, Usefulness in Cerebral Venous Pathology Imaging

Introduction: During the past decade, elliptic centric contrain contrast-enhanced magnetic resonance venography (CE MRV), have been proposed to replace two-dimensional time-of-flight (2D TOF) pulse sequence as the preferred method for imaging intracranial venous anatomy. Several techniques have been proposed to maximize venous signal in CE MRV. We propose to use a time resolved angiography sequence (TRA) to detect venous phase as it allows direct full visualization of cerebral venous system.

Materials and Methods: Throughout a period of 5 months 99 patients who were referred to our institution for MR examination with TRA scheduled had a complementary TRA synchronized CE MRV. CE MRV quality, CE MRV signal evolution were evaluated. 2D TOF and CE MRV were compared by Receiver Operating Characteristics on 22 examinations of patients referred by our Neurology department for cerebral venous sinus thrombosis.

Results: With time resolved angiography usual injection protocol, dural sinus enhancement remains at a high signal plateau for 6 seconds long, all along usable for contrast enhanced MRV diagnostic imaging. Time resolved angiography can be routinely used as a venous enhancement triggering technique. TRATAGEM (Time Resolved Angiography Triggered venous Angiography by Gradient-echo Elliptic MR imaging), combining TRA and CE MRV, avoids flow dependant imaging techniques pitfalls, is more accurate than 2D TOF in venous pathol-
including cortical veins, its sensitivity was best (76% [64%-84%]; AUC, 0.92 [0.88-0.96]), followed by TOF MRV (72% [59%-81%]; AUC, 0.93 [0.88-0.97]). Even for chronic CVT, it showed a relatively high sensitivity of 67% (30%-90%). For thrombosed cortical veins alone, GRE images achieved the highest sensitivity (66% [46%-81%]; AUC, 0.88 [0.78-0.97]). Specificities of all modalities ranged from 96% to 99%.

Conclusions: Combo-4D MRV showed an excellent accuracy for the diagnosis of dural sinus thrombosis. The analysis of dynamic patterns of contrast enhancement in dural sinuses appeared useful to identify chronic thrombosis. To diagnose thrombosed cortical veins, GRE images should primarily be analyzed.

Susceptibility Weighted Imaging (SWI) and Cerebrovascular Disorders

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CT ad MRI are very powerful tools in evaluating cerebral vascular diseases. However, there are obscure lesions on CT and/or MRI, the former may be overlooked even with clinical suspicions. SWI has been well described in detecting calcification, vein and hemorrhage. We are using SWI routiney with objective to identify some cerebral vascular lesions which are obscure in other sequences and to aid differential diagnosis.

Techniques: All patients in these studies underwent MR imaging with a 12 channel head coil in 1.5 T (Avanto; Siemens, Erlangen, Germany) and 3 T (Trio; Siemens, Erlangen, Germany) clinical scanners. The SWI parameters of 1.5 T scanner were: repetition time (TR), 49 ms; echo time (TE), 40 ms; Flip angle, 15 degrees; bandwidth, 80 kHz; slice thickness, 2 mm, with 64 slices in a single slab; matrix size, 177x256. The acquisition time was 3 min and 59 sec. with the use of iPAT factor-2. The SWI parameters of 3 T scanner were: TR, 27 ms; TE, 20 ms; Flip angle, 15 degrees; bandwidth, 120 kHz; slice thickness, 2 mm, with 64 slices in a single slab; matrix size, 182x256. The acquisition time was 3 min and 22 sec. with the use of iPAT factor-2. All images were obtained in axial plane. Subsequently, 2 mm minIP images were generated.

Result and Conclusion: Although there were many reports regarding the clinical applications of SWI in the literature, yet our experiences indicates SWI has much more usage and aid to identify cerebral vascular lesion. SWI has assisted us to identify vascular malformations, telangiectasia, Sturge-Weber syndrome, cerebral infarction with thrombus, cerebral arterial dissection, cerebral venous thrombosis, dural sinus fistula, venous hypertension, hypertension syndrome and diffused hypoxia-ischemic injury. SWI may expand to predict the brain death and prognostic implication of acute stroke.

Research 7

Chairs: H. Ghanaati, L. Saba

16.15-16.30

Comparison between 4D Phase Contrast MRI and Computational Fluid Dynamics with Patient Specific Inflow Boundaries in Unruptured Intracranial Aneurysms

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Purpose/Introduction: Hemodynamics are thought to play an important role in formation, growth and rupture of intracranial aneurysms. Visualisation of the hemodynamics in these relatively small structures is challenging. However, Computational fluid dynamics (CFD), a fluid-simulation technique, is increasingly used to visualize intra-aneurysmal flow patterns. Advantages of using CFD for visualization are its high resolution and the possibility to simulate complex flow in sub-centimeter structures. A drawback of this method is, that it requires invasive 3D rotational angiography (3DRA) data and patient specific 2D PC MR measurements of the inlet velocity as boundary condition. With increasing MR field strength and advancing technique, we are now able to scan a 4D phase contrast volume of an intracranial aneurysm with enough resolution to describe flow patterns. In this study we compare results of time 4D MRI of the aneurysm and surrounding vessels with Time varying CFD simulations obtained from high resolution 3DRA and inflow 2D PC MR velocity measurements.

Materials & Methods: 3 patients with intracranial aneurysms were scanned using a 3T MR system (Philips Medical System, Best, The Netherlands). MR 4D phase contrast scan sequence parameters: voxel size:
0.8 x 0.8 x 0.8 mm\(^3\), TE/TR:2.8/5.6 ms, flip angle: 15\(^\circ\), NSE: 2; Venc (x,y,z): 60-100 cm/s, SENSE factor: 3, 10 cardiac phases, retrospective cardiac gating. MR 2D phase contrast scan sequence parameters: 0.65 x 0.65 x 3.0 mm3, TE/TR:2.8/5.6 ms, flip angle: 15\(^\circ\), NSE: 2; Venc (x,y,z): 70-100 cm/s, SENSE factor: 3, >36 cardiac phases, retrospective cardiac gating. All patients had the MR scan in the diagnostic workup following the detection of an intracranial aneurysm. The extra sequences extended the scan-time with 20-25 minutes, for the extended scan-time, informed consent was obtained. The Computational Fluid Dynamics simulation is build with a geometry segmented from a 3D rotational angiography which was performed during the diagnostic workup, Segmentation software (Vascular Modeling ToolKit)\(^2\) provided geometries with 700,000 to 1.5 million tetrahedral elements. CFD simulations were calculated with Fluent \(\bigcirc\) software (ANSYS, Canonsburg, USA), boundaries were set to rigid walls, no-slip surface, Newtonian fluid, viscosity 0.004 kg/m s\(^{-1}\), fluid density 1060 kg/m\(^3\). Inflow boundaries were set using the measurements acquired with 2D phase contrast MR, an average velocity per timestep was imposed as inflow. Three consecutive cardiac cycles were set to eliminate ‘starting flow disturbances’. The patients’ aneurysms were located in the anterior communicating artery, the middle cerebral artery and the carotid artery. The aneurysms’ size ranged from 4 to 21 mm.

Results: Below is a 2D depiction of flow characteristics in one aneurysm during one cardiac cycle, visualized in 4D using both PC-MR and CFD.

Conclusion/Discussion: With modern techniques, like 4D PC MRI and CFD simulations, it is possible to visualize complicated flow patterns throughout the cardiac cycle. Advantage of PC-MRI over CFD is that with PC-MRI it is much easier to visualize complicated flow patterns, occurring within one voxel, small vessels (<1.5 mm) and small aneurysms (<4mm) are difficult to measure with CFD. 1. Higher resolution scans would decrease these disadvantages, but scan times will increase. It also more difficult to estimate wall shear stress using PC-MR than it is with CFD 1. Doing CFD simulations of this magnitude requires a lot of computational power, simulations lasting for more than 48 hours are no exception.

References

16.30-16.45
10’

Intracranial Aneurysms: Magnetic Resonance Imaging and Magnetic Resonance Angiography vs. Digital Subtraction Angiography

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Purpose: Intracranial aneurysms are pathology of middle age, significantly more often are found in women in 75% of cases. Magnetic resonance imaging is safe diagnostic method that does not have x-radiation. 3D TOF magnetic resonance angiography is non-invasive diagnostic method which gives without contrast media application an overview of brain blood vessels. The aim of this study is to assess the value of evaluation of T2 sequences MRI and MR angiography and 3D time of flight tomography and maximum intensity projection (MIP) algorithm for detection and characterisation of intracranial aneurysms, using digital subtraction angiography (DSA) as the ‘gold standard’.

Materials and Methods: In 102 patients, 60 female, 42 male, range age 12 to 76 years, mean age 49.4 years, 110 aneurysms were diagnosed. 83 patients had nontraumatic intracranial hemorrhage, 18 occasional head aches, and 1 had palpebral ptosis. All patients were examined on 1.0T unit using T2 and 3DTOF sequences, and digital subtraction angiography (DSA) was performed after. Two of reader independently interpreted and graded MRA T2 sequence, MRA 3DTOF tomography and MIP reconstructions and DSA findings for presence, location and size of aneurysms.

Results: According to the result of the DSA findings, as the gold standard there were 14 (12.7%) aneurysms 5mm large and smaller, 62 (43.9%) of medium size (6-12mm), 23 (20.9%) large (13-25 mm) and 11(10%) giant >25mm. There were 2(2.64%) aneurysms on ACA, 38 (34.5%) on MCA, 3 (2.7%) on PCA, 31 (28.2%)on ICA, and 9 (8.2%) on VBA. At each MRI brain examination at a standard T2 sequence can be diagnosed the presence of aneurysm with sensitivity of 0.782, and for aneurysms larger than 12mm with 1 sensitivity. Widely applied evaluation MIP reconstruction of MR angiography is highly sensitiv 0.873 for presence of aneurysms: 0.857 for aneurysms of 5mm and smaller, 0.935 for aneurysms 6-12mm large, and 0.969 for 12-25mm and 0.909 for giant aneurysms larger than 25mm. Evaluation of 3DTOF tomograms gives 0.864 sensitivity for presence of aneurysms: 0.429 for aneurysms of 5mm and smaller, 0.887 for aneurysms 6-12 mm large, and 1 for aneurysms larger then 12 mm. According to the localization of aneurysm sensitivity for ACA, PCA, ICA and VBA is 1, and 0.974 for MCA. One aneurysm that was not diagnosed in this study is the size at bifurcation of MCA. Evaluation of 3DTOF tomograms together with MIP reconstructions gives sensitivity of 0.991 for presence, location and size of intracranial aneurysms. One aneurysm that was not diagnosed in this study is the size of 5 mm at bifurcation of MCA.

Conclusion: At each MRI brain examination at a standard T2 sequence can be diagnosed the presence of aneurysms with high sensitivity. For evaluation of presence, location and size of aneurysms it is of great importance evaluation of 3D TOF tomograms together with MIP reconstruction what results in sensitivity of 0.991.

16.45-17.00
10’

Comparison of 3D TOF-MRA and 3D CE-MRA at 3T for Imaging Intracranial Aneurysms

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Background: Risks and complications associated with the treatment of intracranial aneurysms have decreased with the growing use of less invasive endovascular techniques. Nevertheless, some risk remains and must be balanced with the risk of aneurysm rupture. Both the risk of rupture and selection of treatment are largely based on factors related to specific characteristics of the particular aneurysm obtained from imaging examinations. Because magnetic resonance angiography (MRA) is noninvasive, lacks use of ionizing radiation, and is less costly, it is largely replacing conventional angiography for the diagnosis and follow-up of intracranial aneurysms. Studies have shown that nonenhanced 3D time-of-flight- (TOF-) MRA is satisfactory for follow-up of aneurysms, and that TOF-MRA performed at 3T provides improved depiction of aneurysms compared to 1.5T. Whether the use of MRA with gadolinium contrast

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provides any added benefit is less clear, with some studies showing that 3D contrast-enhanced MRA (CE-MRA) is better for visualizing aneurysmal morphology, while other studies have shown no such benefit, particularly at 3T. Here we compare 3D TOF-MRA and 3D CE-MRA, both at 3T, for their ability to provide detailed characterization of intracranial aneurysms.

Methods: Twenty-nine patients (12 male; 17 female) with known or suspected intracranial aneurysms underwent both unenhanced and contrast-enhanced MRA using an Intra 3 Tesla magnet (Philips Medical Systems, The Netherlands) with an 8-channel SENSE head coil in a single session. The unenhanced acquisition was carried out with a 3D TOF-MRA sequence (3D FFE, TR 2.3, TE 3.5, FOV 250, matrix 1024x1024, SENSE factor 3, 80 slice, 4 chunk, voxel size 0.5x0.5x1 mm), focused on the Circle of Willis and carried out in the axial plane, with fat suppression. Contrast-enhanced images were acquired with a 3D ultrafast FE sequence (TR 3.4, TE1.8, FOV 250, matrix 512x512, SENSE factor 3, 80 slice, voxel size 0.72x0.72x0.80 mm) in the axial plane, focused on the aneurysm, using CENTRA for k-space elliptical selection, including the sac shape, neck measurements, and the presence of arterial branching.

Results: A total of 41 aneurysms were identified with both TOF-MRA and CE-MRA techniques: 20 in the internal carotid artery, 10 vertebrobasilar, 7 in the anterior communicating artery, and 4 in the middle cerebral artery. There were no differences between TOF-MRA and CE-MRA in terms of assessment of the aneurysm dimensions: 23 were <7mm, 11 were 7-12 mm, 3 were 13-24 mm, and 4 were >24 mm. TOF-MRA data detected 12 aneurysms with an irregular sac, whereas CE-MRA acquisitions detected 19 irregularly-shaped aneurysms. Both imaging techniques identified 5 fusiform aneurysms with no neck. Of the remaining 36 aneurysms, TOF-MRA reconstructions did not enable detection of the neck and therefore, did not permit measurement of the sac/neck ratio, in 10 aneurysms. With CE-MRA, the neck was detected and measured in all 36 nonfusiform aneurysms, permitting calculation of the sac/neck ratio. CE-MRA detected 15 aneurysms with branches originating from the sac and/or the neck, whereas the TOF-MRA sequence enabled recognition of branches in only 12 of the 15 aneurysms. Finally, of the 41 aneurysms investigated, abnormalities of the Circle of Willis were found in 4 aneurysms with both imaging techniques. In 3 cases, A1 aplasia was found, and in the fourth case, TOF-MRA and CE-MRA both documented aplasia of the left posterior communicating artery. The diameter of all 4 of these aneurysms was <13 mm: in 2 of them it was less than 7 mm and in the other 2 it was between 7 and 13 mm.

Conclusion: 3D CE-MRA and 3D TOF-MRA at 3T are both excellent imaging techniques for determining the presence, location, and length of intracranial aneurysms. However, CE-MRA is superior to TOF-MRA for detailed visualization of certain aneurysmal features that impact treatment selection, including the sac shape, neck measurements, and the presence of arterial branching.

Figure: 3D MIP reconstruction of (A) TOF MRA data detected 12 aneurysms with an irregular sac, whereas CE-MRA acquisitions detected 19 irregularly-shaped aneurysms. Both imaging techniques identified 5 fusiform aneurysms with no neck. Of the remaining 36 aneurysms, TOF-MRA reconstructions did not enable detection of the neck and therefore, did not permit measurement of the sac/neck ratio, in 10 aneurysms. With CE-MRA, the neck was detected and measured in all 36 nonfusiform aneurysms, permitting calculation of the sac/neck ratio. CE-MRA detected 15 aneurysms with branches originating from the sac and/or the neck, whereas the TOF-MRA sequence enabled recognition of branches in only 12 of the 15 aneurysms. Finally, of the 41 aneurysms investigated, abnormalities of the Circle of Willis were found in 4 aneurysms with both imaging techniques. In 3 cases, A1 aplasia was found, and in the fourth case, TOF-MRA and CE-MRA both documented aplasia of the left posterior communicating artery. The diameter of all 4 of these aneurysms was <13 mm: in 2 of them it was less than 7 mm and in the other 2 it was between 7 and 13 mm.

Conclusion: 3D CE-MRA and 3D TOF-MRA at 3T are both excellent imaging techniques for determining the presence, location, and length of intracranial aneurysms. However, CE-MRA is superior to TOF-MRA for detailed visualization of certain aneurysmal features that impact treatment selection, including the sac shape, neck measurements, and the presence of arterial branching.

Figure: 3D MIP reconstruction of (A) TOF and (B) CE-MRA data from a patient with multiple aneurysms. Note better definition of the aneurysm neck with CE-MRA; (C) VR reconstruction shows sac irregularities and relationship with bifurcation branches of the MCA in considerable detail.

Vascular Malformation of the Brain
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Objectives:
1. Review the pathology of vascular malformations of the brain.
2. Overview of relevant imaging techniques for vascular malformations of the brain.
3. Discuss clinical prevalence and potential complications.
4. Review the appropriate treatment considerations for vascular malformations of the brain.

Presentation Summary: In evaluation of vascular malformations the development of non-invasive imaging is becoming more important. Correlation of dynamic imaging (over time) like catheter angiogram and Time Resolved Imaging of Contrast Kinetics (TRICKS), and its differences with static imaging such as Magnetic resonance angiography and CT Angiogram is becoming more important. Understanding the pathological vascular changes can help in correlating imago findings with the disease process. Although in our opinion catheter angiography remains the gold standard for evaluation of vascular malformation, other dynamic imaging modalities are showing great promise. MRI, MRA, with TRICKS is our first line of imaging for vascular malformation evaluation in pediatric population at our facility. This presentation will encompass imaging and pathologic review of capillary, venous, arteriovenous malformations, developmental venous anomaly and arteriovenous malformations of the brain. Prevalence, risk of hemorrhage and possible treatments are discussed.

References
Palazzo della Cultura e dei Congressi - Indigo Hall
Friday, 8 October - 14.30-17.15

COMMUNICATIONS

AVMs

Chairs: A. Takahashi, G. Gal

14.30-14.45 10’

Cavernous Malformations of the Central Nervous System: A Pictorial Essay

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Purpose/Aim: The purpose of this lecture is: To illustrate the typical and atypical imaging appearances of cavernous malformations in the brain and spinal cord, their associations and complications. To discuss differential diagnoses and management. To highlight the incidence of familial inheritance in multiple cavernomata and screening issues.

Content Organization: - Patient demographics, location and clinical presentation. - Pathology. - Imaging. CT features: Typical, Comparison with MR. MR features, Zabramski’s classification (Types I to IV). Characteristic MR appearances: Imaging the complications. - Associations. - Multiple cavernomatosis and Familial Inheritance. - Differential Diagnosis. - Impact of imaging on management.

Conclusion: Summary. The characteristic imaging appearances of cavernous angiomas must be recognised to avoid invasive diagnostic procedures. Multiple cavernomatosis may be familial and the patient’s relatives must be screened for this condition. Major Teaching Points: Cavernous angiomas have characteristic imaging appearances, which must be recognised to avoid invasive diagnostic procedures. - The classification of these lesions has a bearing on the prognosis and management. - Multiple cavernomas are associated with familial inheritance. - Management approach is determined by location of the lesion.

14.45-15.00 10’

Embolization of Brain Arteriovenous Malformations with Onyx: Results and Complications

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1 Interventional Radiology and Neuroradiology; Pescara, Italy; 2 Interventional Neuroradiology; Firenze, Italy

Introduction: Recently Onyx has become a widely used tool for partial or curative embolization of brain arteriovenous malformations (AVMs). Onyx, is an ethylene vinyl alcohol copolymer, that after infusion a solvent (DMSO) precipitates into a non-adhesive space-occupying cast. Onyx is a has the potential advantage over acrylic glue to allow longer injections and therefore to occlude large or multiple compartments from a single feeder injection. However, the indications to Onyx instead of other embolizing agents is controversial. Moreover, still few large series about Onyx embolization and procedural complications have been published. The aim of our work is to review a large series of AVM embolizations performed with Onyx with the intent to cure the AVM or to occlude it as much as possible before a secondary therapy was applied. We report our results with focus on periprocedural complications and late bleeding.

Materials and Methods: We retrospectively review a series of 72 consecutive patients with brain AVMs embolized with Onyx in a single tertiary centre. The following features of all AVMs were evaluated before the treatment: hemorrhage, Spetzler-Martin grading, type of nidus and shunt, draining veins and feeding arteries. We report the angiographic result and the rate of cure after a single or more onyx embolization. The rate of cure after the complete multimodal treatment was assessed too. Angiographic follow-up after 1-2 months was performed after embolizations. Periprocedural complications were evaluated and stratified. Finally, we compared our results with those reported by the literature.

Results: 42 AVMs were hemorrhagic. Overall, 101 embolizations with Onyx were performed. In 3 cases Onyx and glue were used in the same session. During the course of the treatment, 7 partial glue embolizations were performed. Curative occlusion following a cycle of one or more embolizations was obtained in 36%, of patients in most cases after only one embolization. One patient died because of haemorrhage before treatment completion. One patient died after a procedural complication. 13 patients are still on treatment and waiting for second embolization or follow-up after radiosurgery. The remaining patients underwent curative surgery or radiosurgery. In 3 cases AVMs showed complete occlusion immediately after embolization but had sign of partial recanalization at follow-up; in all cases treatment was completed. In 5 cases small AVM remnants were present after embolization but at follow-up AVMs were fully occluded. In 3 partially occluded AVMs, spontaneous non-procedural bleeding occurred before treatment completion: in 2 cases symptoms were transitory and AVMs occluded while one patient died. Neurological periprocedural complications occurred in 20% of cases with 9% of permanent deficits. Complications included cortical artery perforations, ischemic events, microcatheter trapping, feeding artery laceration because of traction during trapped microcatheter removal (fatal in one case), nidus bleeding. Late rebleeding occurred in three cases (fatal in one case) Our results appear similar to other series but the complete occlusion rate appears higher, maybe because in many cases the embolizations were performed with curative purposes.

Conclusion: AVM embolization with Onyx is very effective with a high rate of complete occlusion after embolization only, even after a single session. Most of residual are small and can be treated by radiosurgery. Follow-up after embolization is necessary as significant modifications can occur, including occlusion progression. Complications are possible and periprocedural haemorrhage is not rare.

15.00-15.15 10’

Double Arterial Catheterization in the Endovascular Treatment of Brain Arteriovenous Malformation with Onyx®

G.S. Nakiri 1, R. Riva 1, D.G. Abub 1, F. Padovani 1, M. Khawaldeh 1, C. Mouayer 1
1 University Hospital of Ribeirão Preto, University of São Paulo, Ribeirão Preto, Brazil; 2 Interventional Neuroradiology; CHU Limoges, France
Predict the effect of embolization and operative neuromonitoring trying to reduce neurological deficit post-operative. We present the technique of double arterial catheterization as an alternative to facilitate the hemodynamic filling of the nidus.

Materials and Methods: Between April 2008 and November 2009, 18 patients with brain AVM received endovascular treatment with this technique (12 at the Limoges University Hospital and 6 at the University Hospital of Ribeirão Preto - Brazil). The neurological examination was evaluated before each procedure, at the end of hospitalization and after discharge. The characteristics of patients, AVMs and technical aspects of treatment were recorded.

Results: The mean age was 31.7 years (6-54 years). The initial clinical presentation was secondary to rupture bleeding in 9 patients (50.0%) and epilepsy in 7 (38.9%). The size of AVMs was 13 to 54 mm (average 29 mm). The double catheter was always used with the objective of curing the AVM. All 18 patients included the endovascular treatment. The average number of sessions conducted was 1.4 (1-3 sessions), with injection of 6.8 ml of material (2 - 25.2 ml). Fifteen AVMs (83%) were angiographically cured. Permanent clinical complications occurred in 1 patient (5.6%). No deaths were recorded.

Conclusions: This preliminary series shows that the double catheter technique presents good results, especially when used with curative intent.

10-15.30

Use of Cervical Spinal Cord Stimulation to treat and Prevent Arterial Vasospasm after Aneurysmal Subarachnoid Hemorrhage

University of Illinois at Chicago, IL, USA

Introduction: Based on past laboratory and anecdotal clinical experience, we hypothesized that prolonged cervical spinal cord stimulation (SCS) in the acute settings of aneurysmal subarachnoid hemorrhage (aSAH) would be both safe and feasible, and that 2-week stimulation will reduce incidence of cerebral arterial vasospasm. The goal of our clinical study was to evaluate clinical effects of cervical SCS in a small group of selected aSAH patients, and to establish feasibility and safety this procedure in this complicated patient population. The study was undertaken in preparation for a larger scale randomized trial of SCS for prevention of cerebral arterial vasospasm following aSAH.

Patients and Methods: Single-arm non-randomized prospective study of cSCS in aSAH patients involved percutaneous implantation of 8-contact electrode in 12 consecutive aSAH patients that satisfied strict inclusion criteria. These inclusion criteria included confirmed subarachnoid hemorrhage that occurred within last 48 hours, ruptured aneurysm confirmed by cerebral angiography or CT-angiography; Hunt & Hess grade 3-4; Fisher grade 2-4; patient age 18 to 65 years; lack of arterial vasospasm on initial angiography; aneurysm is secured with surgical or endovascular procedure; no active anti-coagulation, coagulopathy, thrombocytopenia or anti-platelet agents; no active infection; no history of cervical laminectomy; no significant extracranial arterial stenosis; patient/family agree to participate in research and sign informed consent; SCS electrode is inserted within 72 hours after aSAH. The electrode insertion was performed immediately upon surgical or endovascular securing of the ruptured aneurysm while the patient was still under general anesthesia. The research protocol was approved by local Institutional Review Board after an Investigational Device Exemption was obtained from US FDA. Patients were stimulated for 14 consecutive days or until discharge. Information on clinical/radiographic vasospasm, all interventions aimed at prevention/treatment, and patient's condition during a 1-year follow up were recorded and analyzed.

Results: Enrolled was completed within 7 months. Mean age of 12 patients was 49 years (range 27-62), average H&H grade - 2.9, Fisher - 3.3. Three had aneurysms coiled and 9 - clipped.

There was 1 unrelated death and two electrode pullouts. There were no complications related to the electrode insertion or to SCS during the study. Angiographic vasospasm was observed in 6/12 patients in the first week after aSAH - in 2/12, no patient suffered any vasospasm-related neurological complication. Both incidences were smaller than predicted based on Fisher and H&H grades.

An interesting correlation was found between position of active contacts within SCS electrode and vasospasm occurrence. There were no long-term side effects of cervical SCS during 1-year follow up.

Conclusions: This first North American study of SCS for prevention of vasospasm after aSAH conclusively shows both safety and feasibility of this promising treatment approach. Our data indicate that despite high level of acuity in aSAH patients, impaired level of consciousness, frequent patient re-positioning, need in multiple tests and variety of monitors, SCS electrodes may be safely implanted and maintained for the two-week period. Based on our experience with intra-operative neuromonitoring trying to predict the effect of embolization and to guide the decision making process.
AVMs 2
Chairs: B. Pabon, S. Kim
15.45-16.00 10'
Transvenous Balloon-Assisted Technique in Transarterial Embolisation by Onyx-18 Injection of Intracranial Dural Arteriovenous Fistulas
N. Sourour, A. Biondi, F. Clarencon, F. Di Maria, Y. Guermazi, J. Chiras, Pitié-Salpêtrière Hospital, Paris, France

Object: We report our preliminary experience using a venous balloon-assisted technique (VBAT) in the transarterial embolization of intracranial dural arteriovenous fistulas (DAVF).
Method: We present 2 patients we treated between November 2009 and January 2010 (3 sessions) by transarterial injection of ONYX-18 (EV3) with VBAT protecting the transverse and the straight sinuses.
Results: The first patient, a 45-year-old male presented a fistula of the left lateral sinus with an antegrade venous drainage revealed by invalidating tinnitus. He underwent a transarterial embolization with ONYX via a branch of the occipital artery (a total injection of 3 cc of ONYX) with a FOX cross 6x80 balloon (ABBOTT) inflated in the left transverse sinus for protection of the functional patent sinus as well as the vein of Labbé. The balloon allowed also the diffusion of ONYX to other dural arteriovenous shunts connected to this sinus (posterior meningeal arteries, meningohypophyseal artery and ascending pharyngeal artery). The final angiogram showed near-complete occlusion of the fistula with no complications and regression of the symptoms of the patient. The second patient a 68-year-old female presented with a progressive loss of equilibrium and impairment of intellectual functions. The MRI and Angio MR showed the presence of a fistula in the posterior fossa. The angiogram revealed a diffuse arteriovenous fistula involving both lateral sinuses and the torcula with a retrograde venous drainage in the cortical veins; Presence of angiographic signs of intracranial hypertension. Occlusion of the left sigmoid sinus and left jugular vein was observed. In the first session we injected 16 cc of ONYX in 2 branches of the left occipital artery; we voluntarily occluded the non-functional left lateral sinus with VBAT protection of the torcula and the right lateral and superior longitudinal sinuses. All the fistulas shunts from the left side where excluded. The patient presented a moderate amelioration of her clinical symptoms. Another session is scheduled to treat the fistulous shunts of the right side with protection of the right lateral and straight sinuses.
Conclusion: In our preliminary experience the VBAT provides an important protection of the functional venous pathways in DAVF. It also allows by a single pedicle injection a better diffusion of ONYX to all the different arteriovenous shunts.

EVT of a Arterio-Venous Malformation and Dural Arterio-Venous Fistulae with Onyx. A Single Centre Experience
A. Tournade 1, M. Musacchio 2, A. Lebedinsky 3, N. Sourour 1, T. Tajahmad 3

Purpose: To assess the effectiveness and feasibility of endovascular treatment (EVT) with Onyx for brain arteriovenous malformations (AVM) and dural arteriovenous fistulae (DAVF).
Materials and Methods: From December 2007 to January 2010, 9 patients with 8 AVM and 1 DAVF were submitted to our department for EVT. They were 5 males and 4 females, aged from 30 to 66 years (mean age 48 years). AVM situation was occipito-parietal in 1 case, temporal in 2 and frontal in 5. DAVF was situated in the posterior fossa. Clinical presentation was seizures in 5 cases, intra-cranial haemorrhage in 2 and headaches in 2. All procedures were performed under general anesthesia, full heparinization and intra-arterial perfusion of nicotine or papaverine.
Results: 3 to 9 cc of onyx per session and per patient were injected. Onyx was used exclusively in 5 cases. In the other 4, acrylic glue was also injected in order to treat intra-nidal fistulae. Total occlusion was obtained after a single procedure for DAVF and 2 cases of AVM. In other 2 cases, occlusion was achieved after multiple sessions of EVT. Because of angiarchitectural characteristics of the residual nidus and arterial feeders, 4 patients were submitted for gamma-knife radiosurgery after EVT. Limited subarachnoid haemorrhage was observed in one case due to arterial perforation during microcatheterism. The patient was treated by glue injection, without clinical consequences. One patient with a partially occluded, large AVM died as a result of massive intracranial haemorrhage 6 weeks after the last session of EVT.
Conclusion: EVT of AVM and DAVF using Onyx is feasible. However, occlusion of intranidal fistulae necessitates acrylic glue injection. Although total occlusion of small AVM could be obtained after a single injection of Onyx, multiple EVT sessions, combined or not with other therapeutic modalities, seem to be the best approach for AVM. A multivariate analysis of each case is mandatory in order to planify the best therapeutic approach. Prevention of potential complications related to EVT requires a precise comprehension of anatomical and haemodynamic characteristics of vascular malformations, and experience in fluid embolic agents utilization.

Venous Approach in the Treatment of Cerebral Arteriovenous Malformations: About 5 Consecutive Cases
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1. CHU Dupuytren; Limoges, France; 2. Ospedale Umberto I, Ancona, Italy

Objectives: The total anatomical exclusion of a cerebral arteriovenous malformation (AVM) is the only guarantee of elimination of any risk of bleeding by rupture of the malformation. In certain situations, the treatment by endovascular arterial approach, by surgery or radiosurgery is impossible. The venous approach could be a solution in these selected cases. We report our experience in the selection and treatment of these patients.
Materials and Methods: Between June 2007 and March 2008, 5 consecutive patients carrying a cerebral AVM benefited from this technique. In 4 cases, hemorrhage was the presenting symptom of the AVM and, in one case, epilepsy brought to the discovery. Before the embolisation, 2 patients presented contralateral hemiplegia secondary to the rupture of the malformation. In case of bleeding, the intervention was realized in the acute phase in one patient and in the
distance of the hemorrhagic episode (> 3 months) in 3 patients. Two patients had beforehand benefited from a treatment (surgery, radiosurgery or arterial embolisation).

Results: the jugular venous approach was performed in every case and venous retrograde navigation was realized under road mapping, obtained by arterial catheterization. The nidus was deep located in 4 cases and cortical in one.

The injection of the liquid, embolic agent required preliminary deployment of coils in the draining vein in one case. The venous microcatheter was removed at the end of the treatment in 2 cases and left in 3 cases. In 4 cases, the complete anatomical exclusion of the AVM was obtained at the end of the procedure and confirmed by an angiographic control at 6 months. In one case, the treatment was deliberately partial, targeting and intranidal aneurysm. No neurological modifications were observed at the end of the procedure or at distance.

Conclusion: the endovascular access to the nidus of a cerebral AVM by venous approach can be performed when there are no other therapeutic alternatives.

A Late Haemorrhagic Complication in a Cured Arterio-Venous Malformation

D. Le Feuvre, A. Taylor
Groote Schuur Hospital University of Cape Town, South Africa

Arterio-venous malformations smaller than 3 cm can be treated using one of the three modalities available.

We present a young patient who had an occipital AVM treated endovascularly before being treated definitively with radiosurgery. The two year angiogram showed cure of the AVM but three years later the patient presented with symptomatic and imaging in keeping with a haemorrhage. Surgery revealed a cavernoma as the source of the bleed.

Imaging of Radiosurgical Planning and Follow-Up of Arteriovenous Malformations Treated by Gamma Knife: Ten Years Experience

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1 Department of Radiology, Clinique de Neuroradiologie, Hôpital Erasme, Brussels, Belgium; 2 Department of Radiology, Hôpital Ambroise Paré, Mons, Belgium

Purpose: To define the respective role of conventional MRI (MRI), MR dynamic subtracted angiography (MRDSA) and digital subtracted angiography (DSA) in the planning and follow-up of AVM treated by gamma knife (GK).

Background: Gamma Knife surgery of arteriovenous malformations has been used since about 40 years and has proven its efficiency. Different imaging modalities (MRI, MRDSA, DSA) are performed before treatment and as follow-up control examination.

Material and Methods: Between January 2000 and December 2009, 189 patients were treated for arteriovenous malformations in our Gamma Knife Centre. All patients sustained a conventional MRI as well as MRDSA. Before radiosurgery and when obliteration was suspected by MRDSA during follow-up, DSA was also performed.

Results: The combination of MRI, MRDSA and DSA was sufficient to obtain optimal delineation of the residual nidus for radiosurgical GK planning in all cases. Long term follow-up after treatment was available in 65 patients. Sequential MRI and MRDSA were performed until nidal obliteration was suspected. DSA could confirm the obliteration in all these cases. The obliteration rate was 95% after a period of 6 months to 5 years (mean period 2.1 years). Transient neurological symptoms appeared after treatment in 8 patients (12.5%); a permanent neurological worsening was observed in 3 patients (4.7%). Different MRI aspects will be discussed.

Conclusion: The complementary informations provided by the appropriate combination of MRI, MRDSA and DSA could allow accurate delineation of a target volume before stereotactic irradiation and appropriated evaluation of the response to treatment.

Slow-Injection Technique Using Warmed Diluted NBCA

K. Nakazawa, K. Murao
Shiroyama Hospital, Osaka, Japan

Purpose: ONYX TM still not fully permeated in Japan. Therefore, NBCA (N-butyl cyanoacrylate) is used primarily as liquid embolic material. Warmed diluted NBCA permit very slow injection because there own low adhesiveness. In this paper, to clarify safety and effectiveness of warmed very low concentration (13-17%) NBCA to use embolization.

Method: 13 meningioma embolization of 23 vessels, eight cerebral arteriovenous malformations of 35 vessel, three dural arteriovenous fistula of five vessels, a total of 63 vessels with slow-injection technique low concentrations of NBCA embolization after warm. We examine Type of microcatheter, Time to go out NBCA from the catheter tip until withdrawal of the catheter, Glueing, Thromboembolic complications. Some meningioma cases examine the tumor necrosis on MR Image.

Results: Total of 63 vessels was embolized. Marathon catheter: 40 ; SL-10. 18. Transit 5 was selected. The average injection time of meningioma : 184 seconds, AVM: 45.3 seconds, dural arteriovenous fistula: 52.3 seconds. In the cases of meningioma deep capillary vessel was confirmed in all cases during injection of NBCA. Nine of 11 cases were confirmed intratumoral necrosis on MRI after embolization. There is no case of glueing and complications associated with this technique.

Conclusion: Warmed diluted NBCA have great advantage to make prolong injection and possible penetration to deep capillary vessel than conventional methods.
Friday, 8 October - 14:30-17:30

COMMUNICATIONS

fMRI 7

**Chairs:** M. Thurnher, G. Polonara

**Introductory Lecture**

14.30-15.00 25'

**A Possible Role of Brodmann's Area 8 in Pre-Surgical fMRI**

J. Valk, N. Van Vucht, P.H. Pevenage

**MRI Centrum; Amsterdam, The Netherlands**

A possible role of Brodmann's area 8 in pre-surgical fMRI. J.Valk, MD, PhD, VU medical center and MRI center, Amsterdam-NL. 100 years ago, Brodmann published his cytoarchitectonal map of brain areas (Korbinian Brodmann, Vergleichende Lokalisationslehre der Grosshirrinde in Ihren Prinzipien dargestellt auf Grund des Zellenbaues, Johann Ambrosius Barth Verlag, Leipzig, 1909). Although the Brodmann areas have been discussed, debated, refined, and renamed exhaustively during a century, they remain the most widely known and frequently cited cytoarchitectural organization of the human cortex. Functions have been attributed to these areas, such as the sensory cortex, the motor homunculus, the visual cortices and the linguistic areas.

Cytoarchitecture of BA8: Area BA8 has a diffuse but clearly present internal granular layer (IV); sublayer 3b of the external pyramidal layer (III), has densely distributed medium sized pyramidal cells; the internal pyramidal layer (V) has larger ganglion cells densely distributed with some granule cells interspersed; the external granular layer (II) is denser and broader; cell layers are more distinct; the abundance of cells is somewhat greater. Function of BA8, BA8, is part of the frontal cortex in the human brain. Situated anterior to the premotor cortex (BA6) it includes the frontal eye fields (so-named because they play an important role in the control of eye movements). Damage to this area, by stroke, trauma or infection, causes deviation of the eyes towards the side of the injury. This finding occurs during the first few hours of an acute event such as infarct, or hemorrhage. The area seems also involved in the management of uncertainty. A functional magnetic resonance imaging study demonstrated that Brodmann area 8 activation occurs when test subjects experience uncertainty, and that with increasing uncertainty there is increasing activation (Volz et al.2005). BA8 in fMRI. In many fMRI studies of linguistic areas BA8 is mentioned as one of the areas playing a role in the process of ideation and prosody of language (Ketteler et al.2008). Pragmatic use of the activation of BA8 and its possible signal function in activation of Broca's area is not mentioned in this and other studies. In the last 4 years we have performed >100 presurgical fMRI's for three neurosurgical centers. We developed robust paradigms to activate eloquent centers of the brain, including motor strip, the visual cortex, areas involved in memory and, perhaps most important, areas governing localization and hemispheric dominance of speech and language functions. It is evident that in neurosurgery data about the position of eloquent areas, the establishment of dominance in linguistic functions and their relation towards lesions in the brain are crucial in preparing brain surgery. In activation of language areas we noted that the areas of Broca and Wernicke are not always in their expected position, with or without the displacement by mass lesions. fMRI results in evoking activation in language areas. To activate the areas of Broca and Wernicke several paradigms were used: word generation by generating words beginning with a letter or a group of letters on the projection screen, by using a variation of the TV Tower of London test. All reactions should be produced by "imaging" without speaking. In all cases a simple block - 'on-off'- paradigm was used: activation versus rest. The example in figure shows a typical result of a word generation test. Figure fMRI of patient with left frontal low-grade glioma; activation of expressive speech shows mainly activation on the left side and some on the right. BA8 shows activation on the left, and less on the right, confirming bilateral representation of Broca, with dominance on the left. The relation to the tumor is also well demonstrated. We noticed that in all but 2 patients the word generation paradigm not only activated the Broca area, but also BA8 on the same side as the Broca activation. The transverse and sagittal images showed next in another patient confirm the activation of BA8 and the extension of this area.

**Conclusion:** When in doubt whether Broca is activated, whether there is bilateral representation and which side is more prominent, activation of BA8 may lead to a correct interpretation.

**References**


15.00-15.15 14'

**Pitfalls in fMRI**

S. Haller1, A. Bartsch 2

1 Neuroradiology; Geneva, Switzerland, 2 Neuroradiology; Heidelberg, Germany

Several different techniques allow a functional assessment of neuronal activations by magnetic resonance imaging (fMRI). The by far most influential fMRI technique is based on a local T2*-sensitive hemodynamic response to neuronal activation, also known as...
The Shape of Motor Resonance: Right- or Left-Handed?

M. Cabinò 1, V. Blasi 1, P. Borroni 2, A. Iadanza 1, G. Cerri 1, G. Scotti 1, A. Falini 1

1Neuroradiology Unit and Cermac, Scientific Institute and University Vita-Salute San Raffaele; Milan, Italy; 2Department of Medicine, Surgery and Dental Sciences; Milan, Italy.

Introduction: Mirror neurons are a particular class of visuo-motor neurons. They are involved in action understanding as well as in motor learning. Mirror neurons were first discovered in monkey ventral premotor cortex but subsequent neuroimaging studies demonstrated that the observation of actions performed by others activates a complex cortical pathway also in the human brain, a pathway called Mirror Neuron System (MNS). Neurophysiological investigations also demonstrated that cortical and spinal pathways in the human motor systems, normally activated in movement, are also specifically activated during the observation of the same movements performed by others, and that the activation follows the timing of the observed action, a phenomenon called “motor resonance”. We hypothesized that since motor resonance reproduces subliminally the specific motor program for the observed action, it should be subject to motor constraints, such as handedness. Aim of our study was to understand if handedness shapes the resonant response, by engaging right-handed subjects (RH) and left-handed (LH) subjects in observation and execution of hand actions.

Materials and Methods: 40 normal volunteers, 20 right-handed (8 M, mean age 28.3 years) and 20 left-handed (12 males, mean age 29 years) underwent a functional Magnetic Resonance Imaging (fMRI) study during both observation and execution of grasping movements. The degree of handedness was evaluated with the Edinburgh Inventory. Brain MRI scans were obtained using a 3.0 Tesla Scanner (Intera, Philips Medical System, Best, The Netherlands). Functional MR images were acquired using an Echo-Planar Imaging sequence (TE 30 msec, TR 3000 msec, FOV 240 mm, 40 slices). We used a block design, fully-randomized. Subjects were asked to observe movies of a hand (left or right) that grasps different objects or to perform grasping movements appropriate to the shape of objects projected on a screen (with the right or left hand). fMRI data were analyzed using SPM5 (www.fil.ion.ucl.ac.uk/spm). We defined 4 contrasts for every subject: observation of a right hand grasping (OR), observation of a left hand grasping (OL), perform grasping movements with right hand (GR), perform grasping movement with left hand (GL). In order to identify MN areas we performed two Conjunction Analyses (p<0.001, unc.), between OR and GR contrasts (Conjunction Right) and between OL and GL contrasts (Conjunction Left). With this analyses we determined which voxels were active in RH and LH during both observation and execution of hand movements, distinctly for right hand and left hand. These voxels should be considered part of the MNS. LI Index: we used LI-toolbox5 to quantify the presence of lateralization in the cortical activation for each subject, for each Conjunction Analysis. On these values we made a direct comparison of the two groups and a regression analysis between these indexes and the Edinburgh Inventory. Results: fMRI: in both RH and LH subjects, Conjunction Analyses showed the activation of a network (fig. 1) formed by the frontal cortex (Brodmann area, BA6), the temporal cortex (BA22 and BA42) and the parietal cortex (BA40). All these regions are considered part of the human MNS. In addition to the above areas we found a significant activation in the frontal area BA9, the post-central BA2-3, the posterior parietal BA5 and BA7 and the occipito-temporal BA37. Direct comparisons showed that RH presented a strongly left-lateralized activation of the fronto-parietal areas, mainly during the observation/execution of their dominant hand. The activation was a little more bilateral for actions observed/executed with their dominant hand. LI Index: the two sample T-test analysis made on the LI-index values confirmed the results of fMRI analysis. The regression analysis showed that the pattern of cortical lateralization follows the degree of handedness of the subjects, as measured with the Edinburgh Inventory.

Discussion: The results show the importance of hand dominance in shaping the pattern of motor resonant response. The results obtained with fMRI analysis and with the LI-index demonstrated that the pattern of cortical activation that follows the execution/observation of hand movements changes with the hand dominance. Importantly, the fMRI data were obtained with a Conjunction Analysis identifying the brain areas activated during both execution and observation of object-related hand actions. The areas so identified are the same previously attributed to the human MNS a parieto-frontal network formed by the frontal cortex (BA6), the superior temporal cortex (BA22, 42) and the inferior parietal cortex (BA40).
11 with right-lateralized epilepsy (LE)) and in 14 healthy volunteers. Patients and controls underwent BOLD fMRI to lateralize language functions in the cerebral hemispheres. Six common seed regions related to the language network (Inferior Frontal Gyrus (IFG), Superior Temporal Sulcus (STS) and Temporo-Parietal Junction (TPJ)) of both hemispheres were defined. The seed regions were used to calculate FC with regional homologous regions recruitment in patients with right-LE. The seed regions were also used to calculate FC with linguistic performance in patients with left-LE, whereas suggested an unfavourable effect of non-dominant hemisphere FC correlation with the right-IFG node FC (r = -0.7; p = .03) with the right-IFG node FC (r = 0.7; p = .03), while a positive correlation was found with the intrahemispheric FC (r = 0.7; p = 0.04) and the right-IFG node FC (r = 0.7; p = .03).

Conclusion: In epileptic patients, FC-MRI was able to analyze the distribution of different connectivity patterns in all patients compared to controls. In both groups with left and right-LE, mean FC was found to be significantly reduced within the left (dominant) hemisphere (intra-hemispheric FC), between the two hemispheres (inter-hemispheric FC) and when originating from the left-TPJ and the hemispheres were defined. Region-to-region FC correlations with brain areas that were not found in the control group, were also observed in patients. In Patients with left-LE, Pearson's test showed a positive correlation between the verbal-IQ and the left intrahemispheric FC (r = 0.7; p = .03), while in patients with right-LE, a negative correlation was found with the interhemispheric FC (r = -0.7; p = 0.04) and with the right-IFG node FC (r = -0.7; p = .03).

The Effects of Paradigm Selection and Post-Processing on fMRI Language Lateralization: Threshold-Independent Methods, I

V. Tóth, G. Rudas, L.R. Koszák
MR Research Center - Semmelweis University, Budapest, Hungary

Introduction: Functional MRI methods are integral steps of pre-surgical workup nowadays. However, the protocols applied differ across imaging centers, and the majority of paradigms have been validated on 1.5 Tesla, while higher field scanners are becoming more and more available, adding the need for high signal-to-noise ratio and spatiotemporal resolution. The importance of protocol validation and the establishment of normative databases is widely recognized in clinical fMRI research.

Aims: We evaluated four paradigms with different mapping language function in our clinical practice, and assessed the effects of post-processing on a threshold-independent method of lateralization index (TI-LI) calculation, promising relatively unambiguous activation maps and unbiased within-patient variability [Suarez et al., 2009]. The robustness of lateralization definition and found it to be equivalent with the traditional Brodmann definitions or the Automated Anatomical Labeling (AAL) templates. Further comparisons were made using the Brodmann ROI definitions. Gaussian distribution of the acquired TI-LI data was verified by Kolmogorov-Smirnov test. The effects of data treatment were analyzed using factorial ANOVA. Both the main effect of “Experiment” and the significant interactions between “Experiment” and “Dropped blocks” and “Smoothing” factors were found to be highly significant (p<0.000001). Significant interactions between “Experiment” and “Dropped blocks” and “Smoothing” (p<0.000001) were found. No significant interaction between “Dropped blocks” and “Smoothing” was found. All of the four paradigms tested were able to define language function lateralization. The speech production paradigms and the speech comprehension paradigms provided more robust TI-LIs in the Broca and Wernicke regions, respectively. Shorter examination length was found to decrease robustness of lateralization. Smoothing with 12 mms Gaussian kernel was providing the most robust TI-LIs.

Conclusion: We evaluated a novel, gross anatomy based method for ROI definition and found it to be equivalent with the traditional Brodmann area based approaches. The language paradigms used ubiquitously in clinical practice provided reproducible and robust results. Furthermore, we evaluated a novel approach in lateralization calculation independent of the individually chosen statistical threshold, and found that this methodology produces robust results comparable with previous data in literature. We examined the effects of various factors and post-processing and found that both

15:45-16:00

10’
have a considerable effect on TI-LI. Longer paradigms provide more robust results. We also demonstrated that post-processing may have a more important effect on data gain than examination length. This might suggest that in clinical practice, thorough post-processing might allow for shorter examination time; further investigations are needed to assess optimal methods for this.

The Effects of Paradigm Selection and Post-Processing on fMRI Language Lateralization: Threshold-Dependent Methods, II

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MR Research Centre, Semmelweis University; Budapest, Hungary

Introduction: Functional MRI (fMRI) methods became integral steps of pre-surgical workup. However, the protocols of imaging and image processing differ across imaging centers. Moreover, the fact that different data treatment approaches can yield dramatically different maps further emphasizes the importance of protocol validation, a need that is already widely recognized in clinical fMRI research.

Aims: We evaluated four paradigms used for language mapping in our practice, and assessed the effects of post-processing on lateralization index (LI) calculation. The robustness of lateralization definition between each paradigm was compared as a function of examination length and post-processing of the data. Finally, we compared threshold-dependent LI calculations with a threshold-independent LI, as threshold-independent calculations are not readily available in all centers.

Methods: 17 healthy volunteers (age: 20.4±1.2, 12 females and 5 males) were examined at 3T (Philips Achieva 3T scanner, Philips Medical, Best, The Netherlands). Four language paradigms were examined: picture naming, auditory decision, synonym task, speech comprehension (block design, interleaved 24 seconds active and passive blocks, 12 repetitions). Data analysis was performed with Brain Voyager QX 1.10 (Brain Innovation BV, Mannstricht, The Netherlands). Matlab (MathWorks Inc., Natick, MN, USA) and Statistica 8.0 (StatSoft Inc, Tulsa, OK, USA) softwares. The effect of protocol length was examined by sequentially omitting zero to eight stimulation block pairs from the end of each experiment (“Dropped blocks”). The effect of 3D spatial smoothing was tested with four different Gaussian kernel filters (none, 4 mm, 8 mm, 12 mm smoothing, “Smoothing”). Whole hemisphere ROIs and Broca and Wernicke area ROIs were studied, the latter delineated by Brodmann area definitions. Threshold-dependent lateralization indices were calculated at 8 significance levels (Bonferroni corrected p<0.001, p<0.0005, p<0.001, and FDR corrected q<0.05, q<0.01, q<0.005, q<0.001, “Threshold”). For threshold independent LI estimation, the integrated T score-weighted distributions of all the positively correlated voxels between left and right ROIs were compared [Suarez et al., 2009].

Results: Gaussian distribution of the acquired LI data was verified by Kolmogorov-Smirnov test. The effects of data treatment were analyzed using factorial ANOVA. The main effect factors were paradigm (Experiment and “Dropped blocks”), “Smoothing” and “Threshold” were found to be highly significant (p<0.000001). Moreover, we found significant interactions between factors “Experiment” and “Dropped blocks”, and factors “Experiment” and “Smoothing” (p<0.000001). “Threshold” had significant interactions with all factors (p<0.0001). No significant interactions were found between “Dropped blocks” and “Smoothing”. All of the four paradigms tested were able to define language function lateralization. LIs tended to increase with “Smoothing” and with “Dropped blocks”; the latter finding was surprising given the opposite trend observed with threshold-independent LIs. Threshold-dependent and threshold-independent lateralization indices were found to be significantly correlated regardless of the statistical threshold or the ROI used. The strongest correlation was found for the FDR corrected q<0.05 threshold (r²=0.74, r²=0.76, and r²=0.58 for the whole hemisphere, Broca and Wernicke ROIs, respectively).

Conclusion: All of the investigated language paradigms are able to provide robust LI estimations in line with previous literature. The threshold independent-lateralization calculation approach leads to results comparable with previous threshold-dependent lateralization data in the literature and also in our study. Both the examination length and the post-processing parameters have considerable effect on LI, regardless of the calculation method used. Interestingly, the four mapping paradigms have different sensitivity to data processing, this effect also being contingent on the ROI selection. Our findings suggest that the optimal acquisition and processing paradigm depends on the paradigm used, therefore further investigations are needed to assess optimal methods for clinical practice.
memorability of a trademark, choice of advertising formats, assistance in creation, etc., the applications are broad and are only beginning. Manipulation? That an ad seeks to influence our choice cannot be denied, that is its purpose. Neuromarketing is only one of the increasing number of tools in the arsenal of advertisers. In any case, it does not permit changing the choice of the consumer or manipulating his or her brain unwittingly. The miracle buy button does not exist, but the lovely top-model on the advertising probably still has a bright future!

16.45-17.00 10’

Functional MR Imaging of Patients with Mild Aphasia after Stroke: Activation of Language Network from Acute to Chronic Phase and Preliminary Results of Early Rehabilitation Effect

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Purpose: Aim of the study was to observe reorganization of language-related areas and improvement of language performance in patients with mild aphasia after ischemic stroke with an fMRI auditory comprehension task in the acute, subacute and chronic phase and to evaluate functional correlates of early aphasia rehabilitation.

Methods: Seven right-handed patients with mild aphasia secondary to acute ischemia in left frontal and temporal regions underwent three fMRI examinations within 3 days from clinical onset (time1), at 15 days (time 2) and after 6 to 11 month (time 3). Patients were clinically evaluated at same time points with Aachen aphasia test (AAT). Three randomized patients received early intensive language rehabilitation from second day after stroke. fMRI examinations were performed at 1.5 T (Siemens, Avanto) with an 8-channel receive coil (Invivo-Gainesville - FL) using gradient echo echoplanar imaging (EPI) T2* sensitive sequences (TR 2500ms, TE 50ms, 3.5mm isotropic voxel) and 3D gradient echo T1 dependent images for anatomical definition (TR 2050ms, TE 2.5ms, TI 110ms, 1mm isotropic voxel). The paradigm was based on an auditory comprehension task in an event-related design; a total of 112 fMRI scans per session was acquired divided in 4 runs each of them including 7 randomized meaningful sentences, 7 sentences with semantic violation and 14 corresponding reverse played sentences as control condition. fMRI data were processed with Brain Voyager QX (vs. 1.9- Brain Innovation - Maastricht). A general linear model approach was used for the contrast evaluations. Activation in patients in the acute phase (time 1) was compared with aged-matched control subjects.

Results: Contrast of language with reversed speech all patients at time 1 demonstrate activations in left fronto-temporal regions underwent three fMRI examinations within 3 days from clinical onset. fMRI results on patients with mild aphasia after stroke showed increased activation in left temporal and frontal language-related areas (superior and middle temporal gyrus, frontal operculum, frontal dorsal areas and anterior insula). Comparison with healthy aged-matched subjects showed less extended activations in all these areas. At time 2 a globally increased activation was identified in the language network and shift of the peak of activation in the right-homologue undamaged language areas; patients showed partial recovery of language performance; comparison of not-rehabilitated with early-rehabilitated patients revealed higher gain of AAT score in early-rehabilitated. At time 3 further increased activation in left frontal and temporal network was observed, while right-homologue areas showed decreased activation, with parallel further significant improvement or almost complete recovery of language in all patients. Comparison of not-rehabilitated with early-rehabilitated patients showed a different pattern of activation in the subacute phase with persistence of the peak of activation in left hemisphere.

Conclusion: Our preliminary results confirm previous functional imaging studies showing different phases of brain language reorganization in response to acute ischemic damage: a first global reduction of activation in left frontal and temporal language-related areas, a later strong upregulation of entire network and recruitment of right homologue areas and finally a normalization of activation with return to left dominance. Early-rehabilitation may accelerate the normalization of activation with less consistent right-homologue areas recruitment in the subacute phase.

References:

17.00-17.30 15’

The Prognostic Value of fMRI and H1-MRS Spectroscopy in the Study of Patients in Vegetative State

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Introduction: In our experience, tools as fMRI and H1-MRS spectroscopy may add valuable information to the standard clinical assessment and prognosis in patients characterized vegetative state (VS), minimally conscious state (MCS) and severe disability (SD). Such information could have an impact on clinical decision making, may guide therapeutic options and could be used to stream rehabilitation programs.

 Aim: We used fMRI to study both the presence and the degree of functional activation in VS and MCS and SD patients and tried to discover any possible changes in the markers of neuronal turn-over by H1-MRS spectroscopy.

Materials & Methods: We enrolled 24 patients (age comprised between 17 and 58) with outcome of comas: 20 of them had polytrauma outcomes, 3 of them had encephalitis outcome. Each patient underwent morphological, fMRI and H1-MRS spectroscopy analysis. A 3T Sigma Excite system and an 8 channel phased array coil were used to acquire morphological sequences fMRI and H1-MRS spectroscopy. fMRI. Functional (Axial Single Shot, SS, EchoPlanar Image, EPI, Gradient Echo, GE), and morphological (isovolumetric SPoiled GRass - Inversion Recovery, SPGR-IR) sequences were acquired. We used a block paradigm of the kind: 30 s stimulus vs 30 s rest, for a total length of 5 min. Three different paradigms were applied: 1) in the stimulus phase, the patient heard the voice of a relative telling an emotionally significant episode, vs silence; 2) in the stimulus phase, the patient heard the same voice telling the same episode as in point 1, but the voice was played in the reverse order, vs silence; 3) in the stimulus phase, the patient
heard the same voice as in 1), whereas in the rest phase the patient heard the same reverse voice as in point 2).

fMRI analysis was performed off-line by using BrainWave GE proprietary software. Briefly, the processing of this software is semi-automatic and consists in segmentation and coregistration of the morphologic sequence to the fMRI sequence, after the appropriate corrections (motion correction, smoothing, etc.). The final parametric maps were calculated at a p<0.01 threshold and superimposed to the morphological coregistered segmented images. Spectroscopy (Single voxel, Point-Resolved Spectroscopy Sequence, PRESS). We analyzed the following metabolite ratios: mI/Cr, Cho/Cr, NAA/Cr, NAA/Cho. Resulting spectra were processed by SAGE Software (Spectral Analysis, GE Medical System). Particularly, we focused on NAA/Cho ratio, because it has been showed that a reduction of this ratio has a negative prognostic value. We compared the NAA/Cho values obtained in VS/MCS/SD patients with the corresponding values obtained in 16 healthy volunteers (age comprised between 25 and 57), by placing the voxel in the left frontal white matter. Normal NAA/Cho reference values were in the range of 2.0 ± 0.3.

Results: fMRI. When present, activations were located in the temporal lobes, mono or bilaterally depending of the characteristics of the cerebral lesions. Patients were divided in two groups: the ones showing clear-cut activations (15 patients, 65%) and the ones showing no activation (8 patients, 35%).

H1-MRS spectroscopy: Considering the NAA/Cho ratios, we divided patients in three groups: NAA/Cho ratios = 1 (undoubtedly pathologic), NAA/Cho ratios in the range between 1.1 and 1.6 (moderately pathologic), and NAA/Cho ratios = 1.7 (normal). Considering the NAA/Cho ratio of the 15 activated patients, five (33%) of them showed a NAA/Cho ratio = 1, six (40%) of them showed a NAA/Cho ratio in the range between 1.1 and 1.6, and four (27%) of them showed a NAA/Cho ratio = 1.7. Considering the NAA/Cho ratio of the 8 patients showing no activation, three (38%) of them showed a NAA/Cho ratio = 1, five (62%) of them showed a NAA/Cho ratio in the range between 1.1 and 1.6, and no one (0%) showed a NAA/Cho ratio = 1.7.

Discussion: When taking into account the clinical course of our patients, we noted that the VS showing a clinical improvement in time (from VS to MCS/SD) all appertained to the activated group, whereas all the patients showing no clinical improvement appertained to the non activated group. Moreover, in the activated group, there was a loose correlation between the size of the activations and the NAA/Cho ratio values: the wider the activations the higher the NAA/Cho ratio values. Furthermore, when the follow-up of the patient was feasible, we observed that a favorable clinical evolution was associated with an increase in the size of the activated areas together with a normalization of the NAA/Cho ratio values, whereas an unfavorable clinical evolution was associated with a reduction in the size of the aforesaid values. In the activated group (15 pts), only three patients (20%) showed no clinical improvement.

Conclusions: On the basis of the data at our disposal at present, it is possible to assert that the two advanced techniques (fMRI and H1-MRS Spectroscopy) we used may represent a powerful diagnostic/prognostic support in patients suffering from VS/MCS/SD. Naturally, a higher number of patients have to be examined to confirm our hypotheses.
Encephalopathies 5

Chairs: M. Savoiardo, Z. Rumboldt

14.30-14.45 10’

Acute Toxic and Auto-Immune Mediated Encephalopathies

P. Demaerel
University Hospital K.U. Leuven, Belgium

A general overview of the toxic and auto-immune mediated encephalopathies will be presented. Many of the immune mediated disorders are less well known and new insights in the pathogenesis definitely have consequences for the neuroradiologists. The typical patient with an encephalopathy presents with a decreased level of consciousness. On MRI, the blood brain barrier often remains unaffected and there will be no enhancement. Both gray (cortex, thalamus and basal ganglia) and white matter can be affected. Particular attention will be paid to the diffusion-weighted imaging appearances and to the differential diagnosis with infections and degenerative disorders. Toxic encephalopathy can be the result of external and internal toxin-mediated changes. The more common encephalopathies due to external toxic agents include alcohol intoxication (Wernicke encephalopathy, (extra)pontine myelinolysis), carbon monoxide poisoning, drug abuse (cocaine, heroin) and methanol intoxication. Brain changes associated with anoxia will be shown too. Posterior reversible encephalopathy syndrome has been reported in relationship with different drug therapies, hypertension and renal disease, e.g. nephrotic syndrome. Brain abnormalities in association with diabetes mellitus and vitamin/folate deficiencies will be illustrated. Immune-mediated encephalopathies are increasingly being reported and a wide range of antibodies have been detected. Usually inflammation or an inappropriate response of the immune system causes the brain changes. The immune mediate diseases that will be reviewed include limbic encephalitis (the paraneoplastic and the auto-immune subtype), hemolytic uremic syndrome, SUSAC syndrome, cryoglobulinemia, lymphocytic hypophysitis and Langerhans cell histiocytosis. Diseases associated with abnormalities in calcium metabolism e.g. Blizzard and Fahn syndrome will be illustrated. Acute disseminating encephalomyelitis following viral infection or vaccination, represents the first episode of inflammatory demyelination and is typically accompanied by encephalopathy. New insights in the pathogenesis of the disease and the relationship with clinically isolated syndrome and multiple sclerosis will be discussed. Progressive multifocal leukoencephalopathy in HIV will be discussed as well as some opportunistic infections in immunocompetent patients. MRI plays an important role in excluding other potential treatable diseases but can also, in the presence of a detailed clinical history, contribute to the diagnosis. While many of the toxic mediated diseases are well known, brain abnormalities in auto-immune disorders are more challenging.

14.45-15.00 10’

Amygdalar MR Changes in Systemic Lupus Patients

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Aim of the study: to analyze slight changes of amygdalae and their volumetry in systemic lupus erythematosus (SLE) patients with neuropsychiatric symptomatology (NP-SLE), because patients with depression and mood disorders had been reported to have disability of amygdalae, changes in size and activity, which in some studies correlated with the severity of depressive episodes. NP-SLE includes cognitive deficits up to dementia, mood disorders, depression, stroke, epilepsy etc. We performed amygdalar volumetry by semiautomatic method in special software, using their manual contoured rims in sequence using thin slices. We investigated 23 female patients with proved NP-SLE, aged 19 to 67 years, were recruited for a prospective longitudinal neuroimaging study conducted at Findings were statistically processed and compared with corresponding healthy persons.

Results: in our study we found, that in patients with active NP-SLE right amygdala correlated from all monitored parameters with only the left amygdala (p = 0.01), left amygdala correlated with right amygdala (p = 0.01) and with volumetry in flow attenuation inversion recovery (FLAIR) and T1 weighted images (p = 0.05).

Conclusions: we failed to demonstrate significant volume change in amygdalae. We did not demonstrate significant difference of amygdalar volume due to the duration of NP-SLE or age of the patients. The authors’ research was supported by the research project MZO 00064165, CEZ JI 39811110001 and grant GAUK.

15.00-15.15 10’

Posterior Reversible Encephalopathy Syndrome. Type of Edema Depends on Serum Albumin Levels

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Introduction: The posterior reversible encephalopathy syndrome (PRES) is characterized by seizures, visual disturbances, headache, altered mental status, and magnetic resonance imaging (MRI) changes. The typical MRI finding in PRES is a symmetric vasogenic edema predominantly localized in the occipital cortex, which may extend from cortical to subcortical brain areas, but some patients develop cytotoxic edema as well. Risk factors for de-
development of PRES include hypertension, preeclampsia, HELLP syndrome, use of cytotoxic and immunosuppressant drugs, renal failure, nephrotic syndrome, and blood transfusion. Current pathophysiological concepts suggest an increase in blood pressure overwhelming cerebral autoregulatory mechanisms with consecutive vasogenic edema. This hypothesis does not sufficiently account for PRES developing at normal blood pressure. The fact, that many different etiologies of PRES as mentioned above lead to a similar phenotypical occurrence, suggest a common pathophysiological mechanism. Most diseases associated with PRES, serum albumin levels are significantly reduced. Decrease in albumin leads to reduced oncotic pressure and can affect vascular integrity, alleviating fluid extravasation and therefore vasogenic edema. Therefor we set the hypothesis, that reduced serum albumin is associated with vasogenic edema in PRES.

Aim: We wanted to test, if type of edema in PRES depends on serum albumin levels.

Methods: Twenty two patients were investigated with MRI. Fluid attenuated inversion recovery (FLAIR) imaging DWI and, if available apparent diffusion coefficient (ADC) maps were used to distinguish vasogenic and cytotoxic edema in twenty-eight consecutive patients with PRES. Medical history and routine laboratory tests, including serum albumin were retrieved from medical reports.

Results: In patients with vasogenic edema, albumin was significantly lower (29.3mg/dl ±4.2) than in patients with cytotoxic edema (38.4mg/dl ±6.7), p=0.004, 95%CI 3.2-15.1, see fig 1 A-C. FLAIR, DWI and ADC of patient with vasogenic edema, albumin 21mg/dl, D-F: FLAIR, DWI and ADC of patient with predominantly cytotoxic edema, albumin 37mg/dl.

Conclusion: Patients with vasogenic edema had significantly decreased serum albumin, indicating low serum albumin to be an important co-factor in development of vasogenic edema in PRES. In healthy individuals serum albumin accounts for 73% of plasma colloid oncotic pressure (COP). Microvascular fluid exchange is related to a balance of hydrostatic and oncotic forces in the brain, acting across the capillary. A decrease of serum albumin and COP may lead to fluid extravasation through the vascular wall, promoting development of vasogenic edema, even at normal blood pressure. Albumin is important for prevention of reactive oxidative species formation (ROS) and scavenging of pre-formed ROS. Low albumin levels or oxidation of albumin in the context oxidative stress may blunt these properties of albumin and promote endothelial damage, with consequent development of predominant posterior fossa edema. Seven pediatric patients developed PRES during nephrotic syndrome and low levels of albumin and recovered after substitution of albumin, supporting our hypothesis. Ifosfamide-induced cerebral vasogenic edema, a condition similar to PRES - seems to occur exclusively in patients with low serum albumin. Both investigations further indicate the importance of albumin in pathogenesis of PRES. Our data clearly support the hypothesis that development and type of edema depend on serum albumin, as patients with normal albumin concentrations developed vasogenic edema at a significantly higher proportion, indicating clinically relevant changes of vascular integrity. In summary, our data identified low serum albumin as a novel risk factor for vasogenic edema in PRES. If infusion of human serum albumin in an early and reversible phase to increase oncotic pressure and restore antioxidative potential may prevent widespread oxidative and/or ischemic damage to vulnerable vascular structures in PRES, and should be subjected to prospective studies.

Neuroimaging Findings in Osmotic Demyelination Syndrome. A Review of Typical and Atypical Findings

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Objective: Osmotic demyelination syndrome (ODMS) formally known as central pontine myelinolysis (CPM) and/or extrapontine myelinolysis (EPM). CPM is an acquired condition that results in an osmotic insult and demyelination of the basis pontis. Although the pontine base represents the most common site of involvement, lesions do occur outside of the pons and are termed extrapontine myelinolysis (EPM). The identification of at-risk patients is the first step in the treatment of myelinolysis. Although no specific treatment has been established, early detection does improve clinical
outcome. Knowledge of the typical and atypical neuroimaging manifestation is essential in the early detection and treatment of this disease process.

**Methods**: An institutional retrospective imaging and chart review of ODMS patients and a dedicated literature review were performed evaluating the location, signal alterations, and enhancing characteristics of lesions affecting the brain.

**Findings**: Central basis pontis is more susceptible to acute metabolic stress and in cases of ODMS demonstrate symmetric areas of demyelination within the central basis pontis. It occurs sporadically at all ages, equally affecting both males and females, and its precise incidence is unknown. ODMS hyperintense foci are seen on T2WI and FLAIR sequences and demonstrate symmetric involvement of the cerebellar peduncles, caudate nucleus, putamen, frontal and temporal white matter, fornix, external and extreme capsules, claustrum, thalamus, subthalamic nucleus, internal capsule, amygdaloid nucleus, lateral geniculate nucleus, deep layers of the cerebral cortex, hippocampus, basal ganglia and corpus callosum.

**Conclusions**: ODMS has a high mortality; however a small number of case reports and case series indicate a promising role of steroids, intravenous immunoglobulins, and thryrotroph releasing hormone as promising treatment options. This necessitates an understanding of the common imaging appearance of ODMS to facilitate the early detection and treatment of this life threatening disease.

**Materials and Methods**: 32 patients with pSS (aged 64.56±15.6 years, disease duration 10.5±5.75 years) and 18 age-matched controls were studied using: a) multi-slice, spin-echo planar diffusion weighted (TE=131 msec, TR=9807 msec, matrix size=112 x 128, thickness=3 mm, FOV=230 mm, max b-value=700 sec/mm2) and b) multi-echo T2-weighted (T2-weighted (T2)=20 sec, TR=32-112 sec, thickness=5 mm, gap=0.5, acquisition matrix=156, reconstruction matrix=256) sequences. Differences in fractional anisotropy (FA) and T2 between groups were assessed by applying a voxel-based analysis using the Statistical Parametric Mapping 5 (SPM 5) software.

**Results**: In patients with pSS decreased FA index was observed in the fusiform gyrus, the inferior occipital gyrus, the cuneus, the cingulum gyrus and the posterior cerebellar lobe when compared to controls. Increased T2 time was observed in patients with pSS when compared to controls in areas throughout the whole brain involving mainly the white matter (P<0.05, corrected for multiple comparisons).

**Conclusions**: Increased T2 time, suggestive of brain atrophy, and decreased FA index, suggestive of degeneration along axonal pathways, was observed in patients with pSS when compared to controls. Vasculitis or an immunologically mediated mechanism may be at the base of these changes.

16.00-16.15 10’

**Revised Classification Criteria of Wernicke Encephalopathy**

G. Zuccoli, N. Siddiqui, R. Nardone, Y. Saito, I. Cravo, L. Astrakas, L. Tzarouchi, A. Bocchio, R. Nardone, M. Oggero, N. Milloz, G. Doveri, T. Meloni

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**Objective/Background**: Wernicke’s encephalopathy (WE) is a neurological emergency caused by vitamin B1 deficiency, potentially life-threatening if untreated. Prompt diagnosis and treatment with intravenous thiamine rapidly corrects the underlying metabolic abnormalities and reduces the incidence of fatal neurological outcome. Post-mortem studies indicate that WE is largely under-diagnosed indicating a need for new diagnostic criteria that may facilitate a prompt diagnosis and an adequate treatment. We purpose a revised classification of WE based on an extensive literature analysis identifying the key neuroimaging features of this disease.


**Findings**: WE may present with distinct patterns of MR alterations that have been previously classified as typical and atypical features. However, our analysis shows that the diagnosis of the disease based on the classic signs/symptoms and the involvement of the mammillo-thalamic circuit and periaqueductal area is incomplete. Indeed, the disease may present with varied imaging features and include multiple level involvement of the central nervous system, as well as isolated and diffuse involvement of the brainstem and cerebellum.

**Conclusion**: Our proposed classification indicates four main neuroimaging patterns: prevalent involvement of brainstem, or cerebellar, or basal ganglia, or cortical involvement. An exhaustive understanding of the possible neuroimaging manifestations of WE is essential for the early diagnosis and treatment of this potentially fatal disease.

16.15-16.30 10’

**Wernicke’s Encephalopathy: The Best Way to Make Early Diagnosis**

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We present the case of a patient 50an, hospitalized for confusion; Remote pathological history: quadrantectomy for breast Ca (2001), diabetes mellitus type II, hypertension, liver disease of unknown origin. CT signs of chronic vascular disease, without focal lesions. After a few days of admission: sepsis (blood culture positive for Gram +) and worsening mental status. Neurological examination: comatose, waking up after noicceptive stimulation, does not perform any kind of order, absent doll’s eyes; inconstant nystagmus; MO1 unharmed. Bulb-mimic symmetrical; symmetrical limb fall on PDL. ROT weak-absent in all 4 limbs. SCP in flexion, no meningeal signs (GCS = 9) PL: liquor normal, no signs of infection. Routine blood tests: liver distress (AST, ALT and LDH and reduc-
The mechanism underlying the pathogenesis of the disease is incompletely understood. The deficit of thiamine-related phosphoric esters in cells membranes results in impairment of normal osmotic gradients, leading to blood-brain barrier breakdown. Oedema, increased cellularity, demyelination and occasionally hemorrhages can occur symmetrically in the medial thalami, hypothalamus, periaqueductal region of midbrain and mammillary bodies. Because the condition is potentially reversible, institution of treatment is indicated in patients exhibiting any combination of symptoms and signs; Magnetic Resonance Imaging offers the best way to make a definitive diagnosis antemortem.

Contrast-enhanced CT: unchanged from the previous, nor intra or extraparenchimal pathological enhancement. EEG: diffuse slowing. EMG: axonal polyneuropathy.

MRI: hyperintense outbreaks in DP-T2 and FLAIR sequences at periaqueductal white matter, mammillary bodies, parts of the medial dorsal thalamus and lateral walls of the third ventricle. DWI restricted; ADC values normal. Not significant enhancement after injection of paramagnetic contrast agent.

Findings from the clinical examination and imaging suggested Wernicke’s encephalopathy. The patient was given thiamine, (1 vial x 3 / day) and folate; after 1 week progressive improvement in clinical status, with return of consciousness. Residual attentional deficits and weakness in all four limbs.

Conclusions: Wernicke’s encephalopathy (WE) is a significantly disabling and potentially lethal condition that can be prevented or reversed if treated early. It refers to an acute or subacute syndrome characterized by disorientation, gaze paralysis, ataxia and nystagmus. Typical brain lesions of WE are observed at autopsy in 0.8 to 2.8 percent of the general population in the Western world, and the vast majority of affected patients are alcoholic. The exact mechanism underlying the pathogenesis of the disease is incompletely understood. The deficit of thiamine-related phosphoric esters in cells membranes results in impairment of normal osmotic gradients, leading to blood-brain barrier breakdown. Oedema, increased cellularity, demyelination and occasionally hemorrhages can occur symmetrically in the medial thalami, hypothalamus, periaqueductal region of midbrain and mammillary bodies. Because the condition is potentially reversible, institution of treatment is indicated in patients exhibiting any combination of symptoms and signs; Magnetic Resonance Imaging offers the best way to make a definitive diagnosis antemortem.
Friday, 8 October - 14.30-17.00

COMMUNICATIONS

Foetal MRI Round Table

Chairs: A. Rossi, N. Girard, M. Resta

14.30-14.45 15’

Normal Fetal Brain

P.D. Griffiths
Academic Unit of Radiology, University of Sheffield; UK

In utero MR (iuMR) imaging is becoming an established method of studying developmental and acquired pathology of the fetal brain. Like any other branch of clinical imaging, accurate reporting of pathology is reliant on a deep understanding of normality. Many radiologists have found it difficult, or impossible, to obtain first hand experience of normal iuMR examinations. This primarily because referrals have come from cases in which the ultrasound examinations have already shown known or suspected abnormalities. A limited number of publications are available on the subject such as the excellent monograph of Garel. Our group also recognised the problems associated with the rapidly changing neuroanatomy of the 20-40 week gestational age fetus. To address that issue we have recently published an atlas showing sectional measurements of the fetal brain i.e. trigone widths and head/brain circumference. These are based on iuMR examinations. The primary aim of the present presentation is to review the anatomy that characterises the late second and third trimester fetal brain such as sulcation and the transient structures in the developing cerebral hemispheres. I will also review some of the issues surrounding simple biometric measurements of the fetal brain i.e. trigone widths and head/brain circumference.

References

14.45-15.00 15’

Fetal Brain Injury

A. Righini

Radiology and Neuroradiology
Department, Children’s Hospital
V. Bazzi; Milan, Italy

Ultrasound, especially by using intravaginal probes or 3D technique, is able to detect the vast majority of fetal cerebral lesions, however, some cerebral pathological changes may often be detected exclusively by state of the art fetal MRI. In particular, regarding brain clastic lesions, fetal MRI has been demonstrated to be capable of diagnosing smaller lesions and at an earlier stage of development. Acute hypoxic-ischaemic brain parenchyma insults may be detected within few hours from onset by using diffusion MRI; brain edema, resulting from different causes, as venous congestion, can be better characterized combining diffusion and T2-weighted imaging. T2-weighted imaging itself, through single-shot FSE or through True-fisp (BALANCE, FIESTA) sequences may depict mild white matter signal anomalies in infected fetuses, sometimes as isolated lesions, which prognostic meaning still need to be established. Smaller intraventricular hemorrhages, associated with ventriculomegaly, can be depicted as ependymal hemosiderine deposits by using fast GRE T2* imaging; sometimes also a clot obstructing the aqueduct itself and causing ventriculomegaly may be showed with good details.

Finally, unusual smaller cerebellar or brainstem focal lesions (ischaemic or hemorrhagic) may be demonstrated. In most cases, the prognostic meaning of smaller clastic lesions detected by fetal MRI in current clinical practice is far from being clear.

Fetal Supratentorial Malformations

O. Glenn
Department of Radiology and Biomedical Imaging, University of California; San Francisco, USA

Fetal MRI is being increasingly used to evaluate the fetal brain in cases where an abnormality is detected by routine sonography, or when the fetus is at increased for a brain abnormality. This talk will discuss the supratentorial malformations detected by fetal MRI, their appearance on fetal MRI, as well as the sensitivity and specificity of fetal MRI for different types of malformations. By the end of the talk, the participant should be familiar with the appearance of different types of supratentorial malformations that can be detected by fetal MRI and with some of the limitations of fetal MRI.

15.00-15.15 15’

Anomalies of the Posterior Fossa and the Spinal Ord. Fetal MRI

C. Hoffmann
Department of Radiology, Sheba Medical Center; Tel Hashomer, Israel

Fetal MRI is a useful tool to complement US for imaging of the fetal posterior fossa (PF). MRI provides better soft-tissue contrast, especially within the PF and improves the accuracy of diagnosis of PF abnormalities. The MRI is also an important tool to exclude accompanying abnormalities often seen. The anomalies of the posterior fossa include the Chiari malformations, cystic malformations and heterogeneous groups such as rhombencephalosynapsis, Walker Warburg syndrome and vascular malformations. The two main groups of malformations of the posterior fossa (Chiari and cystic malformations) differ in the size of the posterior fossa. The posterior fossa is small in Chiari 2 and enlarged in the Dandy Walker spectrum. The Chiari 2 malformation is part of the spinal neural tube closure disorders with accompanying myelomeningocele. The posterior fossa is small and parts of the cerebellum herniate downwards through the foramen magnum, as a result of the spinal defect. The differential diagnosis of a sacral meningocele is sacrococcygeal teratoma and currrano syndrome. The radiological signs of all three abnormalities will be presented. Dandy Walker spectrum is characterized by vermian hypoplasia, anti-clockwise rotation of the vermis.
and other associated abnormalities. It is often associated with hydrocephalus and corpus callosum anomalies. Other anomalies of the posterior fossa will be presented such as Walker-Warburg syndrome and vein of Galen vascular malformation.

**Advanced Techniques for Fetal Brain in Utero**

E. Grant  
Fetal-Neonatal Neuroimaging and Developmental Science Center, Children’s Hospital; Boston, USA

**Fetal MRI 2**

**Chairs:** A. Rossi, N. Girard, M. Resta

**Imaging Findings and Utility of Fetal Central Nervous System MRI**

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Department of Radiology, Mitera Hospital, Athens, Greece

**Purpose:** To present the fetal central nervous system (fCNS) MRI findings and evaluate its utility with respect to prenatal ultrasonography (pUS).

**Materials and Methods:** 77 fCNS MRI scans performed in our institution over the past 2 years in 70 pregnant women (7 were scanned twice) using a 1.0T high-field open-magnet. The mean gestational age was 27.07 weeks. 2 cases represented twin pregnancies with only one fetus scanned. Indications for MRI as suggested by pUS were: Ventriculomegaly (51.95%), abnormal posterior fossa structures (23.4%), corpus callosum agenesis (10.39%), technical difficulties in pUS (7.8%), neural tube defects (3.9%), and other findings (2.6%).

**Results:** fCNS MRI confirmed the pUS findings in 79.2% of the cases, revealing additional CNS anomalies in 22%. There was no concordance between pUS and MRI findings in 20.8% of the cases, with MRI not confirming pUS anomalies in 81.3% while it revealed other sonographically occult fCNS anomalies in the remaining 18.7%. Thus fetal management was affected in 22% of the total cases.

**Conclusion:** MRI for evaluation of fCNS is a valuable complement to pUS. It not only confirms anomalies suggested by pUS, especially in technically difficult scans, but it may also reveal other sonographically occult CNS anomalies. The later may be associated with worse outcome, thus affect parents’ consultation and fetal management.

**Discussion:** fCNS MRI is a valuable complement to pUS as it presents higher contrast resolution than pUS and allows better differentiation of normal from abnormal tissue. Its value is justified as fCNS MRI is not susceptible to many of the limitations of sonography and, additionally, it offers the promise of further understanding of fetal brain development. Structural abnormalities may be sonographically occult on pUS yet detectable by fCNS MRI. Thus, fCNS MRI is not only used to confirm and characterize brain abnormalities detected by routine pUS but also to reveal and identify additional sonographically occult CNS abnormalities.

One of the more common sonographically detected brain abnormalities, and therefore referral indications for fetal MRI, is ventriculomegaly. Other common indications include sonographically suspected abnormalities of the corpus callosum and cerebellar vermis as well as complications of monochorionic twin pregnancies. fCNS MRI has several advantages over pUS. It presents improved contrast resolution, allows direct visualization of both sides of the fetal brain and is not subject to several of the sonography limitations, such as oligohydramnios, fetal positioning, acoustic shadowing from the ossifying calvaria, and maternal body habitus. Thus, fetal MRI allows a more detailed evaluation of the developing brain, including direct visualization and assessment of the developing cortex and subcortical region, which is extremely difficult and often impossible with pUS but also often critical in identifying abnormalities. The results of fCNS MRI have been shown to affect clinical decision-making during pregnancy, both by clinicians and parent(s) and lead to changes in pregnancy management in nearly half of the cases.

In most institutions, fCNS MRI is performed during the second trimester. One of the limitations of fCNS MRI is that of fetal motion, which has largely overcome since the advent of ultrafast single-shot T2-weighted sequences (where a single image can be acquired in less than 1 sec). Even with rapid image acquisition, however, fetal motion can still affect the quality of the study. In addition to certain clinical measures taken to reduce fetal motion (such as maternal fasting at least for 4 hours prior to the study, and making sure that she is comfortable during the scan), technical advances that allow interactive scanning have helped to minimize the effects of fetal motion on the study quality. Additional limitations of fCNS MRI include the small size of the structure being imaged, large distance between the fetus and the coil, and maternal claustrophobia and discomfort during the scan, though these are typically more problematic with advanced gestational age.

Future improvements in both MR hardware and software will improve the accuracy of focusing more on the cellular types and organization than on the general shape of the hippocampus and near-by structures. The materials have consisted of limited numbers of aborted fetuses. Hippocampal development begins at gestation week (GW) 8 and the hippocampal sulcus became visible at GW 10. During the development, the hippocampal sulcus deepens and narrows and the dentate nucleus and cornu ammonis infold around the hippocampal sulcus. This inversion process should have been completed at GW 18-21. However, at the GW of the hippocampal fissure continues until the GW 30 and the orientation of the fissure may be changed. Three microscopical studies also included MR studies of very limited numbers of formalin-fixed specimens. One weak point in the studies of formalin-fixed specimens is that the anatomical shape and proportions may have been changed when the brain has been placed in the vessels for formalin fixation and on the table for cutting or imaging. MR studies in utero: Sulcal development has been described in a large material at GW 22-38. The hippocampal sulcus could be seen at GW 22-23 and the collateral sulcus at GW 26. There is only one prenatal MR study focused on the hippocampi demonstrating the continuous change of the angle between the hippocampus and the middle line of the skull at GW 20-27. The general shape of the hippocampus has not been assessed in the above-mentioned studies. The fully inverted
hippocampus is oval in coronal slices. The oval shape is preceded by a round or pyramidal shape. That shape, a sign of incomplete hippocampal inversion, can persist throughout the life in 19% of the common population, most often at the left side. The aim of the study was to analyze the fetal hippocampal development from GW 17 onwards using MRI.

Methods: Four fetuses aborted for extracranial pathology but with a normal brain were included in the study. MRI was performed before autopsy. In utero studies: 31 clinical fetal MRIs in which both hippocampal regions were well seen were included in the study. The indications for MRIs were suspected brain pathology and individual variations and the development of common population, most often at the left side. The aim of the study was to analyze the fetal hippocampal development from GW 17 onwards using MRI.

Results: Fetal MRIs could not be detected before GW 22. From GW 31 onwards it was seen in all fetuses. If the sulcus was visible, it was visible bilaterally.

Conclusion: Evaluation of the hippocampus is difficult on fetal MRI, in particular before GW 25. The material is small but indicates that there are individual variations and the development does not progress simultaneously even in the right and left side of one individual. The hypothesis that the cerebral development may progress faster in the right side could not be supported or disproved by this small material.

In Utero Tractography of Callosal Agensis

1 Medical University of Vienna, Department of Musculoskeletal and Neuroradiology; Vienna, Austria; 2 Medical University of Vienna, Center of Anatomy and Cellbiology; Vienna, Austria; 3 Medical University of Vienna, Department of Pediatric and Adolescent Medicine; Vienna, Austria; 4 Medical University of Vienna, Institute of Neurology; Vienna, Austria

Purpose: The majority of individuals with commissural abnormalities experience different grades of cognitive, psychosocial and general motor difficulties (Moes et al. 2009). The increasing rate in the prenatal detection of these conditions urges the establishment of early imaging markers, which allow a more specific prediction of their postnatal outcome. In vivo diffusion tensor imaging (DTI) and tractography were used postnatally to characterize the abnormal connectivity of commissural tracts in cases of agenesis of the corpus callosum (ACC). Recently it was shown that fetal MRI and DTI enables the 3D visualization of major white matter pathways of the developing brain in vivo and in utero. This study aims to evaluate the potential of prenatal DTI in the detailed visualization of abnormal white matter connectivity in a group of fetuses with ACC.

Methods: Fetal MRI (1.5 Tesla) was performed in 4 non-sedated fetuses (mean age: 26 gestational weeks- GW, ranging from 20 to 32 GW) with complete ACC and 1 fetus with hypogenesis of the corpus callosum (HCC). Multiplanar T2-weighted sequences of the fetal brain were geometrically coregistered with the FA color coded map of a DTI sequence (16 diffusion encoding directions, reconstructed voxel size 0.94 mm x 0.94 mm x 3 mm, b values of 0/2500 and 700/3000). Multiple regions of interest were defined along the assumed anatomical course of the bundles of Probst (BP) and the partially present corpus callosum. A streamline algorithm, with a maximum angle change of 27° and minimum FA of 0.15 was applied to visualize the trajectories. No MR, repeated US or clinical indications for MRIs were suspected on previous ultrasound (US) or abnormal screening laboratory tests. No MR, repeated US or clinical studies could show brain pathology in these subjects. The MR units operated at 1.5 T. No sedation was given in these subjects. The MR units operated at 1.5 T. No sedation was given in these subjects.

Results: Frontocorically oriented trajectories anatomically corresponding to the bundles of Probst (BP), could be visualized 3D by in utero tractography in 3/4 ACC cases bilaterally (Figure) from 20 GW onwards and in 1/4 cases unilaterally. In HCC the forceps minor was depicted partially and the splenium in its entire dimensions. Additionally a sigmoid trajectory connecting homotopic frontal and contralateral parietococcipital lobes was identified. The mean length of the left BP was 29.1mm (16mm-41mm), the mean length of the right BP 27.9mm (22mm-32mm). The mean FA values of BP (358) were not significantly different from those of the intact splenium in the reference data (341).

Conclusion: The abnormal white matter connectivity of the fetal brain can be depicted in a 3D fashion as early as 20GW. In addition to the visualization of the bundles of Probst, a postnatally described aberrant fiber pathway (Tovar-Moll et al. 2007; Wahl et al. 2009) could be detected in utero. These results emphasize the role DTI as potential tool in establishing imaging biomarkers to further characterize abnormalities of the corpus callosum in utero and in vivo.

References
Role of Magnetic Resonance Tractography in the Preoperative Planning and Intraoperative Assessment of Patients with Intra-Axial Brain Tumors

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Purpose: intra-operative MRI is a newly introduced diagnostic tool able to change the efficacy of neurosurgery in the management of brain tumors. MR tractography (MRT) is a technique capable to display trajectories compatible with white matter fibers which has also been proposed to evaluate the relationships between these fibers and a brain neoplasm. The aim of this presentation is to discuss the actual role of MR tractography (both pre and intraoperatively acquired) in the neurosurgical management of brain neoplasm. We examined the usefulness of a neuro-navigation system for the pre-surgical planning, the impact of the informations provided by MRT to the surgical procedure, the anatomical modifications (brain shift) of white matter tracts during surgery and the accuracy of intra-operative MRT compared to the electric sub-cortical stimulation. All these data were analyzed on the basis of pre- and post-surgery clinical condition of the patients.

Materials and Methods: 40 right-handed patients were included in the present study. All patients were clinically assessed by a neurologist both pre- and post-surgery. All MRT exams were performed on a 1.5-T magnet. Using a dedicated software, relative color maps were obtained and the trajectories of the white matter tracts adjacent to the tumour were reconstructed in three dimensions. Separately pyramidal tract, optic radiation and arcuate fasciculus were reconstructed. The trajectories were considered suitable for the surgical planning if there were no interruptions on all the layers at the level of the lesion. Two neuroradiologist evaluated separately the concordance of three-dimensional reconstructions of different white matter tracts. A dedicated software 'merged' the acquired images with the tractographic processing and the whole dataset was sent to the neuronavigation system. Two neurosurgeons were asked whether the tractographic images had modified the access and/or intraoperative approach to the tumour. To evaluate the maximum extent of CST shifting, in 20 patients the maximum distance between the corresponding pre-operative, after dura mater opening and intraoperative contours was measured. Positive or negative values were assigned according to the direction of the shift, which was referred to the craniotomy opening. A positive value was assigned if movement was outward the surface, and negative value was assigned if movement was inward. In nine patients, after tumor resection, the neurosurgeon stimulated areas compatible to CST and the neurophysiologist registered Motorial Evoked Potential (MEP) in specific muscles groups to assess whether motor potential were elicited.

Results: In 81% of cases a concordance of tract reconstructions was obtained between two neuroradiologist. In almost 30% of cases, the modification of Fractional Anisotropy, due to peritumoral edema, prevented the correct reconstructions of tracts. The assessment of trajectories close to the tumour determined an accurate differentiation of the surgical approach to corticotomy in 10 patients (25%); the impact on the definition of the resection margins during surgery was 64% (25 cases). The overall impact percentage on the surgical procedure was 84%. In 37 patients, symptoms had not changed. The maximum intraoperative shifting of CST ranged from an inward shift of 9.7 mm to an outward shift of 11 mm in patients undergoing brain tumor resection. Patients showing inward shifting were affected by tumors with bigger size, smaller peritumoral edema and smaller craniootomy size than patients with outward shifting. In 11 of 20 patients we acquired a diffusion tensor imaging after dura mater opening (range -7 to +8). In 72% of cases (7 patients) a shift of CST was estimated (87% outward shifting, 13% inward shifting), All of patients presenting outward shifting after dura mater opening, compared to patients without tracts shift-
ing, were affected by tumors of similar volume, associated to higher volume of edema and higher craniootomy size. After tumor resection, when the distance between the CST and the site of stimulation was estimated 1 cm or less, all 7 patients showed positive MEP.

Conclusions: MR-tractography provides the neurosurgeon with a new anatomical view which has impact on brain tumor’s pre-surgical planning. Despite the high incidence of cases in which lesions are responsible for changes that avoid the white matter resections (peritumoral edema and mass effect of tumors), the technique can change the surgical approach for corticotomy, defines the extent, of resection and monitors the anatomical modifications during surgical procedures, confirmed by intraoperative MEP registrations.

Integration of Functional MRI and Intra-Operative MRI Provides a High Degree of Precision and Confidence at Surgical Brain Tumor Resection

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Background and Purpose: Many intracranial tumors are located near areas of eloquent cerebral cortex or near vital white matter structures. Historically, neurosurgeons have used several techniques to map areas of eloquent cerebral cortex adjacent to brain tumors, including awake craniotomy and electrophysiological mapping. The advent of functional MRI (fMRI) at high field strength has created the opportunity for noninvasive mapping of the eloquent cerebral cortex adjacent to brain tumors. Diffusion Tensor Imaging (DTI) has similarly created the opportunity for noninvasive imaging of white matter tracts adjacent to tumors. Intra-operative MRI (iMRI) involves the use of MRI hardware within the operating room during the craniotomy procedure to assist the neurosurgeon in tumor resection. By integrating the pre-operative fMRI and DTI data into the imaging data obtained intra-operatively using a deformation model, the neurosurgeon can have a high degree of confidence about the location of eloquent cortex and white matter tracts during tumor resection. The use of a deformable model allows for adjustments related to brain shift and hemorrhage. The purpose of this abstract is to discuss the neurosurgeon’s utility of integrating pre-operative fMRI and DTI data into iMRI imaging data. A secondary purpose is to discuss the role of the neuroradiologist in assisting the neurosurgeon in brain tumor resection.

Materials and Methods: 320 patients with intracranial tumors underwent the combination of pre-operative MRI, DTI, and fMRI over the course of 2.5 years. The pathology of the tumors was wide-ranging, including high-grade, low-grade, and completely benign. All neurosurgeries were performed by one of eight neurosurgeons on staff. The surgeons were assisted by one of seven neuroradiologists on staff. All pre-operative fMRI and DTI examinations were performed at 3.0 tesla. Neuroradiologists interpreted the pre-operative mapping studies (fMRI and DTI) and consulted with the neurosurgeon in operative planning. Neuroradiologists were also present in the operative suite during iMRI and consulted directly with neurosurgeons during the surgery. During each case, pre-operative fMRI and DTI images were transferred to an independent workstation in the operative suite. Newly acquired iMRI images were then fused to the pre-operative fMRI and DTI using a deformable model during surgery. At the end of each case, neurosurgeons were asked to rate the utility of the iMRI and the consultation with the neuroradiologist.

Results: 262 out of the 320 patients (82%) in this study group were assisted by iMRI. In 15 cases (5%), the neurosurgeon found the iMRI the least helpful, but the remaining 247 out of 320 cases (77.2%) in this study group were assisted by iMRI and were described as true partnerships in tumor resection. Among the 247 cases, the iMRI was found to be of highest value in the setting of low-grade tumors (WHO grade 2). In this setting, multiple iMRI was useful in following the progress of tumor resection. Further research is being performed to assess the benefit of these surgical planning techniques on long-term survival outcomes and rehabilitation outcomes.

Conclusions: Integration of pre-operative fMRI and DTI data obtained at high field strength into iMRI imaging data is an effective way of mapping the human brain both before and during surgery for brain tumor resection. This allows for greater surgical precision and confidence during brain tumor surgery. Due to the heavy reliance on imaging for these techniques, the neuroradiologist plays an important role in pre-operative consultation with the neurosurgeon as well as intra-operative consultation with the neurosurgeon.

Exploring Functional Connections in the Living Human Brain with MR Tractography and Intraoperative Subcortical Mapping

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Intraoperative subcortical stimulation is a powerful technique allowing the identification of subcortical tracts located either around or within a lesion, and to preserve them. Combination of MR Tractography and intraoperative subcortical mapping techniques during surgical removal of brain tumors allows to obtain integrated information onto subcortical connections of the brain. We report our experience in studying some complex white matter networks, namely functional connections and structural white matter pathways connecting parietal and frontal areas and their involvement in mechanisms of spatial awareness. MR DTI data were acquired from twenty-five patients with cerebral gliomas (18 LGG, 7 HGG). Imaging was performed on a 3T MR scanner (Philips Intera, Best, The Netherlands) with a 10-channel head coil. DTI data were collected using a single-shot echo planar imaging (EPI) sequence (TR/TE 8986/80 ms) with parallel imaging (SENSE factor, R = 2.5). 32 diffusion gradient directions (b=1000 s/mm²) and one image set without diffusion-weighting were obtained. A field of view of 240 ± 240 mm² and a data matrix of 64×64 were used and this leaded to isotropic voxel dimensions (2.5×2.5×2.5 mm³). Deterministic tractography was performed in all patients using Dti Studio version 2.4.0.1 software (JHU, Mori S, Johns Hopkins University, Baltimore, MD,
USA). Probabilistic tractography analysis was carried out using the method described by Behrens et al. (2003): a multi-tensor model was fitted to the diffusion data using the FDT (PMRI toolbox’s Diffusion Toolbox) and allowed modeling multiple fiber orientations per voxel. SMA connections. Nineteen patients with gliomas located in SMA had awake surgery with the aid of subcortical mapping: the type, number and location of each subcortical response was registered into the neuronavigational system. DTI data were retrospectively processed by placing starting ROI in correspondence of the sites in which positive motor responses were evoked, to segment by both deterministic and probabilistic tractography the position and course of subcortical connections of SMA. During intraoperative subcortical mapping motor responses, mainly contralateral, but also ipsi- or bilateral, were obtained in all patients. Motor responses showed an anterior to posterior somatotopic distribution (from eye to leg); ipsilateral motor responses were located more laterally to the fibers inducing contralateral responses. Correlation with DTI tractography post-processing data showed that SMA contributed to CST, was connected with ipsilateral primary motor area (M1), premotor area (M2), SMA, but not contralateral M1. Connections depicted by tractography had a similar anterior to posterior distribution with distinct foot, face and hand pathways in SMA, suggesting the existence of a topographic subcortical organization of this region. Spatial Awareness. In six patients with right frontal and parietal glioma we performed preoperative tractography in order to reconstruct superior longitudinal fascicle, a major association fiber pathway connecting parietal and frontal cortical regions, and to segment its four subcomponents with a two-ROIs approach, according to the subdivision described by Makris and colleagues. Inferior fronto-occipital fascicle (IFO) was also reconstructed in all patients. Data were transferred to the neuronavigation system; surgery was performed in asleep-anesthesia, allowing to correlate functional subcortical sites identified by intraoperative subcortical mapping with fiber tracts pre-operatively depicted by tractography. During subcortical mapping, a rightward deviation on line by-section test indicated the stimulation of an area involved in spatial awareness, whose electrical inactivation evoked neglect. In five patients subcortical mapping demonstrated a significant correspondence between the stimulated sites corresponding to fiber tracts and the second subdivision of SLF, that extends from the angular gyrus to the caudal lateral prefrontal regions. No significant rightward deviation was observed by stimulating the first or third subdivision of or inferior fronto-occipital fascicle. Combination of preoperative tractography and intraoperative mapping confirms the hypothesis that the long-range white matter pathways connecting parietal and frontal areas are involved in mechanisms of spatial awareness; indeed, disruption of the second branch of SLF seems to be critically associated with unilateral spatial neglect. In conclusion, subcortical networks described by tractography and intraoperative mapping can give new insights into functional neuroanatomy of living human brain: the excellent correlation of intraoperative data and tractography findings may illustrate the future of structure-function investigations in the brain, ultimately to culminate in a comprehensive description of the “human connectome”.

**Brain Tumors 8**

**Chair**: W.Y. Guo, A. Ramos, C.O. Ortiz Vasquez

**15:45-16:15 Introduction Lecture**

**“Leading Edge” Gamma Knife Stereotactic Radiosurgery for Patients with Recurrent Glioblastoma Multiforme**


**Rationale: Local recurrence within 1-2 cm of the original tumor remains the predominant mode of failure for Glioblastoma.** Increasing radiation dose to the original tumor site can improve local control, but trials looking to escalate dose beyond 60 Gy given in standard 1.8-2 Gy fractions have not shown a consistent benefit. Two factors derived from cellular research suggest that a different approach to dose escalation may be more effective. First, Glioblastoma characteristically spreads along well defined white matter pathways. Second, high single fraction doses of radiation are more effective than lower, fractionated doses at interfering with the ability of dedifferentiated astrocytes to migrate down these white matter pathways of spread. We hypothesize that targeting white matter pathways adjacent to the original tumor site (defined as the Leading Edge) with high dose single fraction radiosurgery will improve survival for patients with recurrent Glioblastoma.

**Methods**: Between 3/14/08 and 06/16/08, 31 patients with recurrent Glioblastoma, were treated with the FLAIR - or MR SPECT-defined Leading Edge with Gamma Knife Radiosurgery (Leading Edge Gamma Knife Radiosurgery, or LEGKRS).

**Results**: The median age was 56 years and 58% were male. LEGKRS took place a median of 4.3 months from original diagnosis, with a range from 2.8 to 24 months. Median Karnofsky performance status (KPS) was 80; all had a KPS > 70. An average volume of 39 cc of leading edge tissue was targeted, using a median dose of 10 Gy (range: 8-12) at the 50% isodose line. Median survival from time of recurrence and LEGKRS is 12.6 months. With 24 patients deceased (77%), and median follow up of 27.8 months for the seven survivors, median overall survival from diagnosis is 19.3 months and 2-year survival 36%. These results compare favorably to those reported from phase II trials in recurrent malignant gliomas.

**Discussion**: In this retrospective study we observed considerably improved survival for patients with current GBM who were treated with GKRS to the “leading edges” of their recurrent tumor when compared to historical control data. However, because of the retrospective nature of this study, we cannot be sure that the favorable results are due to this treatment, or secondary to other features of their disease. For instance, it is known that patients who develop a GBM after a previous diagnosis of a lower grade astrocytoma have a better prognosis from the time of a recurrence that is now histologically GBM. Collectively, patients selected for surgical resection have a better prognosis. However, prior to the approval of temozolomide chemotherapy, in a randomized trial patients who underwent a repeat surgical resection of recurrent malignant glioma had a median survival of only 5.3 months, while those who underwent resection with intra-operative placement of carmustine chemotherapy-impregnated wafers had a median survival of 7.2 months. In our own institution, a phase II trial of surgical resection and intralesional placement of lymphokine-activated killer cells was associated with a median survival of 9.0 months from the procedure. [1] In a recent study, the median survival time for patients with recurrent GBM who were healthy enough to receive temozolomide chemotherapy in a phase II clinical trial was 8.8 months. [2] The median survival of 12.5 months observed in the current retrospective analysis is very encouraging given these other results. In contrast to multiple course of chemotherapy, this result was achieved with a single high dose of radiation delivered by GKRS. Based on this experience in
Friday, 8 October - 14.30-17.30 Communications

Evaluation of Corticospinal Tract Radiation Exposure by Implementation of Tractography in Gamma Knife Treatment Planning of Cerebral AVMs

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4Neuroscienze e Riabilitazione; Ferrara, Italy

Introduction: Radiosurgery is an effective treatment for encephalic lesions in eloquent or deep-seated locations and has been increasingly used for cerebral arterio-venous malformations (AVMs). Even if it is a non-invasive procedure, the rate of permanent radiation-related complications is low but not negligible, especially for AVMs located in critical sites. Some critical structures, such as cranial nerves and the brainstem are directly visible on conventional imaging, others such as cortical activation areas and white matter tracts can only be guessed on the T1-weighted images. Semiautomatic segmentation of the CST, measurement of its spatial separation from AVM margins, evaluation of the maximum dose and integral dose to the CST and of the volumes of the tract receiving >= 25-20-15-12 Gy were performed in each case (Figure 1 A,B,C,D,E). Cases presenting clinical or imaging complications were analyzed to find any correlation with CST representation and radiation exposure (CST max dose, CST volume receiving >= 20, >= 15, >= 12 Gy and isodose volume). Results from the retrospective group were compared with the prospective group.

Results: Optimal fiber tracking was obtained stopping the process when a fractional anisotropy value lower than 0.20 was reached and turning of angles greater than 25°. In 2 patients the presence of signal void in the Echo-planar images used to obtain DTI (caused by blood degradation products and by AVM-related vessel flow) interfered with a correct estimation of fractional anisotropy in the CST territory, thus hampering adequate fiber tracking. After image registration, the position of the CST, superimposed on the stereotactic volumetric T1-w study, was checked at the level of the precentral gyrus, of the posterior limb of the internal capsule and of the cerebral peduncle. The time necessary for the overall registration of images and fibers and verification procedures was between 1 and 3 hours in the first 15 cases (retrospective group), but in the following 20 cases (prospective group) it was less than 30 minutes. The distance between AVM margins and reconstructed CST varied from 0 (CST inside the target volume) to 13 mm. Tracts were less visualized in 100% of patients with neurologic symptoms before treatment. No change of their course or penetration of the AVM nidus was seen in 63%, while displacement of the CST was present in 37% of cases (Figure 2 A). AVM volume, isodose volume and 12 Gy volume were significantly lower in the retrospective group, while maximal dose was higher. The volume of the CST receiving >= 20 Gy and >= 15 Gy and the integral dose were higher in the retrospective group. In both series CST radiation exposure was higher in basal ganglia AVMs than other sites. One bleeding in the latency period occurred in the prospective group. Two cases of major complication occurred, with severe hemiparesis due to radiation necrosis (in both patients: hemorrhagic presentation, previous endovascular procedure and mild neurologic deficit). One transient hemiparesis occurred and was considered due to reversible post-radiosurgical imaging changes. Two asymptomatic post-radiosurgical imaging changes were seen at follow-up. Complications occurrence correlated significantly with: CST max dose (> 23 Gy), CST volume receiving >= 15, >= 12 Gy (> 80, 240, 350 respectively) and isodose volume (> 14 cc).

Conclusions: Integration of 3D tractography within GK stereotactic planning is feasible and is compatible within a routine clinical setting. Data obtained with this technique are extremely useful to estimate the radiation exposure of CST. Visualization of individual fiber pathways can help optimizing radiosurgical planning allowing the realization of patient-tailored treatments.

Potential Value of CT Perfusion Maps in Differentiating High Grade Glioma Recurrence from Radiation Necrosis

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Background and Purpose : Conventional MRI is not able to differentiate tumor recurrence and radiation necrosis that remains one of the most im-

10'
important challenges in neuron-oncology. In this setting, emerging evidence indicates that dynamic computed tomo
graphy perfusion (CTP) scanning provides information about the underlying tumor angiogenesis and thus can help to
distinguish between tumor progression and post-treatment radiation ef
fects. Based on these observations, the aim of this study was to verify whether
technique has the potential to discriminate between high grade glioma recurrence and radiation necrosis.

Materials and Methods: Twenty-seven patients (19 male and 8 female; mean age ± SD = 56.1 ± 11.7 years; K
Karnofsky performance status range = 50-100%) with histopathological diag
nosis of high grade gliomas (24 WHO grade IV glioblastoma multiforme and 3 WHO grade III anaplastic astrocy
toma) who underwent surgery, radiation therapy and adjuvant chemother
apy, prospectively included in the study. After radiation treatment, all the 27 patients developed new or progressive enhancing lesions in the radiation field demonstrated by follow-up MRI scans (mean time post-treatmen
SD = 6.9 ± 6.7 months) Tumor recurrence was defined as the presence of progressive clinical deterioration and a size increasing of MRI abnormal brain tissue associated with radiation necro
sis as classified as the occurrence of stabilization or improvement in clini
cal conditions and MRI brain lesion. Accordingly, 18 patients were classifi
ced as tumor recurrence and 9 cases were categorized as radiation necrosis. CTP studies were performed by using a single-section CT scanner equipped for CTP perfusion imaging. CTP perfusion protocol consisted of a series of 45 CT scans acquired in a single slice located at tumor level containing the largest volume of abnormal tissue. Cerebral blood flow (CBF), cerebral blood volume (CBV), mean transit time (MTT) and permeability surface flow (PSF) maps were generated for each patient with a deconvolution-based algorithm and a two-compartmental model by using an imaging workstation. Regional CBF (rCBF), CBV (rCBV), MTT (rMTT) and PSF (rPSF) levels were measured in two different regions of interest larger than 1 cm² and manually outlined on the baseline diagnostic CT scan: 1) the enhancing brain tissue; 2) an area of normal appearing brain tissue located in the enhancing lesion and located in the contralateral hemisphere. CBF, CBV, MTT and PSF values were expressed in ml/100g/min, ml/100g, seconds and ml/100g/min, respectively. Normalized ratios of CBF (nCBF), CBV (nCBV), MTT (nMTT) and PSF (nPSF) were calculated by dividing the absolute level
values from the lesion with those of normal appearing brain tissue (background level). After checking data for normality, statistical analysis was performed by Mann-Whitney U test. A value of p < 0.05 was considered as statistically significant.

Results: rCBF mean levels were significantly higher (p < 0.001 and p < 0.01, respectively) in enhancing brain tissue (84.5 ± 40.2 ml/100g/min) than in contralateral area (53.0 ± 12.2 ml/100g/
min) for patients with tumor recurrence and in radiation necrosis (1.4 ± 0.3 ml/100g/min) injured brain tissue. rPSF mean values were significantly increased (p < 0.0001, p < 0.05 and p < 0.01, respectively) in enhancing brain tissue (3.9 ± 1.9 ml/100g/min) than in contralateral area (1.6 ± 0.9 ml/100g/min) for patients with tumor recurrence, in abnormal brain tissue (1.6 ± 0.9 ml/100g/min) than in contralateral area (0.6 ± 0.3 ml/100g/min) for patients with tumor recurrence in radiation necrosis (1.4 ± 0.3 ml/100g/min) injured brain tissue. rPSF mean values were significantly more elevated (p < 0.001, < 0.0001 and < 0.001, respectively) in tumor recurrence than in radiation necrosis. In addition, nMTT values were significantly more prominent (p < 0.05) in radiation necrosis than in tu
mor recurrence.

Conclusions: In this study we found that tumor reappearance had elevated intralesional levels of CBF, CBV and PSF compared to contralateral normal appearing brain tissue and radiation necrosis. Moreover, radiation necrosis demonstrated slightly higher PSF val
ues than contralateral normal appearing brain tissue. These findings suggest that CTP is a powerful tool in discrimi
nating tumor progression and post-treatment radiation effects since it can reliably recognize increased vascularity and microvascular permeability both consistent with tumor angiogenesis. Our results also indicate that perfusion alterations observed in abnormal brain tissue associated with radiation necro
sis could be attributable to subacute infarction.

16.45-17.00 10’
Perfusion Measurement with T1 Weighted Magnetic Resonance Imaging in Patients with Primary Brain Tumors - Evaluation of Radiation Necrosis and Tumor Recurrence

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Introduction: Conventional con
trast-enhanced MRI delineates areas of blood brain barrier (BBB) leakage, but is less reliable in distinguishing radiation-induced necrosis (RN) from tumor recurrence. In our gold standard for distinguishing RN from tumor recurrence is 18F fluordeoxylucose positron emission tomography (FDG-PET), which provides a measure of the rate of glucose metabolism. A high metabolic rate of glucose indicates ac
tive tumor tissue. Since MRI is used for the routine evaluation of brain tu
mors and less time-consuming than FDG-PET, the development of a MR technique that could help distinguish RN from tumor recurrence would be an advance. It is generally agreed that there is an association between microvascu
lar density and tumor energy me
tabolism meaning estimates of cerebral blood volume (CBV) provided by MR perfusion imaging should provide infor
mation similar to FDG-PET. Dynamic susceptability contrast (DSC) perfusion imaging is confounded by the BBB defi
ciency of brain tumors, due to a change of T1 and T2 relaxation and sampling of the extravascular space. Recently, a T1 weighted MR perfusion imaging method has been developed, where the BBB deficiency can be readily incorpo
rated in the tracer kinetic modelling. Thus, T1 weighted perfusion imaging can estimate the CBV of brain tumors, without a pre-bolus of contrast or add
itional corrections for contrast agent extravasation. Here we investigate whether T1 weighted perfusion imaging is able to distinguish RN from tumor recur
rence using FDG-PET as a reference.

Methods: 9 patients were recruited following surgery and radiation therapy for a brain tumor. All patients had con
trast enhancing lesions, which during the standard MRI examination could not be exclusively determined as tumor recurrence or radiation necrosis. MRI was performed on a 3 T Philips Achieva equipped with an eight-element receive head coil. The perfusion imaging and an initial T1 measurement utilized a saturation recovery gradient echo se
quence. Dynamic image parameters were: saturation delay 120 ms, flip angle=30, TR=3.9 ms, TE=1.9 ms, centric phase ordering, SENSE factor 2, ma
trix 96x61 (reconstructed to 256x256), FOV 230x182 mm², 4 or 5 slices, slice thickness 8 mm, dynamic image time 1.0 s or 1.25 s, 180 frames. The Cd bolus was injected after the 10th frame. The procedure was repeated, if neces-

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sary, to cover the lesion(s) of interest. The voxel in the internal carotid artery (or in some cases the anterior cerebral artery) with maximal signal change during the bolus passage was chosen for the arterial input function. MR signal curves were converted to contrast agent concentration and CBV and BBB permeability were determined from a Patlak plot. For all patients, 1-5 ROIs were placed in enhancing areas, and 1-2 reference ROIs were placed in normal appearing white matter contralateral to the lesion. Relative CBV (rCBV) for enhancing areas was calculated by normalizing to the reference CBV. All subjects underwent FDG-PET within 2 months of the MRI, and lesions were judged either metabolically active (tumor) or inactive (RN). The perfusion analysis was performed without knowledge of the PET result.

Results: 1 patient had 2 enhancing lesions. Of the total of 10 lesions, 2 were judged RN and 8 were judged tumor by the FDG-PET examination. Absolute CBV of tumor, RN, and white matter was 9.0±6.0, 1.3±1.0 and 1.5±0.7 ml/100g, respectively. Examples will be given showing lesions with an increased permeability where neither the blood volume nor the metabolism is increased from normal white matter values, thus indicating that the lesion results from radiation damage. The results for the relative blood volume are summarized in Figure 2. All necrotic areas have rCBV less than 1.7, whereas all tumor lesions have rCBV larger than 2.0.

Discussion: This preliminary study strongly indicates that it is possible to distinguish RN from tumor tissue by a measurement of relative CBV provided by T1 weighted perfusion imaging. The data presented in Fig. 2 shows a clear separation of rCBV from necrotic and metabolically active tissue implying a 100% sensitivity and specificity for detection of tumors if choosing a rCBV threshold of 2.0; though a larger number of patients is needed to confirm this. A half or full dose of Gd was used, whereas for DSC perfusion imaging is often double or even triple dose is employed including pre-bolus. A potential disadvantage of T1 perfusion is the limited coverage. However, we obtained a satisfactory coverage of lesions by acquiring a dataset once or twice.

References

Figure 2: Values of rCBV from contrast-enhancing lesions. All 8 tumors have rCBV larger than 2.0, whereas 2 necrotic lesions (RN) have rCBV less than 1.7.

CT Perfusion in Diagnosis of Radiation Necrosis
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Objective: The increase of Radiation Necrosis (RN) incidence after radiosurgery (to 37%) of brain glial tumors and metastases with low CT, MRI and clinical specificity in diagnosis demands the search of new methods of visualization with higher accuracy and specificity in differential diagnosis between RN and tumor’s recurrence during follow-up posttreatment period.

Purpose: To evaluate the potentialities of CT-perfusion (pCT) in RN diagnosis after radiosurgery.

Material & Method : Fifteen patients with surgically treated brain gliomas (anaplastic astrocytomas -7, glioblastomas- 8, and radiologically treated brain metastases (11 cases), who showed the appearance of contrast enhanced regions in periphery of surgical defect (in cases with gliomas) or ring-like (or patchy -like) patterns (in cases with metastasis) - totally 26 patients, were arranged in the two groups ( G (G) and RN(M)). There was control group: - nine patients with “pure” necrosis (PN) in non-tumor lesions after radiotherapy/radiosurgery (Novatis, Primus, Gamma-knife). Verification of diagnosis of RN was made using biopsy, positron-emission tomography (PET) with methionine and clinical course during one year observation (with repeated MRI). Perfusion maps of cerebral brain volume (CBV), cerebral blood flow (CBF), mean transit time (MTT) were generated at Advantage Windows workstation (CT perfusion III). Normalized ratios (divided by normal white matter values): nCBV, nCBF, nMTT were used for analysis.

Results: In cases with “pure” necrosis (group PN) in the regions of contrast enhancement low perfusion parameters nCBV and nCBF, nMTT were used for analysis. 15 pts in RN (G) group had low perfusion parameters ( CBV: 1.69±0.78, CBF: 1.34±0.46, nMTT:1.3±0.4) with no significant differences of parameters in PN control group. nCBV, nCBF values in cases with RN (M) were a little bit higher then in patients with PN but the differences between them were non-significant (p> 0.2) . Mean values and standard deviations of nCBV, nCBF, nMTT for each group are shown in table. For comparison values of perfusion parameters in cases with pre-treated malignant gliomas (G) were taken from [1] and in cases with recurrent tumor (RT) from [2].

Conclusion: CT perfusion with nCBV, nCBF parameters calculation is minimally invasive and very informative method in the detection of radiation necrosis and very promising tool in differential diagnosis between tumor recurrence and RN. References:

Role of MR Spectroscopy in Differentiating Radiation Necrosis from Tumor Recurrence, Effects of Radiation Injury and the Application of Prediction Models in Clinical Decision Making
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Purpose: The purpose of this presentation is to describe the most current data involving the application of MR
spectroscopy in differentiating tumor recurrence from radiation necrosis using metabolic ratios, which metabolite ratio offers the highest statistical yield, and the potential application to clinical practice by utilizing prediction models for clinical decision making.

Discussion: Presently, the management of new enhancing lesions at the vicinity of a previous treated brain neoplasm involves a combination of invasive brain biopsy, clinical course, and imaging follow-up. Differentiation between recurrent neoplasm and post-radiation change in patients who were treated for primary brain tumors is often difficult, based on conventional MR imaging features alone. New contrast-enhancing lesions, arising on routine follow-up brain MR imaging at the site of a previously identified and treated primary intracranial neoplasm, present a significant diagnostic dilemma. The site of the primary tumor has had a combination of surgical intervention, chemo and radiotherapy, and as a result does not have specific imaging characteristics by conventional MR imaging. Typically, both recurrent tumor and post-radiation-related changes demonstrate post-contrast enhancement with gadolinium. Therefore, the radiologist is often unable to discriminate tumor recurrence from post-radiation inflammatory and necrotic changes. In attempts to improve overall outcome and survival rates, clinicians have adopted aggressive radiation protocols. Although improved outcome has been observed, and there are studies demonstrating a relationship between survival and high radiation dose, there are dose limiting radiation injury late effects. MRS has been shown to detect early radiation changes that could potentially alter how radiation doses are administered to limit these effects. Magnetic resonance spectroscopy findings have shown adequate correlation with pathologic specimens obtained at biopsy and/or resection. Studies suggest that MRS can discern between post-radiation changes and recurrent neoplasm in patients treated for a primary brain tumor who have non-specific contrast-enhancing lesions on follow-up imaging. Our group demonstrated the usefulness of using these standard metabolic ratios in clinical decision-making to stratify patients into those that need surgery, those that need further treatment or those that have findings that can be considered radiation injuries.

Conclusion: In the future, prediction models combining multiple metabolic ratios, with or without clinical data, may prove to be a more effective decision-making tool in reducing the number of patients vulnerable to unnecessary invasive procedures or treatments.
Global Change of Cerebral Hemodynamics in Patients with Chronic Heart Failure

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Aim: Chronic restriction of cardiac output was shown to influence cerebral perfusion and hemodynamics, and a reduction of cerebral oxygenation during exercise [Koike A et al. Circ J 2008, Vogels RLC et al. Eur J Heart Fail 2007] was reported in patients suffering form cardiovascular disease. As interactions of cardio- and cerebrovascular disease may exist a better understanding of cardiovascularly related cerebral alterations is of interest, since therapy in case of more cardiovascularly weighted cerebral affections would additionally need a cardiological approach. Differentiation and, if possible, quantification of impaired cerebral circulation related to chronic cardio- or cerebrovascular disease based on morphological criteria only is difficult, because morphological alterations, associated with both entities, may appear quite uniform. Therefore we aimed to define findings in perfusion magnetic resonance imaging (P-MRI) in patients with chronic heart failure, which could help to identify rather cardiovascularly induced affections of the brain.

Material and Method: Consecutive patients with TIA - symptoms and/or vertigo, who were inconspicuous for acute ischemia in multimodal P-MRI were included in the study and differentiated into two groups.: Group 1 (n=9; f=3; m=6; age: 66-85 years) contained patients with reduced left ventricular ejection fraction (LVEF: 41 ± 16%) and group 2 (n=8; f=5 / m=4; age: 44 - 62) had normal cardiac findings. Global cardiopulmonary function was examined using echocardiography and electrocardiography. Latent hypoxia was ruled out by measurement of O2-blood oxygenation with pulse oxymetry. Vascular risk factors were comparable in both groups. Multimodal P-MRI was performed on a 1.5T-scanner (Avanto, Siemens Medical Systems, Germany) using dynamic susceptibility contrast enhanced MRI. Model-independent calculations of regional cerebral blood flow (rCBF)- and mean transit time (rMTT)-maps were performed [Ostergaard L, d Magn Reson Imaging 2005] using a software package as provided by the manufacturer. Standardised time-to-peak (stdTTP)-maps with slice specific offset calculation derived from a statistical distribution concept were generated as described before [Nasel C et al. AJNR Am J Neuroradiol 2004]. Since stdTTP is assumed to display the bolus distribution velocity between the arterial and venous cerebral vessel compartment, for global estimations of circulation time the stdTTP-based arterial rise time was calculated. Acute ischemia was excluded by assessment of rCBF- and stdTTP-maps using a 15 ml/100g/min threshold for rCBF- and a 7 s limit for stdTTP-measurements. In single-b diffusion weighted imaging (b=1000 sm2) no suspect diffusion findings were found. Relevant stenotic cerebrovascular disease was ruled out by MK-angiography (range: aortic arc - circle of Willis). In the following MRI was assessed for the extent of microvascular disease in both groups using a modified grade 0-4 (rang scaled data quality assumed) scoring system [Nagayama O et al. Circ J 2007]. Perfusion maps were then analysed for differences of CBF, MTT and stdTTP (all parameters: rationally scaled data quality assumed) between the two groups.

Results: Grade of microvascular disease was higher in group 1 (grade 0 vs 3 [median: grp.1 vs grp.2]). Global CBF was comparable between groups 1&2 (31.4 ± 14.5 vs 33.1 ± 4.7 ml/100g/min [mean ± SD: grp.1 vs grp.2]). MTT was higher in group1 (6.3 ± 2.5 vs 3.2 ± 0.4 sec. [mean ± SD: grp.1 vs grp.2]) and stdTTP-based arterial rise time was also higher in group1 (9.2 ±
The Relationship between Leukoaraiosis and Heart Function

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Purpose: The leukoaraiosis or age-related white matter change has been known to be related to small vessel disease, enlarged perivascular space, degeneration of myelin and axon and gliosis. In clinical respects, cognitive impairment is known to be related to leukoaraiosis. Hypertension as well as age is the strongest risk factor of the leukoaraiosis. In the past decade, numerous studies have been published addressing the feasibility and clinical applicability of tissue doppler addressing the feasibility and clinical applicability of tissue doppler imaging (TDI) for hemodynamic assessment. However, the relationship between cardiac function and leukoaraiosis is still unclear.

Materials and Methods: This retrospective study included 382 patients (mean age = 59.8±15.4 years, M:F = 209:173). They were performed brain MR images and echocardiogram with tissue doppler between Jan. 2008 and Nov. 2008. The patients with more than 1 month of time interval between the two examination or with large intracranial lesions, such as large infarct, hemorrhage, neoplasm, etc., were excluded in this study. The leukoaraiosis was evaluated on MR images with FLAIR and T2-weighted images and the leukoaraiosis followed the a new rating scale for age-related white matter changes by European Task Force team. The leukoaraiosis was rated on a 4-point scale (0-3) (Table 1) in five different regions in the right and left hemisphere separately: (1) the frontal area, (2) the parieto-occipital area, (3) the temporal area, (4) infratentorial area, and (5) the basal ganglia and thalamus. Therefore, the score range of the leukoaraiosis is from 0 to 30. The echocardiogram with tissue doppler was performed with biplane transthoracic echocardiography and ejection fraction (EF), left ventricular mass, and tissue doppler parameters (E/A ratio, Sm, Em and E/Em) were evaluated. Statically Pearson correlation was used and P<0.05 was significantly considered.

Results: Transmitral inflow parameters (E/A ratio, Em and E/Em) were significantly correlated with the leukoaraiosis score (p<0.01, correlation coefficient= -0.35, -0.5 and 0.16, respectively). The leukoaraiosis was also well correlated with age (p<0.01, correlation coefficient= 0.63) and was different to the sex (p<0.01).

Conclusion: The leukoaraiosis was related to the tissue doppler of echocardiogram or heart function. This relationship could provide more information for understanding the pathophysiology of the leukoaraiosis and its prevention.
the pediatric population affected by CA, neuroradiological presentation includes a wide range of signal intensity alterations. The patterns of selective brain vulnerability, the predictive role of neuroimaging and the significance of the different pulse sequences.

**Trauma**

**Chairs: A. Taylor, D. Zimatore**

15.30-15.45 10’

**Material and Methods**

The study is based on a prospective evaluation of 9 cases studied with MSCT and autopsy. Height non-decomposed bodies underwent MSCT scanning prior to traditional autopsy, the last victim was studied 10 years after the death. CT images were obtained with 16 or 64 MSCT scanner, with 1,25 mm collimation, and 1 mm reconstruction interval. Two and three-dimensional reconstructions were obtained at a workstation (Advantage Windows 4.3, G.E.M.S.). A board certified radiologist analyzed MSCT images for presence and characterization of parenchyma and bone injuries. The presence, localization and distribution of bone and bullet fragments within the brain tissue were also studied, and intracranial wound track was hypothesized. All the results were compared with autopic findings.

Results: Compared to traditional investigations, in all cases MSCT imaging was able in differentiating the entry from exit wound (when present), and to establish the track of the wound in the deep tissues. Cross-sectional imaging provided a better presentation of all bullet and bone fragments spatial localization, and presented the findings in a manner much easier to grasp by juries and laymen.

Conclusions: In conclusion, MSCT imaging should be considered an highly suggested complementary or even substitutive investigation tool in forensic investigations on fatal cranio-encephalic single gun-shot wounds. This technique is in fact an observational, independent, standardized and non-destructive method, that offers an optimal documentation and visualization of forensic findings in the court and, allows for re-examination of the case, even years after burial.

**Non-Accidental Pediatric Central Nervous System Trauma**

R. Zimmerman

**Children’s Hospital of Philadelphia; PA, USA**

Non-accidental trauma (NAT) is a cause of severe neurological deficits in infants and young children. Failure to recognize early findings on neuroimaging may allow the victim to be further injured.

This presentation deals with the use of CT & MRI in recognizing patterns of cerebral injury due to NAT, their pathologic correlations and their differential diagnosis.

16.00-16.15 10’

**Neuroimaging Findings in Abusive Head Trauma**

G. Zaccai1, A. Panighrahy1, R. Berger1

1Department of Radiology, University of Pittsburgh, Children’s Hospital of Pittsburgh, PA, USA; 2Safar Center for Resuscitation Research, University of Pittsburgh, Child Advocacy, Children’s Hospital of Pittsburgh, PA, USA

Background: Abusive head trauma (AHT) is a form of child abuse occurring when the abuser shakes an infant or small child, causing acceleration-deceleration injuries. AHT is the leading cause leading cause of death from traumatic brain injury in infants younger than 1 year. Commonly, there is no external evidence of trauma. AHT is often fatal and can cause severe neurologic sequelae resulting in life-long disabilities. Associated death raises 40% of the injured patients. Motor, cognitive, behavioral abnormalities ranging from mild visual impairment to blindness are often associated. AHT-related rotational acceleration is associated to diffuse axonal injury (DAI), subdural hematomas (SDH), subarachnoid hemorrhage (SAH) and retinal hemorrhages. Epileptiform discharges are most often seen in asymptomatic neonates. Neuroimaging plays a pivotal role in the evaluation of AHT. Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) represent useful tools in diagnosing clinically unsuspected AHT. CT and MRI may help in: a) determining the timing of injury, b) documenting the nature and extent of AHT and c) diagnosing conditions requiring immediate treatment. Aim of this lecture is to review the neuroimaging findings characterizing AHT.

Methods: An institutional retrospective imaging and chart review of AHT patients and a dedicated literature review were performed evaluating the location, signal alterations, ADC maps, and MRI spectroscopy data.

Findings: In AHT CT discloses a wide spectrum of findings ranging from unremarkable evaluation to diffuse cerebral edema. The reversal sign is associated with worse prognosis and in characterized by loss of gray-white matter differentiation with relative sparing of cerebellum, brainstem and basal ganglia. Differential diagnosis of the reversal sign includes hypoxic ischemic injury and infection. Multiple fractures crossing the sutures are easily depicted with three-dimensional CT reconstructions; however correlation of skull fracture and underlying injury is poor. SDH and SAH are well documented on CT as well as DAL. However MPR and SWI sequences show higher sensitivity in depiction micro hemorrhages as well as countercoup hematomas. Diffuse DWI alteration and low values on ADC mapping are associated with...
a poor outcome. DWI/ADC represent an adjunctive tool in evaluating the injured brain parenchyma. Usually in AHT there is sparing of the basal ganglia and of the hippocampus, thus suggesting that profound anoxia or hyperperfusion could not be solely responsible for the demonstrated findings. On MR Spectroscopy rapid decrease in NAA with increase in ml, Cr, lactate and lipid appears to be specific for AHT. DTI metrics appears to be abnormal in cerebral white matter structures in AHT patients. Reduced anisotropy in the genu of the corpus callosum is associated with poor clinical outcome.

Conclusions: CT and MRI are complementary tools in evaluating brain injury in AHT. DWI/ADC, MRS and DTI are complementary and probably in the near future they will be systematically utilized in the diagnostic work-up of AHT.

Figure Post traumatic left MCA stroke in non accidental trauma.

Long-Term Consequences of "Minimal" Traumatic Brain Injury: The Role of MRI and 99mTc-SPECT

G. Bommarito, R. Manara, D. Cecchin, N. Jelcic, M. Dam, G. Bommarito1, R. Manara1, D. Cecchin2, N. Jelcic1, M. Dam1, 1Neuroradiologic Unit, University Hospital of Padua, Italy; 1Nuclear Medicine Service, University Hospital of Padua, Italy; 1Department of Neurology and Psychiatry, University Hospital of Padua, Italy

Background: Traumatic brain injury (tbi) is one of the primary causes of death and long-term disability, especially in people younger than 45; mild traumatic brain injury accounts for about 70-90% of all tbi. Likely, within the mild tbi class (as defined by the Brain Injury Interdisciplinary Special Interest Group of the American Congress of Rehabilitation Medicine) there are several populations of patient; some of them undergo a minimal loss of consciousness and post traumatic amnesia, they are neurologically asymptomatic with a TC imaging showing no or minimal abnormalities. Patients with this 'minimal' traumatic brain injury could be affected by physical, cognitive and emotional disabilities; they usually recover in three months after injury but, in a small group (about 15%), symptoms persist limiting patient's reintegration in the community and his/her return to work.

Purpose: The aim of the study was to prove and assess cognitive and emotional impairments in patients who were symptomatic over 9 months after a 'minimal' traumatic brain injury (GCS=15, Post Traumatic Amnesia <4 hours, Lost Of Consciousness <30 minutes, no abnormalities on CT images, normal neurological examination) and to verify if the clinical aspects were related to morphological or functional damage (which was detected by SPECT and MRI imaging, the latter with dedicated sequences).

Materials and Methods: We recruited patients who were still symptomatic at least 9 months after a 'minimal' traumatic brain injury as defined by the features previously described. Subjects were assessed with neuropsychological tests (assessing cognitive function, attention, memory, visuo-spatial abilities and behavioural-emotional impairments); they underwent MRI (using T1-w, T2-w, T2*w, FLAIR, Diffusion weighted (DWI) and Susceptibility weighted (SWI) sequences) and 99mTc-HMPAO SPECT imaging.

Results: 15 patients were included (11 males and 4 females), with an average age of 45.5 years. All of their history they had a GCS score of 15 at the emergency department admission , brain CT showed no significant abnormalities and the neurological examination did not detect any pathological condition. The neuropsychological assessment showed cognitive or executive function impairment in 14 subjects and behavioural-emotional impairment in 13 patients (86%). Post-traumatic structural damage was revealed by MRI (especially with T2-w and SWI sequences) in 7 subjects (46%). SPECT imaging showed hypoperfusion areas in all cases; temporal and parietal cortex were the most frequently affected.

Conclusion: Patients with 'minimal' traumatic brain injury, when symptomatic, often present neuropsychological deficits and MRI/SPECT abnormalities. Post-traumatic morphological lesions are displayed in a better way using Gradient Echo and SWI sequences of MRI. Functional imaging (SPECT) is more efficient than morphological imaging to detect abnormalities in a population of subjects. These findings could have important consequences in legal field, especially in the assessment of disabilities after a 'minimal' traumatic brain injury. Revision of mild traumatic brain injury class and its clinical consequences could have a main value in identifying a proper therapeutic strategy.

Change of Regional Cerebral Function in Subjects with Post-traumatic Stress Disorder (PTSD) Survived the Earthquake of April 6, 2009 in L'Aquila: Preliminary Reports

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Introduction: Post-Traumatic Stress Disorder (PTSD) includes different symptoms of anxiety, such as excessive increase in activation, flattening of affect, flashbacks. The neuropsychological functioning of persons with PTSD has become an important area of research. Some studies report that in PTSD is present a diminished or blunted emotional responding, sometimes called "emotional numbing" (EN), constitutes one of the central symptoms in PTSD (Horowitz and Cohen, 1968). Symptoms of EN include diminished emotional responsiveness, feeling detached or estranged from others, and restricted range of affect (American Psychiatric Association, 2000). However, more recent experimental studies suggest that emotional numbing primarily reflects emotional disorder and social detachment. Recent studies have provided evidence that this feelings of detachment from others, and restricted emotional expression correspond to physiological and morphological changes in several brain regions acting to emotional elaboration such as the amygdala, hippocampus, insula and prefrontal cortex in PTSD subjects. The present work has as its purpose the study of emotional components in individuals with PTSD and the principal aim is to examine subjects functional alteration in limbic regions, insula and frontal cortex during emotional task compared with healthy subjects.

Material and Methods: Ten subjects with PTSD (survived the 6.3 magnitude earthquake on April 6, 2009 in L'Aquila) (6 female, 4 male), mean ages 37.8 (12.2); years of education 8.6 (4.1) and 10 healthy controls
(5 women, 5 men), mean ages 22.6 (9.6); years of education 9.3 (4.2) underwnt MRI. PTSD was diagnosed according to DSM-IV-R (APA 2000). All subjects underwent DPST underwnt to clinical and neuropsychological evaluation. Clinical evaluation was performed with Davidson Trauma Scale (Davidson, 1997) and Civilian Mississippi Scale (Reis et al., 1989) to assess the frequency and severity of symptom. Neuropsychological evaluation was performed using Emotion attribution task, Empathy Quotient. All subjects underwent MRI while viewing a content-neutral and negative stimuli (IAPS). Images will be acquired using a General Electric 1.5T whole-body scanner (GE HD), at Department of Neuroradiology, San Salvatore Hospital/University of L’Aquila, Italy. The blood oxygenation level dependent (BOLD) contrast has been obtained using a two-planar T2*-weighted imaging (EPI). The acquisition of 21 transverse slices with an effective repetition time of 2000 ms (64x64, nax 1), oriented according to the bicommissural plane, has provided coverage of the whole cerebrum cortex. The in-planer resolution will be 4x4 mm. A 3D T1-weighted anatomical scan (1x1x1 mm) has been also acquired, covering the whole brain. The expansion data analysis was performed using SuperLab. MRI functional data were analyzed by means of the BrainVoyagerQX software, 1.10.1.

Results: A t test revealed a statistically significant difference in the images minus scrambled contrast in magnitude of activation between the two groups. Data analysis revealed that healthy subjects had significantly greater activation in particular in the right anterior insula (peak activation x 39, y 32, z 7) and in bilateral inferior frontal gyrus (peak activation x 9, y 51, z 55). On the contrary, data analysis revealed that PTSD subjects had significantly greater activation in the bilateral posterior insula (peak activation x 42, y -16, z -8), in the parahippocampal gyrus (peak activation x 18, y -58, z -4) and in the left amygdala not present in healthy subjects. These activations in subjects with PTSD are significantly correlated with the severity of symptoms obtained in clinical measures and in neurocognitive measures in particular in Empathy Quotient Scale.

Discussion and Conclusions: Our results, consistent with previous studies, suggest that in patients with PTSD there is a change in the activation of brain areas responsible for emotional processing. Our data are consistent with previous who demonstrate hyperactivation in fronto-limbic structures during emotional tasks. This study suggest that close personal experience may be critical in understanding the neural mechanisms that underlie the emotional modulation of memory. Our findings provide evidence that significant alterations in brain function, similar in many ways to those observed in post-traumatic stress disorders, can be seen shortly after major traumatic experiences, highlighting the need for early evaluation and intervention for trauma survivors.

16.45-17.00 10’ Quantitative DTI Tractography of the Uncinate Fascicle; Differentiation between Traumatic Injury and Abnormalities in Vascular Disease and Alcoholism

T. Kurki 1, J. Laalo 1, J. Kauh 1
Puls I Medical Center, Dept of Radiology, Univ of Turku, Finland; 2 Helsinki Univ. Hospital, Dept of Radiology, Univ of Turku, Finland

Introduction: Traumatic brain injury (TBI) often leads to persistent cognitive symptoms without findings in conventional MRI. Diffusion tensor imaging (DTI) can reveal changes in these cases as decreased fractional anisotropy (FA), increased apparent diffusion coefficient (ADC) or as reduced tract volume (Vol) or fiber count in tractography. However, there are several other causes to cognitive symptoms leading to DTI changes. Alcoholism (ALC) and vascular diseases (VD) are relatively common etiologies of cognitive decline. These conditions are not always clinically evident and conventional MRI can show only nonspecific changes similar to TBI. Uncinate fascicle (UF) connecting anterior temporal lobe to frontal and other prefrontal cortex, is considered essential for memory functions. Abnormal FA values in UF are common in patients with TBI. Injury of the tract been suggested to be one major cause to cognitive symptoms. Our purpose was to evaluate if findings in quantitative tractography of UF differ in TBI from those of vascular or alcohol-related degradation.

Materials and Methods: 71 patients were studied due to cognitive symptoms after traumatic brain injury. The injury was classified as mild in 40 cases and as moderate or severe (mod/sev) in 31 cases. Additionally, 14 persons with cognitive decline due to ALC and 14 persons with cognitive decline due to VD were studied. Only patients without clinical or MRI signs of other neurological disease or TBI were included. 50 persons with normal brain served as normal controls. DTI was performed as a part of routine imaging protocol at 3T, 15 gradient encodings directions and a voxel size of 2 x 2 x 2 mm was used. Tractography was performed by using a FA threshold of 0.15 and a turning angle threshold of 27 degrees, the UFs were defined by two free-hand include ROIs and two exclude ROIs in standard positions. Vol, mean FA and mean ADC were measured in both UF. The tracts were additionally evaluated visually by two neuroradiologists; the size of central part and the number and length of peripheral frontal fibers were scored from 0 to 3 (0 = normal, 1 = slight reduction, 2 = moderate reduction, 3 = severe reduction or absence). The sum of two scores of each tract was used for analysis.

Results: The tracts with decrease of volume or FA or increase of ADC more than 2 SD from the mean of normal persons were regarded as quantitatively pathological. The number of abnormal findings was:
- Mild TBI: Vol 14, FA 18, ADC 14, abn tracts 29/80 (36%).
- Mod/sev TBI: Vol 18, FA 37, ADC 22, abn tracts 47/62 (76%).
- VD: Vol 2, FA 19, ADC 18, abn tracts 23/28 (82%).
- ALC: Vol 0, FA 22, ADC 16, abn tracts 24/28 (86%).

The volumes of both left and right UF of patients with TBI (both mild and mod/sev) were smaller than those of normal persons (p<0.05). The volumes of UF of patients with VD or ALC did not differ from those of normal persons. The volumes of all quantitatively pathological left UF were in TBI (both mild and mod/sev) smaller than those of patients with ALC or VD (p<0.05). In the right UF the corresponding differences were not significant. In mild TBI the FA were higher and ADCs lower than in VD and ALC (p<0.05). In the quantitatively pathological tracts volume decrease was present in about 50% of the tracts in mild TBI, in less than 40% in mod/sev TBI, in less than 10% in VD and in 0% in ALC. In both cases with volume reduction in VD an infarct was present in the UF. Volume reduction was present without abnormal FA or ADC values in 4 cases in mild TBI, in 3 cases in mod/sev TBI and in 1 case in VD. The mean values for visual scores were: 0.25 for controls; 1.11 for mild TBI; 1.48 for mod/sev TBI; 0.89 for VD; 0.36 for ALC. The scores of patients with mild or mod/sev TBI were larger than those of normal persons (p<0.05) both on the right and left side. The scores of patients with VD or ALC did not differ from those of normal persons. The scores of quantitatively pathological tracts were in mild injury larger than those in VD or ALC on both sides (p<0.05). By using a score > 2 as a limit for pathology the proportion of abnormal tracts was: 2% in normal persons, 25% in mild TBI, 36% in mod/sev TBI, 7% in VD and 0% in ALC.

Conclusions: TBI commonly leads to changes of UF detectable by fiber tracking; the reduction of size and number
of fibers can occur without pathological ADC or FA values. In PD and alcoholism FA and ADC changes occur without volume reduction. However, an infarct can cause volume decrease of the tract. These differences can be related both to the injury type and to the degree of preservation of crossing fibers in peripheral parts of UF. Traumatic injuries often can be differentiated from other pathologies based on fiber tracking in patients with cognitive decline without sure clinical or MRI signs of the etiology.

17.00-17.15 10’

Diffusion Tensor Imaging and Tractography of Traumatic Brachial Plexus Palsies. Preliminary Experience

R. Gasparotti, G. Lodoli, M. Frigerio, C. Ambrosi
Neuroradiology Unit University of Brescia, Italy

Background: In traumatic injuries of the brachial plexus the preoperative assessment of nerve root avulsions is essential for surgical planning. In the diagnostic workup MR myelography has almost completely replaced CT myelography as the first choice examination. To our knowledge there are no reports on the application of Diffusion Tensor Imaging to the study of traumatic brachial plexus palsies.

Purpose: Evaluation of the clinical feasibility of diffusion tensor tractography of the brachial plexus in a selected population of patients with traumatic brachial plexus injuries.

Material and Methods. Ten patients (8 males, 2 females, mean age 27.4, range 16-52) with traumatic brachial plexus palsies (6 left, 4 right) have been examined with 1.5 T scanner (Siemens, Avanto) with the following imaging protocol: a) 3D MR myelography (3DMRM) with multiplanar reconstructions along the course of cervical nerve roots (3D T2 Fast Spin Echo sequences, 0.7 mm isotropic voxel), b) 3D T2 STIR SPACE (TR 2000, TE 149, TI 160, 1 mm isotropic voxel), C) DTI (64 contiguous axial sections from C3 to T2, TR 9200 TE 90, 12 directions, 2.2 mm isotropic voxel, 5 runs, peripheral triggering, FOV 250 mm), DTI data were preprocessed coregistering every single direction of each run with the first b0 and corrected for eddy currents with FSL (FMRIB Software Library; Oxford, UK) FDT tool. Tractography of the brachial plexus and cervical spinal cord was obtained tracing multiple 3D ROIs along the extraradicular course of C5-T1 nerve roots on MPR reformatted b0 coronal images. Nerve root avulsions were defined on MR tractography on the basis of a loss of continuity with the spinal cord fibres. Brachial plexus tractography diagnostic accuracy was assessed comparing it with 3DMMR findings on a per root basis on 100 nerve roots.

Results: 3DMRM detected 18 avulsed nerve roots and 32 intact roots on the injured side. Brachial plexus tractography had 94% sensitivity, 57% specificity, 60% PPV and 98% NPV compared to 3DMRM, with 1 false negative and 12 false positives. The relatively elevated false positive rate is mainly related to the evaluation of C8-T1 nerve roots, which are displayed in a sub-optimal way, due to their anatomical course adjacent to bone. Conclusion: Diffusion tensor tractography is a cutting-edge technique for studying peripheral nerves, which cannot be as readily and reliably performed in the spinal cord and brachial plexus for technical and anatomical reasons such as pulsation artefacts, motion in the thorax and large number of longitudinal fibres. Compared to 3DMRM brachial plexus tractography is characterized by an elevated diagnostic accuracy in the assessment of nerve root avulsions, which can be easily displayed as loss of continuity with spinal cord fibres. Although DTI of the brachial plexus is still an experimental method which needs further testing in order to produce meaningful clinical results, our preliminary experience suggests its promising role in the assessment of nerve continuity in traumatic injuries of the brachial plexus.

17.15-17.30 10’

CT Angiography in Brain Death Diagnosis: Clinical Experience in 184 Patients

M. Musacchio 1, A Meyer 1, I Manoila 1, A Lebidensky 1, J-C Zinck 2, H Oesterle 1, M. Musacchio 1, A Meyer 1, I Manoila 1, A Lebidensky 1, J-C Zinck 2, H Oesterle 1
Neuroradiology - Hôpitaux Civils de Colmar, France; 2 Centre Hospitalier Universitaire, Colmar, France

Purpose: To evaluate clinical usefulness of CT angiography in brain death diagnosis.

Material and Methods: From July 2003 to December 2008, 184 patients (90 women, 94 males) aged from 17 to 86 years (mean age 50 years) were submitted for confirmation of brain death. 79% of patients underwent CT cerebral angiography. Multidetector CT technique also allowed simultaneous visceral exploration in 58% of the cases. Almost all patients benefited at least of one transcranial Doppler exploration before CT angiography, which supported the clinical suspicion of brain death. All patients were hemodynamically stable (mean arterial pressure >65 mmHg). CT cerebral evaluation protocol consisted of a first non-enhanced acquisition, followed by a second acquisition obtained 60 second after intravenous injection of a single bolus (2 cc/kg) of non ionic contrast medium in a antecubital vein (3 cc/sec). Cerebral circulatory arrest diagnosis was based on the absence of enhancement 60 second after contrast medium injection. Each patient was examined in the thorax and large number of longitudinal fibres. Compared to 3DMRM brachial plexus tractography is characterized by an elevated diagnostic accuracy in the assessment of nerve root avulsions, which can be easily displayed as loss of continuity with spinal cord fibres. Although DTI of the brachial plexus is still an experimental method which needs further testing in order to produce meaningful clinical results, our preliminary experience suggests its promising role in the assessment of nerve continuity in traumatic injuries of the brachial plexus.

Results: CT angiography allowed confirmation of cerebral circulatory arrest in 87% of the cases. 13% required supplementary exploration by other methods (EEG, digital subtraction angiography) to confirm brain death. Nevertheless, revised criteria reduced the necessity of multiple explorations. Simultaneous CT visceral scan permitted to identify certain pathologies (not related to the initial medical condition or the cause of death) that restrict or forbid organ removal for transplantation (19% of the potential donors).

Conclusion: CT angiography allows confirmation of brain death. Non enhancement of distal cortical vessels and internal cerebral veins/vein of Galen seems to be sufficient criteria to confirm the diagnosis of cerebral circulatory arrest. However, the method demands a strict respect of the acquisition protocol and a careful analysis of the results. Multidetector CT technique also permits to simultaneously explore all internal organs in a single exploration.
Palazzo della Cultura e dei Congressi - Yellow Hall
Friday, 8 October - 14.30-17.30

COMMUNICATIONS

Spine 7

Chair: I.S. Choi, J. van Goethem
14.30-14.45

Efficacy of Percutaneous Vertebroplasty with Calcium Sulfate: A Preliminary Experience

S. Marcia, S. Marini, E. Piras, M. Marras, C. Boi, G. Mallarini
Radiologia Universita’ di Cagliari, Italy

Aim: to prove the effectiveness of a bone substitute (Cerament, Bone Support, Sweden) in the treatment of osteoporotic or traumatic vertebral fractures with percutaneous vertebroplasty.

Material and Methods: from March to December 2009 17 patients (male, 16 female, average age: 64) underwent percutaneous vertebroplasty. We treated 41 vertebral bodies by means of injection of Cerament (calcium sulfate 60% + hydroxyapatite 40%) through 10 and 13Gauge bevel-edge needles (Gangi type). About 3cc of bone cement was injected for each vertebra. Patients had been previously evaluated with clinical examination and with X-Ray, CTms and MRI T2w STIR. All the procedures were executed with local anaesthesia under digital fluoroscopic guidance. Clinical evaluation and assessment of pain by means of a Visual Analogue Scale (VAS, 0-10) and a Oswestry Disability Index (ODI, 0-50) test was performed before and one month after the procedure. We also carried out X-Ray, CTms and MRI checks at one, three and six months. It was also evaluated the use of analgesic drugs before and after the procedure.

Results: we have obtained a progressive reduction of the pain in all the patients (Av. VAS pre: 8.52, av. VAS post 2.17, av. VAS difference: 6.35) and a good improvement of the quality of life (Av. ODI pre: 24.3 av. ODI post: 11.7 av. ODI difference: 12.6), a progressive reduction of bone edema evaluated through MRI T2w STIR and a progressive inclusion of the bone cement evaluated through CTms. 100% of patients were used to take analgesic drugs before the implantation, while only 21% continued to do. No complications arose.

Conclusions: our preliminary studies prove that calcium sulfate could result in being an actual substitute of PMMA in the treatment of osteoporotic and traumatic vertebral fractures, especially in young patients.

14.45-15.00

X-Press BKP: A Preliminary Experience

S. Marini, S. Marcia, C. Boi, E. Piras, M. Marras, G. Mallarini
Radiologia Universita’ di Cagliari, Italy

Aim: to evaluate the effectiveness of a new device for balloon kyphoplasty in the treatment of traumatic vertebral fractures by means of pain reduction and height restauration.

Material and Methods: from June to October 2009 we performed percutaneous kyphoplasty on 18 patients (5 male, 13 female, average age: 64,4) with traumatic vertebral fractures using the new kit called “xpress” (Kyphon Medtronic). It’s characterized by 10 Gauge needles and 10 or 15 mm balloons. For each patients was used a bone cement composed by PMMA (60%) and hydroxyapatite (40%) (Activos, Kyphon Medtronic). All the procedures were executed with local anaesthesia under digital fluoroscopic guidance. A total of 25 vertebra was treated. Patients had been previously evaluated with clinical examination and with X-Ray, CTms and MRI T2w STIR. Clinical evaluation and assessment of pain by means of a Visual Analogue Scale (VAS, 0-10) was performed before the procedure and one month after, Height restauaration by means of volume calculation with CTms was made before and after the procedure. It was also rated the degree of patient satisfaction.

Results: we have obtained a progressive reduction of the pain in all the patients (Av. VAS pre: 7.3, av. VAS post 2.9, av. VAS difference: 4.4), a good restoring of the height (Av. h pre: 142 mm, av. h post: 157mm, av. h difference: 1.5mm), and a good increasing of the volume of the vertebral bodies (Av. V pre: 15.0 cm³, av. V post: 15.7 cm³, av. V difference: 0.7 cm³). Patients reported a good satisfaction with the procedure. No complications arose.

Conclusions: from our preliminary studies Xpress BKP resulted to be safe and effective in the treatment of VCF. It also demonstrated to be more feasible: better placement of the needles and shorter procedure with less suffering of the patients is allowed by a thinner working cannula.

15.00-15.15

Preliminary Experience with new Synthetic Ceramic Bone Substitute Cerament™ Spine Support in Vertebral Compression Fracture (VCF): Short Term Follow-Up at 9 Months about 15 Cases

F. Zeccolini, G. Ambrosiano, P. Vassallo, A. Lavanga, G. Guarnieri, M. Muto
Neuroradiology Service Cardarelli Hospital; Naples, Italy

Purpose: To illustrate our preliminary experience about a new synthetic ceramic bone substitute Cerament™ Spine Support in the treatment of Vertebral Compression Fracture (VCF) showing our clinical results at 9 months short term follow-up.

Material and Methods: 15 patients (9F, 6M, ages means 55years) affected by osteoporotics VCFs (13/15) and by traumatic VCFs (2/15).All pts. were studied by MRI protocol (Sagittal T2W,STIR,T1W). VCF distribution was:5 at level L2,L4,2 T12,2 T11.All procedures were performed under local anesthesia with trans-peduncular approach.A new synthetic ceramic bone substitute -Cerament™ Spine Support-was used to intend for augmentation of the vertebral body. It’s constituted by 60% alpha-calcium sulfate (α-CaS) and 40% hydroxyapatite (HA). A clinical short term follow-up at 9 months was performed with VAS and ODS.

Results: VP for osteoporotic or traumatic VCF was archived. Ceramic
bone substitute -Cerament™ Spine Support - is new cement safe and effective to use for osteoporotic and traumatic cement. A long term follow-up is recommended.

15.30-15.45 10'

Safety and Clinical Efficiency of Percutaneous Vertebroplasty in the Elderly (/>= 80 year-old)

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Pitié-Salpêtrière Hospital, Paris, France

Purpose: To evaluate safety and clinical efficiency of percutaneous vertebroplasty (PV) in patients aged 80 or more.

Materials and Methods : Fifty-three patients (40 female; 13 male) aged between 80 and 95 (mean : 84.5) underwent 63 PV procedures (120 vertebrae) in our institution from June 2008 and December 2009. Thirty-nine patients had osteoporotic vertebral compression fractures (VCF) (73%) and 14 patients (27%) were treated for vertebral metastases (8 patients) or hemopathy (6 patients). Periprocedural and delayed complications were systematically assessed. A semiquantitative scale of clinical efficiency was established integrating pain evaluation and pain-killer drugs use before and at one month follow-up: 0: marked pain worsening; 1: moderate worsening; 2: unchanged; 3: improvement; 4: disappearance.

Results: No peri or postprocedural complication occurred ; no pain worsening were observed. Pain was unchanged in 27.5% of cases, improved in 30% and disappeared in 42.5%. We identified 12 new fractures in 9/53 patients (27%) on imaging follow-up. The mean delay to new fractures in 9/53 patients (27%) on imaging follow-up. The mean delay to new fracture was 12.7 months ± 8.6. The most frequent pattern of leakage was venous in 50%, pedicular and bi-pedicular approaches leakage noted in 8% of cases. Both uni-pedicular and bi-pedicular approaches showed leaks in 50% of cases. The most frequent pattern of leak was venous indicated in 52% of leaks, the adjacent disc in 46%, and paravertebral in 5%. The pattern of leakage was always limited to one region except in two cases. There were no asymptomatic leaks that required surgical intervention.

Conclusions: Vertebroplasty in osteoporotic fractures using a highly viscous cement that can be safely controlled and injected via a hydrolic system can be performed safely without significant complications.

15.45-16.00 10'

“Primary Care” Vertebroplasty Clinic in a Free Standing Radiologist Owned Diagnostic Imaging Center - Diagnosis, Treatment, Prevention, and Follow-Up of VCFs

H. Hatten, Jr.
Indian River Radiology, p.a., Vero Beach, FL, USA

Indian River Radiology is a radiologist owned, independent, free-standing, Diagnostic Imaging Center located in Vero Beach, Florida. Indian River Radiology provides multiple imaging modalities including: CT scanning, MRI scanning, plain films, ultrasound, DEXA, fluoroscopy. Soft tissue biopsies are routinely performed under CT, fluoroscopic, or ultrasound guidance in the center. Several years ago, the radiologists at Indian River Radiology participated in the construction of an Ambulatory Surgery Center (ASC) located adjacent to Indian River Radiology. The author is a neuroradiologist who performs all vertebroplasties referred to Indian River Radiology. Indian River Radiology has made a concerted effort to provide subspecialty coverage to our referring physicians. The author has performed approximately 650 vertebroplasties since 2000. In addition to vertebroplasties, the author has an active pain clinic where ESI, SI joint inyect, the bony techniques, etcetera are performed. Vertebroplasties are performed in the Ambulatory Surgery Center adjacent to the facility using a Siemens C-arm fluoroscopic unit. Indian River Radiology employs a registered nurse (R.N.) who has worked at Indian River Radiology for approximately 10 years. The R.N. serves as the coordinator for vertebroplasty patients in the pain clinic in addition to her other nursing responsibilities. She is available to patients by phone and coordinates appointments and procedures for patients with persistent and continued pain. The R.N. coordinates all follow-up evaluations and is involved in counseling patients for osteoporosis. Indian River Radiology has made a commitment to serve as a treatment resource for osteoporosis, particularly in our vertebroplasty population. Patients are questioned about and encouraged to take bisphosphonates. Patients are educated regarding the importance of vitamin D, calcium levels, regular exercise, and the R.N. provides information on inexpensive calcium and vitamin D supplements. Indian River Radiology has initiated a Reclast Infusion Center where Reclast is given as an annual infusion. The author has had the opportunity to use several bio-injectable materials for vertebroplasty and has used multiple vertebroplasty kits sold by multiple vendors. The most recent bio-injectable material has been a bioplastic material, Cerament TM (Bone Support / Lunde, Sweden). Cerament TM is an FDA approved bone filler which has been used off-label in vertebroplasty protocols. Cerament TM provides excellent pain relief and is unique because of its bone healing potential and appears to stimulate new bone growth. An integrated approach to osteoporosis in patients with vertebral compression fractures has allowed Indian River Radiology to serve as a “primary care” resource for patients with back pain. Indian River Radiology’s ability to treat their pain, counsel them about vertebroplasty alternatives, and provide follow-up of any new pain and additional vertebral compression fractures, makes Indian River Radiology a “primary care” resource both for our patients and for referring physicians. In addition to pain control and vertebroplasties, our patients often return for additional imaging to evaluate whether new or pre-existing conditions not related to their backaches (CT abdomen, ultrasound, et cetera).
One Session Multi-Level Vertebroplasty: Indications and Results of 55 Patients

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Neuroradiology Service Cardarelli Hospital; Naples, Italy

Aim: To illustrate the validity of one session multi-level vertebroplasty (VP) as treatment to prevent new vertebral fractures (VBFs) in patients affected by osteoporosis, who present, in the follow up, a new fracture in a vertebral soma adjacent or distant from the collapsed one.

Materials and Methods: From our 2350 vertebral bodies treated by VP until 2008, retrospectively, we have observed that, in same session, a multi-level VP (minimum 4, max. ten bodies) was performed in 55 pts affected by osteoporosis VBF. All patients complained a pain syndrome resistant to continuous medical medication due to recurrent VBFs either in patients with systemic collagenopathy (rheumatoid arthritis, pulmonary ventilatory disease or Marfan disease. All procedures were performed in prone position under fluoroscopy with local or neuroleptanalgesia and by an unipedicular approach in 95% of cases.

Results: In the following 24-72 hours, a successful outcome has been observed with a resolution of pain symptom, registering a reduction of 4 points in the VAS and a 40% reduction in the ODS. During multilevel or post treatment, no thrombo-embolic complications or extra-vertebral vascular or discal leakage have been observed. 3/55 patients (5%) developed a new fracture or re-fractures with a resolution of pain symptom, registering a reduction of 4 points in the VAS evaluation and a 40% reduction in the ODS score. In 27% of the patients no specific treatment was prescribed for osteoporosis after vertebroplasty; a new vertebral fracture occurred in 78% of these patients as compared with 42% of those who took an antiresorptive drug (mostly oral risedronate, alendronate and ibandronate). In conclusion:

* Half of the patients treated with vertebroplasty for an osteoporotic fracture get across a new vertebral fracture within few years;
* Age and low bone mineral density are the main clinical risk factors;
* Oral bisphosphonates treatment lowers the risk, but this remains unacceptably high;
* Vertebroplasty should be prescribed only in limited, extremely symptomatic patients. The interventional procedure should be associated with a thorough investigation and treatment for osteoporosis.
to match patient’s anatomy. The Osseofix implant is intended for use in the thoracolumbar spine. They are not used for placement in the cervical spine.

Methods: In some patients with lumbar spinal fractures we used this new technique with a bilateral peduncular access, using a K-wire and a new system of introducer. We positioned titanium stent implant inside the body of the vertebra restoring the height. Then we filled with PMMA the positioned, opened, stent-implant, only with local anaesthetic.

Results: All the procedures let patients to feel well soon without any pain, immediately. Even though the number of fractures treated is little, we found a new efficient approach to spinal fractures, that creates composite (bone + Titanium +PMMA) rather than single bolus of material, giving more stability and strength to the spinal cord.

Conclusion: OsseoFix, a new minimally invasive technique, might be considered as the evolution of vertebroplastica and kiphoplastica, because of the permanent position of titanium stent (instead of the temporary pressured balloon) with a reduced amount of cement (less probability of leakage outside the vertebral body), no pressurization during reduction (reducing chance of endplate breakthrough).

**Materials and Methods**: 99 (68 females and 31 males) with 152 osteoporotic vertebral compression fractures (VCF) were treated with RFK using the StabiliT Vertebral Augmentation System (DFine Inc. San Jose, CA). The StabiliT System provides a navigational osteotome to create a site and size specific cavity prior to delivering an ultrahigh viscosity cement with an extended working time (done by applying radiofrequency energy to the cement immediately prior to entering the patient). Three months follow up in 85 patients (59 females and 26 males) with 128 treated VCFs are reported. 122 (73 females and 49 males) underwent 202 BKP procedures. Three months follow up in 105 patients (63 females and 42 males) with 175 vertebrae treated are reported. Patient-related outcomes of pain (Visual Analogue Scale) and disability (Oswestry Disability Index) were assessed pre- and postoperatively and after 3 months. Correction of vertebral height and kyphotic deformity were assessed by radiographic measurements. Cement leakage was evaluated postoperatively.

Results: Mean pain visual analogue scale and Oswestry Disability Index significantly improved in both patients groups from pre- to post-treatment (P<0.001), this improvement being sustained up to 3 months follow up. A significant gain in height restoration and a reduction of the post-operative kyphotic angle were seen post-operatively and at 3-months in the RF Kyphoplasty and Balloon Kyphoplasty. Cement leakage was noted in 7% (7 out of 99 vertebrae) of the RFK procedures and 17.2% (21 out of 122 vertebrae) of the BKP procedures. No symptomatic cement leaks or serious adverse events were seen in the RFK and BKP group during 3-months of follow up. Site specific cavity creation and delivery of ultra-high viscosity cement in RF Kyphoplasty resulted in the added benefits lower cement leakages intraoperatively.

**Percutaneous Anterior Column Stabilization of Focal Metastatic Lesions of the Spine: The Value of Plasma-Mediated Radiofrequency Ablation before Cement Injection**

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Purpose: Spinal metastatic lesions which are located in the anterior or posterior regions of the vertebral body (Weinstein Types III and IV) are usually treated by extensive anterior corpectomy stabilization and posterior fusion. This study assesses the value of creating a cavity in the anterior 2/3 of the vertebral body using plasma-mediated radiofrequency ablation prior to cement injection, aiming to stabilize the anterior column through a non-heat-driven method.

Materials/Methods: Retrospective assessments of CT images were performed pre- and post-procedure in 24 patients (27 levels). A void was created in the anterior portion of the tumor-infiltrated vertebral body using a bipolar plasma-mediated radiofrequency-mediated wand (ArthroCare Corporation, Austin, TX) and bone cement was inserted. Pain was recorded both pre- and 2-4 weeks afterwards using a visual analogue scale (VAS).

Results: In 11/12 levels with anterior lesions, cement was deposited inside the lesion. Cement was also successfully deposited anterior to the lesion in 13/15 levels with posteriorly-located lesions. VAS pain scores were available for 21 patients: 19 reported significant pain relief while 2 exhibited no change. No clinically significant leakage was observed.

Conclusion: Cavity creation using plasma-mediated radiofrequency ablation can be performed percutaneously before standard vertebroplasty, and results in more control over cement deposition in the anterior part of the vertebral body, regardless of the lesion location. This approach could treat focal metastatic lesions while avoiding the more invasive standard technique of extensive anterior surgical debulking and reconstruction. In cases displaying neurological deficit, it can complement a simpler posterior decompressive laminectomy and fusion.
III WORLD CONGRESS
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Neuroradiology of Trauma

Chairs: R. Zimmerman, A. Beltramello

Minor Brain Trauma: Pathology, Imaging and Clinical Aspects

D. Chakeres
The Ohio State University, College of Medicine; Columbus, OH, USA

Over 5 million Americans live with long term disabilities as a result of traumatic brain injury (TBI). Many other have less severe injuries, but still are symptomatic. The understanding and classification of TBI is frequently not well defined by either imaging or clinical measures. There is no effective treatment. The measures are not very good. The Glasgow Coma Scale does not categorize individuals well, particularly those with minor head trauma. There are other clinical testing methods, but they have problems as well. The individual may have a deficit that is severe, but unless the ideal diagnostic method is utilized it may remain occult. Minor TBI has many definitions based on clinical and imaging criteria. The American Academy of Neurology (AAN) classifies Grade 1 as transient confusion with no loss of consciousness and symptoms resolve in less than 15 minutes. Grade 2 is similar, except symptoms last more than 15 minutes. Grade 2 is similar, except symptoms last more than 15 minutes. Grade 3 is loss of consciousness. For this discussion minor head trauma will include those individuals with normal head CTs or up to Grade 3. The pathologic of major and minor brain trauma is better understood. Gross brain contusions, infarcts, hemorrhages, regions of edema are commonly seen in severe TBI. There are many injuries beyond the sensitivity of routine imaging though including: disruptions of the axolemma, and neurofilament organization. Animal studies of minor head trauma have demonstrated ball like swelling of axons suggesting frank axonal separations without any evidence of focal parenchymal or vascular injury. The degeneration is thought to be due to the stretching and tearing of nerve fibers at the moment of the accident. Loss of consciousness may be a clinical marker of disruption. The location of injury can be diffuse or focal. The exact location is critical in terms of the patient’s final outcome. In animal studies degenerating axons were noted in the inferior colliculus, pons, and dorsolateral medulla. Injuries in the midbrain are associated with much worse outcomes in human studies. Besides the cellular distribution of trauma the intracellular properties are also important. For example APOE 4 is a genetic marker that can be associated with an increased risk of Alzheimer’s disease. Those individuals with this specific genetic risk factor are also at increased risk of more serious outcomes related to TBI. Beta-amyloid deposits are found in patients who die of severe head injuries and correlate with possession of an apolipoprotein E APOE 4 allele. Therefore, individuals with the same trauma can respond quite differently because of genetic or other predispositions.

Imaging can be insensitive to TBI depending on technique. Head computed tomography (CT) can be normal, but the patient can still have a profound TBI. CT is good for acute hemorrhages associated with extra-cerebral collections, brain contusions, subarachnoid/intra ventricular blood, skull fractures, retained secretions, focal brain edema, cerebral spinal fluid (CSF) fistulas. CT is not good for diffuse brain edema, sheath/axonal injuries, diffuse ischemia. CT angiography (CTA), magnetic resonance angiography (MRA), catheter angiography are good modalities for the diagnosis of major brain vessel injuries, but not good for micro vessel disorders. MR holds the promise of being the best method for minor TBI. Subtle regions of edema can be seen on T2 weighted spin echo (SE) imaging. Gradient echo imaging (GE) is more sensitive than T2 SE for the diagnosis of hemorrhage. Susceptibility weighted imaging (SWI) incorporates phase information with GE imaging and can be many times more sensitive than GE imaging for hemorrhage.

Standard diffusion weighted imaging (DWI) used for infarction can be sensitive for regions of necrosis secondary to trauma. Diffusion tensor imaging (DTI) evaluates the properties of the spatial restriction of the diffusion of water in cells that have directional organization. The brain particularly the white matter tracts abundantly demonstrate this type of property. Apparent diffusion coefficients (ADC) and fractional anisotropy (FA) can be sensitive demonstrating traumatic pathology in regions otherwise normal on standard imaging similar to studies used for demyelination.

A decrease in FA suggests less organization of the brain. There is no single "standard" method to acquire or analysis data related to DTI so the results vary widely based on acquisition, and post processing methods. DTI can define the direction of the general neuron course and the apparent total number and length of “fibers”. DTI can evaluate other factors such as axial and radial diffusivity. We have been evaluating the same subjects at 3T and 7T using similar methods to see which is most sensitive. 7T is very sensitive for hemorrhage. At 7T DTI is promising, but will need ongoing technique improvement.

Vascular Trauma

U. Limaye
Department of Neuroradiology, KEM Hospital; Mumbai, India

Traumatic Intradural Arterial Aneurysm(s): Etiologies, Clinical Manifestation and Treatment Strategies: Experiences in Thailand (and Some SE Asian Countries)

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Introduction: In Thailand, as well as in many SE Asia countries, traumatic aneurysms are frequently related with high velocity vehicle accident, especially motorcycle accident. We have millions of motor cycles spreading all over the country. Traumatic intracranial aneurysms are considered rare conditions, reported about 0.15-0.4% of all intracranial
aneurysms, and about 8% of post traumatic subarachnoid hemorrhage (SAH) have traumatic aneurysms. This condition carries predictable high mortality and morbidity, ranging between 27-50% and even higher in ruptured traumatic aneurysms. Awareness and proper selected investigation and treatment strategy can prevent and reduce incidence of such high morbidity and mortality.

Material and Method: We retrospectively review all patients with traumatic intra and extracranial vascular lesions in Ramathibodi hospital between June 1995 to May 2005, and describe in term of incidence, pathophysiology, natural history, treatment strategy and results.

Results: Among 420 cases of traumatic intra-extracranial vascular lesions (during 1995-2009), we find 385 carotid cavernous fistulae (TCCF), 20 external carotid (ECA) fistulae, 48 traumatic aneurysms of internal carotid arteries (ICA)(20/48 isolated aneurysms), 19 isolated arterial dissection with 10 associated aneurysms, 12 ECA aneurysms, 5 vertebrovertebral fistulae (VVF), 3 vertebral aneurysms, 3 anterior cerebral artery (ACA) aneurysms and 2 middle cerebral artery (MCA) aneurysm. (Table 1) In our series 45/85 of all traumatic aneurysms are related with traumatic AVF.

10.15-12.00
Cases Discussion
A. Osborn with M. Thurnher

12.00-13.00
Closing Ceremony

Welcome to Istanbul 2014
Kamil Karaali

Farewell
M. Leonardi
Posters
Advanced Imaging Modalities

P 001

Semi-Automatic Dynamic Causal Modeling: A Further Step towards Clinical Translation of Neuroscience

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Objective: Dynamic Causal Modeling (DCM) represents a powerful technique to analyze the effective and functional brain connectivity. In contrast to the Granger causality it is a sophisticated model based approach and enables to compare different experimental designs according to Bayes factors. However DCM strongly depends on the experience of the neurologist and the design of the experiment (paradigm). In this sense, the initial user defined configuration of the associated system matrices (A-D) plays the crucial role with respect to the convergence of the DCM. In this study it is examined, to which degree the initialization of the context dependent modulations (B) with Granger causality functional connectivity values has any impact on the convergence and the outcome of DCM compared to an estimated initial guess of B.

Methods: The simulations were performed using the example data available from http://www.fil.ion.ucl.ac.uk/spm/data/attention/: Attentional modulations (B) with Granger causality matrix for specific regions prior to DCM parameter estimation and establishes a further step towards clinical translation of neuroscience.

Results: The best results were achieved using the Granger pre-configuration of B. Consistent evidence is in favour of model 2 - Bayes factor > 6.21.

Conclusion: The presented technical optimizations are essential with respect to more robust convergence behavior of DCM simulations. Whereas the structural information in A is mainly dominated by anatomical knowledge of the user and by measured data (e.g. diffusion tensor), the context dependent modulations (B) are more difficult to estimate. The new approach helps to simplify the handling of DCM by initializing B with the Granger causality matrix for specific regions prior to DCM parameter estimation and establishes a further step towards clinical translation of neuroscience.

References:

P 002

Evaluation of Cerebral Disconnections in Prolonged Consciousness Disorders by Steady State Functional MRI: Preliminary Results

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4 Service de Réanimation Chirurgicale, Hôpital de Hautepierre - CHU de Strasbourg; Université de Strasbourg, France;
5 Service de Médecine Nucléaire, Hôpital de Hautepierre - CHU de Strasbourg; LINC; Université de Strasbourg, France;
6 Service de Réanimation Chirurgicale, Hôpital de Hautepierre - CHU de Strasbourg; Université de Strasbourg, France;
7 Grenoble Image Parole Signal Automatique, Centre National de la Recherche Scientifique; Grenoble, France

Introduction: Recent studies have demonstrated the importance of intracerebral connections during sleep and wakefulness. Alterations of these connections have been demonstrated in schizophrenia and Alzheimer disease. The aim of this work is to evaluate these connections in severely brain injured patients in order to better understand the pathophysiology of prolonged consciousness disorders.

Material and Methods: 8 severely brain injured patients presenting prolonged consciousness disorders (5 global brain ischemia, 1 head trauma, 2 stroke) and 20 healthy volunteers underwent steady state functional MRI acquisition (TR=3s, TE=50ms, 20 min. acquisition). We constructed a whole brain connectivity graph for each patient to evaluate the remaining hubs by comparison with a control group. The graph construction was performed following the method described elsewhere (Achard et al. 2006). The topological properties of the graph was computed using the nodal efficiency relying on long-distance connections and hub regions. The comparison between groups is summarized using boxplot representations and tested for statistical significance at 0.05.

Results: The connectivity graphs of the patients’ brain are highly subject dependent. They indicate qualitatively different large decorrelation patterns as compared with a typical control subject. For each patient, the functional connectivity graphs underline a global overview of all the remaining connections. Interestingly, in particular the fronto-parietal connections, part of the ‘default mode network’ (DMN), are absent in the two patients who later died and present in the patient who fully recovered. After quantification of long-distance connections the hubs are characterized by high nodal efficiency and small variance. We can observe that the patients have multiple hubs disconnections in primary areas and in high-order associative areas, among them the precuneus.

Discussion: This approach allows to evaluate the overall remaining functional connections by constructing the global connectivity graphs, contrasting with the DMN approach used by others which considers only restricted areas in the brain (Cauda et al., 2009, Vanhaudenhuyse et al.). We find global disconnections between...
primary and associative areas, a result suggested by Giacino and collaborators (Giacino et al. 2006). Remaining methodological issues must be addressed such as a contribution from physiological noises. Furthermore, this method relies on BOLD acquisition, dependent on a neuro-vascular coupling which is impaired in these patients. This new approach might provide a very strong potential for diagnosis and prognosis for consciousness disorders patients since it is applicable to a single individual.

Conclusion: Steady state functional MRI is easy to perform in severely brain injured patients as soon as the patients are able to ventilate spontaneously and are free of any drugs. This technique could bring additional informations on cerebral connections involved in wakefulness, whose absence could possibly have a prognosis value.

P 003

Interscanner Variability of Normal Fractional Anisotropy Values

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Purpose: Evaluate if the values of fractional anisotropy (FA) measured on DTI acquisitions is independent of the mri-scanner.

Patients and Methods: 85 healthy subjects were explored on 8 different scanners using several DTI acquisitions (12 directions, 3mm isotropic voxel in 5 centers, 5mm isotropic voxel in 2 centers and 2mm isotropic voxel in 1 center). FA values were calculated using a region-of-interest approach (VBM: Voxel Based Morphometry) and a Tract-Based Spatial Statistics (TBSS) approach.

Results: We observed significant differences (p<0.001) between the different mri-scanners. Results were similar with the 2 approaches. These differences were harmonious in all the studied regions. FA values were inversely correlated to slice thickness (p<0.001 in most of the tracts), confirming the importance of partial volume effects. With equal parameters, we observed differences between the MR units, including among identical scanners provided by the same manufacturer. Regions of highest variability were the cerebellar peduncles and the corpus callosum, whereas the internal and external capsules and the corona radiata were more stable.

Conclusion: We observed significant interscanner variations in FA measures. These variations were only partially explained by partial volume effects and were observed using identical sequences in identical scanners. Therefore, we strongly recommend the inclusion of control subjects in multicentric studies to normalize the data.

P 004

Oculomotor Nerve Palsy. High Resolution MR Imaging

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DCA Imaging Research Centre; New Delhi, India

Introduction: The oculomotor nerve (the third nerve [CNIII]) palsy is caused by numerous etiologies that involve the brainstem, subarachnoid space, cavernous sinus or superior orbital fissure. MRI is the most suitable neuro-imaging technique in patients with this presentation to rule out mass, aneurysm or ischemic vasculopathy. We wish to present here a pictorial review of various pathologies of affecting the oculomotor nerve highlighting the importance of MR imaging in its early diagnosis as well as differentiation of various pathologies.

Learning objective: To study normal course to the oculomotor nerve with high resolution MR imaging. To present various pathologies including inflammatory, vascular & neoplastic causes oculomotor nerve palsy.

Methods: Imaging was performed on 1.5 Tesla using PD/T2W, T1W & diffusion weighted sequence for the brain, T2W fat suppressed & T1W coronal sequences (3mm thickness) and constructive interface steady state (CISS) sequence for orbits & cranial nerves. Contrast study was whenever clinically indicated.

Results: The vascular pathologies include nerve compression by a vessel or aneurysm. There was involvement of the oculomotor nerve nucleus in one of the patients with inflammatory granuloma. Bilateral nerves were involved in one of the patients with meningitis. Involvement of cavernous segment of the nerve was seen in both inflammatory & neoplastic lesions. Compression of the nerve in oculomotor cistern by a pituitary tumor was seen in one of the patient. Neoplastic case includes metastasis from carcinoma breast to this nerve.

Conclusion: MRI is the most suitable neuro-imaging technique in patients with CN III palsy in differentiating various pathologies to guide timely intervention for a favorable prognosis.

P 005

Serial DT MRI Study of Corpus Callosum and Corticospinal Tracts in Patients with Severe Diffuse Axonal Injury

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The Burdenko Neurosurgery Institute; Moscow, Russia

Background: Diffuse axonal injury (DAI) results in neurodegenerative changes that may progress for weeks and months and even years after traumatic brain injury (TBI). Only single publications are devoted to dynamics of structural changes of the corpus callosum (CC) and corticospinal tracts (CST) at different time after TBI. This work is aimed at studying dynamic structural changes of CC and CST in severe DAI by using Diffusion-Tensor (DT) MRI.

Material and Methods: Twenty two patients aged 9 - 54 years with severe DAI (GCS<= 8) were selected for this study and examined by 1.5T MRI. DT-MRI was primarily performed at 3-17 days after trauma and repeated in 12 of 22 patients at 3 - 33 weeks after injury. Relationship between MRI findings, neurological status of patients and GOS (Glasgow Outcome Scale) were studied at 3 months after injury and later on.

Results: FA values in CC and CST as well as ADC (apparent diffusion coefficient) in splenium of CC evidently correlated with outcome of patients examined within 10-17 days after trauma. We revealed a significant bilateral FA decrease along CST in 4 patients with tetraparesis and on the contralateral side in 11 patients with hemiparesis. Repeated MR-tractography revealed almost complete disappearance of ascending CC fibers at 3-20 weeks after injury in 4 patients with unfavourable outcome (severe disability or vegetative state). Simultaneously we observed an aggravating
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P 006

Branching Pattern of Lenticulostriate Arteries Observed by MR Angiography on 3.0T

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Background and Purpose: Lenticulostriate arteries (LSAs) are perforating arteries arising mainly from horizontal segment of middle cerebral artery (MCA). These arteries supply the basal ganglia and the internal capsule and closely related to the lacunar infarction. Although anatomical variation of LSA branching patterns and its significance have not been elucidated sufficiently, it is considered that the size and shape of infarction is dependent on the occlusion point of LSA. In this study, we focused on the anatomical variation of LSAs and hypothesized that distribution of LSAs including their branching pattern have relation to the distribution and extent of the infarction of this area.

Methods: We utilized 3.0T MRI scanner and evaluated the LSAs and their branching patterns to show the relation between the area of infarction and LSA branching pattern.

Results: In 200 hemispheres, 330 LSAs were visualized. In 3.5% of all hemispheres, no LSA was depicted, while 1 LSA was depicted in 38%, 2 LSAs in 46.5%, and 3 LSAs in 11%. There was no subject in which more than 3 LSAs were visualized within a hemisphere. Subjects in whom the maximum number of depicted LSA branches was 5 accounted for 2% of all subjects; Respectively, for 7%, 3 for 26%, and 2 for 49%. Large LSA trunk that diverges into 3 or more branches was found in 35%.

Discussion: Anatomy or visualization of LSAs have been reported by using various modalities such as cerebral angiography, vascular cast, CT angiography, MRI on 1.5T, and recently MRA on 7.0T. In this study, MRA on 3.0T could demonstrate 330 LSA trunks more clearly in 96.5% of all hemispheres. It was reported that 66 LSAs in 42 hemispheres (mean 1.57) were visualized by MRA on 1.5T. This result is similar to ours just only concerning the number of depicted LSAs. However, the ability of visualization of LSAs is different between MRA on 1.5T and on 3.0T. It is reported that MRA on 7.0T demonstrated LSA trunks 5 accounted for 7.1. Territories of LSA were closely related to lacunar or striatocapsular infarction. Topological variety of lacunar infarction is hypothesized to be associated with territory of the LSA branches. However, most of these literatures did not pay much attention to the LSA branching pattern and its clinical significance. We evaluated 100 subjects of sufficient numbers to figure out the variability of LSA branching pattern and their proportion, and defined large LSA trunk as a LSA trunk with three or more branches. MRA on 3.0T demonstrated large LSA trunk which branches off three or more than three arteries in 35% of 100 healthy subjects. Occlusion of the large LSA trunk will cause larger infarction such as striatocapsular infarction or branch artery infarction. There are several limitations in this study. First, MRA on 3.0T cannot demonstrate all LSAs. LSAs arising from horizontal segment of MCA were reported to be between two and twelve (mean 7.1) by the vascular cast study. The numbered LSAs depicted in this study (mean 1.65) is fewer because small LSAs are difficult to be demonstrated. Therefore, it is not always abnormal even if no LSA is depicted by MRA on 3.0T.

Conclusion: 3.0T MRA could visualize LSAs in 96.5%. Branching pattern of LSAs was variable and large LSA trunk that diverges into 3 or more branches were not rare. Variation of LSA distribution will be one of the factors accounting for diversity in the distribution of perforating artery infarction.

P 007

Relation between Chronic Subcortical Encephalopathy and Onset of Haemorrhagic Complications in Patients Submitted to Intravenous Thrombolysis

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Hemorrhagic transformation is a complication of acute ischemic stroke treated with i.v. rtPA. The chronic subcortical encephalopathy seems to be an element to be related with this phenomenon. We observed the CT correlation between the chronic subcortical encephalopathy and onset of haemorrhagic complications in patients submitted to intravenous thrombolysis for acute stroke.
Patients with acute ischemic stroke (AIS). Intra-arterial thrombolysis (IAT) and mechanical desobstruction (MD) in patients with IVT contraindication. Randomised controlled trial showed complete flow restitution in all patients. Immediate angiographic control after the intra-arterial procedure respect-fully and efficiently the primary and secondary outcomes in the treated patients. Percutaneous revascularisation was performed up to 5 attempts of thrombolysis (Penumbra Inc.) and/or clot retrieval using a Solitaire® stent (ev3 Inc.). IAT (Penumbra Inc.) and/or clot retrieval using a Solitaire® stent (ev3 Inc.). IAT consisted in fractioned rt-PA adminis-tration at clot level at different stages of the intra-arterial procedure respect-ing a maximum amount of 0.3 mg/kg.

Results: Recanalisation was obtained in all patients. Immediate angiographic control showed complete flow restitution (TIMI 3) in 11 patients, whereas 5 patients had partial flow restitution (TIMI 2). Twelve patients had good clinical outcome (modified Rankin score 0-2 or less) with preserved autonomy at hospital discharge. No procedure relat-ed complications occurred. One pa-tient died after stroke recurrence sev-eral days after the procedure. None had symptomatic cerebral haemorrhage. In 15 of 16 patients penumbra was rescued.

Conclusion: Combined IAT and MD appears to be a safe and efficient treatment in acute ischemic stroke in patients with IVT contraindication. Randomised clinical studies are necessary to define its place in acute stroke treatment.

Combined Intra-Arterial Thrombolysis and Mechanical Desobstruction in Acute Ischemic Stroke

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Purpose: Prospective evaluation of feasibility and efficiency of combined intra-arterial thrombolysis (IAT) and mechanical desobstruction (MD) in pa-tients with acute ischemic stroke (AIS).

Patients, Materials and Methods: From September to December 2009, out of 38 consecutive patients admitted for fibrinolytic therapy to Strasbourg University Hospital, 16 (10 male, 6 female, mean age 61.3 years) were treated by a combined technique. Patients had arterial occlusion of basilar artery (n=4), internal carotid artery (n=8 cases) or middle cerebral artery (4 cases). Af-ter multidisciplinary discussion this treatment was decided according to IVT contraindications (n=14 cases) or clinical worsening during IVT (2 cases). For MD vascular access was obtained via common femoral artery using a 8F sheath and guiding catheter. Then we performed up to 5 attempts of throm-bospiration with a Neuro® stent catheter (Penumbra Inc.) and/or clot retrieval using a Solitaire® stent (ev3 Inc.). IAT consisted in fractioned rt-PA adminis-tration at clot level at different stages of the intra-arterial procedure respect-ing a maximum amount of 0.3 mg/kg.

Results: Recanalisation was obtained in all patients. Immediate angiographic control showed complete flow restitution (TIMI 3) in 11 patients, whereas 5 patients had partial flow restitution (TIMI 2). Twelve patients had good clinical outcome (modified Rankin score 0-2 or less) with preserved autonomy at hospital discharge. No procedure relat-ed complications occurred. One pa-tient died after stroke recurrence sev-eral days after the procedure. None had symptomatic cerebral haemorrhage. In 15 of 16 patients penumbra was rescued.

Conclusion: Combined IAT and MD appears to be a safe and efficient treatment in acute ischemic stroke in patients with IVT contraindication. Randomised clinical studies are necessary to define its place in acute stroke treatment.

Clinical Applications of Whole Brain CT Perfusion & CT Angiography with 320 Detector CT Scanner

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Background: Previously, conven-tional CT perfusion was limited to 20 mm z axis coverage at the level of the basal ganglia. With the advent of 64 detector CT scanners, coverage of 40 mm wide detector row and table toggling, Monash Medical Centre acquired the first 320 detector Toshiba Aquilion One CT scanner in Australia. This enables 160 mm of z axis coverage (whole brain) using 0.5 mm detectors in a single rotation with volume acqui-sition. This type of scanning has the advantage of simultaneously acquir-ing dynamicCTangiography and perfusion images in one bolus contrast injection. In this mode, 12 dynamic vol-ume acquisitions were obtained in less than 60 seconds.

Method: Scanning range covered from below the C1 vertebrae to the skull vertex. A biphasic contrast in-je-ction using a Stellant dual chamber contrast injector consisted of 60mls of Ultravist 370 followed by a 50ml saline flush. A ‘mask’ Volume scan was performed with delayed flow to the ipsilateral hemi-sphere. This enables 160 mm of z axis coverage (whole brain) using 0.5 mm detectors in a single rotation with volume acqui-sition. This type of scanning has the advantage of simultaneously acquir-ing dynamic angiography and perfusion images in one bolus contrast injection. In this mode, 12 dynamic vol-ume acquisitions were obtained in less than 60 seconds.

80 mm was possible with a combina-tion of perfusion and angiography.

Conclusion: Whole brain perfusion and dynamic CTA provide excellent anatomical data on the arte-rial and venous phase of the cerebral circulation and perfusion maps for the whole brain.
fusion-weighted magnetic resonance imaging (DWI) after stenting of symptomatic and severe (over 70%) internal cerebral carotid artery stenosis without distal protection system / device.

**Materials and Methods.** We prospectively collected all patients who underwent carotid artery stenting from January 2007 to December 2009. The technical technique consists of stent placement before angioplasty balloon dilatation. All patients were examined by DWI magnetic resonance 2-4 hours pre-procedure and within 24 hour after the procedure. We excluded patients with MRA contraindication or MRI performed out of the timeframe established (24 hour) and patients who did not sign the informed consent form.

**Results:** Seventy-one procedures were carried out. In one case, it was not possible to pass through the stenosis. Of the remaining seventy cases, 45 underwent MRI (61.42%). Mean age was 71.62 years (range 49-80) and 8 were women. In 9 cases (20.93%), it was not possible to place the stent initially so we had to perform angioplasty prior to stenting. The stent used were as follows: Carotid Wall Stent (Boston Scientific) in 37 cases, Precise (Cordis) in 2 and Multilink (Guidant) in one. Twelve patients were females and underwent all of them with severe stenosis (over 90%). Three patients (50%) were treated with standard technique and in three (50%) dilatation was performed prior to stenting. The majority of new lesions (five patients) were located in the vascular territory of the treated carotid artery but one patient showed lesions in contralateral carotid territory.

**Discussion:** In our experience, carotid artery stenting without distal protection system shows a very low incidence of peri-procedural complications and new brain lesions seen on post-procedure DWI. It is very likely that stent placement prior to angioplasty may reduce the number of cerebral embolisms.

P 011

**Eco-Color-Doppler, CT Angiography, High Resolution MRI and PET/CT Findings of Idiopathic Inflammatory Pseudotumor of the Carotid Bifurcation**

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Inflammatory pseudotumor is an uncommon proliferative lesion of unknown etiology that occurs most commonly in the lung, abdomen, retroperitoneum, pelvis, heart, head and neck, upper respiratory tract, trunk, bladder and extremities. Proximity of the tumor to vital structures or involvement of vital organs compromises the opportunity for complete resection, thus higher recurrence rates are often reported even after surgical treatment. The authors report a case of inflammatory pseudotumor originating from the common carotid artery in a 59-year-old male patient with a growing neck mass and carotidynia. Under ultrasonography, the mass was characterized by a homogenized low echoic shadow surrounding the right common carotid artery. CT showed a mass encasing and narrowing the common carotid artery and MRI showed a mass with hypointense signal in T2 and hyperintense signal in T1, with enhancement after contrast media administration; a CT/PET also showed a highly concentrated mass. Fifteen days after the steroid treatment no significant radiological and clinical improvement was observed. The patient treated by embolization of inflammatory pseudotumor and a long segment of common carotid artery followed by PTFE graft interposition. Histological examination revealed markedly fibrotic tissues surrounding the carotid artery with extrinsic lymphocytes and plasma cells infiltrating and a diagnosis of sclerosing inflammatory pseudotumor was made.

P 012

**Meta-Analysis on the Mortality Rate Following Stent-Assisted Coil Embolization of Intracranial Aneurysms**

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**Keywords:** cerebral aneurysm, embolization, stent, coil, endovascular therapy

**Objective:** To investigate the safety and efficacy of stent-assisted coil embolization of intracranial aneurysms.

**Study Design and Methods:** The authors used MEDLINE, bibliographies, review articles, and experts’ opinions to retrieve articles published from January 1990 to May 2010. We reviewed each article independently to extract the relevant data on the mortality rate.

**Results:** Twenty-two articles with 1058 patients who underwent stent-assisted coil embolization met the inclusion criteria. The mortality ranged between 0% and 19.7% in different reports, and the pooled mortality after stent-assisted coil embolization was 5.3% (95% confidence interval [CI], 3.4%-8.0%).

**Conclusions:** The mortality rate of stent-assisted coiling of intracranial aneurysms is low.

P 013

**Surgical and Endovascular Treatment of Basilar Artery Trunk Saccular Aneurysms**

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**Purpose:** The purpose of this retrospective study was to report the morphological characteristics and results of surgical and endovascular treatment of basilar artery (BA) trunk saccular aneurysms.

**Materials:** Twenty-two patients with 22 BA trunk saccular aneurysms underwent surgery including endovascular intervention.

**Results:** In this series, BA trunk aneurysms showed characteristic features such as so-called lateral aneurysm (41%), multiple aneurysms (32%), including two de novo aneurysms, and various vascular anomalies. Eleven craniotomies for neck clipping were performed for 11 ruptured aneurysms. However, in one of these cases, we abandoned neck clipping because of concern for neck tearing and embolized it later. Five ruptured and five unruptured aneurysms were successfully treated by endovascular surgery. Another one incompletely embolized aneurysm had grown to huge size, and the patient underwent a Hunterian ligation with a flow reconstruction.

**Conclusion:** The unusually high incidence of various associated vascular anomalies suggests that focal wall weakness must be based on the mechanism of aneurysm initiation. Most patients presented with subarachnoid hemorrhage. The pretreatment neurological state was predictive for clinical outcome. And clinical outcomes in this series were not affected by the choice of treatment. However, considering that three of 11 surgical cases needed subsequent treatment, endovascular surgery should be considered as a first choice.
Analysis of Atherosclerotic Basilar Artery in Patients with Isolated Pontine Infarction Using MR Voxel Based Histogram

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Introduction: Carotid artery stenting has become a common procedure to treat symptomatic carotid stenosis in patients deemed to be at high risk for surgery. However, the relative effects of stent self-expansion on plaque and parent vessel dimensions have not been well quantified, and are germane to performing analyses of stent expansion in vitro. We evaluated these parameters using pre- and post-procedural ultrasonography, and hypothesized that the radial force of the stent would impact the plaque to a greater degree than the native artery.

Methods: A prospectively maintained database of 136 patients who underwent carotid artery stenting between March 2000 and September 2008, 32 were identified who had pre- and post-stent ultrasound available for review. Total vessel diameter, ventral and dorsal plaque thickness and minimal luminal diameter were directly measured by a single experienced ultrasonographer. The degree and location of plaque calcification (mild/moderate/severe) were also qualitatively described.

Results: All patients who underwent carotid artery stenting experienced an increase in minimal luminal diameter (mean increase of 1.5mm), corresponding with a mean decrease in ventral and dorsal plaque thickness of 1.1mm and 1.0mm, respectively. Total vessel di-ameter demonstrated a mean increase of only 0.65mm at the site of maximal narrowing, and actually decreased slightly at the proximal and distal portions of the arterial wall, but demonstrated a highly significant (p<0.001) effect on ventral and dorsal plaque diameter. Minimal luminal diameter also increased post-stenting to a significant (p<0.001) degree.

Conclusions: Carotid artery stents have a much greater effect on the plaque than on the native arterial wall. This information will be useful in future experiments aimed at assessing stent self-expansion in vitro.
Conclusion: IPH is associated with carotid stenosis severity, and to a lesser extent with age, male gender, and recently symptomatic carotid stenosis, factors that are all risk factors for ipsilateral stroke. These potential confounding factors need to be taken into account in prospective studies as- sessing the value of IPH to predict ipsilateral stroke. These potential confounding factors need to be taken into account in prospective studies assessing the value of IPH to predict ipsilateral ischemic events.

Figure 1 A bright signal on all 4 MR sequences corresponded to intraploque hemorrhage.

P 017
Fibromuscular Dysplasia of Middle Cerebral Artery in an Adolescent: Case Report
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A pictorial presentation of a case of fibromuscular dysplasia (FMD) of the middle cerebral artery in a 16 years old male with classic presumptive digital subtractive angiographical (DSA) findings is presented. The focal neurological findings and characteristic changing pattern seen on sequential brain scans clearly associate the presence of this lesion to cerebral infarction. Various proposed aetiologies and the characteristic pathological and radiological appearance of FMD are discussed. Emphasis is placed on imaging presentations including DSA.

P 018
Brainstem Compression and Hemorrhage in Direct Carotid-Cavernous Fistula
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Direct carotid-carvenous fistula (CCF) often occurs after head injury with skull base fracture and leads to typical ocular sign due to transmission of arterial pressure via the cavernous sinus to the ophthalmic veins. Herein, we report a case of left side direct CCF, without the presence of typical ocular manifestation but brainstem compression from a large venous varix. Engagement of the left cavernous sinus, tortuosity and ectasia of both superficial and deep venous system were also noted. Brainstem hemorrhage occurred during the admission and emergent transcatheter arterial embozilation with Guglielmi detachable coils and n-butylcyanoacrylate of the left interna carotid artery were performed. The patient has presented with stable vital sign, clear consciousness but bilateral limbs weakness in the follow-up period, and the venous ectasia subsequently disappeared on the follow-up image studies. We discuss the etiology and management of the CCF with intracerebral hemorrhage.

P 019
Congenital Vascular Variations Masquerading as Intracranial Aneurysm on 3D Time-of-Flight Cerebral Magnetic Resonance Angiography in Correlation with Catheter 3D Rotational Angiography
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Purpose: 3D time-of-flight (TOF) MR angiography (MRA) is one of the routine pulse sequence used for brain MRI evaluation to detect vascular lesion but with limitation. We discussed some situations of congenital vascular variations that can mimic intracranial aneurysm on 3D TOF MRA with 3D rotational angiography (3DRA) correlation.

Methods: From September 2008 to September 2009, a total of 14 patients with initially suspected intracranial aneurysms on the 3D TOF MRA undertook catheter 3DRA for confirmation and therapeutic planning at our institution. Two patients with fenestra-tions of anterior communicating artery (AcomA) and 2 patients with prominent posterior communicating artery (PcomA) infundibula masquerading as AcomA and PcomA aneurysms on their 3D TOF MRA. We compared both study modalities and discussed possible cause for the misinterpretation.

Results: A total of 19 aneurysms (AcomA:4, PcomA:6, ICA:3, MCA:4 and basilar artery:2) were suspected in the 14 patients on their 3D TOF MRA studies, 15 aneurysms were confirmed by the further catheter 3DRA. Two AcomA aneurysms and 2 PcomA aneurysms suspected on 3D TOF MRA turned to be fenestrations of AcomA and prominent infundibula of PcomA.

Conclusions: Both fenestration of AcomA and prominent infundibulum of PcomA are unusual congenital vascular variations which can mimic intracranial aneurysm on 3D TOF MRA, catheter 3DRA can improved visualization of these congenital vascular variations and make the accurate diagnosis.

P 020
Ischemic Stroke Imaging with DWI and ADC Maps beyond Hyperacute Stage
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Learning objectives: To investigate DWI, ADC and Expo-ADC value at the various stages of ischemic stroke.

Background: Parameters such as hemorrhagic transformation of brain infarction, determination of the stage or correspondence in treatment of a
stroke, in addition with the need of differential diagnosis with many other brain abnormalities makes MRI protocols with DWI and ADC values calculation necessary for a better and more integrated approach of an MRI study of the brain. 26 patients, with symptoms of ischemic stroke of various time of appearance, were examined and retrospectively analyzed with the conventional MRI and additional DWI images. ADC maps were created and ADC values were calculated in the specific areas.

Imaging findings: DWI (b-value: 1000s/mm²) showed increased signal intensity in all acute and subacute stages of ischemic stroke, except from chronic stage of gliosis, that showed hypointensity. ADC values were calculated in the specific areas showing low values relatively to normal appearing contralateral white matter at acute and early subacute stage, iso- to hyperintense at late subacute stage, and increased ADC value at neuronal loss of chronic stages. Exponential ADC values appeared to be hyperintense at the first stages and isointense to hypointense at late subacute stage, and increased ADC value at neuronal loss of chronic stages.

Conclusion: In spite its well-established usefulness at hyperacute ischemic strokes in the first 6 hours, DWI, ADC and Exponential ADC map might be helpful in the determination of other stages of ischemic strokes.

P 021
Stent-In-Stent for Acute In-Stent Thrombosis after Carotid Artery Stenting. Case Report
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In-stent thrombosis with or without plaque protrusion is relatively rare but important complication after carotid artery stenting (CAS). A 72-year old man presented repeated transient ischemic attack. DSA showed severe stenosis of left internal carotid artery at its origin. Cerebral MRI revealed a carotid soft plaque. Balloon protected CAS was planned. A self-expandable open-cell-type stent (Presice) was successfully deployed in the first Presice stent under distal balloon protection. A satisfied angiographic result was achieved. After the second procedure, he showed good recovery of the neurological symptoms and no more TIAs. This case demonstrated usefulness of stent-in-stent technique for the medically reflected in-stent thrombosis with or without plaque protrusion. A closed-cell-type stent is theoretically more effective for this situation.

P 022
Turn-Back Embolization Technique for Effective Transvenous Embolization of the Dural Arteriovenous Fistulas
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Purpose: Transvenous embolization (TVE) has become a standard technique for the treatment of dural arteriovenous fistulas (DAVF). For effective TVE, it is important to place coils at the shunting venous pouch in initial stage of procedure. However, it is often difficult to navigate a microcatheter to the shunting venous pouch due to difficult anatomical relationship of approach routes with targeted pouches. We demonstrate a simple technique of the turn-back embolization technique developed for successful TVE for such cases. Materials and Methodic: Three transverse-sigmoid sinus (TSS) DAVFs and 3 cavernous sinus (CS) DAVFs were treated by TVE using the turn-back embolization technique. The TSSDAVF showed ipsilateral sigmoid sinus occlusion, and the AVFs involved the proximal parts of the transverse sinuses in two, and involved transverse sinus and torcular in one. The CS-DAVFs showed the shunting pouches localized at the postero medial portion of the cavernous sinus in two and postero lateral and posterolateral portion in one. Results: The microcatheters were advanced through the occluded sigmoid sinuses in TSSDAVF cases and inferior petrosal sinus in CSDAVF cases, which could be turned back within the involved sinuses into the target pouches in all cases. Coils were placed at the shunting pouches in initial stage. Complete occlusion or marked regression of AVF with disappearance of cortical reflux was obtained in TSSDAVF. All CSDAVFs disappeared, in which two could be treated by selective embolization alone. No complications were observed. Conclusion: Turn-back embolization technique is a simple and useful technique for effective transvenous embolization of DAVFs.

P 023
Persistent Hypoglossal Artery Arising from the External Carotid Artery
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Introduction: Persistent hypoglossal artery (PHA) is the second most common anastomosis between the internal carotid artery and verteobasilar arteries. External carotid artery (ECA) origin of the PHA is extremely rare. Only 3 cases are reported in the English-language literature.

Case Report: A 75-year-old man with sudden-onset right hemiparesis and dysarthria underwent emergency cerebral magnetic resonance (MR) imaging and cerebral MR angiography that included the cervical internal carotid artery. Diffusion-weighted images showed acute cerebral infarction in the left anterior cerebral artery (ACA) territory, and MR angiography showed occlusion of the A2 segment of the left ACA. The proximal right vertebral artery (VA) was not visible. An anomalous artery arose from the proximal right ECA, ascended just like the ascending pharyngeal artery, entered the hypoglossal canal, and finally connected with the terminal segment of the right VA.

Conclusion: This PHA of ECA origin seemed to be extremely rare collateral circulation via the hypoglossal branch of the ascending pharyngeal artery to the terminal VA in patients with ipsi-
lateral proximal VA aplasia/hypoplasia. We would like to name this variation “PHA type 2”.

P 024

Persistent Primitive Olfactory Artery: MR Angiographic Diagnosis

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Introduction: Rarely, the A1 segment of the anterior cerebral artery (ACA) courses extremely anteroinferiorly, makes a hairpin turn, and connects posterosuperiorly to the A2 segment. Usually, the primitive olfactory artery regresses and remains as the recurrent artery of Heubner during early gestation, but when it persists, this anomalous artery forms. Thus, patients with the persistent primitive olfactory artery have no ipsilateral recurrent artery of Heubner. An aneurysm may occur at the hairpin turn.

Materials and Methods: Over the last 2 years, we diagnosed 9 patients (4 men, 5 women, aged 36 to 81 years) with this variation in our 2 university hospitals using magnetic resonance (MR) angiography with standard 3-dimensional time-of-flight (3D-TOF) technique on five 1.5-tesla scanners. We made partial maximum-intensity-projection (MIP) images to demonstrate the variation clearly.

Results: In 4 patients each, either the right or left side was affected; in one, both sides were affected. None had associated aneurysm at the hairpin turn. Associated arterial variations included a triple ACA and an extracranial fenestration of the vertebral artery.

Conclusion: A persistent primitive olfactory artery is relatively rare. There is no laterality in frequency; bilaterality is extremely rare. Its typical configuration permits easy diagnosis by MR angiography, especially in lateral projection.

Free Topics

P 025

Outcome Prediction in Head Injury Based on Computed Tomography Abnormalities

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Purpose: The aim of this study has been to investigate the possibility of predicting outcome in head injured patients hospitalised in the Intensive Care Unit (ICU) of a tertiary care university public hospital in Alexandroupolis, Greece, using specific Computed Tomography (CT) findings.

Patients and Methods: The medical records of head-injured patients who were admitted consecutively to the mixed ICU of the University Hospital in Alexandroupolis, Greece, from 1994 to 2003 were retrospectively examined. Inclusion criteria (the absence of other injury and a complete medical record including Glasgow Coma Scale (GCS) score, initial CT findings and outcome) were met by 60 patients. Outcome was defined as survival or death at the day of discharge from the ICU. CT findings were analysed with the Principle Component Analysis (PCA) method (selection variable: death as outcome) and rotated with the Varimax system (Kaizer normalization), taking into account the internal consistency reliability (Cronbach’s alpha coefficient). A variable in order to become a part of a summed scale had to present a correlation limit >0.5. In addition, the differences in correlation coefficients of each variable with different components (factor loadings) should be >0.20. The variables found to present an adequate internal consistency were employed in a binary logistic regression model. Furthermore, these variables and outcome were incorporated into a summated scale. The Spearman coefficient (rs) and Kappa measurement of agreement (Kappa) were calculated. The odds ratios (OR) were also computed.

Results: The mean age was 45.85±9.29 years, the male:female ratio was 9:1, the mean GCS score was 6.12±2.589, and the mean Acute Physiology And Chronic Health Evaluation II (APACHE-II) score was 16.4±9.994. The mean length of stay (LOS) was 13.12±2.459, and the traffic accidents/falciassaults ratio was 7:2:1. Twelve head-injured subjects (45%) and thirty-three died (55%). At admission to ICU there was only 1 normal CT scan (1.7%). Abnormal CTs indicated fractures (70%), epidural hematomas (EDH) (18.3%), subdural hematomas (SDH) (43.3%), intracerebral hematomas (20%), subarachnoid hemorrhages (SAH) (50%), intraventricular hemorrhages (IVH) (5%), edema (55%), and pneuma-toma was (25%). The Kappa-Meyer-Olkin measure of sampling adequacy gave a value of 0.745. Four components were found which constructed four summed (multi-item) scales. The first component explained 22.676%, the second 18.399%, the third 13.320%, and the fourth 11.281% of total variance (65.676% in total). The first summed scale included the fractures, ICH and pneumoencephalus. The second one included EDH and contusions, the third one included SDH and SAH, while the fourth one was comprised of IVH and edema. The overlapping Cronbach’s alpha coefficients were 0.489, 0.575, and 0.265. Moreover, the corresponding Hotelling’s T2 values were 63.297 (p=0.000), 2.172 (p=0.146), 0.887 (p=0.350), and 59.000 (p=0.000). Finally, using binary logistic regression (dependent: outcome, covariates: SDH, SAH, method: enter) the following equation for outcome prediction was derived: 1.617 + 0.887*SDH + 0.453*SAH - (0.683*SAH). The correct classification percentage for this equation was 71.75. The chi-square value of Hosmer and Lemeshow goodness-of-fit statistic was 0.008 (df=2, p=0.996). The cross-tabulation of SDH with outcome provided a rs of 0.453 (p=0.000) and a Kappa of 0.441 (p=0.000), while the cross-tabulation of SAH with outcome provided a rs of 0.302 (p=0.019) and a Kappa of 0.300 (p=0.020). The OR for SDH was 7.7 (95% CI: 2.313-25.629) (3.965 for survivors and 0.47 for non survivors). The OR for SAH was 1.35 (95% CI: 1.201-10.196) (2.000 for survivors and 0.571 for non survivors). The limitations in this study resulted from the relatively small sample size (60 patients) and the limited number and experience of those collecting the data (residents). In addition, one of the main shortcomings of the study was the definition of outcome as survival or death. Ideally, all patients would have been assessed with the Glasgow Outcome Scale or (preferably) the Extended Glasgow Outcome Scale. The authors found no such data in the records examined, and the relatively more crude outcome measure of survival or death was used.

Conclusion: The patients whose CT scans indicated the presence of SDH or SAH were more prone to a worse outcome (death) as compared to those with other CT findings. It is of note that those head-injured subjects surviving a SDH had a worse prognosis.
in comparison with other head-injured subjects sustaining a SAH. However, more studies are urgently needed to confirm these findings in a much bigger head-injured population. Outcome prediction should not be based solely on CT abnormalities; the GCS score and other clinical information (pupil reaction, age, metabolic profile) are also of utmost importance.

P 026

MRI Findings of Dorsalgia

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The Background: At the patient who was enforced in the MRI of the thoracic vertebra, making a dorsalgia a chief complaint, at all, receptacle qualitative abnormality was not admitted but much case that the thoracic cord shifts to the abdominal side in the width of the cavity under the back side arachnoids occurred. The case which is causing high-velocity signal loss (CSF flow artifact) among them in the cavity under the backside arachnoids was conspicuous.

Purpose: It reviews the thoracic vertebra MRI finding of the patient the chief complaint of whom is a dorsalgia (or the lower back pain)

Object: March, 2003-October, 2008 134 cases (man 61, woman 73), 11-89 years old (an average of 58 years old). The breakdown of the case: first dorsalgia: 103 (76.9%). (1) Container qualitative alteration group: 58 (45.3%); tumors 11, dorsal symptom-related myelopathy 11, disk hernia 6, compression fracture 15, postoperative 5, OPLL / OYL 10. (2) There is no container qualitative alteration: 45 (33.6%). Second, other symptoms: 51 (29.1%), weight loss of 31 (23.1%) lower limbs, numbness 18, lumbago 11, neck pain 2 (an examination item) The MRI image: thoracic vertebra sagittal. T2wi in the largest diameter part of the spinal canal, it measures bias percentage to the abdominal side of the thoracic cord from the center. It reviews about the ratio with the cavity diameter of the spinal cord to the radius of the maximum antero-posterior diameter of the spinal canal under the back side arachnoid, the ratio with cavity diameter under the abdominal side arachnoid.

Result: Container qualitative alteration (-): 45 (33.6%) eccentricities, dorsal space: space abdominal more than 0.55. Container qualitative alteration (+) equal to or less than 0.43. other symptoms: we are less than 0.43 more than 89 cases (66.4%) 0.55. It is chief complaint for 44 (32.8%) dorsalgia: 89 less than 0.43 assume dorsalgia chief complaint more than 0.55 of 37 (27.6%) whole (45+44). Container qualitative alteration (-): 45 (50.6%). Container qualitative alteration (+): 37 cases (41.6%) 82/89 (92.1%)

Discussion: What is the dorsalgia? Compression syndrome of the spinal cord contained the root sign + chorda symptom + sympathetic nerve disorder + atrophy, initial root sign: girald pain is neuralgia like pain at a pain. A pleuritis-like pain (a rheumatism-like pain) or neuralgia-like pain: we are distributed over several nerve trunks without having false neuralgia, a pressure point. Thoracic cord pressure or root sign: pressure from the rear where there is not the motor paralysis symptom by the intercostal neuralgia type (side chest pain, girdle pain), root disorder: especially strong spontaneous pain to begin with the symptom of the dorsal root. Influence with the expansion of the dorsal subarachnoid space. First, anterior displacement of the spinal cord => anterior root, the front imposition of the dorsal root => it is influenced an appearing meningeal branch by a dorsal root => dorsalgia. Around the spinal cord => an attraction of apical ligament of odontoid process / the intermediate cervical septum => arachnoid, an endocranial attraction => dorsalgia. The other hand, an anterior root is neuralgiform at a pain. A circular failure of the previous median vein.

Conclusion: A difference was seen to the cavity diameter under the back side arachnoid at 62 and 74 which were enforced in the MRI inspection by the thoracic vertebra in the other symptom the chief complaint of which was a dorsalgia and a chest pain. At the patient of the dorsalgia, the ratio with cavity diameter under the abdominal side arachnoid was equal to or less than 0.5 to the ratio with cavity diameter under the back side arachnoid. It made a dorsalgia a chief complaint but the example which could not admit a receptacle qualitative-alteration from 0.55 to 0.43 was 37 example (27.6%). They were equal to or more than 0.55 back side space: equal to or less than 0.43 abdominal side space. There was a receptacle qualitative-alteration and the ex space:. There was a receptacle qualitative-alteration and the example from 0.55 to 0.43 was 37 example (27.6%). Regardless of the existence or non-existence of the receptacle qualitative-alteration, about 92% of the example eccentricity from 0.55 to 0.43 has a dorsalgia. The cavity extension under the back side arachnoid can become the cause of the dorsalgia. The cavity diameter under the back side arachnoid is wide. => A spinal cord is done by the exclusion to the abdominal side, anterior root is towed and the condition that posterior root is bent is supposed. It adds and it reports reviewing having to do with an anatomy.

P 027

An Early MRI Change Following Reversible Hypoxic Brain Injury: A Case Report

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A prognostic prediction of the clinical outcome of the comatose patient following global cerebral hypoxia is difficult in the acute stage. The presence of changes in diffusion-weighted image (DWI) has been put forward as a possible predictor, but there are few reports on these images following reversible hypoxic brain injury. We report here a patient who became comatose following asphyxiation and recovered within 24 hours.

Case: An 84-year-old hypertensive male was admitted to our otolaryngology ward on Dec. 15, 2008 with a diagnosis of a large larynx tumor. Two days later he complained of dyspnea from early morning and an emergency tracheotomy was planned, but on the way to the operating room his respiration ceased, and he rapidly became comatose. Nearly 10 minutes elapsed before ventilation was possible through the tracheotomy, during which time his pulse rate fell to 20/ min and his blood pressure became too small to measure. However, he did not appear to suffer complete cardiac arrest. DWI 3.5 hours after the hypoxic insult showed a high intensity area in the left temporo-occipital cortex (MCA territory) that was thought to be due to cytotoxic edema. He started to recover consciousness 7 hours after resuscitation, and had recovered fully, without any new neurological deficit, 24 hours later. In DWI taken 9 days later, the abnormal lesion had disappeared, but two small high intensity spots mimicking lacune were revealed. His condition remained essentially unchanged in the following month when he underwent radiation therapy for the larynx tumor.
Discussion: It has been reported that in most patients without DWI abnormalities in the acute phase a good recovery can be expected, but in patients with extended lesions in DWI disturbed consciousness almost never recovers. The present patient recovered from coma, even though a change in DWI had been detected. Thus the presence of cytotoxic edema in the acute stage may not necessarily indicate a poor prognosis.

Raising Diagnostic Accuracy in Detection of Brain Metastasis: High Field MRI or High Molar Gadolinium Contrast?

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Purpose: To compare the quality and efficacy of two kind of contrast intra-individually, at 1.5 and 3.0 Tesla (T) in patients with brain metastasis.

Material and Methods: We retrospectively analyzed 18 consecutive patients (11 males, 7 females; mean age 55) who had brain metastasis and received gadobutrol as a localization MRI during 3D model (Figure). We chose to normalize aRPV, aLPV, aRCV, and aLCV to total brain volume in order to exclude the inter-subject variability. Student’s t-test was used to assess the effect of motor learning between the AG and CG. All analyses were two-tailed, and a p-value <0.05 was considered as statistically significant (SPSS version 12.0; SPSS Inc., Chicago, IL, USA). All data are represented as mean ± standard deviation.

Results: The volumetric analyses of aRPV showed no significant difference between AG and CG. The relative volume of left putamen (rLPV) also revealed a significant difference with the basketball players’ are larger than controls, whereas the relative volume of right putamen (rRPV) between AG and CG revealed no significant difference between the two groups. The volumetry of aRCV showed no significant difference between AG and CG. The volumetry of aLCV showed a significant difference between AG and CG. The average aLCV of AG was 3.81 ± 0.46 cm³, whereas that of CG was 3.47 ± 0.52 cm³ (t(37) = 2.20; p = 0.03). Finally, the relative volumes of right caudate nucleus (rCV), and left caudate nucleus (lCV) did not differ between the groups.

Conclusion: The larger volume of left striatum especially left putamen in basketball players might reflect changes in neuronal ensemble activity and synaptic plasticity as in animal models and suggests that the left putamen plays an important role in learning and retention of motor skills. Sports-related motor learning could activate structural plasticity of brain. Therefore, sports activity like basketball training may have a beneficial effect on brain.

Normal Anatomy of the Limbic System. An MRI Memento

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Introduction: The limbic system is complex cerebral structure, composed by several cortical and subcortical constituents, interconnected by an intricate network of white matter bundles. It also has multiple reciprocal connections with other brain areas. Limbic system has an important role in numerous high-order brain functions, related to memory, learning, emotion and behaviour.
Purpose: To outline the normal anatomy of the limbic system in multiplanar MRI and evaluate diagnostic capability of new DTI sequences.

Materials and Methods: 10 adults (5 females and 5 males) aged from 21 to 46 years, were explored in a 1.5T MRI unit. All subjects had no history of neuropsychological or psychiatric impairment, non-enhanced, high-resolution T2 and T1-weighted images were used for multiplanar anatomic study of limbic structures. DTI acquisition was carried out in 3 subjects, and used for further analysis of white matter limbic connections.

Results: Grey cortical limbic structures were easily identified in T1-weighted acquisition. T2-weighted images allowed better visualisation of white matter connections. Fractional anisotropy analysis, and particularly DTI 3D reconstructions, showed lesser performance in the identification of intralimbic connecting bundles. Some structures, such as the induseum griseum, were not directly visualized. However, their anatomic boundaries were easily recognized.

Conclusion: MRI permits an exceptional "in vivo" analysis of the limbic anatomy. Recognition of its principal components is mainly of help in imaging study of neuropsychological and psychiatric disorders, to facilitate identification of possible structural damage and guiding etiologic diagnosis.

P 031

Superficial Siderosis Following Braquial Plexus Avulsion Injury

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Background: Superficial (SS) is a rare entity that consists in hemosiderin deposition in the leptomeninges and subpial layers of the neuroaxis. It is associated with changes in the cerebrospinal fluid (CSF) consistent with recurrent bleeding in the subarachnoid space (SAH). Clinically it is characterized by progressive signs and symptoms such as deafness, ataxia, spastic paraparesis and mental deterioration. Known causes include vascular malformations and tumors, but in 50% of the cases the source of bleeding cannot be detected. We present a clinical case of SS after a traumatic brachial plexus lesion with formation of pseudomeningoceles.

Objective: To present the clinical case of a patient with previous brachial plexus trauma and multiple subacute episodes of intense headache. To describe the clinical findings, the imaging tests, to analyze and to discuss the diagnosis.

Material and Methods: Analysis of the medical records and clinical examination of the patient; description of imaging findings and review of the literature.

Results: The Magnetic Resonance Imaging (MRI) and Mielo-CT ventricles images showed an extensive pattern of superficial siderosis of the brain and spinal cord and associated pseudomeningoceles in C7 and C8 roots.

Discussion and Conclusion: Superficial siderosis of the CNS is a rare and progressive disorder caused by chronic and recurrent hemorrhage in the CSF spaces. There is consequent deposition of hemosiderin in the leptomeninges of the brain and spinal cord. The first case was described in 1940 by Noetzel. In the past this diagnosis was only possible by autopsy, but now new MRI tools allow us to see meningeal and sub-pial ferromagnetic pigment "in vivo", and also help to clarify the cause of recurrent bleeding. There are reports of SS after brachial plexus trauma with formation of pseudomeningoceles or dural diverticula. It is believed that the formation of a scar tissue, with vascular fragility, may lead to intermittent bleeding causing the superficial siderosis. MRI is the only imaging method that allows the diagnosis of this entity, being very sensitive and specific. The early diagnosis and intervention are important to prevent the progression of the disease and severe deficits.
Introduction: The persistent hypoglossal artery (PHA) is one of the four embryonic carotid-basilar anastomoses. The PHA originates from the cervical internal carotid artery (ICA) and runs upward and posterior until it passes through the hypoglossal canal. In the standard cerebral time-of-flight (TOF) MR angiography (MRA) sequence, at which the lower limit of the scan range is around the foramen magnum, the branching point of the PHA is usually out of the range. So, there is a possibility that we mistake the PHA for the dominant vertebral artery (VA) in maximum intensity projection (MIP) images of cranial MRA. Therefore we need to evaluate the source images of TOF to indicate the existence of PHA by showing the finding that the artery passes through the hypoglossal canal. However we consider that we can predict the existence of PHA in MRA MIP image by the following findings: PHA or dominant VA to ipsilateral ICA in maximum intensity projection (MIP) images of cranial MRA. The results were compared between two groups and statistically analyzed.

Results: The average distances at the level of transitional zone between pons and medulla, at the upper and lower level of the hypoglossal canal were 21.0mm, 20.1mm, and 21.5mm in dominant VA group and 19.3mm 17.7mm and, 1.5mm in PHA group respectively. There was a significant difference (P<0.001, Mann-Whitney U test) in the distance at the lower level of the hypoglossal canal, although there was no significant difference at the other two levels.

Discussion: The PHA is the second frequent carotid-basilar anastomosis (0.02 to 0.09%) after the trigeminal artery. It arises from the cervical ICA in front of the C1-C3 space. It has a short ascending course with a slight medial and posterior curve before penetrating the hypoglossal canal and ends into the basilar artery. Lie proposed the four anatomical criteria to diagnose the PHA: (a) robust branch of the internal carotid artery that arises from its posterior aspect at the level of C1-C3, (b) an artery that must enter the skull through the hypoglossal canal, (c) a basilar artery that must fill distal to the abnormal vessel, and (d) no posterior communicating artery. Our finding indicates the artery which looks like dominant VA comes too close to ipsilateral ICA in lower region in MIP image of cranial MRA (white arrow in Figure). This sign indicates the Lie’s criteria (b) and (c) and can predict the existence of PHA significantly. There are many past reports associating the importance to find PHA. In the patients with PHA, the ipsilateral vertebral artery (VA) and posterior communicating artery (P-com) are hypoplastic and contralateral VA and P-com are only present in one third of cases. So PHA becomes the exclusive or mainly exclusive feeder of the posterior circulation. Temporarily clamping the PHA or ICA under the branching point of the PHA during carotid endarterectomy presents important ischemic risks in posterior circulation. The PHA generates a bifurcation in the internal carotid artery and it causes hemodynamic stress. The increased wall shear stress and wall shear stress gradients observed in arterial bifurcations are potentially dangerous hemodynamic insults that induce aneurismal formation. It was reported that the frequency of vascular disease such as aneurysm and arteriovenous malformations associated with the PHA was 27%. Therefore, it is important to find the PHA for the preoperative evaluation of carotid surgery and monitoring of normal patients. Of course, we can diagnose the existence of the PHA by detailed evaluation of MRA source images. The advantage of our finding is that we can decide easily whether a case is worth the detailed evaluation or not. The average distance of 1.5mm between ICA and PHA is too short and must be smaller than the diameter of the arteries. If we can not separate ICA from another artery like a dominant VA in any angle of MIP image of TOF MRA, we can suspect the artery of the PHA and evaluate the source images.

Conclusions: The “VA approaching ICA sign”, the finding that the artery which looks like dominant VA approaches to ipsilateral ICA on MIP image of cranial MRA, can predict the existence of PHA significantly. The PHA is important clinically and it is useful to know the existence of PHA in advance before performing vascular surgery and conventional angiography.

Intentional and Unintentional Injuries in Shkodra District, Albania

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Key words: Shkodra, injuries, road traffic accidents, violence

Introduction: Mortality rates from intentional (violence) and unintentional injuries (especially from traffic road accidents) have increased significantly in Albania since the early 1990s, when the transition to the market economy took place. In that period the number of vehicles increased from 20,513 in 1990 to 129,671 in 1993, to 274,652 in 2004. Although Albania is still considered to have the lowest traffic density in the region, mortality rates from road traffic accidents have exceeded the rates in the European Union since 1992. Furthermore, Albania is a country with a very high fatality rate (0.68 deaths per accident) primarily due to poor roads and irresponsible driving. The situation is particularly problematic in big cities of Albania, like Shkodra, which are undergoing a rapid transition. Nevertheless, there are no systematic evidence about the exact magnitude and determinants of injuries in this city.

Aim: To describe the incidence and mortality rate of some types of intentional and unintentional injuries in Shkodra district, during some specific historic and socio-economic conditions.

Methodology: A cross-sectional study was conducted, including all recorded unintentional and intentional injuries in Shkodra district, for the period 1984-2009. All the data are taken by the statistic offices of Regional Hospi-
Head and Neck Imaging and Intervention

P 036

Imaging Study of Oral Cancer

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Purpose: This study is aiming to characterize oral cancers with their specific imaging findings and relevant anatomy.

Materials and Methods: We evaluate surgically-confirmed 112 patients (M:F=67:45; Age: 21-90, mean 58 year-old) with CT and MRI, surgical and histological findings for last 10 years. They include histologically proven cancers in tongue (64), floor of mouth (FOM) (20), palate (10), buccal mucosa (11), retromolar trigone (4) and alveolus (5). Characteristic CT and MRI imaging features of oral cancers are analyzed with their relevant anatomy.

Results: The most common site of oral cancer is the tongue (57.1%), and then the FOM (17.9%) and the buccal mucosa (9.8%). Most oral cancers are squamous cell carcinomas (85.7%) and then adenoid cystic carcinomas (8%), mucoepidermoid carcinomas (5.4%) and carcinoma ex pleomorphic adenoma (1%). Patients have been diagnosed at stage, IVA (33%) and then I (26.8%), III (20.5%), and II (19.6%). Most FOM cancers arise near the anterior midline FOM with a propensity for lateral spread involving the adjacent mandible or lingual neurovascular bundle. Buccal cancers most commonly originate along the lateral margins. The most common spread patterns of gingival and buccal cancers are laterally and submucosally along the buccinator muscle to the pterygomandibular raphe. Most oral tongue cancers arise from the anterolateral undersurface of the tongue, which spread along the styloglossus to the skull base. Cancers of the hard palate, especially adenoid cystic carcinoma, have a propensity for perineural tumoral spread along the greater and lesser palatine nerves into the pterygopalatine fossa. The retromolar trigone is a junction between the oral cavity, oropharynx, and nasopharynx, which allow complex spread of tumors.

Conclusion: Patients have been more often diagnosed at advanced stage, IV, resulting in poor stage-related survival rate. Imaging study of oral cancer with CT and MRI plays a critical role in staging and determination of tumor margin for either resectability or radiation planning.

P 037

Osteoma or Meningioma?

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Osteoma is a localized protruding mass resulting from an exaggeration of bone formation. It is normal bone that is abnormally dense. Osteomas are most commonly found in the skull and facial bones but the temporal bone can be involved also. They are most often asymptomatic. However, there location can effect the clinical presentation because of cosmetic reasons, obstruction or compression.

Case presentation: A 53-year-old woman presented with a one-year history of a protrusion in the left frontal area. She had no history of head trauma, and physical examination revealed no neurological or systemic abnormality. Routine laboratory tests were within normal limits. Skull radiography revealed the presence of an ovoid radiopaque lesion in the left frontal area (Figure 1). Native computed tomography (CT) and CT with bone windows depicted a lentiform osseous lesion in the left frontal skull, obliterating the adjacent CSF space (Figures 2, 3). The diagnosis was osteoma or meningioma. Brain MRI revealed low intensity signal on both T1 and T2 images corresponding to osteoma (Figure 4,5).

Discussion: Osteomas are usually dense, unilateral, solitary, round masses with pedunculated or wide base. Non-enhanced axial and coronal high-resolution CT are most useful in localizing and characterizing these lesions. Reactive bone is shown as areas of absent or low signal intensity on all pulse sequences of MR images. In contrast, meningiomas can be either hypointense or isointense to gray matter on T1-weighted images and isointense or hyperintense on T2-weighted images. Other lesions involving the skull and facial bones that can be considered are osteosarcoma, osteoblastic metastasis, isolated eosinophilic granuloma, Paget's disease, giant cell tumor, osteoid osteoma, calcified meningioma, and monostotic fibrous dysplasia. Imaging findings should allow differentiation of these lesions from osteomas. In conclusion, detailed CT examination can provide precise information about the origin of an osseous lesion in extra-axial space.

P 038

Characteristic Dynamic Enhancement Pattern of MR Imaging for Malignant Thyroid Tumor

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Background and Purpose: The purpose of this study was as follows: to determine the characteristic dynamic enhancement pattern of MR imaging for malignant thyroid tumor.

Materials and Methods: The eight patients were collected, who were pathology confirmed malignant thyroid tumor preoperatively. There are 6 papillary carcinomas, 1 medullary carcinoma, 1 follicular carcinoma. All images were obtained with a 3.0-T MR imaging unit, Magnetom Verio (Siemens Medical Systems, Erlangen, Germany). MRI protocol included the following pulse sequence: axial fast spin-echo T2-weighted MR image, axial T1-weighted image and contrast-agent-enhanced dynamic T1-weighted images. Paramagnetic contrast agent (gadobutrol, Gadovist; Schering, Berlin, Germany) was administered intravenously.

Results: Based on preoperative MR imaging, the adjacent CSF space can be identified easily. The diagnosis was osteoma or meningioma. Brain MRI revealed low intensity signal on both T1 and T2 images corresponding to osteoma (Figure 4,5).
imaging, we compared dynamic MR enhancement pattern relating to pathologic type. All biopsy proven malignant thyroid tumor show hypoechogenicity on previous US imaging, except 1 follicular carcinoma (isoechochogenicity). 1) On T1-weighted image, one papillary carcinoma shows high SI and one medullary carcinoma shows low SI. And other cases were not differentiated with normal parenchyma. 2) On T2-weighted image, 3 papillary carcinoma and one follicular carcinoma show high SI and one papillary carcinoma shows low SI. And other case was not differentiated with normal parenchyma. 3) On contrast agent-enhanced dynamic T1WI, 5 papillary carcinoma and one medullary carcinoma shows delayed enhancement comparing to normal parenchyma. And one follicular carcinoma shows strong enhancement than normal parenchyma, one papillary carcinoma shows delayed enhancement than normal parenchyma. Conclusion: Although this study has limitation of small patients population, the data suggest that delayed enhance- ment on enhanced dynamic T1WI is possible characteristic MR finding of malignant thyroid tumor.

P 039

The Utilization of Covered Stent for the Treatment of Recurrent Vein Graft Aneurysm

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Objective: We report a case of the treatment with covered stent for recur- rent vein graft aneurysm.

Clinical presentation: A 60-year- old man had recurring vertigo attacks because of severe stenosis of bilateral vertebral arteries. In 1992, left subcla- vian-to-vertebral artery bypass opera- tion was performed with an interposed vein graft. In 1996, pulsating mass ap- peared in left supraclavicular region. A giant aneurysm of the vein graft was shown by angiogram and was surgically resected. In 2004, recurrence of the vein graft aneurysm was observed. There was rich collateral flow from muscular branch to distal left verte- bral artery. Embolization of vein graft aneurysm and endovascular trapping of vein graft was performed after nega- tive balloon occlusion test of vein graft. In 2007, vein graft aneurysm recurred again. Covered stent was placed in left subclavian artery to seal orifice of the vein graft. There was no visualization of the aneurysm by angiogram after the procedure. Follow up MRI showed marked size reduction and no recanalization of the aneurysm.

Conclusion: Covered stent is less flexible and its long term patency is still controversial. However, there exist cases which are difficult to treat without covered stent like presented case. Utili- zation of covered stent for neuro inter- vention must be made cautiously under correct understanding of the material.

P 040

Usefulness of Multidetector Computed Tomography (MDCT) Images with Soft Tissue Algorithm Reconstruction and with Bone Algorithm Reconstruction for Head and Facial Trauma

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Objective: The brain computed tomog- raphy (CT) and facial bone CT were performed simultaneously for evalua- tion of head and facial trauma in emer- gency department. The purpose of this study is to evaluate the usefulness of multidetector CT (MDCT) scan images with soft tissue algorithm reconstruction and with bone algorithm reconstruction for head and facial trauma evaluation by compared with conventional brain CT and facial bone CT.

Material and Methods: We retro- spectively reviewed the CT findings of the cases in which intracranial hem- orrhage in soft tissue algorithm recon- struction images and facial bone frac- tures in bone algorithm reconstruction images had been observed by using 64 slice MDCT. All patients underwent follow up conventional brain CT and facial bone CT.

Results: The diagnostic accuracy of reconstruction images in detection of intracranial hemorrhage or facial bone fractures by compared with conven- tional brain CT and facial bone CT was similar. And there were no significant different of image qualities between two groups.

Conclusions: The reconstruction MDCT images with soft tissue and bone algorithm was useful in detection of intracranial lesions or facial bone fractures and decreased radiation does to the head trauma patients.

P 041

Do You Remember the Branches of the External Carotid Artery? A CT Scan Review of the Arterial Anatomy of the Face

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Introduction: External carotid ar- teries vascularize all the structures of the face and anterior cervical spaces (cutaneous, fibro-muscular, visceral, nervous and osseous), with the only exception of the intra-orbital organs and the para-spinal cervical space. The arterial anatomy of the face is com- plex. However, anatomical rapport and topographic environment could help to recognize the contribu- tion of the major branches of the external carotid artery. The recognition of the arterial anatomy of the facial spaces have a particular importance in trauma and tumoral pathology, especially in pre-operative evaluation for surgical and endovascular procedures.

Purpose: To review the arterial anatomy of the face using CT angiog- raphy multiaplanar and 3D reconstruc- tions. In addition, anatomic bounda- ries of water-shed arterial zones, with contralateral arterial circulation and homolateral branches of the internal carotid arteries, were described.

Material and Methods: 10 patients (5 males, 5 females) aged from 19 to 45 years, with no history of facial trauma or surgery, were submitted for cerebral and/or cervical CT angiography. Multi- detector row scan protocol consisted of a single volume acquisition, in caudo- cranial direction, using an automatic bolus tracking placed in the common carotid artery, after intravenous injection of contrast medium (2 cc/kg; >300mg/ml). No CT scan evidence of tumoral, inflammatory or congenital anomaly of the cranio-facial region, nor stenoses of the carotid arteries were observed. Arterial anatomy of the face was studied on native images, multi- planar (MIP, miniMIP, average) and 3D reconstructions.

Results: Superior thyroid, facial, lingual, occipital, superficial temporal, posterior auricular and internal maxil- lar arteries were identified, from their origin to their second order branches. Middle meningeal artery, branch of the internal maxillary artery, was also eas- ily visualized. Ascending pharyngeal and transverse facial arteries were seen in 60% of the cases, especially on multiaplanar reconstructions. Anatomi- cal rapport of major branches were easily recognised on CT scans. More precise morphological analysis of deep facial spaces allowed identification of anatomical areas corresponding to the break-point arterial anastomosis be- tween external and internal carotid territories.
Conclusion: Multi-detector row CT angiography may represent a rapid, non-invasive method to recognize major branches of the external carotid arteries. This technique would have clinical relevance in pathologic situations requiring pre-operative identification of the possible source of bleeding or tumoral vascularization.

Imaging in Epilepsy

P 042

Neuroimaging in Seizures Patient Associated with Nonketotic Hyperglycemia (NKH)

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Purpose: Hyperglycemia may rarely be seen with visual seizure. Neuroimaging in seizures associated with nonketotic hyperglycemia (NKH) is considered normal. We report magnetic resonance imaging (MRI) abnormalities in NKH patients complicated with seizures.

Methods: We prospectively evaluated clinical and radiological abnormalities in six patients with NKH. The clinical signs were consisted of severe hyperglycemia, hyperosmolality, and intracellular dehydration without ketoacidosis. Except the neurological examination and EEG studies, the without and with contrast enhancement CT scan, and MRI study included T1WI, T2WI, FLAIR, Diffusion-weighted imaging (DWI), post contrast images and MRS spectroscopy (MRS), and Tc-99 m HMPAO SPECT were performed.

Results: All patients were presented with simple or complex partial seizures. Four of them had transient visual hallucination and two had hemianopsia. MRI showed subcortical T2 and FLAIR hyperintensity in the occipital and/or temporal white matter (five patients), T2 and FLAIR hyperintensity of the overlying cortex (four patients) and focal overlying cortical contrast enhancement (four patients). DWI performed in all patients showed restricted diffusion. With clinical recovery, the subcortical T2 hyperintensity and striatal hyperintensity were reversed in five patients. The MRS showed decreased NAA and/or Choline. The initial cortical change evolved to FLAIR hyperintensity was suggestive of focal cortical gliosis. The radiological differential diagnosis considered initially included encephalitis, malignancy and hemorrhagic infarct rendering a diagnostic dilemma.

Conclusion: Occipital seizures and hemianopsia can be caused by hyperglycemia and may be accompanied with special imaging findings. We identified subcortical T2 hyperintensity rather than hyperintensity and the contrast enhancement as a characteristic feature of seizures associated with NKH. The Restricted diffusion on DWI and decreased NAA and/or Choline on MRS studies can also be noted.

P 043

Phosphorus Magnetic Resonance Spectroscopy (31P MRS) in Patients with Mesial Temporal Lobe Epilepsy: Preliminary Results

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Purpose: 31P NMR spectroscopy is a non-invasive method that allows measurements of several phosphorus metabolites related to energetic state. The aim of this study was to determine by 31P MRS which phosphorous metabolites rate are altered in the mesial temporal lobe of patients with temporal lobe epilepsy.

Materials and Methods: Three-dimensional 31P MRS imaging of 8 patients (3 women, 5 men; mean age, 33.7 years; range, 22 to 45 years) and 7 controls (5 women, 2 men; mean age, 35 years; range, 18 to 48 years) was performed on a Philips 3.0T system. Double-tuned 31P/1H head coil was used to obtain both the H images and the 31P spectra T1 axial isotropic sequence with reconstructions on sagittal and coronal planes were acquired for the purpose of localization. Pulse acquire sequence was used with total number of voxels of 6x7x6 with each voxel size of 30x30x20 mm. Individual voxel located in the left mesial temporal area was selected in patients and controls.

Data analysis and voxel selection were performed in a identical way (same position, same size) for patients and controls. Absolute values of each metabolite (phosphodiesters- PDE, phosphomonoesters-PME, inorganic phosphate - Pi, phosphocrreatine- PCR, γ, α, β-adenosine triphosphate-ATP) (Picture 1), as well as the ratio of each metabolite by the sum of all metabolites, PCr/ATP, Pi/sum of all metabolites, and ATP/sum of all metabolites ratios were decreased in patients however with a non significant p value (higher than 0.05).

Conclusion: The decrease of PCr, Pi by sum of all metabolites may indicate that there is dysfunction related to declining energetic metabolism in patients with temporal lobe epilepsy.

Table 1 Values of PCr, Pi and Pi/sum of all metabolites in the left mesial temporal region of patients.

<table>
<thead>
<tr>
<th>Patient</th>
<th>PCr</th>
<th>Pi</th>
<th>Pi/sum of all metabolites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>177.6 ± 48.0</td>
<td>100.6 ± 48.0</td>
<td>1.76 ± 0.46</td>
</tr>
<tr>
<td>2</td>
<td>176.4 ± 49.0</td>
<td>100.4 ± 49.0</td>
<td>1.75 ± 0.45</td>
</tr>
<tr>
<td>3</td>
<td>176.6 ± 50.0</td>
<td>100.5 ± 50.0</td>
<td>1.75 ± 0.46</td>
</tr>
<tr>
<td>4</td>
<td>175.3 ± 48.0</td>
<td>100.2 ± 48.0</td>
<td>1.75 ± 0.47</td>
</tr>
<tr>
<td>5</td>
<td>175.8 ± 48.0</td>
<td>100.3 ± 48.0</td>
<td>1.74 ± 0.48</td>
</tr>
<tr>
<td>6</td>
<td>174.6 ± 46.0</td>
<td>100.2 ± 46.0</td>
<td>1.74 ± 0.47</td>
</tr>
<tr>
<td>7</td>
<td>172.8 ± 44.0</td>
<td>100.0 ± 44.0</td>
<td>1.72 ± 0.46</td>
</tr>
<tr>
<td>8</td>
<td>170.4 ± 42.0</td>
<td>99.8 ± 42.0</td>
<td>1.70 ± 0.43</td>
</tr>
</tbody>
</table>

Table 2 Values of PCr, Pi and Pi/sum of all metabolites in the left mesial temporal region of controls.

<table>
<thead>
<tr>
<th>Patient</th>
<th>PCr</th>
<th>Pi</th>
<th>Pi/sum of all metabolites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>174.5 ± 48.0</td>
<td>100.5 ± 48.0</td>
<td>1.74 ± 0.46</td>
</tr>
<tr>
<td>2</td>
<td>174.6 ± 49.0</td>
<td>100.6 ± 49.0</td>
<td>1.74 ± 0.47</td>
</tr>
<tr>
<td>3</td>
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<td>100.7 ± 50.0</td>
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</tr>
<tr>
<td>4</td>
<td>172.5 ± 48.0</td>
<td>100.5 ± 48.0</td>
<td>1.72 ± 0.47</td>
</tr>
<tr>
<td>5</td>
<td>171.8 ± 48.0</td>
<td>100.4 ± 48.0</td>
<td>1.71 ± 0.48</td>
</tr>
</tbody>
</table>

Table 3 Means, standard deviation and p values of PCr, Pi and Pi/sum of all metabolites in patients and controls.

<table>
<thead>
<tr>
<th>Patient</th>
<th>PCr</th>
<th>Pi</th>
<th>Pi/sum of all metabolites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>1.75 ± 0.46</td>
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<td>4</td>
<td>175.2 ± 15.5</td>
<td>100.2 ± 15.5</td>
<td>1.75 ± 0.47</td>
</tr>
<tr>
<td>5</td>
<td>174.1 ± 15.5</td>
<td>100.1 ± 15.5</td>
<td>1.74 ± 0.48</td>
</tr>
</tbody>
</table>

Figure 1 Spectroscopy of left mesial temporal lobe region showing left to right: phosphoroethanolamine, PE, phosphocholine, PC, inorganic phosphate, Pi, glycorosphorylcholine, CPE, glycero-phosphorylcholine, GPC, phosphocreatine, PCR, γ, α, β-adenosine triphosphate ATP.
Bilateral Symmetric Amygdaloid Calcifications: A Pathognomonic Brain Anomaly of Lipoid Proteinosis

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Introduction: Lipoid proteinosis is a rare autosomal recessive disease, characterized by severe mucocutaneous lesions and neurologic abnormalities due to intracellular deposition of amorphous hyaline material.

Observation: We report the case of a 36-year-old man admitted for post-traumatic persistent seizures. Admission CT and MRI revealed cerebral haematoma and symmetric amygdaloid calcifications. Clinical history revealed chronic ethylism, familial history of consanguinity, long history of skin lesions and neurological abnormalities, including seizures, amnesic impairment, slight psychomotor retardation and abnormal social interaction pattern. Cerebral haematoma could explain "status epilepticus". But history of neurological abnormalities, mucocutaneous lesions and familial consanguinity suggests lipoid proteinosis or Urbach-Wiethe disease. Medial temporal lobe calcifications are the essential imaging finding in lipoid proteinosis.

Conclusion: Symmetric bilateral amygdaloid calcifications may suggest the diagnosis of lipoid proteinosis.

Imaging of Brain Tumors - Multimodality Approach

P 045

Tumor Recurrence and Radiation Brain Necrosis: Differentiation Using Newer MRI Techniques

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Aim: The study was performed to evaluate the accuracy of newer MRI techniques in differentiating recurrent brain tumour from radiation necrosis.

Materials-Methods: We reviewed a group of 15 patients who underwent follow-up examination after radiation treatment of histologically classified as grade 3 or grade 4 primary tumours. The final diagnosis between tumour recurrence and non-neoplastic necrosis due to radiation treatment was based on clinical findings and follow-up examinations. In 7 cases the diagnosis was histologically proven: in 5 cases by stereotactic biopsy and in 2 cases with surgical resection. The remaining 8 cases were based on follow up examination: decreasing or disappearing lesions was regarded as radiation necrosis; increasing lesions and clinical worsening was considered pathognomonic of tumor recurrence. Among the 15 patients included in the study, 9 were tumor recurrence cases and 6 brain radiation necrosis. In addition to conventional MRI sequences (pre-contrast and post-contrast axial, sagittal and coronal T1, T2 and Flair), advanced MRI sequences were performed: diffusion-weighted imaging (DWI) with apparent diffusion coefficient (ADC) mapping and perfusion-weighted imaging (PWI) with cerebral blood volume (CBV) mapping. The ADC and CBV values were calculated for each pathological region of interest in each patient, and compared with those of normal controlateral white matter.

Results: The group of 15 reviewed patients included 9 tumor recurrence cases and 6 brain radiation necrosis cases. The ADC values in the 9 recurred brain lesions were significantly lower (p<0.027), if compared to the corresponding ADC values of the 6 patients with radiation necrosis. On the contrary, the CBV values in the 9 recurred lesions were significantly higher (p = 0.027), if compared to the corresponding CBV values of 6 patients with radiation necrosis.

Conclusions: There were significant differences in ADC and CBV values between brain radiation necrosis and tumor recurrence. DWI and PWI may be very accurate tools in differentiating brain necrosis from radiation injury.

P 046

3D MR Spectroscopy in Brain Tumor Recurrence and Radiation Necrosis

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2 Diagnostic Imaging Center. Oncology Institute of Vojvodina; Sremska Kamenica, Serbia
3 Special Hospital for Cerebrovascular Diseases Sveti Sava; Belgrade, Serbia

Introduction: Contrast-enhancing lesions on routine follow-up brain MRI at the site of a previously treated intracranial neoplasm surgically, chemically, or irradiated, are a significant diagnostic dilemma. MRI can not reliably discriminate tumor recurrence or progression from postradiation changes. Progressive and enhancing lesions on MRI related to treatment, can decrease in size or stabilise without any treatment and can remain asymptomatic. Tumor recurrence and treatment-related necrosis may be distinguished by a brain biopsy, by patient’s clinical course, and follow-up MRI. Three Dimensional Multivoxel Spectroscopic imaging 3D CSI enables coverage of a large volume and investigation of multiple regions of the lesion and surrounding tissue. The aim of this study was to explore the feasibility of performing 3D CSI MR spectroscopy in the evaluation of these lesions in patients who presented with new areas of contrast enhancement at the site of a previously treated neoplasm, irrespective of the lesion’s histopathologic nature. Materials and Methods: 59 patients, who had been initially diagnosed as intracranial neoplasm, underwent resection followed by radiotherapy and chemotherapy. 47 of 59 patients had gliomas (grades II-IV), and other were 5 PNET, 6 ependymomas, 1 glycosacromma WHO gr IV. All patients had a new contrast-enhanced lesion seen on follow-up MRI. A determination of recurrent tumor versus radio necrosis was difficult from the conventional MRI. We performed MRS on 59 patients in an attempt to distinguish recurrent tumor from treatment-related necrosis. Tumor progression lesions were regarded if they progressed on subsequent MRI consistent with tumor growth (n = 37). Radiation injury lesions showed prolonged stability or spontaneous regression (n = 22) on follow-up MRI. The follow-up time after the initial MR spectroscopy, after initial identification of the recurrent contrast-enhancing lesion, was 3-12 months. PRESS with TR/TE 1500/135 was used. The CSI slab size: Field of view (FOV) 80×80×80 mm, VOI 40×40×40 mm, was positioned parallel to the axial images, covering post-operative lesion including contrast-enhancing area and part of adjacent brain parenchyma. Number of phase encoding steps was 12 in all directions, interpolation resolution was 16 in all directions resulting in VOI of 5×5×5 mm. Interfering signal contributions from areas outside the VOI were suppressed by multipulse gradients, manually positioned along the
margin of the VOI. The spectra were analyzed for the signal intensity of NAA, choline, and creatine and for the presence of lactates and lipids and expressed as ratios of Cho/Cr and NAA/Cr. Metabolite ratios among the recurrent tumor population and treatment-induced injury population were compared. The highest Cho/Cr, and NAA/Cr ratios were seen in the recurrent tumor population and treatment-induced injury population.

Results: Three dimensional CSI spectroscopy performed over the post-operative lesions including contrast-enhancing part, resulted in high-quality spectra with readily quantifiable choline, creatine, NAA, and lactate peaks in all patients. On the basis of the clinical and imaging follow-up data, the contrast-enhancing lesions of 37 patients were categorized as tumor recurrence and the lesions of 22 patients were categorized as radiation injury. The lesions in the recurrent or residual tumor group had significantly higher Cho/Cr ratios than those in the radiation injury group (p < 0.001). Lesions in the tumor group had significantly lower NAA/Cr ratios (p < 0.0001) than those in the radiation injury group. None of the lesions classified as radiation injury reached the value 2.1 for Cho/Cr. In 17 (46%) of 37 patients with recurrent or residual tumor, pathologic spectra consistent with the presence of tumor (i.e., markedly elevated choline and depressed NAA) were identified both in voxels placed inside and in voxels outside the contrast-enhancing lesion.

Conclusions: Our study suggests that 3D CSI spectroscopy has the potential to discriminate recurrent tumor from treatment-related necrosis in patients with recurrent or residual tumor. The contrast-enhancing lesions showed higher Cho/Cr and lower NAA/Cr ratios in the recurrent tumor than in the radiation injury group. The presence of high Cho/Cr and low NAA/Cr ratios in the recurrent tumor is suggestive of tumor recurrence, but the absence of these ratios does not exclude the possibility of radiation injury.
grade 7, high grade 15), 5 malignant lymphomas, and 3 metastatic tumors. To assess the degree of FDG uptake, the maximum SUV within each tumor was calculated semi-quantitatively. To measure the minimum ADC value, we placed several ROIs on solid parts within tumors. The lowest ADC value in each tumor was chosen as the minimum ADC.

Results: An inverse correlation was found between maximum SUV and minimum ADC for all cases (p=0.0007) and for glioma cases (p=0.009). A correlation was found between WHO glioma grading and maximum SUV (p=0.005). An inverse correlation was found for WHO glioma grading and minimum ADC (p=0.003). Low-grade glioma showed significantly lower maximum SUV than high-grade glioma did (p=0.015). Low-grade glioma showed significantly higher minimum ADC than high-grade glioma did (p=0.006). Lymphoma showed significantly higher maximum SUV than high-grade glioma did (p=0.007). In contrast, no significant difference was found for minimum ADC between high-grade glioma and lymphoma.

Conclusion: An inverse correlation was found between maximum SUV and minimum ADC for solitary brain tumors. Both minimum ADC and maximum SUV were useful for glioma grading. Maximum SUV was useful for differentiating lymphoma from high-grade glioma.

P 050

White Matter Integrity and Cognition in Familial Cerebral Cavernous Malformations: A Diffusion Tensor Imaging Study

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Purpose: Cerebral cavernous malformation (CCM) is a common vascular malformation. The prevalence of CCMs in the general population is about 0.5%. Multiple lesions are associated with the autosomal dominant inherited form of the disease. Diffusion tensor imaging (DTI) can assess axonal integrity in vivo. To test the hypothesis that white matter (WM) integrity is reduced in patients with familial CCMs and to examine the relationship between WM integrity and standard neuropsychological testing.

Method and Materials: This prospective study included 11 subjects with familial CCMs and 12 age-matched healthy control subjects. All patients underwent MRI at 1.5T (Siemens). The protocol included Susceptibility Weighted Imaging (SWI) and DTI (b-values = 0 and 1000s/mm², diffusion gradient directions = 12, 20 or 30, N=4). The DTI was used to calculate Fractional Anisotropy (FA) maps as the primary indicator of WM integrity, Apparent Diffusion Coefficient (ADC), parallel (PDC) and transverse (TDC) diffusivity maps. Regions of interest were carried out on data from each subject and hand-drawn (figure 1). We compared for each ROI the mean value of FA, ADC, PDC and TDC between the two groups. Then correlations were calculated between diffusivity parameters and both number of lesions seen on SWI and neuropsychological tests.

Results: Patients with CCMs showed an overall decreased in FA (p<0.05) and increased ADC (p<0.05) and TDC (p<0.05). In the ROI analyses, this decrease is significant in the sagittal stratum (p<0.001), external capsule (p<0.05) and cingulum (p<0.05) for the FA, in the anterior corona radiata, corpus callosum, and forceps minor for the ADC (p<0.05), in the anterior corona radiata, external capsule, cingulum fibers and forceps major for the TDC (p<0.05) and finally the PDC is increased in the anterior corona radiata, corpus callosum, and forceps minor (p<0.05). There was no significant correlation between the number of lesions seen on SWI and the mean FA value for the whole brain whereas ROI analyses showed this correlation to be negative in the anterior corona radiata, forceps minor and external capsule (p<0.05).

The neuropsychological testing of these patients demonstrated executive dysfunctions which was correlated with FA decrease in the frontal region.

Conclusion: This is the first study to demonstrate a reduction in WM integrity in patients with multiple CCMs. This loss of WM integrity is correlated to the number of lesions in the frontal region (anterior corona radiata and forceps minor) and is supported by impaired neuropsychological tests.

P 051

Differences in Peritumoral Architecture Organization Evaluated with Diffusion-Tensor Imaging (DTI) and MR Spectroscopy (MRS) in Patients with Low and High Grade Gliomas

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The Catholic University of Korea, College of Medicine; Seoul, South Korea

Purpose: Diffusion tensor imaging and MR spectroscopy are quantitative tools for the preoperative assessment of gliomas with various quantitative parameters including fractional anisotropy (FA) and N-acetylaspartate (NAA)/creatine(Cr), NAA/Choline (Cho). The purpose of our study is to evaluate whether DTI and MRS depict differences in low and high grade gliomas on the basis of peritumoral architecture organization, and the results of DTI and MRS in low and high grade gliomas.

Materials and Methods: DTI and MRS were performed in 21 patients (13 men, 8 women; mean age, 54 years) with pathologically confirmed brain gliomas (8 grade II, 4 grade III and 9 grade IV gliomas). Regions of interest were drawn in the peritumoral region with high signal intensities on T2-weighted images, and FA ratios were calculated for regions of interest (ROI) in relation to the corresponding white matter of the contralateral hemisphere. From multi-voxel MRS, NAA/Cr and NAA/Cho ratios were calculated for the ROI in the same way of the FA ratios measurement. Comparisons between low and high grade gliomas were performed and correlation between the results of MRS and FA ratios were evaluated.

Results: The peritumoral region of both low and high grade gliomas displayed significant decreases in FA and NAA/Cr and NAA/Cho ratios when compared with those of contralateral normal appearing white matter. The measured mean peritumoral FA ratio of high grade gliomas (0.452) was significantly lower than that of low grade gliomas (0.694, p < 0.05). The calculated peritumoral NAA/Cr and NAA/Cho of high grade gliomas (0.91 and 0.83) were significantly lower than that of low grade gliomas (1.37 and 1.21). The results of MRS and FA ratios were well correlated (r = 0.83, p < 0.05).

Conclusion: Not only peritumoral FA ratios but also MRS NAA/Cr, NAA/Cho enable the differentiation of high grade gliomas from low grade gliomas in the aspect of differences in peritumoral architecture organization. Multi-voxel MRS can be used for evaluation of peritumoral infiltration in gliomas as a supplementary method in addition to DTI.
MR diffusion and perfusion imaging, MR spectroscopy are difficult task because of artifacts from bone structures. The review of literature has shown a few reports of CTP use in orbital pathology diagnosis. The aim of our work was to determine the CTP opportunities in diagnosis of various orbital tumors (or growing into area of an orbit) and evaluate the efficiency of this method in consideration of radiation dose on the eyes.

Material and methods: CTP was performed in 20 patients on multispiral CT scanners (Philips, GE): 5 - with intraorbital meningioma, 3 - neurinoma, 2 - chondrosarcoma, 2 - pilocytic astrocytoma, 3-low-grade astrocytoma, 2-neurofibroma, 3-recurrent of heman-giopericytoma. CTP at a level of orbit included 4 slices with 5 mm thickness, 160 images, acquisition time - 40s, radiation dose - 2.2 mSv. All patients have undergone enhanced MRI before and after surgical treatment.

Results: Hemangiopericytomas, meningiomas had highest values CBV, CBF as compared with white matter of brain. Neurofibromas and neurinomas distinguish from others by a higher MTT. For chondrosarcomas CBV, CBF were comparable to brain tissue values, but were marked higher MTT. By results of CBV and CBF it is possible to differentiate pilocytic astrocytoma from low-grade astrocytoma.

Conclusion: CTP is an effective method in diagnosis of various orbital tumors which allows to assess tumors hemodynamic, its vascularization and to make more specific differential diagnosis. It may help to decrease the number of patients undergoing biopsy and plan optimal surgical approach.

Figure 3: pilocytic astrocytoma, 2- low-grade astrocytoma, 3- chondrosarcoma, 5-neurinoma, 6- neurofibroma, 4- hemangiopericytoma, 9- meningioma, 8- N.

P 053 Neurocysticercosis Mimicking Brain Tumor. Case Report
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Introduction: Neurocysticercosis together with brain tumors is one of leading causes of seizures in the developing world.

Materials and Method: We report a case of a 30-year old woman who had a first epileptic seizure type grand mal during sleep in January 2008. MRI scan showed a single, cystic lesions, looking like a low-grade tumor in the left paramedian occipital region. She received antiepileptic therapy (Tegretol) and was followed up. In May 2008 a repeated MR examination showed the unchanged lesion. In December 2008, patient had a vision disturbance, sudden loss of memory, and dizziness. In January 2009 patient had a more severe epileptic crisis. After this an MR with spectroscopy and CT scan were done, both showing a progression of changes in the left occipital region. The patient was referred to the surgery and operated in June 2009. During the operation the cystic change was safely removed. It had a well-defined wall and was filled with clear liquid. Inside the cyst there was a grape-like formation filled with colloid content. PH analysis showed cysticercosis cyst.

Discussion: Our case was one of the unusual clinical and neuroradiological presentations of brain cysticercosis. The clinical condition of the patient, as well as the MR findings suggested cerebral neoplasm rather than parasitosis, particularly due to the clinical deterioration of patient.

P 054 Fractional Anisotropy of Corticospinal and Thalamofrontal Pathway in Parkinson's Disease
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Aim: Diffusion Tensor Imaging (DTI) is an MRI method for visualizing white matter tracts. The aim of this study was to assess the DTI application to Parkinson's disease (PD). An evaluation of the integrity of the corticospinal tract (CTS) and thalamofrontal tract (TFT) in patients with Parkinson's disease in comparison to normal individuals and correlation of fractional anisotropy (FA) values of these tracts to clinical parameters were performed.

Materials-Methods: N=55 patients and c=15 matched for age healthy subjects (NC) were examined by DTI. Fractional anisotropy (FA) and DTI- Tractography (DTI). PD patients mean age was 68.4 ± 5 years. Their motor disability was evaluated by means of the Unified Parkinson's Disease Rating Scale (UPDRS). The integrity of myelin sheath and axonal membrane is reflected by restriction of diffusion orthogonal to the fiber and positively correlated with diffusion parallel to the fiber. DTI was performed first and followed by post-processing of data with generation of FA maps tractography of the CTS and TFT as well as measurement of FA values of already defined areas of tractography OF CST and TFF.

Results: Mean FA values concerning the CTS and TFT in PD patients and controls were calculated. Significant decrease of FA values was observed in the CTS at pons level in PD patients. FA results yielded a moderate significant area under the curve (p=0.047) for mean CTS FA values at pons level. The cut-off level for discrimination between PD/NC was 0.44. (Specificity 0.80 sensitivity 0.46).

Conclusions: A subtle FA changes in CST at pontine level observed in PD compared to healthy individuals, but this is not related to the disease severity. Further studies are needed to elucidate the diagnostic validity of FA measurements in PD patients.

P 055 Are Decreased ADC and CBV Values Diagnostic for Central Nervous System Lymphomas?
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Aim: The study was performed to test the hypothesis that diffusion weighted imaging (DWI) with apparent diffusion coefficient (ADC) maps and
ADC values calculation in combination with perfusion weighted imaging (PWI) with cerebral blood volume (CBV) maps and CBV values measurements can be used to diagnose brain lymphoma.

**Materials-Methods:** The study included sixteen patients with intracranial lymphoma. Conventional MRI sequences as well as, a DWI with ADC mapping and PWI with CBV mapping were performed, with ADC and CBV values calculation in pathological regions of interest. These values were compared with those of normal control lateral white matter.

**Results:** Histopathologically proven lymphoma demonstrated restricted diffusion with mean ADC values 1.5 ± 0.11 × 10−3 mm²/s (mean ± standard deviation) and reduced perfusion with CBV values 2.63 ± 1.48 (mean ± standard deviation).

**Conclusions:** Restricted diffusion with low ADC values and reduced perfusion with decreased CBV values are of diagnostic value for cerebral lymphoma.

### Imaging of the Spine and Spinal Cord

#### P 056

**Sparganosis of Upper Cervical Cord**

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**Purpose:** Sparganosis is a rare cerebral parasitic infection caused by the larvae of diphyllobothrid tapeworms belonging to the genus Spirometra. Sparganosis involving spinal cord has been more rarely reported, mostly at thoracolumbar area. We report the sparganosis presenting as an upper cervical cord lesion, from C1 to C4 level.

**Materials and Methods:** A 51-year-old male presented with radiating pain and motor weakness in the both upper extremities, more severe on the left side since 4 months ago. He had a past history to eat raw snakes in his twenties. MRI study of cervical spine was performed for the possible cervical cord lesion.

**Results:** MRI of cervical spine revealed a multiloculated, honey-comb like enhancing lesion from C1 to C4 level, with extensive surrounding edema. Follow-up MRI after 20 days presented the morphological change of the enhancing lesion. Surgery revealed the granulomatous inflammatory tissues along the tunnel-like cavities including necrotic larva of sparganum. Enzyme-linked immunosorbent assay (ELISA) of the cerebrospinal fluid and histopathologic staining were consistent with sparganosis.

**Conclusion:** Sparganosis can involve any part of spinal cord, which should be considered for the differentiation of the spinal cord lesion. Although sparganosis involving spinal cord is extremely rare, it should be differentiated for the spinal cord lesions, especially if accompanied with the followings: characteristic multiloculated, honey-comb like enhancing lesion on MRI, short-term change of the lesion on the follow-up imaging studies, and the past history of eating raw snakes.

#### P 057

**Evaluation of Cervical Cord Decompression Surgery by Using Diffusion Tensor Analysis at 3T MRI**

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**Purpose:** We exhibit the finding change on diffusion tensor MR imaging in association with the therapeutic effect of decompression surgery in compressive cervical myelopathy.

**Materials and Methods:** Echo planar imaging based 6 axis diffusion tensor imaging (b value = 700) at 3.0T MR unit was performed to six patients (4 males, 2 females, mean age 65.0) at before and after posterior decompression surgery. Apparent diffusion coefficient (ADC) and fractional anisotropy (FA) value was measured at C2/3 - C7/Th1 intervertebral levels (including compressed area) and intermediary vertebral body levels were evaluated.

**Results:** All cases had intramedullary T2 high signal area at compressed region. T2 high signal revealed no change or expansion after decompression regardless of clinical improvement. Abnormality of ADC and FA extended beyond T2 high signal area. After surgery, the abnormality of ADC and FA was improved though T2 high signal remained. FA was more sensitive than ADC to the therapeutic effect.

**Conclusion:** Diffusion tensor analysis was suitable for evaluation of therapeutic effect of cervical decompression surgery.

#### P 058

**Lumbosacral Radiculography by 3D MR Rendering for Diagnosis of Symptomatic Extraforaminal with or without Foraminal Disc Herniation**

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**Objective:** To investigate significance of lumbosacral radiculography by 3D MR rendering in the diagnosis of symptomatic extraforaminal with or without foraminal disc herniation.

**Materials and Methods:** 17 patients with extraforaminal and combined extraforaminal with foraminal lumbar disc herniation were included in this study. Conventional spin echo sequence and T2 coronal fast-field echo (FFE) sequences with selective water excitation by using the principles of the selective excitation technique (Prosset imaging) were acquired. Indentation and swelling of the existing nerve roots and DRG in the symptomatic sides and levels were evaluated on 3D MR rendering images of the spine. The tilting angle of the nerve root was measured using a parallel line to the thecal sac and another line passing through the center of the nerve root in the intra and extraforaminal zone and parallel to its long axis.

**Results:** Swelling of DRG and existing nerve roots were seen in 13 patients (76%). Four patients revealed indentation of DRG and abnormal tilting angle of the nerve root.

**Conclusion:** Swelling of DRG and existing nerve root in diagnosis of the symptomatic extraforaminal disc herniation is the most important finding. 3D MR radiculography is very useful method for diagnosis of the symptomatic extraforaminal disc herniation.

#### P 059

**MR Imaging Findings of Intramedullary Spinal Cord Metastasis**

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**Purpose:** The incidence of intramedullary spinal cord metastasis is rare. The purpose of this study is to analyze MR imaging findings of intramedullary spinal cord metastasis and to correlate MR imaging findings with clinical symptoms and its course.

**Material and Methods:** Patients were consisted of 7 males and 5 females. Ages range from 53 to 83 year old (average 67). MR studies were performed with 1.5T scanner. T1weighted, T2...
weighted imaging and contrast study were done. MR imaging lesion extent, size, location, edema, contrast enhancement and associated syrinx were reviewed. Clinical condition of the patients were analyzed with chart reviewing.

Results: Size of the tumor was less than 2 cm. Prominent edema was associated in all cases. Strong contrast enhancement was noted in all cases. No syrinx were observed. All of the patients had pain and motor weakness. Rapid progress of the clinical course was seen. Most of the cases except one had multiple metastasis other than spinal cord. Most frequent primary tumors are lung cancer.

Conclusion: Characteristic MR imaging finding of spinal cord metastasis are strong enhancement and disproportionate edema.

P 060
Spinal Subdural Tuberculous Abscess
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A 31-year-old pregnant woman (gestational age, 11 weeks) who with tuberculous eningitis and miliary tuberculosis, treated with antituberculous medications for three weeks, showed severe back pain and voiding difficulty. Spinal MRI revealed diffuse subdural mass compressing spinal cord. Although surgery was recommend, the patient refused to follow it. Paraparesis rapidly developed on day 43 after-admission. Emergent decompressive laminectomy and abscess drainage were performed on thoracic spine (T3-T12). Pathology and abscess drainage were performed. MRI revealed diffuse subdural mass compressing spinal cord. Although surgery was recommend, the patient refused to follow it. Paraparesis rapidly developed on day 43 after-admission. Emergent decompressive laminectomy and abscess drainage were performed on thoracic spine (T3-T12). Pathology revealed caseous tuberculosis. One of these patients DSA showed AV fistula feeded by single dental feeder, neither the anterior spinal artery at right L1 level, with venous drainage into a dilated tortuous vein extending rostrally to Th10. This fistula was also embolised. In the third patient neither spinal DSA did not show any evidence of AV malformation, so the conclusion was that the enlarged vein along the thoracic spinal cord was the consequence of disc compression at the lumbar level.

Conclusion: For more accurate conclusions we need more experience and maybe some technical improvement in postprocessing of the spinal vasculature. However, the results from literature together with our modest results indicate that it is possible to visualise spinal AVM by CT-angiography rather precisely. In order to avoid or to shorten a complicated, time consuming and expensive spinal DSA, with up-to-date technology, spinal CT-angiography should be used as a screening method in patients with suspect vascular abnormality of the spine, as well as the follow-up method in patients treated by surgery or embolisation.

P 061
Evaluation of Spinal Vascular Malformations Using 64-Slice CT-Angiography. A Propos 3 Cases
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Introduction: There are relatively few reports in literature about CT angiography of spinal vascular lesions. Several studies of spinal vascular malformations demonstrated by magnetic resonance angiography (MRA) have been reported. With today state-of-art, digital subtraction angiography remains a gold-standard in diagnosis of vascular malformations of the spine, but it is interesting to establish the possibilities and the accuracy of CT angiography as an noninvasive method together with MRA for this kind of pathology.

Methods: In the period from May to December 2009 we have done three spinal CT-angiographies on 64-slice scanner. All patients had initial clinical and MR findings suggesting a spinal vascular disease. Spinal CT-angiography was performed on multislice 64 row scanner (GE VCT Lightspeed). We injected 100 ml of iodine contrast agent (Iohexol 370) at the rate of 4 ml/sec under following parameters: 0.625 mm slice thickness, 0.8 sec rotation, delay time depending on bolus tracking, smart-scan positioned at the level of descending aorta. Postevaluation was done using VR and MIP protocols. After CTA, in 3-4 days, patients underwent spinal DSA that was performed on the Axiom Artis angiographic unit. Each segmental artery was injected with 3 ml of contrast medium (Iohexol 370) at the rate of 1 ml/sec.

Results: In one patient CT-angiography showed not only the tortuous draining vein descending from Th 4-5 level to Th12, but also the AV-fistula itself at the level of Th5, fed by right segmental Th5 artery (Figure 1,2). However, we were unable to visualise Adamkiewitz artery. This finding was confirmed by DSA and the fistula was successfully embolised. In other two patients CT angiography demonstrated dilated draining veins, but not the arterial feeders, neither the anterior spinal artery.

In one of these patients DSA showed dural AV fistula feeded by single dural artery at right L1 level, with venous drainage into a dilated tortuous vein extending rostrally to Th10. This fistula was also embolised. In the third patient neither spinal DSA did not show any evidence of AV malformation, so the conclusion was that the enlarged vein along the thoracic spinal cord was the consequence of disc compression at the lumbar level.

Case report: A 31-year-old female with no relevant medical background, spontaneously developed left cranio-cervical pain associated with left hemi-corporal dysesthiesia, evolving since 2 weeks. Medical treatment (paracetamol and corticoids) didn't improve the symptomatology. 48 hours before hospitalization, she underwent cervical manipulation that rapidly aggravated and complicated the clinical presentation. On admission, the patient presented left hemispheric hypoesthesia, with brachial predominance, ipsilateral Claude Bernard-Horner syndrome, ipsilateral inferior monoparesis, urinary retention, and painful flexion of the left side of the body. MRI scan showed

P 062
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Background: Posterolateral bulbar infarction is not an infrequent complication of verteobasilar arterial disease. However, its extension to the upper cervical spinal cord is extremely rare.

Purpose: To report clinical and radiological findings of a posterolateral infarction of the bulbo-medullary junction due to distal dissection of the left extracranial vertebral artery, with extension to the upper cervical spinal cord.

Case report: A 31-year-old female with no relevant medical background, spontaneously developed left cranio-cervical pain associated with left hemi-corporal dysesthiesia, evolving since 2 weeks. Medical treatment (paracetamol and corticoids) didn't improve the symptomatology. 48 hours before hospitalization, she underwent cervical manipulation that rapidly aggravated and complicated the clinical presentation. On admission, the patient presented left hemispheric hypoesthesia, with brachial predominance, ipsilateral Claude Bernard-Horner syndrome, ipsilateral inferior monoparesis, urinary retention, and painful flexion of the left side of the body. MRI scan showed
Inflammatory, Demyelinating and Degenerative Diseases of the Brain

Diffusion Tensor Imaging of Amyotrophic Lateral Sclerosis: How to Analyze and Recent Results

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Purpose/Aim: We reviewed here DTI and its findings in patients with ALS as follows.
1. To show what is diffusion tensor imaging DTI and diffusion tensor tractography (DTT).
2. To show how to analyze DTI presenting our studies about Amyotrophic Lateral Sclerosis (ALS).
3. To show the recent results of studies about ALS and demetia

Content organization: DTI is a unique tool which enables visualization and quantitative analysis of specific white matter tracts. With DTI, neurodegenerative diseases can be evaluated radiologically. We discuss especially ALS because ALS has attracted researcher’s attention in both new aspects of motor neuron disease (MND) involving extramotor area and one of the neurodegenerative diseases having spectrum of manifestation of frontotemporal lobe degeneration (FTLD) associated with TDP-43. Recently TDP-43 was disclosed to be the major disease protein involving various neurodegenerative diseases including ALS, FTLD-MND, and FTLD with ubiquitinated inclusions.

1. a) What is DTI and DTT
DTI is a technique based on the fact that water molecule's motion or diffusion is much faster along the white matter tracts than perpendicular to them. We can visualize white matter tracts as DTT along the largest principal diffusivity in each pixel.

Addition to that, quantitative analysis of white matter tracts is possible by measurement of fractional anisotropy (FA) and apparent diffusion coefficient (ADC) with DTI. b) Clinical utility of DTI and DTT
Visualization of white matter tracts have been used for evaluation of relationships between certain white matter tracts and the lesion such as infarction or tumor. FA reduction and ADC increase represent damage of white matter fibers though they have been seen in various pathological conditions. Many studies have indicated that damage of white matter fibers in neurodegenerative diseases including ALS can be quantitatively evaluated by measuring FA and ADC.

2. There are several methods to analyze DTI. We performed studies measuring FA in patients with ALS using different method, Region-of-interest (ROI) method and Tract-specific analysis (TSA). Combination of DTI and voxel-based analysis is also useful. a) ROI study. In ROI study, ROIs are placed on obtained MR images based on known anatomical structure. Using ROI method, we investigated FA and central motor conduction time in 31 patients with ALS and 31 normal controls. Mean FA decreased significantly in all regions of the corticospinal tracts in patients with ALS as compared with controls. FA showed a significant correlation with the intracranial part of the central motor conduction. b) TSA. TSA have been developed to enable more accurate and sensitive analysis of specific white matter tracts by placing ROIs on visualized tracts. We compared 16 patients with ALS and 9 age-matched volunteers using TSA. It showed the ability of TSA depicting subtle changes between subtypes of ALS as well as the changes between the patients and volunteers. c) combination of DTI and voxel-based analysis. With combination of DTI and voxel-based analysis, we can evaluate whole brain FA excluding differences of brain volume and figure among individuals through process of spatial normalization and creating FA maps. We created normalized corticospinal tractography from the diffusion tensor data of 11 age- and sex- matched controls. Significant FA decrease in the group of 7 patients with ALS was found in the right frontal subcortical white matter and left frontal precentral white matter.

3. a) evaluation of the UF in patients with ALS. ALS has been recognized as a disease associated with manifestation of cognitive/behavioral impairment associated with TDP-43. Changes in the frontal lobe, the temporal lobe, and the corticospinal tract (CST) have been described using various imaging techniques. The uncinate fasciculus (UF) makes up the core of the anterior temporal stem and is critical for frontal-temporal interactions. It is considered to be related to cognitively behavioral function. We quantitatively evaluated changes in FA and ADC of the UF by TSA to evaluate the damage of the UF in patients with ALS. We obtained diffusion tensor images of 15 patients with ALS and 9 volunteers. Patients with ALS showed significantly lower mean FA compared with volunteers. The results suggest that damage of the UF in patients with ALS can be quantitatively evaluated with FA.

Summary: 1. Diffusion tensor imaging is a unique tool to visualize white matter tracts and analyzing specific quantitatively. 2. Our study showed sensitivity of TSA method and objectivity of combination of DTI and voxel-based analysis. 3. Damage of the UF in patients with ALS can be quantitatively evaluated with FA.

P 064 Creutzfeldt-Jakob Disease (CJD), A Diagnostic Challenge for MRI

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Key words: sporadic CJD, prion, dementia, DTI.

Purpose: The sporadic Creutzfeldt-Jakob-disease is a rare cerebral disease with unknown origin. Similar entities of spongiose encephalopathies must be carefully differentiated.

Methods/Material: By evaluating the results of actual research the unclear pathomechanism can be focused on some basics. Recent experiments have revealed that particularly the white matter shows changes resulting in increased diffusion.

Results: DTI is an approved MRI technique to assess diffusion disorders of neural network in vivo. It can be used to define the cerebral features of spongiose changes.

Conclusions: In correlation with the
typical clinical findings the present DTI classification of the different symptomatic stages could be helpful to diagnose the disease earlier.

P 065

The Factors Associated with Atrophy of Parahippocampal

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Objectives: We had studied the correlation between the factors affecting Alzheimer's disease and parahippocampal atrophy.

Methods: Using Voxel-Based Specific Regional Analysis System for Alzheimer's Disease (VSRAD), we performed Magnetic Resonance Image (MRI) on 110 consecutive patients (42 males, 68 females, age 31 to 93) from December 2006 to July 2008. We also inspected the correlation between parahippocampal atrophy and multiple factors including Mini Mental State Examination (MMSE) score, the ischemic change on MRI, and HbA1c.

Results: The low MMSE score indicates the specific atrophy of parahippocampus. Patients with ischemic change on MRI showed the high atrophy rate of hippocampus and hippocampus/whole brain. Over 5.8 HbA1c indicates higher Z score, hippocampal atrophy rate, and rate of hippocampus/whole brain.

Conclusion: We indicate that ischemic change on MRI and HbA1c may affect specific on parahippocampal atrophy. Severe parahippocampal atrophy suggests cognitive disorders, and that leads to diagnosis of Alzheimer's disease.

P 066

Characteristic MR Imaging Findings of Acute, and Chronic Progressive Neuro-Bechect Disease

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Purpose: Recent studies describe acute, and chronic progressive forms of neuro-Bechect disease (NB), their different clinical courses, prognosis and effective treatments. Acute NB patients have an onset of meningeocerebritis accompanied by fever. They are treatable with steroids and their neurologi- cal prognosis is favorable. On the other hand, chronic progressive NB patients frequently have onset of gait disturbance and dysarthria. Neurological disturbances develop gradually without neurological attacks and the neurological prognosis is quite poor. We reviewed 38 Japanese NB patients to determine MR image characteristics of each form.

Materials and Methods: We retrospectively reviewed MR images of 38 NB patients (acute NB; 19, chronic progressive NB; 19), investigated between 1994 and 2008. We also measured the area of the pons and midbrain of 23 of the patients (acute NB; 8, chronic progressive NB; 15) on mid-sagittal T1WI, and compared 142 control subjects.

Results: In acute NB, 2 patients presented thickened meninges and abnormal meningeal enhancement. T2 prolonged lesions were observed in the brainstem (n=6), thalamus (n=4), basal ganglia (n=2), or temporal deep white matter (n=5). No significant differences were observed in the pons and midbrain of patients and controls. In chronic progressive NB, T2 prolonged lesions were observed in the brainstem (n=7), thalamus (n=1), basal ganglia (n=3) and cerebral deep white matter (n=5). Cerebellar atrophy was seen in 12 patients. Visually apparent atrophy of the brainstem was seen in 14 patients and the area of the pons and midbrain was significantly smaller than in controls.

Conclusion: In chronic progressive NB, brainstem and cerebellar atrophy were frequently seen. These findings were also seen in a patient within the first year of onset, indicating that brainstem and cerebellar atrophy can develop in the early stages of chronic progressive NB.

P 067

Striatal Distribution of Dopamine Transporters and Dopamine D2 Receptors at Different Stages of Parkinson's Disease

A CFT and RAC PET Study

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Introduction: Parkinson's disease (PD) is a progressive degenerative neurological disorder characterized by rest tremor, bradykinesia, cogwheel rigidity, and postural instability. These symptoms result primarily from the loss of dopaminergic neurons in the substantia nigra. Positron emission tomography (PET) has enabled the acquisition of in vivo images of dopamine metabolism in patients with PD (1, 2). The distribution of presynaptic membrane dopamine transporter (DAT) in the human brain can be shown by means of PET with [C-11]ß-carbomethoxy-3ß-(4-fluorophenyl)tropane (CFT) (3). Uptake of DAT-ligand [C-11]ß-carbomethoxy-3ß-(4-fluorophenyl)tropane (CFT) is thought to be more sensitive for detecting dopaminergic dysfunction in early PD than is [F-18]DOPA PET because of a compensatory down-regulation of DAT to maintain dopamine levels at the synapses (4). PET with [C-11]raclopride (RAC) has shown that the number of dopamine D2 receptors (D2Rs) is increased in the putamen in PD. The aim of this study is to investigate the alteration of dopaminergic metabolism in the putamen of the patients with PD at different stages using CFT, RAC and PET.

Methods: We studied eight elderly healthy volunteers (Group A; 62.3±6.9 y.o.), 15 drug naïve patients with PD (Group B; 65.1±2.1 y.o., disease duration = 2.0±1.3 years), and seven advanced PD patients with mild dyskinesia (Group D; 65.0±8.0 y.o., disease duration = 11.2±7.0 years). In drug naïve patients group, seven patients were re-examined after antiparkinsonian therapy (Group C; therapeutic duration = 14.5±4.1 months). Levodopa-equivalent dose was significantly larger in the Group D than in the Group C. PET was performed in the Tokyo Metropolitan Institute of Gerontology Positron Medical Center with an SET-2400W PET scanner (Shimadzu Co., Kyoto, Japan). If the patients took antiparkinsonian agents, the administration of the agents was not stopped before obtaining the PET scans. CFT was prepared as described before (5). Each subject received an intravenous injection of 300 MBq of CFT. Starting 75-min post-injection, an emission scan was performed in the 3D mode for 15 min. RAC was prepared as described before (6). Each subject received an intravenous injection of 300 MBq of RAC. Starting 40-min post-injection, an emission scan was performed in the 3D mode for 15 min. In the CFT and RAC PET images, circular regions of interest (ROIs) 10 mm in diameter were drawn.
UI of CFT in the striate body was the largest in the Group A and the lowest in the Group D (Fig A). UI of RAC in the CN and AP was larger in the Group A and B than in the Group C and D, and that in the PP was the largest in the Group B (Fig B). UI of CPT in the AP and PP was the lowest in the Group A (Fig C). AI of RAC in the PP was larger in the Group B and C than in the Group A and D (Fig D).

**Conclusion:** Distribution of DAT and its asymmetry in the striate body is decreased as the disease progression in the patients with PD. Several studies of direct drug effects on DAT ligands showed no significant change on PET imaging with levodopa or dopamine agonists (7). The endogenous dopamine and antiparkinsonian agents decrease the binding of RAC, because RAC has a weak affinity for D2Rs. Therefore, UI of RAC was the largest in the drug naive PD.

**References**

**Introduction**
Lyme neuroborreliosis demonstrates variable central manifestations. Imaging findings are non specific, sometimes misleading and their course has been rarely described.

**Purpose:** To describe an unusual and
severe leukoencephalitis, whose clinical and radiological reversal was dramatic after appropriate antibiotherapy. To bear emphasis on the direct pathogenic role of spirochetes in neuroborreliosis.

Case report: A 68-year-old woman presented with a 2-month history of diplopia, gait ataxia, and rapid reversal of leukoencephalitis. The condition did not improve. At the second hospital day the patient was given ceftriaxone at this time a follow-up MRI showed, in FLAIR images, widespread hyperintense lesions of the supratentorial white matter and in the mesencephalon, without gadolinium enhancement, and a recent ischemic stroke in the left posterior arm of the internal capsule. Cerebrospinal fluid examination showed mild lymphocytic pleocytosis and intrathecal IgG synthesis with oligoclonal bands against Borrelia burgdorferi. Intravenous infusions of ceftriaxone led to a complete resolution of clinical signs within 4 weeks and to a dramatic reversal of MRI lesions in 3 months.

Conclusions: Central manifestations of Lyme neuroborreliosis may be misleading and take the presentation of a devastating leukoencephalitis. Prompt antibiotherapy may lead to a complete and rapid reversal of leukoencephalitis, a point which argues for a direct role of active infection, rather than an immune-mediated mechanism.

P 071

Basal Ganglia and Extensive Cerebellar Involvement in an Atypical Case of WE: Neuroimaging Findings

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Introduction: Wernicke's encephalopathy (WE) is an acute neurological syndrome resulting from thiamine deficiency. Early recognition is important because timely thiamine supplementation can reverse the clinical features of the disease. WE is characterized by a quite distinct pattern of MR alterations; typical MRI findings are symmetrical alterations in the medial thalamus, mamillary body, periaqueductal gray matter, and floor of the fourth ventricle. We report here on a nonalcoholic atypical case of WE which presented with reversible symmetrical lesions in the basal ganglia and in the cerebellum alongside minimal alterations of the mamillary bodies.

Case report: The 65-year-old woman was admitted to the hospital for altered consciousness. Four days prior to admission, the patient gradually developed unsteadiness of gait, a worsening of dizziness, and recurrent episodes of vomiting; successively she gradually developed somnolence, and confusion. At the time of admission she was deeply stuporous, did not respond to simple commands, but could withdraw from dolorous stimuli. The pupils reacted sluggishly to light, but oculeophychic reflexes were present. In 1992 the patient had undergone total gastrectomy because of a neoplastic disease and been receiving monthly infusions of vitamin B12 for 3 years. In the last 3 weeks before onset of the neurological symptoms she complained of flu-like symptoms with abdominal pain, nausea and inappetence. The patient had maintained her alcohol consumption of 1 to 2 drinks per day, but had restricted her dietary intake owing to poor appetite. Upon admission to our department, moderate hypotension and tachycardia were present but subsided rapidly after antibiotherapy. To administer fluids. Blood chemistry showed mild anemia and hyponatremia, serum creatinine and creatinine kinase were within normal limits. Cerebrospinal fluid examination revealed severe gait ataxia, moderate bilateral limb dysmetria and bilateral horizontal nystagmus. At this time a follow-up MRI disclosed signal intensity alterations involving the basal ganglia, cerebellum and mamillary bodies. Cerebellar lesions disclosed hemorrhagic transformation. The patient was initially treated with Mannitol and dexamethasone, but her condition did not improve. At the second hospital day the patient was given intravenous thiamine 900 mg/day and her symptoms and signs gradually resolved. A week after the beginning of the treatment, the patient was fully alert but the signs of cerebellar dysfunction were still present; neurologic examination revealed severe gait ataxia, moderate bilateral limb dysmetria and bilateral horizontal nystagmus. At this time a follow-up MRI showed that the previously high signal intensities had mostly resolved.

Discussion: We report here a patient with WE who showed an unusual location of high reversible signal lesions with basal ganglia and extensive, partially hemorrhagic cerebellar involvement. The history and the response to thiamine were taking as confirming the diagnosis of WE. In a setting of marginal thiamine equilibrium, poor appetite, moderate alcohol consumption, and vomiting precipitated WE in our patient. Symmetric basal ganglia alterations with involvement of the putamen have previously only been observed in pediatric patients and always in association with at least one of the typical findings. Other causes of high signal on T2-weighted images of the basal ganglia include HIV infection, mithochondrial disorders, hypoxia, methanol and carbon monoxide poisoning, haemolytic-uremic syndrome, extrapontine myelolysis and encephalitis. Cerebellar signal intensity alterations are rare in WE being reported in patients both with and without alcoholism. Pathologic studies have shown a higher prevalence of cerebellar involvement compared with that observed in imaging studies. In fact, the cerebellum has been reported to be involved in more than half of WE cases. In particular, Purkinje cells are selectively vulnerable to thiamine deficiency and this damage contributes significantly to the clinical signs of WE. However, there have only been a few reports of high signal abnormalities in the cerebellum on MRI during the acute stage of WE, such as were exhibited by our patient. Furthermore, in the most previous reports lesions were confined to the superior portion of the cerebellar vermis or anterior hemisphere. Bilateral basal ganglia and cerebellar changes on MRI have been observed in the Brownell-Oppenheimer variant of Creutzfeldt-Jakob disease (CJD). However, radiological hallmark of cerebellar pathology in CJD is atrophy, which is identifiable on ADC maps but poorly visualized in nonquantitative DWI images. In conclusion, WE may present with varied imaging features and include multiple level involvement of the central nervous system as well as isolated and diffuse involvement of the brainstem and cerebellum.
P 072

**Pseudo Continuous Arterial Spin-Labeled Perfusion MRI in Patients with Alzheimer Disease: A Correlative Study with 99mTc-ECD Spect**

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**Purpose:** To compare the use of whole brain pseudo continuous arterial spin labeling (ASL) and 99mTc-ECD SPECT to assess cerebral blood flow (CBF) in patients with Alzheimer disease for the validation of quantitative pseudo continuous ASL perfusion in an altered hemodynamic state.

**Materials and Methods:** Fifteen patients with Alzheimer disease were studied with pseudo continuous ASL and conventional MRI (3Tesla, GE Medical Systems, Milwaukee, USA). CBF was also evaluated with 99mTc-ECD SPECT. The average values within region of interests (ROIs) drawn on co-registered pseudo continuous ASL and 99mTc-ECD SPECT images were used for the linear regression analysis and to assess the effect of transit time on CBF quantification using pseudo continuous ASL.

**Result:** In all patients there was a significant correlation between the CBF values from pseudo continuous ASL and 99mTc-ECD SPECT.

**Conclusion:** Pseudo continuous ASL MRI showed regional hypoperfusion with Alzheimer disease in brain regions similar to those seen in 99mTc-ECD SPECT. Quantification of CBF using pseudo continuous ASL is feasible and reasonable, even when employed in a routine clinical setting.

**Interventional Neuroradiology**

P 073

**Matrix2 Coils for Endosaccular Occlusion of Intracranial Aneurysms: Comparison of One-Year Outcomes with Bare Platinum Coil Cohort**

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**Background and Purpose:** The durability of aneurysm occlusion has shown limitation in Matrix coil as well as in the bare platinum coil (BPC). To over-come limited durability, in Matrix2, the percentage of Polyglycic Acid-Lactic Acid were reduced from 70% to 30%. We evaluated the one-year outcomes of the Matrix2 coil by comparing historical control of BPC.

**Methods:** The 121 consecutive aneurysms in 114 patients who underwent coil embolization by using BPCs alone during the period from October 2007 to October 2008. The initial endosaccular coiling outcomes including packing densities, occlusion grades, and complications, and the one-year follow-up results on MR angiography was compared between Matrix2 coil group and BPC group.

**Results:** The Matrix2 coil group and BPC group with similar baseline demographic characteristics showed comparable initial endosaccular coiling outcomes. The rates of overall recurrence, major re-canalization, and retreatment of the Matrix2 coil and BPC were 17.4%(21/121) versus 7.8%(11/151), 14.0%(17/121) versus 5.3%(8/151), and 10.7%(13/121) versus 4.6%, respectively (p=0.066). However, those with aneurysm volume between 50 mm3 to 200 mm3 were 23.7%(9/12) versus 13.3%(8/60), 31.9%(4/12) versus 22.2%(1/151), 10.5%(4/121) versus 0%, and 10.5%(4/121) versus 0%, respectively (p=0.022). Those with packing density less than 30% were 38.3%(18/47) versus 13.3%(8/60), 31.9%(15/47) versus 11.7%(7/60), and 23.4%(11/47) versus 10%(4/60), respectively (p=0.025).

There were no difference of mean packing density (p=0.152), initial occlusion grade (p=0.098), one-year follow-up outcomes (p=0.209) according to the length of Matrix2 coils used.

**Conclusions:** The initial coiling outcomes including complications, packing densities, and occlusion grades of Matrix2 coil are comparable to those of BPC on our single center experience, but the one-year durability of Matrix2 is inferior to that of bare platinum coils in specific subgroup of aneurysm volume and packing density. Besides to the cost and technical disadvantages, it does not provide benefits from the use of Matrix2 coil over the use of BPC.

P 074

**Progressive Myelopathy in Spinal Epidural Arteriovenous Fistula: Case Treated by Endovascular Approach**

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Spinal epidural arteriovenous fistulas (AVFs) are rare vascular malformations located in epidural space that may show clinical symptoms and magnetic resonance (MR) imaging similar to dural AVF fistulas. These epidural lesions are fed by multiple arteries which drain in the epidural venous plexus and sometimes in perimedullary veins. The latter drainage may be not visible on selective spinal angiography. We report a case of a patient with a lumbar spinal epidural AVF that presented myelopathy and MR images of venous congestion treated successfully by embolization using Onyx material. We underline the mandatory role of angiography in detecting such a type of fistulas and that the endovascular approach is the best therapeutic option.

P 075

**Unprotected Stenting in Symptomatic Patients with Severe Carotid Artery Stenosis. 30 Days Results**

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**Purpose:** To determine the safety and efficacy of stent placement without emboli cerebral protection devices and to examine our experience in symptomatic patients with high-grade carotid artery stenosis.

**Methods:** Between March 2002 and December 2009 we developed a prospective study including all symptomatic patients with carotid artery stenosis treated in our center by stenting. According to our protocol we crossed the stenosis with a .014" guidewire, care-
fully advanced the stent delivery catheter across the lesion and then deployed the stent. We only performed predilation in 15% of stenoses. All patients were monitored in order to record hemodynamic variables and clinical events during the procedure. No protective devices were used. Epidemiologic and clinical data, grade of stenosis, periprocedural and 30 days complications were collected.

**Results:** 177 patients (83% men, and 17% women, mean age 66 years) with 188 stenoses of at least 70% of luminal diameter were treated. A total of 95% of patients were symptomatics, and 5% were asymptomatics. A 74% of carotid arteries had stenosis > 80% of diameter, 58% were > 90%, and 8% were pseudoocclusions. 187 stents were implanted. The technique was successful in 95% of cases, with no residual stenosis in 77.7%, and residual stenosis < 30% in 17.3%. In 2 patients persisted a residual stenosis superior to 30%. 8 patients were not treated because it was impossible to cross the stenosis with the guidewire. Two major neurological complications (reperfusion intra cranial haemorrhages) occurred in the first 24 hours (1%). In the periprocedural period (30 days) one patient had a disabling ischemic stroke, two patients had non disabling strokes, and another one died due to a myocardial infarction, therefore the cumulative incidence of any stroke or death was 3.2%.

**Conclusion:** Unprotected carotid artery stenting is a safe procedure in patients with symptomatic severe stenosis, is comparable to stenting with emboli protection device or endarterectomy. We think the most critical point in the technique is the balloon dilatation, and the low incidence of complications is probably due to the protective effect of stent implantation prior to dilatation with the balloon angioplasty.

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**Method and Materials**

We retrospectively reviewed the CT, MRI, and conventional angiographic findings of the 58 patients (25-88 years) who were diagnosed with intra cranial meningo mas by surgical resection. The location, tumor staining, and feeding arteries were evaluated.

**Results:** Meningiomas at the central skull base (cribriform plate, intrasella, tuberculum sella) were observed in 12 patients. Predominant blood supply by the middle meningeal artery or internal maxillary arteries were emobilized in two of 12 patients (16.7%). Feeding arteries superselective was not performed due to small and multiple feeders in 2 cases. Eight of 12 patients cannot be performed tumor embolization because feeding arteries originated from ICA branches.

**Conclusions:** In this study, preoperative embolization of meningiomas at the central skull base is impossible in many cases. The individual risk-to-benefit ratio of conventional cerebral angiography should be thoroughly considered.

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**Direct Puncture Casting of Scalp Arteriovenous Fistulae with N-Butyl-2-Cyanoacrylate: Usefulness of Modified Circular Compression Device**

**Materials and Methods**

We have retrospectively analyzed 157 UAA (Internal carotid artery 93, Posterior circulation 31, Anterior cerebral artery 27, Middle cerebral artery 6) treated with ECE between 2005 and 2009 in our department. ECE were indicated for UAA greater than 5mm and smaller than 20mm considering the age, the history of SAH or polycystic kidney diseases, family history of SAH, particular location such as anterior
communication artery, and irregular shape. Antipatelet agents were adminis-
tered prior to the treatment. We had used bear coils or bioactive coils, and
adjunctive balloon catheter during em-
bolization for 110 UAAn (70%). Angi-
ographical follow-up was done one year
after the treatment.

Results: Immediate angiographical
results are as follows: complete occlu-
sion (CO) in 28 (18%), small neck rem-
nant (NR) in 76 (48%), residual aneu-
rysm (RA) in 49 (31%), and treatment
failure in 4 (3%). We had five transient
complication (3.9%) including 1 aneu-
rysm rupture, 1 vessel perforation and
3 ischemic complications. All patients
suffered complication discharged with-
out any neurological deficits. One year
angiographical follow-up had been done
in 92 UAAn with the results of 43 CO
(47%), 27 NR (29%), 20 RA (22%) and
2 TF. Follow-up angiographical results
had improved comparing to immediate
angiographical results. Re-treatments
were done for 17 UAAn (11%) by 14
ECE and 3 surgical clipping with one
intraoperative rupture resulted in per-
mature death.

Conclusion: ECE for relatively small
UAAn are safe as initial treatment
without any permanent morbidity, and
stable in the one-year angiographical
follow-up.

P 079
Endovascular Treatment (EVT) of
Anterior Communicating Artery
Aneurysm Associated with
Unilateral Moyamoya Disease

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Objective: Saccular aneurysms as-
associated with moyamoya disease are
commonly located in the vertebrobas-
ilar circulation. Anterior circulation
aneurysm associated with moyamoya
disease are uncommon and usually
treated by neurosurgical clipping. We
reported a case of a ruptured anterior
communicating artery aneurysm in a
patient with a left middle cerebral ar-
tery moyamoya disease treated using
endovascular treatment with success.

Clinical presentation: A 23 years old
man presented with 5 days history of
headache, diplopia and fever. Com-
puted Tomography (CT) scan of the
brain showed a large left frontal intra-
parenchymal haemorrhage with associ-
ated subarachnoid and intraventricular
haemorrhages. The cerebral angiogram
showed a bllbed anterior communicating
artery aneurysm. There is also severe
M1 segment stenosis of the left middle
cerebral artery with multiple collater-
als, representing moyamoya vessels,
forming the M2 and M3 segment of the
left middle cerebral artery.

Intervention: The patient underwent
EVT for the anterior communicating
artery aneurysm. Using an Excelsior
SL-10 microcatheter (Boston Scientific)
and Transcend microguidewire (Boston
Scientific) for aneurysm cannulation,
the aneurysm was occluded with three
detachable platinum microcoils (Micro-
plex, Microvention). Post embolisation
angiogram showed a 10% residual slow
filling of the aneurysm neck and sac. No
significant flow reduction was seen
in the anterior communicating, right
anterior cerebral and left anterior cer-
bral arteries.

Conclusion: Endovascular treatment is
a good treatment option for ruptured
anteor circulation saccular aneurysms
associated with moyamoya disease.

P 080
Large Vertebral Artery
Ateriovenous Fistula with
Epidural Varix Treated via
Endovascular Hybrid Technique:
Two Case Report

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Purpose: To report two cases with
large vertebral artery AV fistula with
marked cervical spinal epidural varix.
Because of very high flow shunt of these
lesions, we use combination techni-
que (hybrid) including coils, stenting,
vascular plug and NBCA embolization
to completely preservation or trapping
of the vertebral arteries according to
each patient’s condition.

Summary of cases: Case 1: A 51
year-old female suffered from right side
pulsatile tinnitus and right upper limb
numbness. MRI and angiogram re-
vealed right proximal VA large fistula
with multiple paraspinal and epidural
venous drainage. Besides, a small dis-
secting aneurysm was noted at distal
VA. Embolization was performed by
scarification of the distal dissecting an-
eurysm with coils first. A vascular plug
(Amplatzer, AGA) was then deployed
above the fistula segment and tried to
trapping the VA via coils but in vain
due to very high flow of fistula and the
undetached coil was pushed into heart.
A Zilver stent (Cook) was deployed
across the fistula segment of VA to pre-
vent the coils migration and finally the
VA was trapped via intra-stent detach-
able coils and pushable coils. Follow-up
angiogram showed complete occlusion
of the A-V fistula.

Case 2: A 35 year-old female pre-
sented neck pain and progressive gait
disturbance, weakness and numbness
of right limbs. MRI and angiogram re-
vealed bilateral extracranial vertebral
artery dissection with a large A-V fis-
tula at right VA with marked epidural
venous drainage causing spinal cord
edema due to compression. Stentgraft
placement was planned to treat the
dissection and fistula and preserve the
bilateral VA. Because of high flow of
right VA fistula, NBCA intravenous
injection was performed to improve the
apposition of stent graft and prevent the
further endoleak. Follow-up angiogram
half year later showed complete obl-
eration of the A-V fistula with patency
of bilateral vertebral arteries.

Conclusion: Hybrid vascular aterio-
vertebral A-V fistula sometimes can’t
be totally treated by only one method
(materials). Combination (hybrid) of
coils, stents, NBCA and other occlusion
device may be an efficient technique to
deal with these lesions.

P 081
Endovascular Treatment of Distal
Cerebral Aneurysms

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Purpose: Distal cerebral aneurysms
are difficult to treat. Endovascular
treatment (EVT) although challenging
in many cases allows sparing of the
parent artery. If deconstructive approach
is necessary, EVT enables hyperselective catheterization with sac-
rificing the only branch on which an-
eurysm is located. Consequently much
of the surrounding arterial circulation
is spared. We present our series of en-
dovascular treated distal cerebral an-
eurysms in 2009.

Methods: This is a retrospective
review of 7 consecutive patients (5
women) with 8 distal cerebral aneu-
rysms (4 ruptured) who underwent em-
bolization in 2009. Patient age ranged
from 44 to 69 years. Aneurysm size
distribution was: 7 small (0-10 mm)
and 1 big (11-24 mm). Two aneurysms
required deconstructive approach. Em-
bolization was performed with coils in
six cases, and with liquid embolic mate-
rial Onyx in two cases.

Results: Endovascular treatment was
successful in all cases. Immediate
angioimages revealed complete occlu-
cision in 6 aneurysms, none with neck remnants, and incomplete occlusion in 2 aneurysms. On first follow-up (3-6 month) obtained in 6 patients, 5 aneurysms showed stable occlusion, and one recanalization due to coil impaction. None of the patient died. One patient had neurological deficit GOS (Glasgow Outcome Scale) score 3 caused by parent artery occlusion, which gradually improved to GOS score 4.

Conclusion: EVT is safe and effective technique for distal cerebral aneurysms.

P 082
Endovascular Treatment of a Giant Cranio-Cervical Aneurysm with a New Self expandable Stents Leo and Leo Plus
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Purpose: To analyse outcome of EVT of cerebral aneurysms using auto-expandable intracranial stents (LEO and LE Plus).
Material and Method: From October 2003 to December 2008: 20 patients with 20 aneurysms were submitted to our department for endovascular treatment. 17 patients were females and the mean age was 55.2 years old. 18 aneurysms were unruptured. 26 stents were used, and in 3 cases stenting was associated with coil embolisation. All procedures were performed under antplatelet therapy (aspirin, clopidogrel) and anticoagulation (heparin). Clinical and radiological follow-up extended from 4 to 60 months.
Results: Ischemic complications were observed in 2 patients due to inappropriate antplatelet therapy, and in 1 case due to transient distal hemodynamic perturbation related to inadequate stent expansion. In one case a mild neointimal hyperplasia was detected during follow-up. Aneurismal exclusion was obtained in 2 cases using stenting and coiling. Modification of vascular wall was observed in 17 cases, with significant reduction of arterial ectasia. No morphological modification was observed in one case. Morbidity rate was 15 % and mortality rate was 5%.
Conclusion: Intracranial stenting is feasible but necessitates appropriate antplatelet therapy. Correct positioning of the stent is mandatory in order to avoid hemodynamic complications. Stenting of sacular aneurysms must be associated to coiling. Stent can modify arterial wall, allowing vascular reconstruction.

P 083
Carotid Artery Stenting for Asymptomatic Cervical ICA Stenosis
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Purpose: We evaluate the safety and clinical efficacy of Carotid artery stenting (CAS) for asymptomatic cervical internal carotid artery stenosis (ICA) at our institution.
Method: During 2000-2009, 94 asymptomatic patients with cervical ICA stenosis (≤85%) were included. Following subjects were retrospectively accumulated. Types of embolic protection devices, antplatelet agents, complications and outcome.
Results: The mean preoperative stenosis ratio was 87±19% by the NASCET measuring method, and 10 were accompanied by contralateral ICA occlusion. Antplatelet agents were given at least 48 hours before the procedure and continuously given after the procedure (1 agent 34cases, 2 agents 60 cases). All procedures were performed under local anesthesia and protected with embolic protection devices (2 Navi balloon, 59 Guard wire and 31 Angioguard XP). Guard wire and a modified Parodi method were used for vulnerable plaque. The plaque characteristics was evaluated by MRA black blood method, CT angiography and ultrasonography. During and after the operative procedure, 2patients had transient hemiparesis, but recovered within 48h. High Spatiates had bradycardia (below 40 HR / min) and low blood pressure (below70 mmHg in systolic blood pressure), they were asymptomatic and transient. The mean postoperative stenosis ratio was 22.7±30.3% by the NASCET measuring method. There was no case worsen in modified Rankin Scale after perioperative period. We could pursuit 86patients(91.4%) after hospitalization and 8 patients were lost to follow-up. The mean pursuit period was 58 months (2 to 108 months ), and during the period there was no case with restenosis above 50% or onset of cerebral infarction.
Conclusion: CAS for asymptomatic cervical ICA stenosis can be safely enforced and prevent future ischemic stroke effectively with preoperative plaque quality evaluation, selection of a suitable embolic protection device, and antplatelet agent medication of a perioperative term.

P 084
Intracranial Myotic Aneurysms, Experience from Ramathibodi Hospital
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Introduction: Intracranial myotic aneurysms are rare, especially in posterior fossa and posterior cerebral arterial location, and accounting for 2% of ruptured intracranial aneurysm. Moreover ruptured myotic aneurysms carry higher risk of fatal recurrent rupture. Infectious or inflammatory process of the arterial wall is the leading cause, usually co-existing with conditions such as infective endocarditis, septicemia or local infection surrounding proximal artery at skull base such as cavernous sinus ICA, or more distally located artery that abutting to the brain abscess. The presenting symptoms are usually due to subarachnoid hemorrhage or arteriovenous fistula. We report our case series of the rare symptomatic myotic aneurysms in our institute.
Methods: We retrospectively review all myotic aneurysm in Ramathibodi hospital since 2000 to 2015, interim of in term of clinical presentation, natural history of the disease, radiologic findings, treatment strategies and prognosis.
Results and Discussion: Among more than 300 ruptured aneurysms in our institute in the past 10years, we found 6 cases of atypical myeurysmal locations, which we concluded to be myotic or infectious pathology. Including two distal PCA aneurysms, one distal right PICA aneurysm, one distal right MCA and two cavernous ICA aneurysms. Treatment options for ruptured myotic aneurysms which include medical therapy, endovascular clipping and endovascular treatment. Medical therapy with antibiotic or antifungal is known as first option of treatment, with close clinical and imaging follow up in 2-3 weeks when complete therapeutic course. However, significant risk for re-rupture of myotic aneurysms during medical therapy have been reported. Surgery in acute phase of this fragile aneurysm can lead to high morbidity and mortality than conservative management. In our experience, all distal aneurysms showed poor response to conservative medical therapy, leading to the endovascular treatment later on, with successful result and no recurrent rupture. Most reports use liquid adhesive as embolic material for treating the ruptured myotic aneurysms. The cavernous ICA aneurysms have better prognosis and they response better with medical therapy, moreover, the risk of stroke or intracranial hemorrhage is lower in this
group due to the factor of intact thick cavernous dural wall. The natural history of the myotic aneurysms in different locations, pathophysiology, clinical presentation, angiographic findings, and treatment options with prognosis will be discussed more extensively with review of the literatures.

Molecular Imaging

P 086

Clinically Different Stages of Alzheimer's Disease Associated with Amyloid Deposition by [11C] PIB PET Imaging

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Background: The Alzheimer's disease (AD) pathology is detectable in vivo using selective imaging ligand for beta-amyloid by carbon 11-labeled Pittsburgh Compound B ([11C]-PIB) PET. Post-mortem study of typical AD brain has recently demonstrated that in vivo retention of PIB is related directly to the amount of insoluble amyloid b peptides, including amyloid plaques.

Objective: The present study was conducted to determine whether the amyloid imaging of [11C]-PIB PET detects underlying amyloid deposition at clinically different stages of AD and preclinical dementia. We sought to clarify the association between cerebral amyloid deposition, glucose metabolism and cognitive function in clinical stages of AD. Method: A total of 205 subjects, including 56 with AD, 58 with mild cognitive impairment (MCI) and 91 healthy control (HC) subjects, underwent cognitive testing, and 60-min [18F]-FDG PET imaging is conducted to determine whether the amyloid plaque formation is not directly responsible for cerebral glucose metabolism. The [18F]-FDG PET imaging is associated with the neuronal degeneration, being useful to evaluate the progression of only AD dementia. This diagnostic framework with brain amyloid deposition, in clinical different stage of AD, would allow an earlier and more specific AD diagnosis and play an important role of anti-amyloid strategies.

Pediatric Neuroradiology

P 087

Synaptic Plasticity, Detectable by Diffusion Tensor Imaging (DTI)?

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Key words: DTI, synaptic plasticity, learning, memory.
Introduction: Susceptibility-weighted imaging (SWI) exploits phase shift itself to enhance contrast caused by the susceptibility differences between tissues, and creates contrast between deoxygenated veins and the neighboring tissue in the brain. SWI provides high-spatial resolution, blood-oxygen-dependent, venography without requiring contrast media. Clinically, SWI has been applied to the visualization of small developmental venous anomaly (venous malformation) and to the detection of venous congestion caused by acute venous thrombosis. We present two pediatric patients who showed prominent cortical veins with marked hypointensity on SWI in the acute stage after onset of generalized seizure, and investigate the clinical role of SWI in pediatric epilepsy.

Materials and Methods: MR examinations were performed with a clinical imager operating at 1.5-T (MAGNETOM Avanto, A Tim system, Siemens). SWI were acquired with a three-dimensional fast low-angle shot (FLASH) sequence with a TE of 40 ms, a low bandwidth (90Hz/pixel), a full, first-order, velocity-compensated gradient moment nulling in all three orthogonal directions and 72 partitions, a voxel volume of 0.8 x 0.7 x 1.6 mm3. The coverage volume was 115 mm thick, and the total acquisition time was 6 min and 19 sec using parallel imaging.

Results: Case 1: A 6-year-old male presented with a sudden-onset, generalized tonic-clonic seizure. The patient was afebrile but still in a drowsy state on admission. Emergency MR was performed 90 minutes after the onset, before starting intravenous administration of diazepam. Diffusion-weighted images (DWI) and T2-weighted images (T2WI) showed neither abnormal signal nor decrease in ADC. MRA represented normal appearance without spasm or hyperperfusion. SWI demonstrated tortuous draining veins with marked hypointensity in the left cerebral hemisphere, particularly in the left parietal lobe compared to the contralateral hemisphere (figure). Those SWI findings suggested increased deoxy-Hb in the draining vein and decreased oxy-Hb in the surrounding brain tissue. Electroencephalogram demonstrated slow waves with sporadic spikes in the left frontal region. Case 2: A 6-year-old female admitted with a sudden-onset, generalized tonic-clonic convulsion. Mild consciousness disturbance persisted after his arrival at the hospital. Emergency MR was carried out 2 hours after onset, before starting drug administration. DWI and T2WI showed no definite abnormality, either in the gray matter or white matter. There was no developmental anomaly or neuroepithelial neoplasm. SWI demonstrated markedly tortuous cortical veins with significant hypointensity in the right cerebral hemisphere, particularly in the parieto-occipital lobes. The patient was improved completely without hemorrhage or infarct.

Conclusions: These two patients were diagnosed as having generalized tonic clonic seizure and postictal encephalopathy of unknown origin. Global decrease of cerebral cortical blood flow oxygen metabolism has been reported in patients with cryptogenic symptomatic epilepsy. Global decrease of rCBF and rCMRO2 and a slightly increase in OEF were proven by positron-emission tomography. It is probable that the SWI findings reflect transient misery perfusion state secondary to hypoxecitation or vasospasm in status epilepticus. Uncoupling between oxygen supply and demand in the epileptogenic excised tissue is considered to cause a relative increase of deoxy-Hb level and a decrease of oxy-Hb in the tissue capillaries and the draining veins. SWI directly detected impaired oxygen metabolism caused by increased oxygen demand of the cerebral tissue in pediatric patients with epileptic seizures. SWI has the possibility to diagnose acute postictal encephalopathy, before cytotoxic edema occurs on DWI.

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FLAIR sequences were performed pre-dose, with T1wSE sequences and any optional sequences performed at discretion of investigator obtained at 3-10 minutes after contrast injection. Safety monitoring included adverse events (AE), pre- and post-dose lab test on blood and urine, and vital signs and serial 12-lead electrocardiograms (EGCs) (1 hour pre- and 1.2, and 24 hours post-dose). All subjects were monitored for AE for 72 hrs and followed up at 30 days to determine final diagnosis. Images were evaluated by 3 blinded readers for lesion enhancement, border delineation, and visualization of internal morphology. Lesion-to-brain ratio (LBR) and contrast-to-noise ratio (CNR) were calculated from regions or interest placed by the readers.

Results: 92 children (45 boys, 47 girls; mean age: 10.6 yrs [range: 2.0-17.8 yrs]) were enrolled and dosed with 89 children completing all safety evaluations (13 patients 2-5 yrs, 34 patients 6-10 yrs, and 45 patients were 11-17 yrs). The mean contrast dose was 8.4 mL (range: 2.9-22.8 mL). A total of 9 AE were reported in 8 children (8.7%). Headache was reported in 2 patients with all other reported AE occurring once. All AE were mild or moderate and resolved completely. No clinically meaningful changes in vital parameters, laboratory values, or ECGs were observed.

Diagnoses included: 28 (30.4%) non-tumor, 60 (65.2%) tumor, and 4 (4.3%) normal parenchyma. The tumors consisted of malignant and benign neoplasms (germ cell tumor, high grade glioma, medulloblastoma, PNET, pineal cyst, pilocytic astrocytoma, fibrous meningiomas, neurofibromatosis, etc.). Other diagnoses included vascular malformations (AVM & aneurysms) or other conditions (demyelinating processes, hemangiomas, pseudotumors). Of the tumors, 43 (71.7%) were intraxial and 17 (28.3%) were extra-axial; 25 (41.7%) were benign and 35 (58.3%) were malignant. In all children with enhancing lesions, gadobenate dimeglumine resulted in improved definition of disease extent, lesion border delineation, and visualization of lesion internal morphology. Readers blinded to clinical history judged that gadobenate dimeglumine provided additional diagnostic information over predose images in 83.7 - 96.7% of all children. Quantitative assessments by the 3 readers showed gadobenate dimeglumine resulted in significantly greater mean LBR (p<0.0001) and CNR (p<0.0016). The mean changes across readers ranged from 0.9 to 1.1 for LBR and from 49.9 to 74.6 for CNR.

Conclusion: At a dose of 0.1 mmol/kg, gadobenate dimeglumine was found to be safe and efficacious for contrast-enhanced MRI of CNS lesions in children. Gadobenate dimeglumine provided clinically significant information which led to a greater understanding of the disease processes found on pre-dose images. The clinical advantages of greater signal intensity with gadobenate dimeglumine in children may include improved detection and/or diagnosis of small or poorly enhancing tumors and more precise definition of tumor borders.

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P 091
MRI Findings in Moebius Syndrome-Clinical Case
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Introduction: The Moebius syndrome is characterized by congenital and non-progressive palsy of the VI and VII cranial nerves. It may be associated with palsy of other cranial nerves (III, IV, VIII and XII), craniofacial and musculoskeletal dysmorphisms. Most cases are sporadic, although there are cases of genetic transmission described. The imaging alterations, although subtle, are characterized by ponto-medullary hypoplasia with straightening of the floor of the fourth ventricle and aplasia of the colliculus facialis, justified by agenesis / hypoplasia of fibers of the knee of the facial nerve and the nucleus of the VIIth cranial nerve.

Case report: A 6-year-old caucasian male with glossoptosis, micrognathia and cleft palate (Pierre Robin S.), congenital talipes equinovarus and bilateral clinodactyly. In his family background emphasis is placed on paternal cousin with Pierre Robin Syndrome associated with hemiatrophy of the tongue and hypoplasia of the left pectoral muscle. Physical examination showed milkshake facies, complete ophthalmoplegia (paresis of the III, IV and VI) and inability to swallow (paresis of IX). The MRI revealed brainstem dysmorphia with straightening of the floor of the fourth ventricle, absence of the colliculus facialis or medial eminence.

Conclusion: The Moebius syndrome is a rare condition with only 300 cases documented. It has typical clinical manifestations and may be associated with other malformation syndromes. MRI can identify changes, which although subtle can help the clinician.

P 092
Neuroimaging of Acute Encephalopathy in Neonates
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Acute encephalopathy in neonates is characterized by nonspecific symptoms such as a decreased level of consciousness, seizures, abnormal muscle tone and reflexes, apnea and feeding difficulties. These clinical findings may result from a wide spectrum of pathologic entities. These include: hypoxic-ischemic events, infections, metabolic abnormalities, vascular malformations and space occupying lesions such as congenital neoplasms. The clinical work up demands a detailed history, physical examination, and laboratory evaluation of blood glucose, arterial blood gas, lactate, ammonia, ketones and amino acids. The appropriate combined use of sonography, computed tomography and magnetic resonance imaging may elucidate the specific cause for the acute cerebral dysfunction and resulting complications. Familiarity with the imaging findings of these common and uncommon entities should result in prompt and accurate diagnosis. This will permit initiation of appropriate specific therapy and hopefully decrease morbidity and mortality in this serious clinical syndrome.

P 093
Leigh Syndrome in a 20 Month Old Child: Case Report
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Purpose: Leigh syndrome or subacute necrotizing encephalomyelopathy is the prototype mitochondrial disease, with hallmark neuroimaging findings. It is a progressive degenerative disorder caused by mitochondrial DNA (mtDNA) or nuclear DNA (nDNA) mutations that affect infants, children, and sometimes adults. Clinical presentation can include global developmental delay, brainstem dysfunction, spasticity, dystonia, abnormal eye movements and multiple organ involvement. MRI findings may suggest distinct etiologies of Leigh syndrome. MRI scans of patients with COX deficiency and underlying SURF-1 mutations have lesions in the brain stem, subthalamic nuclei, and possibly cerebellum with few patients having ganglia abnormalities. Patients with Leigh syndrome from other etiologies have T2 hypersignal in the putamina with involvement of the caudate nuclei, globus pallidi, thalami, and brain stem, while some patients with diffuse supratentorial white matter changes. Lactate peaks in the area of MRI abnormality on Spectroscopy MR should prompt further investigation.

Case Report: A 20 month old female child presenting with vomiting episodes at 6 months old, development delay, progressive ataxic gait and palpebral ptosis with vespertine worsening, without extrinsic ophthalmoaparesis. A MRI scan was performed and revealed bilateral and symmetric T2 hyperintensities in the brain stem, namely the inferior olivary nuclei, the medullary pyramids, the medullary tegmen, lateral pons tegmen and restiform bodies; the subthalamic nuclei and middle cerebellar peduncle. Diffusion weighted imaging (DWI) didn’t show any ADC map restrictions. 1H-MRS found leisolan and CSF elevated lactate.

Conclusion: MR imaging pattern recognition in several neurometabolic disorders has established it as a powerful diagnostic method. Recognition of the described MR imaging pattern in patients with LS should prompt a search for COX deficiency and SURF1 gene mutations leading to muscle biopsy and DNA testing.

P 094

Gemella Morbillorum Subdural Empyema and Hematoma Complicating Acute Sinusitis

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Purpose: Gemella morbillorum, a commensal of the oropharynx, upper respiratory, urogenital and gastrointestinal tract is rarely associated with infections in humans. Only 5 cases of cerebral abscesses were described in the literature. Sub-dural empyema (complication of frontal sinusitis) are also uncommon.

Case Report: A 10 year old female case of left frontal subdural empyema and hematoma (SEH) by Gemella morbillorum secondary to ipsilateral acute sinusitis, complicated with frontal cerebritis is described. Altered speech and meningeal signs led to SEH and left sinus surgical drainage. Meanwhile, the patient became hemiparetic and afasic. Due to focal seizures, a status epilepticus episode, an altered consciousness state and a head computerized tomography (CT) showing worsening of the left frontal edema with significant mass effect and mid-line right shift despite maximal medical treatment. An emergent decompressing pterional craniotomy was performed. At diagnosis, high dose empirical antimicrobials (cefotaxime, vancomycin, metronidazole) were introduced and replaced when antibiogram sensitivities (ampicilin, clindamica and voriconazol) were known. All antimicrobials were suspended, because of an idiossacratic reaction - exanthema multiforme - and chloramphenicol was given until 6 weeks of treatment. Anticonvulsivants (phenytoin and phenobarbital) and high dose dexametasone to reduce the mass effect and mid-line shift were also introduced. The patient had a progressive neurologic and imaging recovery. Control CT showing only a small sequelar lesion in anterior left frontal lobe. At hospital discharge, there still were still some motor deficits with difficulty in fine motor skills in the right hand and trouble in climbing stairs.

Conclusion: Gemella morbillorum should not only be considered as commensal to the mucous membranes, but appear as emerging pathogens involved in endocarditis, septic shock, necrotizing pneumonia and serious intra-cranial infections.

P 095

Possible Clinical Applications of the MR-NOVA Software in Cerebrovascular Diseases

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Aim: To evaluate the possible diagnostic applications of the NOVA software (Non invasive- Optimal- Vessel-Analysis, VasSol inc.) in order to obtain measurements of cerebral blood flow.

Patients and Method: we evaluated a total number of 32 patients (12FP20M, range 5-81y-o, mean age 59y): 15 patients with extracranial stenosis, 8 with intracranial stenosis; 5 with stenosis/occlusion due to giant aneurysm, 3 after extra-intracranial by-pass and 1 with intracranial venous thrombosis. Protocol: angioMR-3D without contrast administration, automatic elaboration of the data with the NOVA software, further elaboration with NOVA-PC (Phase-Contrast) 12. Check of the quality of the results and, if necessary, further data acquisition. Only for venous study contrast administration is mandatory.

Result: All the acquisition have been successfully performed. Timing: angiomR-3D 6 minutes, 3D-reconstruction and positioning of the “roi of interest” 3 minutes, NOVA-PC 1 minute/vessel, data elaboration 3 minutes. Mean time for a 6 vessels study: 18 minutes. We confirmed significant hemodynamic anomalies in 18 patients.

Discussion: Our preliminary experience shows that NOVA represents an useful tool in case of 1) Noninvasive cerebral blood flow study with NOVA is a feasible and safe technique without specific contraindications and with a numerous clinical diagnostic indications (3). Moreover, more extensive study are necessary in order to validate the technique in the study of cerebrovascular diseases.

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POSTER EXHIBIT 2nd
Thursday, 7 October - Saturday, 9 October

Advanced Imaging Modalities

P 001

Clinical Utility of DTI Sequence in Brain: Fraction Anisotropy (FA) Add New Information to Conventional Imaging in Some Pathologies

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Introduction: Diffusion tensor imaging (DTI) has been used in many brain studies with the aim to find differences between controls and different kinds of brain illness. These studies go from psychiatric disorders to brain tumours. In these studies it is possible to see imaging that look normal to totally abnormal. Actually it is unclear the utility or not of this sequence as a clinical one, in the sense to use it routinely, because it is unclear if it adds new information to the usual imaging. Here we presented some clinical patients, who came with different diagnostics, who had “normal” brain imaging, where as “normal” we mean that a radiologist defined it as normal, but with an abnormal FA pattern, easy to see in a common FA imaging. The processing was done with the software provided by the scanner manufacturer. We concluded that sometimes the DTI helps to find some abnormal regions in epilepsy patients unseen in classical imaging. In traumatic and psychiatric patients FA show much more abnormal affected regions, unobserved in other sequence.

Methods: 7 patients were scanned in a 3 T o 1.5 T GE scanner with a commercial 8 channel brain coil. The sequences and spatial orientation depended on the type of pathology to study, but in general it consist of 2D T2, T1 and Flair imaging, a 3D SPGR T1, GRE, a high resolution T2 in hippocampus in epilepsy protocol and a DTI. The DTI acquisition were made with 55 directions, 24-25 cm FOV (depending head size), b=1000 mm/seg2, TR:1000 mseg., and a thickness slice of 3 mm in 3T and 4 mm in 1.5 T (8:30 min aprox). Epilepsy patients had spectroscopy acquisitions in both hippocampus. Total scanner time 1-1:15 hs.. DTI post-processing was made with Functool the GE software to post processing functional studies.

Conclusion: Being DTI a relative new sequence in the group of MR imaging, this sequence it is not used routinely in brain studies, mainly as it seems not to give additional information. In this presentation we showed the utility to perform DTI acquisitions as FA imaging add new information in some diseases like traumatic and psychiatric disorder. It also helps to find a lesion or possible epileptic origin in epilepsy patients that could not be seen in common MRI imaging. We also believe that as the FA imaging could be unfamiliar to radiologist, learn to interpret DTI imaging is the principal stage to consider before making some assumptions.

Epilepsy with left temporal focus determined by electroencephalogram with a FA reduction in left temporal and normal imaging. Spectroscopy was done (not showed) with NAA reduction un left hippocampus.

Psychiatric patient with a m inor brain atrophy with a clear FA reduction in parietal and occipital regions unseen in T2 and Flair imaging.

Possible Gliomatosis Cerebri tumour, with positive perfusion in thalamus, with a clear FA reduction in frontal and parietal regions that have not seen in T2 and Flair imaging.

Hypoxia in a 45 older patient with a clear FA reduction non seen in normal imaging.

P 002

The Usefulness of Susceptibility Imaging in Clinical Practice

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Objective: To evaluate the usefulness of susceptibility weighted imaging (Swi) in clinical brain MRI.

Materials and Methods: Retrospective study was performed after approval from institutional Ethical Committee (May 2008). The brain MRI with Swi was selected from data base of the radiology department. Only cases with no abnormality in extra-axial location were included into the study. Two neuroradiologists (20 years and 5 years experience respectively) revealed the images from the PACS without knowledge of patients’ history and diagnosis. The Swi was first interpreted. Then conventional MRI (cMRI) was interpreted after finishing data collection from Swi. Clinical data and final diagnosis were collected from information given on requested forms and follow up imaging studies. Descriptive analysis was performed.

Results: From January-May 2008, 45 cases were satisfied the inclusion criteria. There were 26 males and 19 females with age 7-79 years old (means = 46.69). The diagnosis of the patients were vascular disease (infarction/small vessel disease/intraparenchymal hemorrhage in 21 cases), tumor (14 cases), dementia (2 cases), epilepsy (1 case) and inconclusive (7 cases). There were 9 cases (20%) with normal cMRI and Swi. Abnormal findings on Swi related to those found on cMRI in 34 cases (75.6%). Nineteen cases (42.2%) showed abnormal Swi added more information on cMRI which had diagnosis of vascular disease (10 cases), tumor (7 cases), inconclusive (1 case) and atypical Parkinson disease (1 case). For vascular disease, Swi showed microbleed and increased transmedullary vessel which was not seen on cMRI. For tumor group, Swi showed microvascular structure inside the mass which was not demonstrated on cMRI.

Conclusion: In selected cases with suspected or diagnosis of vascular disease and tumor, Swi added more infor-
Feasibility of Fine Anatomical Mapping for Evaluation of the Substantia Nigra Pars Reticulata and Subthalamic Nuclei Using Susceptibility-Weighted Phase Images at 3T

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Introduction: The natural increase in brain iron concentration is observed in the globus pallidus (GP), substantia nigra (SN) and subthalamic nuclei (STN). Abnormal iron accumulation is acknowledged to increase free radical connections that are hard to delineate on standard T2- and T1-weighted images. Phase mapping of SWI is potentially useful for evaluating neuromelanin and microvascular structure. Further study of the relationship of the findings and dynamic/pathophysiologic conditions to predict outcome and plan of patient management is needed.

Results: Increased iron content was observed in the GP and SNpr in all subjects. The phase images of SWI were successfully mapped out for a variety of internal structures of the GP (the internal segment, internal medul lary lamina and external segment) and SN. However, no intense accumulation of iron was detected in the SNpc that contains neuromelanin. It is clearly observed that the SNpr is connected to the GP internal portion through multiple fascicula nigrale tracts (figure). The STN was identified on SWI phase images in most of the subjects. Particularly iron content was clearly shown in the medioventral part of the STN. The GP internal segment seems to connect to the STN through subthalamic fasciculare that is a part of the indirect pathway of the basal ganglia motor loop. Abnormal iron accumulation was identified in the medial portion of the SN in 14 of 60 with PD, although fast spin-echo T2-weighted images failed to depict iron accumulation.

Conclusions: Susceptibility-weighted phase images at 3 tesla make it possible to demonstrate anatomical details of the basal ganglia and their fiber connections that are hard to delineate on standard T2- and T1-weighted images. Phase mapping of SWI is potentially useful for evaluating neurodegeneration with iron accumulation in PD.

References:

Diffusion Anisotropy Analysis of Association Fibers Tracts in Heroin Abuser

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Background: The association fibers unite different parts of the same cerebral hemisphere. The function of association fibers is considered to be part of the limbic system. Heroin is the diacetyl derivative of morphine. Heroin-induced encephalopathy and neuropsychological deficits have been identified. We hypothesized that chronic heroin abusers may have microstructure change of association fibers of brain. Diffusion Tensor Imaging (DTI) can provide both structure and functional information of brain white matter. The purpose of this study is to identify the microstructure change of association fibers in chronic heroin users.

Materials and Methods: DTI were obtained in 35 chronic heroin users (mean age, 35.6; 6 females and 29 males) and 35 healthy volunteers (mean age, 39.4; 24 females and, 11 males) by using a 1.5T MR imaging scanner. All participants provided written informed consent and approved by the Institutional Review Board of Chung Shan Medical University Hospital. The region of interest (ROI) were positioned in the right temporal lobe and left temporal lobe compared with those of the controls (P value<0.001 and =0.028). The FA analysis revealing significant low in right ILF of the chronic heroin users compared with the controls (P value=0.009).White matter FA values of the other brain regions in the chronic heroin users did not significantly differ from the healthy controls.

Conclusion: Our study shows the microstructure change in white matter of bilateral temporal regions of chronic heroin users. These focal structural deficits may explain, in part of neuropsychological deficits in chronic heroin abuser subjects.

SPECT in Neuroimaging: A Pictorial Review

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Learning Objectives: 1. To understand basic principles of SPECT, commonly used radioligands, procedure, advantages and safety issues. 2. To highlight various common and rare indica-
tions. 3. To illustrate normal, various pathologies, pitfalls and limitations.

**Background:** SPECT is a specialist adjunctive functional investigation in the diagnosis of various CNS pathologies. The images are acquired using a gamma camera after a gamma emitting radioisotope tracer is injected into the blood stream. A clear understanding of SPECT and the normal brain perfusion is important to interpret the scan. There are range of variations seen within normal SPECT and should be recognised. We illustrate imaging findings in various diseases such as dementia, epilepsy, parkinsonism, meningioma, glioma and recurrence of intracranial tumours.

**Imaging Findings:** We describe basics of SPECT imaging: commonly used radioligand such as Tc-99m HMPAO, FPCIT, thallium scan, iodium labelled octreotide, and other radioligands used in current ongoing research in our department such as beta- CIT, Ms IENT and 51A-85380.

**Conclusion:** SPECT provide important information about pathologies not given by other imaging modalities such as CT and MRI. In this pictorial review, we describe basics of SPECT, radioligands and various pathologies as an introduction to junior radiology trainees.

### Cerebrovascular Disease: Imaging and Intervention

**P 006**

**Usefulness of Three-Dimensional Digital Subtraction Angiography in Endovascular Treatment of a Spinal Dural Arteriovenous Fistula**

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The use of 3D digital subtraction angiography (DSA) provides a better understanding of spinal vascular lesion architecture. The authors report on 4 cases involving a spinal dural arteriovenous fistula (DAVF) and demonstrate the usefulness of 3D DSA for endovascular treatment of these spinal DAVFs. In all cases, middle-aged and elderly male patients suffered from bilateral leg hypesthesia, gait disturbance, and urinary dysfunction several months before treatment. Spinal angiography revealed DAVFs that were fed by a radicular artery branching from the intercostal artery and draining veins proceeding superiorly along the perimedullary veins. Endovascular embolization was performed in all cases. Selective 3D DSA of the intercostal artery clearly demonstrated the tortuous course of the feeder and the relationship among the feeding artery, fistula point, and draining veins in each case. This information was very useful in selecting a working angle for manipulating the microcatheter and for glue injection. In addition, the maximum intensity projection image from rotational DSA data clearly showed the fistula point at the dural sleeve and feeder entering the spinal canal via the intervertebral foramen and the relationship with the bone structure. Successful obliteration of the fistulae was achieved in both cases. Selective spinal 3D DSA was very useful in understanding the complex spinal vascular architecture and in choosing the best working angle and therapeutic strategy for endovascular treatment of spinal DAVFs.

**Figure 3D DSA images obtained from rotational angiography data. A and B: non-subtraction (A) and subtraction (B) 3D DSA images show the relationship between bone and vascular structures. B: Selective 3D DSA image of the working angle used for catheterization and NBCA injection. C: Selective intercostal angiogram of a similar view to panel B. D: Schematic illustration; radicular artery (1), fistula point (2), and draining vein (3). E: The fistula point is clearly visualized (arrow). F: NBCA penetrated into the draining vein (arrows).**

**P 007**

**Comparison of Multidetector Computed Tomography Venogram (MDCTV) and magnetic Resonance Venogram (MRV) in Suspected Cerebral Venous Sinus Thrombosis**

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**Background and Purpose** MR venography (MRV) has long been considered the non-interventional ‘gold standard’ in diagnosing cerebral venous sinus thrombosis (CVST). Our purpose is to determine the sensitivity and specificity of multi-detector CT venography (MD-CTV) in diagnosing CVST as compared to various field-strength of MRV. We also studied comparison of visualization rate of the cerebral veins and dural sinuses among these imaging modalities.

**Materials and Methods** MDCTV were prospectively performed on 27 patients with clinical suspicion of CVST. 16-sliced multidetector CT was used with the scan acquisition obtained at a delayed 90 seconds interval in order to obtain peak venous enhancement. Our patients underwent corresponding MR brain / MRV scan of either 0.3T, 1.5T or 3.0T field-strength. Two neuroradiologists reviewed the images for presence of CVST. The results were compared with final diagnosis derived from constellation of clinical findings. Sensitivities, specificities, positive and negative predictive values and diagnostic accuracy were calculated for MDCTV and MRV findings. In the non-thrombotic group of patients, descriptive study of the anatomical visualization of cerebral veins and dural sinuses was undertaken.

**Results:** There were 10 cases of CVST. The neuroradiologists’ consensus reading correctly identified these 10 cases in both the MDCTV and MRV scans with sensitivity rate of 100% respectively. However, there was one false-positive result in MDCTV and 3 false-positive cases in the MRV group with positive predictive values of 90.9% and 76.9% respectively. MDCTV was more reliable than MRV in diagnosing CVST with specificity rate of 94.1% and 82.4% respectively.

**Conclusion:** Diagnosis of CVST depends heavily on radiological imaging and our study shows that MDCTV is a sensitive diagnostic tool. It can be performed in shorter scanning time with lesser artefacts as compared to MRV. Better anatomical visualization of the cerebral venous system at MDCTV in comparison with various field-strength of MRV may increase the confidence level of the radiologist in diagnosing this elusive pathology.

**P 008**

**Variation of Dural Sinuses in Intracranial Dural Arteriovenous Fistulas**

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**Background:** Variation of dural sinuses can be found in intracranial dural arteriovenous fistulas (dAVFs) and can affect the venous drainage from dAVFs. In this paper, we demonstrate the cases of dural AVF with several types of variation of dural sinuses and discuss its clinical significance and relationship with potential pathogenesis.
Materials and Methods: We reviewed radiological findings including selective angiography, MR angiography, and CT angiography, interventional procedures, and clinical findings in 86 cases of intracranial dAVFs diagnosed in our institutions. Locations of dAVFs are 36 cavernous sinuses (CS), 28 transverse-sigmoid sinuses (TSS), 6 condylar veins, 6 tentorium, and 6 others, respectively. Results: CS dural AVFs showed several variations including unusual termination of superficial middle cerebral vein and inferior petrosal sinus, and developed uncal vein. Duplication/ septation and/or parasinus venous structures of TS and superior sagittal sinus (SSS) were often observed in TSS and SSS dAVFs. Several variations of sinus confluence were related to clinical symptoms in cases of TSS and SSS dAVFs. Developed occipital sinus and primitive tentorial sinus were also observed.

Conclusion: DAVF can be often associated with variation of dural sinus, some of which can affect the technical difficulty during transvenous embolization procedures, and clinical symptoms. Septation/duplication of the dural sinus may cause the development of dAVFs.

P 009

EEG and MR Findings in Neuropsychiatric Lupus Patients with Epilepsy


Aim of the study: we evaluated the morphological and electrophysiologically findings in patients with definite systemic lupus erythematosus (SLE) affecting the central nervous system (NP-SLE).

Patients and Methods: we have prospectively investigated 27 NP-SLE patients with epilepsy by the electroencephalography (EEG) and magnetic resonance imaging (MRI). The EEG abnormalities were divided to slow persistent, slow general episodic and diffuse slow ones. 1.5 T MR was made in T1 weighted, T2 weighted and flow atenuation inversion recovery (FLAIR) mode.

Results: we observed the predominance of generalized episodic and persistent slow wave EEG abnormalities but the EEG was not specific in different kinds of clinical impairment. The focal slow EEG abnormalities were nonspecific without correlation with any types of epileptic attacks or other symptomatology. The episodic abnormalities slightly prevailed in SLE patients with cognitive disorders accompanied by an intensive recurrent headache or stroke, but were not specifically bound to this symptomatology.

The diffuse EEG abnormalities correlated with case history of epileptic- tonic-clonic seizures. Relatively small (<3mm) subcortical white matter lesions in frontal and parietal lobes sparing U fibers prevailed in all our active NP-SLE patients in MR.

Conclusions: MR lesions were localized in the subcortical region thus affecting the long corticocortical pathways and cortico-subcortical circuits. No special regional affection was observed in patients with particular type of epilepsy or EEG pathiology. The consequence of multiple axonal degeneration, neuronal functional or structural impairment is a disruption of nonspecific reticular projections to cerebral cortex and deafferentation of thalamocortical circuit which can be reflected by EEG changes.

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References


P 010

High Resolution MRI in Diagnosis of Intracranial Arterial Dissection


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Background and Purpose: Discrimination between dissection and atherosclerosis of intracranial artery is sometimes difficult without subarachnoid hemorrhage or clear demonstration of intimal flap which is often invisible on angiograms. The purpose of this study was to validate the usefulness of high resolution (HR) MRI in diagnosis of dissection of intracranial arteries.

Methods: Ten patients who had suspicious findings for dissection of intracranial artery (3 middle cerebral arteries, 1 basilar artery and 6 vertebral arteries) on angiograms were included.

The HRMRI was performed with a 3T MR machine and based on proton density-weighted images of transaxial and/or coronal plane with parameters of TR/TE = 2500/30 msec, field of view = 120 x 110 mm, matrix size = 256 x 223, echo train length = 6, number of excitation = 4, slice thickness = 2mm, longitudinal coverage = 40-60 mm (20-30 slices), reconstructed voxel size = 0.23 x 0.23 x 2 mm.

Results: The angiographic findings were aneurysm (n=2), pearl-string appearance (n=5), stenosis (n=2) and obstruction (n=1) (Table 1). On HRMRI, 5 patients showed intimal flap, 3 patients showed atherosclerotic plaque instead of intimal flap at the stenosis or obstruction site and the remaining 2 patients showed thinning and dilatation of vessel wall without intimal flap or atherosclerotic plaque. In one patient (Figure 1), stenosis at right middle cerebral artery was due to intimal flap and subsequent follow-up HRMRIs showed gradual healing of intimal flap and partial improvement of stenosis.

Conclusion: HRMRI may be a useful method in confirmation or exclusion of dissection of intracranial artery by demonstrating intimal flap or atherosclerotic plaque.
Focal Alopecia in Embolization of Brain Arteriovenous Malformation (BAVM) with Onyx HD-500: Case Report and Review

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Introduction: Arteriovenous malformations of the brain (BAVMs) are considered congenital and are formed prior to birth. BAVMs are an abnormal tangle of vessels where the arteries are connected directly to the veins without the smaller capillaries. Without capillaries, slow the blood flow, high pressure blood flowing into the veins causes them to widen and sometimes rupture and hemorrhage. BAVMs are fed by one or more arteries, and are drained by one or more major draining veins; these feeding and draining vessels may be unusually tortuous and unusually large. The greatest concentration of vessels in the central portion of the AVM nidus, is made up of abnormal blood vessels that are hybrids between true arteries and veins. Approximately 80% of the estimated 300,000 Americans with AVMs will experience few, if any, symptoms. Those who do experience symptoms vary greatly in severity. In addition to seizures and headaches, AVMs can also cause a wide range of neurological problems such as muscle weakness, loss of coordination, dizziness, memory deficits, and mental confusion. Patients with AVMs have a 3-4% risk per year of hemorrhage from the AVM. When a patient suffers such a bleed, there is a 10% chance of dying, and a 20% chance of a stroke.

Case Report: A 19-year-old young woman, with a history of headache from childhood, presented to our Hospital in June 2009, after a right hemiparesis with muscle weakness and loss of coordination. TC/CT and Digital Angiography show a BAVM “large”, 6x5x4 cm, in left fronto-parietal hemisphere, deep and cortical, with arterial feeder from branches of both anterior cerebral arteries (ACA), left media cerebral artery (MCA) and left posterior cerebral artery (PCA), with large draining vessels in dural venous system; without signs of acute hematoma. Grade 3 in Spetzler-Martin classification. We performed partial embolization with Onyx in June (30% of the BAVM, M; 3cc of Onyx; 0, 58 min of Fluoroscopy, F) and July (25% M; 4,8 O; 108 min of F) 2009 without major complications, she has only transient little troubles of verbal expression and dioplia, completely disappeared. In few weeks after the embolization, appears a focal alopecia (F.A) in left parietal side of the skull, slowly decreasing but not yet recovered (January 2010).

Discussion: In literature there are not studies reporting cases of FA following neuro-endovascular treatment by Onyx. Nevertheless the largest multicentric study about Onyx in the United States, the Investigational Device Exemption (IDE), report an high incidence of generic Alopecia (21,2%). The largest multicentric european study about the use of Onyx as embolic agent, called Complex Aneurysm Multicenter European Onyx (CAMEO; American Journal of Neuroradiology, AJNR 2004) and the largers european single center studies, made by Cekirge (Neuroradiology 2006) and Moret (AJNR 2007) groups, no mention alopecia, as complication of Onyx embolization. Also the last international study about embolization with Onyx in pediatric BAVMs (AJNR 2010) no mention any single case of FA.

Conclusion: Principals studies about Onyx in treatment of neurovascular pathologies report major complications, mainly neurological damages. This point and the percentage of Alopecia of IDE study suggest that focal Alopecia could be not so rare as a literature review could show. So we think could be convenient include FA in consent form. This could reduce, mainly in young patients, the psychological impact of this unusual unpleasant event and avoid legal problems for the physician.

Purpose: We propose a case of embolization, with Onyx, of a BAVM in a young girl, provocating Focal Alopecia (FA) of the skull in the side of BAVM, embolized and show a literature review about this unusual minor complication.

Case: Young girl, nineteen years old, with story of headache from childhood, progressively intensifying, appears a focal alopecia (F.A) in left parietal side of the skull, slowly decreasing but not yet recovered (January 2010).

Purpose and Background: This study’s objective was to compare the accuracy of various imaging modalities such as spiral computed tomography (sCT), magnetic resonance angiography (MRA) and digital subtraction angiography (DSA) in detection and quantitative assessment of occlusive and stenotic diseases of the carotid arteries, with evaluation of the character and extent of arterial wall lesion and the structure of the atherosclerotic plaques. The correlation between hemodynamic parameters measured with phase contrast MRI (pcMRI) and duplex scanning in carotid arteries was also performed.

Materials and Method: 67 symptomatic patients underwent sCT, MRA (3D TOF and 2D TOF, bolus chased MR angiography), pcMRI with assessment of both linear and volume blood flow rates and duplex scanning. 53 symptomatic patients underwent DSA as carotid endarterectomy was planned in those cases. The degree of carotid artery stenosis was evaluated according to NASCET criteria.

Results: In patients with 70% carotid stenosis the specificity and sensitivity were found to be of 96% and 87% respectively when comparing between the sCT and DSA data. The sensitivity and specificity of MRA relative to the DSA in patients with carotid occlusive lesions were found in patients with occlusive lesions of the carotid arteries of various degrees were included in the study. All patients underwent sCT, MRA (3D TOF and 2D TOF, bolus chased MR angiography), pcMRI with assessment of both linear and volume blood flow rates and duplex scanning. 53 symptomatic patients underwent DSA as carotid endarterectomy was planned in those cases. The degree of carotid artery stenosis was overestimated in six cases of MRA. In comparison to the MRA, sCT had an advantage in evaluation of the structure of the atherosclerotic plaque. The plaques with density of 50-130 HU were considered as “mild” ones, plaques with density of 50-130 HU and more than 130 HU were considered as fibrous and calcified ones respectively. 3D TOF MRI was performed as a preliminary technique for subsequent planning of pcMRA and bolus chased MR angiography. The difference in values of linear blood flow measured with pcMRA and duplex scanning ranged from 18% to 25%.

Conclusions: Strong correlation between sCT, MRA and DSA data was found in patients with occlusive lesions of carotid arteries. sCT is a preferable technique because of its advantages. The combination of sCT and duplex...
scanning provides reliable data sufficient for planning of the surgical treatment. sCT and bolus chased MRA measurements correlated highly with DSA data. Further studies need to establish the significance of the differences in blood flow values obtained by pcMRA and duplex scanning and the role of these techniques in surgical planning.

P 014
Quantitative Evaluation of the Penumbra in Acute Cerebral Infarction Using Whole-Brain CT Perfusion
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Purpose: In acute cerebral ischemia, a region of mild ischemia referred to as the penumbra is present around the ischemic core. The region that is presumed to be the penumbra can be quantitatively evaluated using whole-brain computed tomography perfusion (CTP). The present study was conducted to assess whether quantitative evaluation using whole-brain CTP is useful for determining whether areas in the penumbra will subsequently change to become part of the ischemic core.

Methods: The subjects were 11 patients (6 men and 5 women, age range: 59 to 80 years, mean age: 73 years) with acute cerebral infarction (time after the onset of symptoms: 1.25 to 24 hours, mean time after onset: 4.4 hours) as diagnosed by magnetic resonance imaging (MRI). They included 9 patients with middle cerebral artery occlusion and 2 with internal carotid artery occlusion. Whole-brain CTP was performed for all subjects using a 320-row area detector CT scanner (Aquilion ONE, Toshiba Medical Systems Corporation). The reformulated singular value decomposition method was used for CTP analysis. First, the sizes of the areas of infarction observed by MRI soon after onset were compared with the sizes observed by follow-up CT or MRI, and the subjects were then classified into two groups: the group without expansion of the area of infarction (Group A) and the group with expansion of the area of infarction (Group B). The region in which the time-to-peak (TTP) was prolonged and the cerebral blood volume (CBV) was greater than 2 mL/100 g was defined as the penumbra. In this region, the cerebral blood flow (CBF), CBV, mean transit time (MTT), TTP, and Tmax were measured using automatic regions of interest (ROI) analysis (prototype template ROI function, Toshiba Medical Systems Corporation). The differences in these measured values between the two groups were then analyzed to determine their statistical significance.

Results: In the 11 subjects, follow-up CT or MRI showed that the area of infarction had increased in size in 4 subjects (group with expansion of the area of infarction) and had not increased in size in 7 subjects (group without expansion of the area of infarction). The measured values for the penumbra in the group without expansion of the area of infarction were CBF = 20 Å̂4.65 mL/100 g/min, CBV = 2.4Å̂0.29 mL/100 g, MTT = 7.2Å̂1.02 s, TTP = 22.2Å̂8.31 s, and Tmax = 8.3Å̂13.58 s, and the values in the group with expansion of the area of infarction were CBF = 28Å̂6.46 mL/100 g/min, CBV = 2.8Å̂0.51 mL/100 g, MTT = 5.9Å̂0.95 s, TTP = 17.1Å̂2.41 s, and Tmax = 7.5Å̂13.19 s.

The group with expansion of the area of infarction showed significantly higher CBF and CBV values and significantly lower MTT and TTP values than the group without expansion of the area of infarction. Quantitative assessment of the Tmax values showed no significant difference between the two groups.

Discussion: Automatic ROI analysis makes it possible to perform quantitative evaluation objectively using whole-brain CTP. Areas in the penumbra with a relatively small reduction in perfusion pressure and a slightly elevated CBV are likely to subsequently change to become part of the ischemic core. Further studies involving larger numbers of patients must be conducted to assess the usefulness of this method for evaluating each type of cerebral infarction as well as to determine the optimal CBV threshold setting for evaluation of the penumbra.

P 015
Flow Dynamics of Cerebral Aneurysms Using Time Resolved 3D Phase-Contrast MRI (4D-Flow)
- Comparison with Computer Fluid Dynamics
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Background & Purpose: Cerebral aneurysm is formed by the flow dynamic stress against the intima at the arterial bifurcation. Computational fluid dynamics (CFD) is a popular method to clarify the blood flow pressure, wall shear stress for the analysis of intracranial flow dynamics. We developed the 4D-flow simulation method using 3T MRI, and the data obtained from this new method was compared with those from CFD.

Material & Method: We investigated 13 patients with cerebral aneurysms including two rupture and 11 unruptured ones. The patients underwent the 3T MR imaging with 3D phase contrast methods, and the DICOM data was analyzed with postprocessing software (Flow visualization and analysis (Flowa)) to make 3D image including 3D streamline, flow velocity profile and wall shear stress. 3D-CT angiogram was taken in all patients and the 3D-reconstructed image using supercomputer (VPF5000) was analyzed to make the same imaging simulation with FURITSU a FLOW.

Results & Discussion: Both methods to visualize the aneurysm flow dynamics are well correlated on visual and quantitative evaluation. However, the resolution of detailed flow patterns like as lamina flow, interference and vortex formation is obviously superior to 4D-Flow. Further, total time of processing speed is more rapid in 4D-Flow. MRI flow analysis is the very useful method for outdoor patients with unruptured cerebral aneurysm to predict the growth and rupture in the future, and to suggest the proper treatment strategy.
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Aim of the study: is to determine the extent of brain impairment in patients with verified systemic lupus erythematosus (SLE) with neuropsychiatric manifestations (NP-SLE) and cerebral vascular events. The study has two parts: one part is retrospective, second part prospective, both are based on the monitoring of SLE patients with stroke in the nationwide register of SLE patients in the Czech republic. Impairment of their brain was evaluated by magnetic resonance imaging (MRI) and correlated with: - the results of other investigative methods, - with the occurrence of risk factors for atherosclerosis, - with age, sex, disease activity index, - with a range of other organ impairment induced SLE disease and complications of treatment.

Patients and Methods: a cohort of 30 verified NP-SLE patients with clinical stroke were studied (only females), second group of 30 SLE patients without stroke represented the control group. All patients were investigated by clinical and laboratory examination and 1.5 T magnetic resonance imaging (MR). MR investigation was done in T1-weighted, T2-weighted images (Spin-echo and turbo spin-echo modes) and flow attenuation inversion recovery (FLAIR). The pathologic lesions in cerebral white matter were rated by their size, localization and type.

Results: all patients had pathologic MR findings as supratentorial foci up to 3 mm in size, predominantly in the frontal and parietal lobes subcortically. Periventricular and infratentorial foci were less frequent. In 80% of NP-SLE patients wedge-shaped post-maternal pseudocysts were detected in various regions of the brain due to clinical event, which were not present in SLE group. Stroke in patients with SLE is found most often within five years from the beginning of clinical manifestations of the SLE disease, in 10% of NP-SLE patients. In patients with arterial stroke were more frequently represented: cigarette smoking, discoid lupus, valvular disease, arterial hypertension, epilepsy and anemia in comparison with SLE patients without stroke. Patients with arterial stroke had more active disease than patients without stroke. The study was supported by research project MZO 00064165 and grant GAUK.

Purpose: To evaluate the CT imaging findings in patients with acute stroke. To determine the therapeutic decisions based on CT Perfusion and CT Angiography findings.

Introduction: Stroke can be defined as an acute central nervous system injury with an abrupt onset. Since acute stroke is now considered a potentially treatable condition, a rapid and correct diagnosis must be made. The first step is to exclude hemorrhage, then to visualize any early ischemic changes, demonstrate the presence of hypoperfusion and locate the presence of a vascular underlying pathology as well as elucidate the presence of a potential penumbra (tissue at risk). The decision to treat a patient has to be done based on the time window and other factors such as the duration of the symptoms, the age, risk factors, clinical status of the patient, location and size of the infarct, demonstration of penumbra, arterial obstruction and the presence of collateral vessels. Currently brain imaging has been proposed as a method for identifying patients likely to respond favourably or unfavourably to IV thrombolysis. On CT perfusion imaging the CBV region of abnormality represents the injured tissue and the CBF/MTT CBV/TPT mismatch represents the surrounding region of tissue that is hypoperfused but salvageable.

Material and Methods: From October 2008 to June 2009 we have treated 196 stroke patients. The time window we used was 4 hours and a half since the beginning of symptoms. We used a 64 multidetector CT. The protocol includes a baseline non contrast CT. CT angiography of the supraaortic and intracranial vessels using 50ml of non ionic contrast media, with an injection rate of 2ml/sec and a perfusion study using 50ml of contrast with an injection rate of 5ml/sec. The perfusion study was centered on the basal ganglia with 4 slice acquisition. CBV, CBF and TTP were calculated using the commercially available SiemensLeonardo Workstation. 76 patients were treated intravenously, 12 patients received intra-arterial treatment, three cases received only intra-arterial treatment, in seven cases a mechanical extraction of the thrombus was performed with a Merci catheter, in one case a micro catheter was used to extract mechanically the thrombus, in one case the patient received intravenous, intra-arterial treatment and a stent placement, one case intra-arterial and stent placement and in one case only a stent placement. 94 cases were not treated due to hemorrhage or other clinical or imaging findings that excluded the patient as a candidate.

Conclusion: CT perfusion can be used to demonstrate the salvageable tissue and the extension of tissue at risk. CT angiography represents a useful tool to assess vessel status. Arterial occlusion gives information about the mechanism of the infarct, influences the prognosis and the therapeutic decisions intravenous or intra-arterial treatment.
enough enhancement and no diffusion restriction. Follow-up MRI performed 5 days later showed complete resolution of the above findings.

Cerebral Ischemia: The prevalence of cerebral infarction and transient ischemic attacks is estimated to increase fivefold to 10-fold during pregnancy, with middle cerebral artery occlusions, even bilateral, being the commonest. There was one case of post-partum basal ganglia infarction in our series in a 26-yr old woman who developed cyanosis and loss of consciousness during difficult labor. The lesions were located in both thalami and had mild increase signal intensity in T2-weighted and FLAIR images.

Subarachnoid Hemorrhage (SAH): Although the commonest cause of SAH remains the rupture of an intracranial aneurysm, primary nonaneurysmal SAH can rarely occur. We illustrate a case of nonaneurysmal SAH in a 46-yr old woman who presented with severe headache, visual disturbances, nausea and loss of consciousness 8 days after delivery, with a history of HELLP syndrome during pregnancy. T1-weighted and FFE images showed SAH at the suprasellar, perimesencephalic and prefrontal cisterns. Additional FLAIR images revealed subtle SAH over the convexities. The DSA that followed excluded the presence of an intracranial aneurysm.

Cerebral Venous Thrombosis (CVT): Pregnancy is a prothrombotic state and the prevalence of CVT during the course of pregnancy, with middle cerebral artery occlusions, is very high. There were 2 cases of CVT both involving pregnant women, at 8w and 38w GA respectively. Transverse venography revealed subtle SAH over the convexities. The DSA that followed excluded the presence of an intracranial aneurysm.

MR Imaging and MR Angiography in Migrainous Patients

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MR Imaging and MR Angiography (MRA) in migrainous patients and their correlation to the attacks frequency. In adult population, the incidence of migraine is significantly higher in women (65 - 75% migraineurs).

The patients: the prospective study included 40 migraineurs, 30 of patients suffered from migraine without aura, 10 from migraine with aura. All patients were investigated by MR imaging and MRA (1.5T). Findings were related to the age of patients, the clinical parameters, the findings in electroencephalography (EEG), seizures frequency and related treatment statistically.

Results and Discussion: the aura arises by reducing regional cerebral flow in the occipital region. This hypoperfusion gradually spread forward to the parietal area regardless of the blood supply of the area. The period of oligemia is followed by hyperemia inducing meninges irritation in area of trigeminal innervation. Cerebral MRI shows the area where the perfusion has led to brain ischemia featuring the image of postischemic pseudocysts. Fine perfusion disorders are not detected, but it both groups of migrainous patients we found a higher incidence of extended perivascular spaces around small arteries and higher incidence of hypoperfusion.

Conclusion: the aura is expected to be areas of hypoxia/ischemia, caused by migrainous attacks which should be in the areas around small arteries.

References

Stenosis Asymmetry Index between Symptomatic and Symptomatic Patients in the Analysis of Carotid Arteries

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Purpose: Extracranial carotid artery stenosis is accepted as a significant risk factor for cerebrovascular events. The purpose of this work was to compare the stenosis asymmetry index (SAI) in symptomatic and asymptomatic patients. Methods: 60 consecutive symptomatic (male 36, median age 64) patients and 60 consecutive non-symptomatic patients matched for gender and age, were analyzed by using a 40-detector-row CT angiography. Each patient was analyzed by injecting 80 ml of contrast material at a 5 ml/sec flow rate. Stenosis degree of 240 carotids was calculated according to NASCET method. For each patient, the ratio between the most severe stenosis and the contralateral was calculated to obtain the SAI. Wilcoxon test was applied to evaluate difference between asymmetry index in symptomatic and asymptomatic group. ROC curve was also calculated.

Results: Results of our study indicate a mean SAI of 1.49 (95% CI 1.39 - 1.58) in asymptomatic group and a mean SAI of 1.69 (95% CI 1.54 - 1.84) in the symptomatic group with a statistically significant difference (p value = 0.003). The ROC curve analysis indicated that an SAI value of 1.8 has a specificity of 85% presence of cerebral symptoms whereas to have a sensitivity of 85% we should use a 1.2 AI.

Conclusion: Clinical detection of re-bleeding of intracranial aneurysms may be difficult in intubated, high clinical grade patients. The imaging features of active rupture during angi-CT must be known and immediately recognized, since this critical information leads to timely treatment.

Rupture of an Intracranial Aneurysm during Anglo-CT

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Introduction: Anglo-CT is widely used for the diagnosis of ruptured intracranial aneurysms. At times, it can reveal intraprocedural re-bleeding. Recognition of the latter is crucial, especially in the unconscious patient where there are no other indicators for neurological deterioration.

Methods: Case report of an intraprocedural rupture of an anterior commu-

nicking artery aneurysm and review of the relevant literature.

Results: A 52 year old female pre-

senting with headache, followed by seizure and rapid neurological deter-

ioration necessitating intubation and sedation. CT showed a right paramedian frontal intracerebral haem-

matoma associated with subarachnoid and intraventricular haemorrhage. 3D-angiographic reconstruction demon-

strated the ejection of contrast medium from the aneurysm. After emergency craniectomy, the surgical clipping of the aneurysm, and intensive post-operative care, the patient recovered most of her cognitive function. Imaging features of intraprocedural aneurysm ruptures are reviewed.

Conclusion: Clinical detection of re-

bleeding of intracranial aneurysms may be
difficult in intubated, high clinical grade patients. The imaging features of active rupture during angi-CT must be known and immediately recognized, since this critical information leads to timely treatment.
formation in the stroke area after 5-7 days since the disease onset. At least 63% of venous infarct cases were accompanied by hemorrhage which could significantly influence the therapy tactics. Summarizing the above mentioned it should be noted that reliable non-invasive differential diagnosis of arterial and venous infarcts is possible only with the implementation of MR or CT angiography, CT-perfusion which allow to specify which main vessel (arterial or venous) is affected and becoming the cause of a stroke without critical time loss for active therapy. Perhaps, a venous infarct will become not so rare diagnosis resulting the implementation of tomaangiographic techniques adding common CT or MRI of brain. Venous nature of a stroke - if taking into account high risk of hemorrhage - can become one of the contra-indications to intravenous systemic thrombolytic therapy (not for selective procedure).

P 023
Pre- and Post-Angioplasty Perfusion Study with Perfusion CT in Patient with Cerebrovascular Stenotic Disease
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Purpose: Diamox Single Photon Emission Computed Tomography (SPECT) is a representative method for the evaluation of reservoir capacity in the patients with cerebral ischemia. However, its low image resolution is a major drawback. The authors assessed cerebral hemodynamics by using perfusion CT (PCT) including acetazolamide challenge.

Materials & Methods: Thirteen patients were diagnosed as cervical carotid stenosis and 4 patients as intracranial internal carotid artery (ICA) stenosis the other 13 patients as middle cerebral artery (MCA) stenosis. All patients underwent PCT with acetazolamide challenge. Region of interest (ROI) values of MCA territory were obtained at mean transit time (MTT), cerebral blood flow (CBF), and cerebral blood volume (CBV) in PCT.

Results: The mean stenosis rate was 76.6±11.9 %. Significant decreases in CBF (13.1±17.6, P=0.000) and CBV (10.5±14.9, P=0.001) and significant increases in MTT (37.4±41.1, P=0.000) were found after acetazolamide challenge in MCA territories of stenotic side. Meanline, linear correlations were found between the stenosis rate and so-called basal MTT, CBF, and so-called Diamox MTT, CBF, CBV. Besides, the ratio differences between ROI values of basal PCT and diamox PCT were also correlated with stenosis rate (MTT: Y=94.3+1.7X, r2=0.228, P=0.004, CBF: Y=34.8+0.6X, r2=0.153, P=0.019, CBV: Y=30.4+0.5X, r2=0.151, P=0.017).

Discussion & Conclusion: Perfusion CT with acetazolamide challenge may be a useful tool to evaluate patients with unilateral cerebrovascular stenotic disease when we should decide to do angioplasty and postoperative follow-up.

P 024
Blooming Hypointense Middle Cerebral Artery of Acute Stroke on T2* Weighted Gradient Echo Imaging: Association with the Response to Intra-Arterial Thrombolysis
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Purpose: To determine whether the “blooming index” of acute stroke, the diametric ratio between blooming hypointensity and sound middle cerebral artery (MCA) on T2*-weighted gradient echo imaging (T2*-GRE) is related with outcomes of intra-arterial thrombolysis (IAT).

Methods: The 81 patients who underwent IAT were included for this retrospective study. The Thrombolysis-Cerebral-Ishemia (TICI) grades and the presence of residual luminal narrowing (RLN) were assessed after classical IAT by using intra-arterial fiberoptics infus and clot disruption. The incidence of TICI2-3 after classical IAT was compared on the blooming index. The ROC curve analysis was performed on the blooming index to predict TICI2-3 after classical IAT and RLN, respectively.

Results: The mean blooming index was 1.66±0.66. The 72.8% of patients treated with TICI2-3 after classical IAT. The TICI2-3 after classical IAT was achieved at 90.3% of blooming index less than 1.3 and 72% of blooming index<1.3 (p=0.049), and it was predicted by the blooming index less than 1.3 (area under the curve, 0.629; p=0.0382). Among TICI2-3 after classical IAT, the RLN was detected in 28.3% (17/60), and blooming index TL 1.3 was optimal in predicting RLN (area under the curve, 0.821; sensitivity, 88.2%; specificity, 69.8%, p=0.0001).

Conclusions: The less blooming hypointensity on T2*-GRE predict the favorable response to classical IAT and the presence of RLN.

P 025
Carotid Cave Aneurysms Causing Subarachnoid Hemorrhage
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Background: Classification of an aneurysm as intra or extradural is of fundamental importance in assessing the risk it presents to a patient. Identification of the point at which the internal carotid artery traverses the dura is considered key, in deciding on active or conservative management. The origin of the ophthalmic artery is usually taken to indicate the location of the dural ring. The carotid cave aneurysms of the ICA arising below the ophthalmic artery origin may cause subarachnoid hemorrhage. We review the anatomy of this region; discuss the differentiation of carotid cave from other paracanoid aneurysms and present illustrative cases.

Learning Objectives: 1. Understand the anatomy of carotid cave and distal dural ring; 2. To discuss image findings and review of literature; 3. To discuss the differentiation of carotid cave from other paracanoid aneurysms.

Conclusions: Approximately 150 aneurysms a year receive endovascular treatment at our institution, representing approximately 80-90% of all aneurysms treated. Over the last year 2 ruptured carotid cave aneurysms have received endovascular coiling in our department. We review the anatomy of this region; discuss the differentiation of carotid cave from other paracanoid aneurysms and present illustrative cases.
through the dura into the subarachnoid space are important areas for neurosurgeons and neuroradiologist. Familiarity with the carotid cave and aneurysms in this region will allow appropriate management of these aneurysm causing occasional subarachnoid hemorrhage. We emphasize the critical importance of anatomical knowledge in the safe practice of endovascular procedures.

P 026
Moya Moya Phenomenon as a Delayed Complication of Aneurysm Clipping
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Background: Moya moya disease is a chronic, progressive occlusive cerebrovascular disease characterized by stenosis involving the terminal portion of the internal carotid artery and its main branches. The disease is associated with formation of dilated and fragile collateral vessels at the base of the brain, which are termed as moya moya vessels. Moya moya means 'puff of smoke' in Japanese and this characteristic appearance of collateral vessels are well seen on cerebral catheter angiogram and CT angiogram. Intra- and subarachnoidal hemorrhage is the major cause of death in patients with moya moya disease.

Learning objectives: 1. To discuss moya moya phenomenon, its presentation; 2. To illustrate moya moya phenomenon, its presentation; 3. Genetic association with the disease, 4. To discuss the presentation, imaging and management of these aneurysm causing oc- casional subarachnoid hemorrhage. We emphasize the critical importance of anatomical knowledge in the safe practice of endovascular procedures.

P 028
Petrus Apex Cephalocele
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Introduction: The petrous apex, although is a small area in the skull base, presents multiple anatomic and pathologic variations. Imaging plays a primary role in the evaluation of lesions in this region. Most petrous apex lesions are characterized as either surgical lesions or incidental nonoperative findings. Petrous apex cephalocele (PAC) is a rare lesion of the petrous apex. The pathologic explanation for it is herniation from the posterolateral portion of Meckel's cave into the petrous apex, which may range from a meningocele to an arachnoid cyst.

Case report: The patient was a 54-year-old woman who presented with a 3-month history of headaches. On neurological examination no abnormalities were detected. Brain computed tomography (CT) showed a lesion centered in the posterosferal portion of the right Meckel's cave into the petrous apex. It had sharply defined osseous margins with homogeneous central low attenuation on bone algorithm CT scan. Magnetic resonance imaging (MRI) revealed a cystic appearing lesion centered over the right posterior portion of Meckel's cave, eroding into the petrous apex.

P 029
Imaging Artifacts in MRI...
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Summary: Artifactual images are those in the process of conducting an imaging test distort reality, ie do not correspond to the image but that arise from them, then are false. This paper aims to present that image artifact in MRI can determine misdiagnosis, analyze their causes and learn their early detection.

Introduction: Artifactual images can reduce the quality and resolution of a test or simulate images of pathologi- cal nature. Artifact in MRI images are a difficulty which usually neuroradiologists are exposed to. This situation adds to the normal process of image interpretation. It is needed: 1) the early detection of an artefactual image 2) to identify the cause, 3) correcting determining factors.

Classification: Imaging artifacts can be classified according to cause by magnetic field, magnetic susceptibility gradient, radio frequency, image acquisition, patient-related factors. In this case, sort it out according to its visual aspect: 1. Artifacts ghost-cyclical movements 2. With mismatch 3. Fluctuations 4. Linear straight 5. False contours 6. Shadows, 7. Geometric Distortion.

The phantom are replicas of the image features. As it was an incidental finding (the clinical symptoms were nonspec- ific and did not correspond to the presence of the PAC) no surgical treatment was required. Longitudinal study of the patient was scheduled.

Conclusion: Petrous apex lesions are uncommon. The differential diagnoses of a cystic petrous apex lesion include benign obstructive lesions of air cells (cholesterol granuloma, mucocele), epidermoid, congenital or acquired cholesteatoma, apical petroisis, petrous apex effusion and PAC. Significant advances in diagnostic imaging have greatly facilitated the diagnosis of petrous apex lesions. On CT studies PACs are lesions with smooth, noninvasive bony excavation of the petrous apex bone and on MRI they are unilateral or bilateral fluid-intensity masses that originates from the ipsilateral Meckel's cave and secondarily erode into the petrous apex. Once the definitive diagnosis is made, the lesion must be classified into one of two groups: a symptomatic lesion requiring surgical intervention or an asymptomatic finding requiring no treatment.
or part of it. They can be caused by repetitive motion, mechanical vibration sensitivity of the receiving coil, magnetic field fluctuations, imbalance and quadrature and stimulated echos, symmetry (mirror image). Cyclic mismatch artifact (aliasing) determines that a structure appears out of focus set on one of the outer edges of the image. It is also called for involvement. The artifacts associated with the diameter of the object are greater than the field used (FOV). It occurs in phase encoding direction. 2. The motion artifacts can be voluntary or involuntary, rhythmic or not rhythmic, can or cannot be controlled by the patient or synchronization mechanisms. The artifacts generated by movement appear in the phase encoding direction. The device determined by cardio respiratory movements is corrected by synchronization techniques. 2. The motion artifacts can be by changing the direction of the phase. 3. The fluctuations are planned with sharp edges, bright and dark lines alternating, parallel to the line fell from where they originate. They have different origins as the truncated K-space where they originate. They have different motion, mechanical vibration or part of it. They can be caused by repetitive motion, mechanical vibration sensitivity of the receiving coil, magnetic field fluctuations, imbalance and quadrature and stimulated echos, symmetry (mirror image). Cyclic mismatch artifact (aliasing) determines that a structure appears out of focus set on one of the outer edges of the image. It is also called for involvement. The artifacts associated with the diameter of the object are greater than the field used (FOV). It occurs in phase encoding direction. 2. The motion artifacts can be voluntary or involuntary, rhythmic or not rhythmic, can or cannot be controlled by the patient or synchronization mechanisms. 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tic chiasm, optic radiation and visual center in the occipital lobe. Demyelinating pathology like retrobulbar neuritis and tumor of the optic nerve (gliomas) are the common cause of optic nerve involvement from the retinal level to intracanalicular part. Bilateral optic nerves gliomas are seen in patients with neurofibromatosis. Optic chiasm is involved by primary tumor / sella -supra-sellar tumor. Occipital lobe involvement is seen in infarction and tumor arising in the occipital lobe. Reversible encephalopathy involving posterior circulation is also presented.

Conclusion: MRI is the most suitable neuro-image technique in imaging visual pathway whereas MDC and USG are complementary to it.

P 033
Neurological Manifestations and MRI Findings in a Novel GJA1 Missense Mutation in a Family with ODDD
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Introduction: Oculodentodigital dysplasia (ODDD) is a rare genetic disorder characterized by malformations that variable involve the eyes, teeth, fingers. Affected patients presented a distinctive physiognomy with a depressed nasal bridge, thin lips, with hypoplastic alae nasi, bilateral microphthalmos, anomalies of the iris and cornen, microdontia, enamel hypoplasia and digital anomalies (syndactyly and camptodactyly). Few studies report neurological impairments in a subset of patients including gait disturbances, neurogenic bladder, hearing loss, dysarthria and seizures. Typically ODDD is inherited in an autosomal dominant fashion with high penetrance and intra or interfamilial phenotypic variability. Rare autosomal recessive pattern as well as sporadic cases associated with advanced paternal age have been reported. Autosomal dominant ODDD is caused by heterozygous mutation in the gap junction protein alpha 1 gene (GJA1) which encodes connexin 43 protein. Connexins are involved in the formation of gap junctions between adjacent cells through which direct intercellular communications can be achieved. A number of different connexin proteins are expressed in different tissues and their abnormal function results in a wide range of clinical features.

Materials and Methods: We report a 4-generation Italian family with ODDD whose affected members presented typical phenotypic characteristics of this disorder, as well as variable expression of neurologic manifestations and abnormal brain magnetic resonance imaging findings. This family included 18 subjects with 7 affected individuals distributed among 4 generations, suggesting an autosomal dominant inheritance. We performed clinical evaluation, brain MRI and genetic investigations on 6 members of this family, two of which were not affected. Among this family there are other three members who were not examined, described by relatives as having clinical characteristics typical of ODDD: a grandfather died at 42 and two babies (8 months and 6 years old). The screening for mutations was performed by direct sequencing of the GJA1 gene in the 6 members of the affected family and in a control group of 128 healthy individuals. The MRI were acquired on a 1.5T equipment (GE Sigma, Milwaukee, USA), including structural and functional data (MR spectroscopy and Diffusion tensor images).

Results: The proband was a 40 years old female whose neurological examination showed mild lower limb hyperreflexia and optic neuropathy. Her brother was affected by neurogenic bladder and spastic paraparesis. The other two affected ones (mother and sister of the proband) presented only a mild tendon hyperreflexia. On MR structural images all affected individuals showed diffuse white matter high signal intensity in on T2-wighted images, involving both emispheres and spreading along the cortico-spinal tracts. The abnormal white matter did not show contrast enhancement or mass effect. Proton MR single voxel spectroscopy with acquisition at short (35ms) and long (144ms) echo times provided no relevant alterations of the metabolites normally detected in the brain. Any significant abnormalities in white matter Mean Diffusivity and Fractional Anisotropy were observed. The screening for mutations in the GJA1 gene identified a new dominant heterozygous substitution at position 416 resulting in a missense mutation at codon 139. The mutation changes thymidine to citosine at position 139 affecting a highly conserved amino acids of GJA1 gene and suggesting that pathogenicity is caused either by a gain of function or a dominant negative effect. This alteration segregated in members with ODDD phenotype. The 2 healthy members of the family didn’t show any clinical, genetic or MR abnormality.

Conclusion: Our MR data confirm, as previously reported, that MR abnormalities are a useful predictor for neurologic dysfunction. The absence of significant spectroscopic abnormalities rule out the neurodegenerative diseases which may show similar structural MR findings. So we think more likely a myelination disorder. Our investigation expands the genotipe of ODDD and also demonstrates the great degree of variability in neurological defects within a single family.
following operation had prolonged SI in the resection cavity on FLAIR images, and that SI increase and recurrence were detected on the same MR study without priority of SI increase.

**Conclusion:** In resected meningiomas, encapsulation of resection cavity, presumably by tumor cells, manifest as SI increase on FLAIR and indicates residual or recurrent tumor. But unlike the previous work in partially resected gliomas, SI change cannot precede the tumor progression or recurrence.

**P 035**

**Imaging Features of the Various Cavernous Sinus Lesions and Review of the Literature**

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**Purpose:** This poster presents the MR imaging features of the various cavernous sinus (CS) lesions including neoplastic, infective, inflammatory, and vascular ones and review the literature.

**Methods:** We reviewed the clinical, and MR imaging features of various lesions, involving the CS, including neoplastic lesions (schwannoma, meningioma, hemangioma, epidermoid, invasive pituitary adenoma, lymphoma, chordoma, chordosarcoma, nasopharyngeal carcinoma, sphenoïd carcinoma, metastasis), infective, inflammatory lesions (Tolosa-Hunt syndrome, invasive fungal infection, polychymenigitis, granulomatous lesion (CP, dural AVF, Aneurysm, thrombosis)).

**Results:** Schwannomas show usually cystic portions in the tumor. cavernous hemangiomas usually show homogenous high T2SI, homogenous enhancement. Epidermoid cysts of the CS show high SI on DWI. Malignant tumors, and inflammatory pseudotumors (Tolosa-Hunt syndrome) usually show intermediate to low T2SI, with weak enhancement. Inflammatory, infective, and granulomatous lesions show linear or nodular enhancement of the meninges of the CS, but often have nonspecific MR imaging features. Vascular lesions of CS is well detected on MRI or MRA-source images.

**Conclusion:** MR imaging features of various neoplastic, infective, inflammatory, and vascular lesions, involving the CS are often specific, but some non-specific. In many of these cases, involvement elsewhere suggests the diagnosis. MR imaging is sensitive for detecting vascular lesions of CS. To understand the clinical, MR and features of CS lesions help the accurate diagnosis and the appropriate treatment.

**Head and Neck Imaging and Intervention**

**P 036**

**Diagnosis, Incidence and Prognosis of Vascular Intra and Extra-Cranial Lesions in the Moderate-to-Heavy Head Trauma**

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Heavy and moderate body and cranial trauma are often associated to vascular lesions, intra and/or extra-cranial (i.e. carotid traumatic dissections, external carotid artery branches ruptures, etc.). The diagnostic of these associated lesions are very important in a larger context of trauma management. We share our experience on diagnosis, incidence and prognosis of these vascular traumatic lesions.

**P 037**

**CT and MRI Correlation in Patients with Suspected Cholesteatoma after Surgery**

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**Objective:** To make a correlation between both techniques findings in patients with suspected recurrent or residual cholesteatoma who had been previously operated.

**Methods:** We studied our patients with multislice helical Computerized Tomography (CT, Siemens Somatom, 40 slice configuration) obtaining axial and coronal reconstructions and with Magnetic Resonance Imaging (MRI, General Electric, 1.5 teslas) performing conventional posterior cranial fossa sequences including the use of gadolinium and echo planar diffusion weighted images (DWI).

**Background:** Diagnosis of cholesteatoma is difficult in postoperative cavities. We present our experience with patients who previously underwent at least one surgery for the presence of cholesteatoma and had clinical suspect of recurrent or residual cholesteatoma. After studying every patient with both CT and MRI we made a correlation between both techniques findings.

**Results:** Bone erosions were far better detected in CT. The presence of a soft tissue mass with soft peripheral enhancement in MRI was very suspicious for cholesteatoma. DWI hyperintensity in postoperative cavity was the most indicative finding to determine recurrent cholesteatoma.

**Conclusions:** In our experience MRI was a more useful imaging technique than CT to evaluate possible post-surgical cholesteatoma.

**P 038**

**Carotid Blowout Syndrome. Emergent Endovascular Management by Stenting**

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**Introduction:** Carotid blowout syndrome (CBOS) is a catastrophic emergency associated with high morbidity and mortality. The usual etiologic causes are post operative, inflammation, trauma, and head and neck malignant tumor invasion. The conventional surgical management is fraught with high morbidity, mortality and complications and may be ineffective. This includes carotid artery and/or branch ligation. Carotid artery bypass can be performed with limited success. With the advent of uncovered and covered stents, the emergent endovascular management of CBOS has improved and, perhaps, at this time, a desperately fatal disease can be managed with temporary success.

**Materials and Methods:** During the last three years, we have studied five patients (men and women of middle and advanced age) with CBOS of different etiologies, who were considered difficult or not manageable with emergency surgery; therefore, the patients were managed with endovascular approaches. Insertion of different types of uncovered and/or covered stents, both self-expanding and balloon-expandable, such as: Gore Viabahn® Endoprosthesis, iCast™ (Atrium) covered stent, Fluency® Plus Stent-Graft (Bard), Wallstent (Boston Scientific) and Protégé (Bard) was performed, in all patients.

**Results:** The procedures were done in the interventional radiology suite and were successful in temporarily managing the CBOS. No major com-
plications related to the endovascular management were encountered. No arterial rupture, occlusion, thrombosis, stroke or infection resulted in a short follow up.

Conclusions: The emergent insertion of covered or uncovered, self-expanding or balloon-expandable stents, is a safe, effective and easy alternative therapy to temporarly manage CBOS. A longer follow-up and more patients treated are necessary to assess the definitive long-term role of stenting in CBOS.

Take Home Messages: CBOS is a catastrophic emergency associated with a prohibitive morbidity and mortality. The “conventional” surgical treatment may be difficult and ineffective. Endovascular treatment with self-expand- ing or balloon-expandable, covered or uncovered stents must be considered the “first choice” in some desperate situations. A longer follow-up is needed.

P 039
CT-Angiography in the Follow-Up of Carotid Thromboendarterectomy
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The CT Angiography (CTA) represents an important diagnostic tool not only within the context of a feasibility study of the carotid thromboendarterectomy (TEA); it represents also a precious follow-up technique after the TEA. In a context of a close collaboration between a Neuroradiology unit and a Vascular Surgery unit, the CTA follow-up of TEA represents a routine but essential step. We share our experience in CTA follow-up of TEA during the last five years.

P 040
Magnetic Resonance Imaging of Acute Optic Neuritis: Optic and Perioptic Conditions
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Background and Purpose: The optic nerve and the peripen optic cerebrospinal fluid (CSF) space are surrounded by a sheath, and the CSF space forms a cul de sac at the cribriform plate. There are two categories of optic neuritis according to the affected sites: optic neuritis in a narrow sense which affects the optic nerve itself and optic perineuritis which affects the peripen subarachnoid space (SAS) and sheath. The purpose of this study is to evaluate MR findings retrospectively in patients who presented with visual impairment and were clinically diagnosed as acute optic neuritis.

Materials and Methods: MRI was performed in 11 patients who were suspected of having acute optic neuritis (ON). 14 of these patients had multiple sclerosis (MS) or neuromyelitis optica (Dyeyelinating disease (DmD)). Of the remaining 11 patients without DmD, two had optic neuritis associated with meningitis or cerebritis, one had ischemic ON, one had Behcet’s disease, one had ON associated with Wegener’s granulomatisis, one had compressive ON, and the other five were diagnosed as idiopathic ON. MRI findings of the 18 orbits of DmD-ON group, and 17 orbits of Non DmD-ON group were evaluated. MR images were retrospectively evaluated by two experienced neuroradiologists. The optic nerve was divided into three segments: intracranial segment (S1), optic canal segment (S2), and intracranial segment (S3). The following 5 findings were evaluated on Gd-enhanced T1-weighted and fat-suppressed T2-weighted images: (A) swelling, (B) Gd-enhancement, and (C) increase in T2 relaxation time of the optic nerve, which suggested the pathologic category of pure optic neuritis; (D) Gd-enhancement of the SAS around the optic nerve and (E) dilatation of the peripen SAS (finding E) at S1 (94%), and Gd-enhancement of the peripen SAS (finding D) at S1 (93%) and S2 (71%). Comparison between the two groups. The mean scores of finding A, finding D, and finding E at S1 and S2 in Non DmD-ON group were significantly higher than those in DmD-ON group (p<0.05). Increased signal intensity was observed on diffusion-weighted images in some patients, which seemed to be related to T2 shine-through.

Conclusion: MR imaging demonstrates the various pathologic conditions of acute optic neuritis and optic perineuritis. Optic perineuritis is distinct from demyelinating optic neuritis on MR imaging. Idiopathic optic neuritis is thought to have a broad spectum including optic and/or peripen disorders. MR imaging is expected to be useful in predicting the outcome of the acute optic neuritis.

Imaging in Epilepsy
P 041
Epilepsy: Comparative Analyses in 1.5 Tesla and 3 Tesla MRI
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Purpose: We compared patients with unclear etiology epilepsy in magnetic resonance imaging (MRI) 1.5T and 3T, trying to find more or different types of lesions.

Methods: Both 1.5T and 3T were performed: 3D T1 IR, FLAIR and coronal T2 high resolution in hippocampus. The studies were reported by neuroradiologists.
Results: The analysis between studies from 1.5T and 3T demonstrate that new lesions were found in 3 studies from 3T MRI. Therefore, 3T allowed a better characterization in different epilepsy lesions.

Conclusion: Currently, the available technology with diagnostic study epilepsy performance was better 3T than 1.5T.

P 042
Epilepsy: RMI Comparative Analyses in 1.5T and 3T

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Purpose: We compared patients with unclear etiology epilepsy in mri 1.5t and 3t, trying to find more or different type of lesions.

Methods: At both 1.5 and 3t we studied five patients: 3 women and 2 men, between 3 and 52 years old. MRI protocols were perfomed : 3t t1, t2. flair and coronal t2 high resolution in hippocampus. The studies were reported by neuroradiologist.

Results: The analysis between studies from 1.5t and 3t demonstrate that new lesions were found in 3 studies from 3t mri. Therefore, 3t allowed a better characterization in epilepsy lesions.

Conclusion: Currently the technology available with diagnostic study epilepsy performance was better 3T than 1.5T.

P 043
Focal Cortical Dysplasia (FCD): Pictorial Review

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Summary: Abnormalities of cortical development are frequent cause of refractory epilepsy (RE). Among these pathologies, the FCD are an heterogeneous group of disorders pathologically characterized by loss of normal cortical structure. Two distinct entities with different etiology have been described (FCD type I and FCD type II). This poster aims to present relevant case studies, highlighting the features in magnetic resonance imaging (MRI) in relation to the pathological substrate.

Introduction: In Epilepsy It can be recognized generalized seizures (GS), abnormal electrical discharges simultaneously in both hemispheres, and partial seizures (PS), originating in a particular area of the cortex. Of patients with partial seizures, up to 30% are refractory to treatment (refractoriness defined as lack of response to treatment with three anti-epileptic drugs at appropriate dosage). In these patients the imaging studies have improved performance, with reported sensitivity for MRI between 82% and 95%. The pathologies underlying cases of focal epilepsy traditionally have been categorized into 5 groups: hippocampal sclerosis (HS), malformations of cortical development (MCD), neoplasms, gliosis and vascular anomalies with associated anomalies. After HS, MCD are the most common cause of focal RE, accounting for 10 to 50% of cases of medically intractable secondary epilepsy in pediatric patients and 25% of cases in adults. Are classified into four categories: CMO (normal cortex), MCDO (normal cortical organization), and MCDO (neural apoptosis, migration anomalies, malformations by abnormal cortical organization) and unclassified disorders.

Focal Cortical Dysplasia (FCD): This encompasses an heterogeneous group of malformations of cortical development, which in common have loss of normal cortical structure, abnormal neurons and glial cells. FCD are a common cause of RE; up to 25% of cases of PS are attributable to this pathology, whereas up to 76% of patients with FCD have RE.

FCD Type I: This is a disruption of CO (along with polymicrogyria and schizencephaly). Histological abnormalities are limited to cerebral cortex. With or without immature giant cells(GC), According to this last feature, FCD type I is subdivided into type 1A (no GC) and type 1B (GC can be found). Patients may have epilepsy, learning disorders or other cognitive impairments. Up to 25% can be asymptomatic: a study found a prevalence of FCD type I up to 1.7% in autopsies of asymptomatic patients. MRI can demonstrate cortical thinning and hyperintensity with loss of volume of subcortical white matter (WM). Alterations in the WM intensity are subtle and do not extend to the ventricular surface. Also is described focally increased subarachnoid space and blurring of the gray-white matter junction. More frequently on the temporal lobes (TL). FCD Type II (Taylor-Type): Described by Taylor (1971). Abnormal proliferation and cell differentiation (like microcystic cortex and hemimegalencephaly). Have dysmorphic cells (type IIA and balloon cells type IIIB). The BC express receptors of both neurons and glial cells, by a very early failure in cellular differentiation. There are dysmorphic cells and increased cellularity. There is a second alteration of migration, as associated alterations of WM. Type II FCD areas are more epileptogenic than type I, with greater frequency of crises, at a younger age. RE is also more common. The most frequent MRI findings are cortical thickening, blurring of the G-WM) and funnel-shaped WM signal abnormalities from the subcortical region to the ventricle (secondary to abnormal migration). These alterations are found more often in extratemporal situation. Low-grade glial neoplasms and tuberous sclerosis lesions must be included in the differential diagnosis. MRI: There is overlapping imaging findings. Then the MRI findings may be subdivided.

Gray M alterations: alterations in cortical thickness. Thickening (the most frequent) or focal cortical thinning. The signal changes are mainly characterized by increased signal in T2. Can observe widening of the gyri and shallow sulci. MRI alterations found more frequent in type II FCD. The most common is the increased WM signal in T2 weighted imaging and decreased signal in T1 weighted sequences, which translates hypomyelination and gliosis secondary to abnormal electrical activity of the dysplastic cortex. Often, these changes only become apparent after the patient has reached a certain degree of myelination. Some patients may go unnoticed until they are 18-24 months of age. Transmantle WM signal alterations are unique to the FCD type II, and can be seen in up to 20% of cases. The MR imaging shows a funnel-shaped area. Apex contacts the wall of the ventricle and its base is directed toward the cortex, often thickened.

Conclusion: FCD is a common cause of RE, especially in childhood. There are two different entities. The MRI findings may help with the differential diagnosis.

Imaging of Brain Tumors: Multimodality Approach

Brain Metastasis of Melanoma in a Child: A Rare Case Report

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Key words: Melanoma; nevus; child; brain metastasis.

Introduction: Melanoma is very rare in children, accounting for only 1% to 3% of the malignant tumors in this age group. 2% of all reported melanoma have occurred in patients younger
Magnetic Resonance Spectroscopy (MRS) is a special technique, which is used for the characterization of certain pathologies in brain. It can demonstrate the biochemistry of tumours and infarcts, tumour aggressiveness, anaerobic metabolism and the characteristic internal biochemical makeup of the glioblastoma multiform. Magnetic resonance spectral patterns have been shown to be distinct for different tumour types and grades. We report a case in order to contribute to the study concerning the ability of MRS to differentiate brain tumours.

Case presentation: A 66 years-old female patient was admitted in our clinic because of a large space occupying midline lesion. Brain MRI revealed that this lesion was a glioblastoma multiform (Figure 1). Histology was obtained and was compatible with a malignant neoplasm from small cells that could not be identified further. The differential diagnosis included anaplastic ependymoma, metastatic carcinoma from small cells and primitive neuroectodermal tumor (PNET). MRS was performed postoperatively, which revealed that the lesion was a glioblastoma multiform (Figure 2). Radiation therapy followed.

Discussion: Different pathologies of the brain can be diagnosed by a brain biopsy, the patient’s clinical course and follow-up imaging. Available non-invasive methods for diagnosing intracranial tumours are: single photon emission computed tomography (SPECT), positron emission tomography (PET), and proton magnetic resonance spectroscopic imaging (MRS). There are many studies assessing the accuracy of MRS in the diagnosis of adult brain tumours. MRS has the potential to discriminate contrast-enhancing intracranial lesions and can contribute to diagnosis of indeterminate brain lesions as in our case. From our case we conclude further that MRS could differentiate some certain types of malignant tumours from a glioblastoma. We could suggest that MRS could lead to a reduction in biopsy rates or changes in therapy. The study of the potential of MRS to diagnosis needs to be extended to demonstrate the range and the potential for diagnosis of malignant brain tumours.

Magnetic resonance imaging (MRI) has a key role in the management of many brain tumours. Magnetic resonance spectroscopy (MRS) is a magnetic resonance technique which gives information on tumor biology in vivo and on tissue biochemistry. It plays a valuable clinical role, which is not yet well defined although there is a paucity of data from multi-centre clinical trials. We present this case in order to denote the limitations of MRS as a diagnostic tool.

Case presentation: A 72-years-old woman presented in our clinic with dizziness and headache. Brain MRI revealed a diffuse lesion in the left frontal lobe, 3.5x3cm in size (Fig. 1). The diagnosis was either an astrocytoma or a demyelinating lesion. MRS of the brain was performed further which showed the same findings and was not diagnostic (Fig. 2). Brain biopsy revealed that the lesion was a glioblastoma multiforme.

The Role of MRI Spectroscopy in Evaluating Malignant Brain Tumours

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Magnetic resonance imaging (MRI) has a key role in the management of many brain tumors. Magnetic resonance spectroscopy (MRS) is a magnetic resonance technique which gives information on tumor biology in vivo and on tissue biochemistry. It plays a valuable clinical role, which is not yet well defined although there is a paucity of data from multi-centre clinical trials. We present this case in order to denote the limitations of MRS as a diagnostic tool.

Case presentation: A 72-years-old woman presented in our clinic with dizziness and headache. Brain MRI revealed a diffuse lesion in the left frontal lobe, 3.5x3cm in size (Fig. 1). The diagnosis was either an astrocytoma or a demyelinating lesion. MRS of the brain was performed further which showed the same findings and was not diagnostic (Fig. 2). Brain biopsy revealed that the lesion was a glioblastoma multiforme.

Discussion: Different pathologies of the brain can be diagnosed by a brain biopsy, the patient’s clinical course and follow-up imaging. Available non-invasive methods for diagnosing intracranial tumours are: single photon emission computed tomography (SPECT), positron emission tomography (PET), and proton magnetic resonance spectroscopic imaging (MRS). There are many studies assessing the accuracy of MRS in the diagnosis of adult brain tumours. MRS has the potential to discriminate contrast-enhancing intracranial lesions and can contribute to diagnosis of indeterminate brain lesions as in our case. From our case we conclude further that MRS could differentiate some certain types of malignant tumours from a glioblastoma. We could suggest that MRS could lead to a reduction in biopsy rates or changes in therapy. The study of the potential of MRS to diagnosis needs to be extended to demonstrate the range and the potential for diagnosis of malignant brain tumours.

Discussion: MR spectroscopy is a helpful method that shows high specificity and sensitivity in characterizing brain lesions especially malignant infiltrative lesions. The infiltrative growth patterns of malignant cranial tumors result in intratumoral regions composed of various amounts of normal...
brain, inflammatory tissue, necrosis, and active tumor. Such heterogeneity presents a considerable challenge for radiologists and surgeons attempting to find the most suitable region for making diagnosis. The effectiveness of the subsequent treatment plan and accuracy of the prognosis are greatly enhanced when the most malignant or anaplastic region of the tumor is revealed as image modality or as a biopsy sample.

Conclusion: From our case we conclude that primary malignancies of brain probably in early stage have a high potential for producing misleading or even false-negative results in MRS. There are still areas and patients cases concerning MRS that need to be developed and studied further. The conclusion of this article is simple; no single diagnostic test should be considered as 100% accurate, as false negative studies may occur that may mislead the patient and clinician.

P 047
A Multicentric Glioblastoma Multiforme after a Breast Carcinoma

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Introduction: Glioblastoma multiforme (GBM) is the most malignant and common primary brain tumour presenting in adults aged 40-70 with a median survival of 9-12 months. Breast cancer is the most common cancer and the second cause of cancer deaths among women. An association between these two frequent neoplasms is possible but rare. We describe herein the coexistence of these two diseases.

Case presentation: A 69-years old female patient with a history of breast cancer (invasive ductal carcinoma) five years previously, was admitted to our department with headache and mild left hemiparesis the last thirty days. Magnetic resonance imaging (MRI) of the brain revealed a multifocal mass lesion in frontal and parietal lobes with surrounding edema (fig. 1). A biopsy of the tumor revealed a glioblastoma multiforme. The post-operative course was without any complications and radiotherapy followed.

Discussion: Brain tumors are relatively rare with a frequency 1-2%. GBM is the most common, aggressive and fatal primary brain tumour. Surgery followed by radiotherapy with concomitant Temorolomide (TMZ) is the standard treatment. Despite the recent treatment strategies the survival of GBM-patients remains poor. It is believed that genetic and hormonal factors are the primary risk factors for breast cancer. It may be attributed to inherited factors in up to 15-27%. There is evidence that a genetic link exists between breast cancer and various primary intracranial tumors. An association between breast cancer and glioblastoma multiforme is observed in the rare autosomal dominant Li-Fraumeni syndrome which can be presented with a wide range of different malignancies.

Conclusion: May be there is a common hormonal or oncogenetic basis for the growth of these two associate diverse primary malignancies in our patient. May be not only the sex hormones are implicated in the growth of GBM but also the chemotherapy treatment of breast cancer, which could have a carcinogenic effect. Further studies including mutational analysis may help to investigate the coexistence of these two diseases.

P 048
Intracerebral Capillary Hemangioma: A Case Report

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Capillary hemangiomas are benign vascular lesions that commonly present at birth or in early infancy in the head and neck. Intracerebral capillary hemangioma arising in an adult is extremely rare, with only few reports in the literature. We report a case of intracerebral capillary hemangioma developing in the temporal lobe. An 69-year-old man presented with a seizure-like movement. A CT scan showed a very well enhancing area in the right temporal lobe. The mass lesion appeared as an isointense area on T1-weighted MR images and as a hyperintense area on T2-weighted MR images, and showed spongiform enhancement by gadolinium-DTPA. Cerebral angiography showed delayed staining of the lesion on late venous phase. An operation was performed and the histological findings were consistent with capillary hemangioma. The tumor-like lesion consisted of a proliferation of capillary vessels lined by endothelial cells.
lyzed DWI images and ADC images obtained as a part of MRI examination of 84 patients with diagnosis of brain tumor confirmed by histopathological findings.

Apparent diffusion coefficient, kurtosis factor and standard deviation (determined from ROIs which contained whole lesion), together with their ratios, were analyzed by hierarchical and K-means cluster analysis in order to separate parameter values in distinctive groups.

Contents of obtained clusters were compared with grouping of those parameter values according to histopathological findings and successfulness of classification was evaluated. Our results showed that used statistical techniques have potential value in differentiation and grading of brain tumors without prior knowledge of underlying pathology.

P 051

Solitary Brain Metastasis: Diffusion Weighted Imaging and MR Spectroscopy Features
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Background and Purpose: Diagnosis of solitary brain neoplasm is a challenge especially with unknown primitive neoplasm because the spectrum of possible lesions is large.

The aim of this study is to present MR features of solitary brain metastasis including DWI and monovoxel H1MRS spectroscopy.

Material and Method: We retrospectively reviewed MRI examination of patients with histologically confirmed solitary brain metastasis in the period of January 2006 to December 2009. 16 cases were recorded, 13 males and 3 females (age range from 31 to 64 years, with a median age of 52 years). MRI including DWI and H1MRS (TE 35 ms and TE 144 ms) were performed in all patients. The single-voxel of H1MRS was located either in tissular component on FLAIR sequence or in the enhanced component T1 weighted images.

Results: Brain metastases were of lung cancer (n = 10), mammary carcinoma (n = 1), ovary carcinoma (n = 1), colonic carcinoma (n = 1) and from unknown primary (n = 3). Supratentorial location was noted in 11 cases. On the conventional MR sequences, tumors were poorly marginated on precontrast, located in the sub cortical white matter with a large amount of vasogenic oedema and an irregular thick ring enhancement pattern. Low or isointense/intensive, ADC maps - $D_{av}$ (~1.3-1.9)x10^-3 mm^2/s. 1H MRS demonstrated slightly decreased height of NAA and slightly increased Cho peak.

Conclusion: The low metabolic pattern with predominant lipid lactate peak appears highly suggestive of metastatic origin.

P 052

Evaluation of Dynamic Changes of Brain Perirumoral Oedema before and after Operation by DTI and MRS
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Purpose: Our purpose was to evaluate the extent of peritumoral oedema region, evaluate it by DTI and MRS, and compare the values before and after surgery.

Materials and Methods: Thirty seven patients (males-21, females-16, mean age 46.6 +/-11.2 years) with supratentorial neoplasms and peritumoral oedema underwent MRI examination before and after surgery. Histologically verified tumors were gliomas (low malignancy - 7, high malignancy -12), metastases of cancer - 10, meningiomas - 6, hemangiopericytoma-1. MRI imaging was performed on 1.5T unit (Signa EXITE, GE). The examinations included T1-wi, T2-wi, FLAIR, DTI b=1000s/mm^2, 6 directions), 1H MRS (2D CSI, TE=144 ms) and T1+GD-wi in every cases. All patients underwent MR imaging one day before surgery and 7 pts were investigated two times before surgery: the 1-st examination were conducted before the beginning of pre-surgical anti-oedema treatment (dexametazone 8-12 mg per day) 7-15 days before the operation. The first control post-operative MRI was conducted on the 2-nd-5-th days after surgery, the next ones were repeated with interval of 5-8 days. The average number of post-operative MR scanning was 5, maximal-5 (4 pts), Mean diffusivity(Dav), fractional anisotropy (FA) and metabolite maps were calculated off-line (Functool 4.3, Sage). Measurements of Dav, FA, height of NAA and NAA/Cho ratio were performed in small ROI (mean are 60-70 mm^2), taken in peritumoral region and on the contralateral side.

Results: Peritumoral region had features of vasogenic oedema: T1 wi - hypointensive, T2 wi, FLAIR-hyper-intensive, ADC maps - Dav ~1.3-1.9 x10^-3mm^2/s. 1H MRS demonstrated slightly decreased height of NAA and normal value of NAA/Cho ratio in vasogenic oedema, but near the marging
of tumor, especially in the cases of gliomas there were zones of infiltration, together with vasogenic edema, characterized by high pike of Cholin and decreased NAA/Cho ratio. Pre-surgery anti-ooedema treatment resulted in clinical improvement and decreasing of oedema volume on (4-6)% in 5 from 7 patients, which were examined two times before surgery. Two patients (GB and hemangiopericytoma) demonstrate enlargement of oedema volume in spite of dexametazone therapy (fig.1a) DTI of 4 pts demonstrated appearing of zones of cytotoxic oedema together with ones of vasogenic oedema in early postoperational studies. Dav=(0.4-0.6)x10^-3mm2/s. Zones of low Dav were interpreted as regions of post-surgery ischemia. FA maps demonstrate the disturbance of nerve fibers by tumors (fig.1b). FA maps demonstrate the injury of nerve fibers by tumor in cases of gliomas. Regress of the oedema with a time after operation was clearly shown by control MRI in all cases. Total regress of oedema was seen in cases of intraxial tumor at radical tumor surgery on 4-6-th week. Dav and FA maps show normalization of brain tissue after surgery.

Conclusions: Combined MRI investigation including DTI and MRS allowed detecting and quantifying zones of peritumoral oedema in dynamics. MRS and DTI are very informative for planning the surgery. Clearly seen regress of oedema is a sign of total tumor resection.

P 053

Unusual Rare Pituitary Lesions Masquerading Pituitary Adenoma: MR and Pathologic Features and Review of the Literature

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Purpose: Sometimes there are intraxial-looking masses, which are turned out to be unusual meningeal mass, where as there area conventional meningioma- looking mass, which are turned out to be unusual meningeal lesions. This poster presents the MR and pathological features of these intraxial-looking meningeal masses and conventional meningioma-looking unusual meningeal lesions and review the literature.

Methods: We reviewed the clinical, MR and pathological features of intraxial-looking meningeal masses, including angiomatous meningioma, microcystic meningioma, atypical meningiomas, chordoid meningioma, clear cell meningioma, rhabdoid meningioma, anaplastic meningioma, hemangiopericytoma and meningioma-looking unusual meningeal lesions including dural lymphoma, idiopathic hyperviscous pachymeningitis and meningeal melanosis.

Results: Unusual meningeal masses such as angiomatous, microcystic, atypical, chordoid, clear cell, anaplastic, rhabdoid meningiomas and hemangiopericytomas were often misdiagnosed as intraxial malignant masses because of relatively narrow attachment to the dura, or poor enhancement, or lobulating irregular outer margin, while other types of unusual meningeal masses such as dural lymphoma, idiopathic hyperviscous pachymeningitis and meningeal melanosis were often thought as conventional meningiomas or even subdural or subarachnoid hematoma because of their various mimicking features. To understand the clinical, MR and pathological features of them help the accurate diagnosis and the appropriate treatment.
thinner than intracranial arachnoid membrane. Also, the dynamic range of turbo spine echo pulse sequences which we usually use on the spinal imaging are so narrow to see the intensity differences between intra-arachnoid CSF intensity and subdural CSF one. Results: Fat suppressed T1 weighted images with Gd enhancement and STIR pulse sequences are useful to find intraspinal subdural hygroma. It is suspected that we have overlooked many intraspinal subdural hygroma before using Gd enhancement and STIR pulse sequences. We suspect the frequency of intraspinal subdural hygroma in the cases of intracranial hypotension is more than we have already found. Because not so much Gd enhanced spinal MRI have been performed, on the contrary to Gd enhanced brain MRI in the cases of intracranial hypotension.

Conclusion: When we find a intracranial hypotension, we should perform Gd enhancement, not only brain Gd enhanced MRI but also spinal Gd MRI with fat suppressed T1 weighted scans. Etiologies of intracranial hypotension will be discussed by previous literatures.

P 056

MR Findings in Subacute Combined Degeneration of the Spinal Cord

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Subacute combined degeneration (SCD) is a rare cause of demyelina-
tion of the dorsal and lateral columns of the spinal cord, and is a neurogenic complication due to vitamin B12 deficiency that the observer with unusual frequency. SCD of the spinal cord is an uncommon cause of myelopathy but is the most frequent clinical mani-
 festation of vitamin B12 deficiency. It can induce disorders of the brain, spi-
nal cord, optic nerve, and peripheral nerves. Early diagnosis and treatment prevent severe anemia and irreversible damage to the nervous system. The au-
thors report a case with history associ-
ated with vegetarianism that had typi-
cal symptoms and signs of vitamin B12 deficiency. Magnetic resonance imaging (MRI) showed increased T2-weighted signal in lateral and posterior columns of the spinal cord. The patient was treated with B12 supplements and clinical improvement was associated with marked reduction of the abnormal signal intensity in the cervical cord. It is important to distinguish B12 deficiency from other causes of myelopathy. Subacute combined degeneration is curable, but early detection is necessary for full clinical recovery.

P 057

Indentation of the Dorsal Root Ganglia in patients with Extraforaminal Disc Herniation with or without Foraminal Disc Herniation on Contrast Enhanced MR Imaging

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Objective: The purpose of this study was to investigate the significance of dorsal root ganglia (DRG) in the diagnosis of symptomatic extraforami-
nal disc herniation with or without foraminal disc herniation on contrast enhanced MRI.

Materials and Methods : Thirty-two patients with extraforaminal and com-
bined (extraforaminal with foraminal) lumbar disc herniation were included in this study. Focal disc eccentricity, nerve root displacement, and paraspinal fat plane loss on axial MR images were evaluated. The degree of DRG indentation caused by either extrafo-
raminal or combined disc herniation was evaluated with axial T1, T2, and contrast enhanced T1-weighted images.

Results: Focal eccentric disc contour was seen in 20 patients (71%), loss of paraspinal fat plane surrounding the nerve root or DRG was seen partially or completely in 23 patients (82%), and the nerve roots or DRG were displaced in 3 patients. In 19 cases, a change in the thickness of existing nerve root or DRG was not definite on T1 and T2-weighted images, while in contrast en-
hanced T1-weighted images, indentation of DRG was reported to be severe in 15 patients, mild in 10, and absent in 3. Conclusion: The focal eccentric disc and loss of paraspinal fat plane sur-
rounding the nerve roots were com-
mon findings; however, utilizing the evaluation of changes in nerve root or DRG in order to diagnose symptomatic disc herniation on noncontrast images was somewhat challenging. Direct visualization of the indenta-
tion of DRG on contrast enhanced T1-weighted images is vital for the diagnosis of symptomatic extrafo-
raminal or combined disc herniation.

P 058

The Unknown Guilty: Spinal Arachnoid Cyst as an Infract Cause of Spinal Cord Compression

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Purpose: We want to familiarize the radiologist with MR technique and the findings spectrum in the diagnosis and evolution of secondary or intradural arachnoid cyst as infract cause of spinal cord compression.

Content Organization : Arachnoidal cyst can be congenital/ primary or ac-
quired/secondary associated to spinal arachnoiditis. The spinal cord/ con-
pression can be related with antecedents of trauma, infection, haemorrhage or surgery, but in some cases no anteced-
ent is described. We make a revision of the cases diagnosed in the last two years at our Hospital and we conduct a literature revision. The patients had ages between 64 and 76 years old, they referred spastic paraparesia as main clinical symptom and they were re-
ferred for suspicion of spinal cord com-
pression. The imaging finding was an intrarraquideal extramedular lesion with the same signal as cerebrospinal fluid (CSF) that compromises spinal cord. Simple septation or a whole cyst wall can be identified. They were all localised in dorsal spine and the main localization was posterior. MR is the technique of choice for arachnoid cyst.

Summary: Arachnoid cyst is an infrequent diagnosis and sometimes complex, as the clinical symptoms are not specific and the imaging findings are subtle. That is the reason why we should be familiarised with MR find-
ings for correct detection.

P 059

Primary Spinal Glioblastoma Multiforme WHO Grade IV in a Child - Imaging Findings

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**Poster Exhibit 2nd - Thursday, 7 October - Saturday, 9 October from P 001 to P 101**

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**P 060**

**Late-Onset Autosomal Dominant Limb Girdle Muscular Dystrophy and Paget’s Disease of Bone Unlinked to the VCP Gene Locus**

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Clinical Case: A 13-year old previously healthy boy presented in October 2009 with paresis of the left leg for several weeks and new-onset of mild proximal weakness of the right arm and leg in our Hospital. There was no history of trauma or previous infections. On clinical examination the child presented discrete hemiparesis with increased deep tendon reflexes and a positive Babinski sign on the right side. Analysis of cerebrospinal fluid showed no abnormal findings. MRI revealed the presence of an intramedullary mass extending from C2-C4 and a second lesion at the level of C6-T4. Neurosurgical intervention allowed gross total resection of the lower part of the lesion with decompressive laminectomy (C6-T4). The second lesion was left untouched (C2-C4). The initial post-operative course was uneventful. A combined therapy of local radiation and temozolomide chemotherapy was started. Four weeks after termination of radiotherapy the patient showed clinical progression with tetraparesis and neurological bladder dysfunction.

Imaging: The patient had full brain and spine MR imaging. Findings in the brain were negative for masses and signal intensity alterations. The initial spinal MRI showed two space occupying lesions extending from the cervical spine (C2-C4) along to the proximal parts of the thoracic spine (C6-T4). Both lesions were hyperintense on T2-weighted images with an iso- to mild hyperintense signal on T1-weighted images. After administration of Gadolinium the superior lesion showed a rather heterogeneous, yet clear enhancement. On postoperative 18F-FET PET CT the remaining cervical tumour showed increased, tumour specific amino acid turn-over. Histology: The histology sections show an anaplastic glioma with high degree of cellular polymorphism. Diagnoses: Primary Spinal Glioblastoma multiforme, WHO grade IV.

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**P 061**

**Imaging Techniques in the Paraspinal Muscular Hypertrophy**

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Purpose: Born of the observation of a relation between the harmony of the paraspinal muscles and the distal muscular strength, the paraspinal muscular hypertrophy method uses mainly original acupunctural and/or homeopathic stimulations of the paraspinal muscle. We present the imaging techniques used to document objectively the therapeutic effect of the method.

Material and Method: Paraspinal muscular hypertrophy method has been routinely used for several years in various indications including the painful pathologies of the spine with or without hernia, diffuse painful symptoms and scolioses. Four imaging techniques have been used before and after stimulation: 1) photography 2) GDV bio-electrography (whole body digital projection of the Kirlian effect) 3) cerebral spectroscopy of the supratelamic areas 4) thermography.

Results: Thermography and cerebral spectroscopy show immediate significant modifications: a) thermography appears especially simple of use while showing an obvious cutaneous cooling after stimulation. b) cerebral spectroscopy shows a reversible decrease of the NAA/Cr ratio, glutamatergic (Glx) and Cho/Cr changes. C) Photography as well as bio-electrography show constant modifications but sometimes more belated.

Conclusion: Imaging techniques document objectively the effect, otherwise clinically obvious, of the method.

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**P 062**

**Comparison of Axial T2 Mapping with CT Discography in Assessment of Lumbar Intervertebral Disk Degeneration**

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Autosomal dominant myopathies with adult-onset are a heterogeneous group of disorders. Most common entities are the geneticallydefined myotonic dystrophies type I and II and facioscapulohumeral muscular dystrophy, usually confirmed by genetic testing. Another less common group is represented by six autosomal dominant limb girdle muscular dystrophies (LGMD). These are originally defined by proximalmuscleweakness and dyprophic findings on a skeletal-muscle biopsy.

The combination of late-onset muscular dystrophy, rimmed vacuoles and inclusion bodies in the muscle biopsy, and Paget’s disease of bone suggests a mutation in the Valosin-containing protein gene (VCP, p97 or CDC48). We report on a German family with late-onset autosomal dominant muscular dystrophy starting in the pelvic girdle, Paget’s disease of bone but no cognitive impairment. All affected individuals showed muscle weakness beginning in the lower proximal extremities and later progression to the distal lower extremeties and shoulder girdle.

Histopathologically, muscle biopsy showed myopathic changes with rimmed vacuoles and inclusion bodies. No protein accumulation could be detected on desmin, myotilin and αβ-crystallin on immunofluorescence staining. Immunolabelling for dystrophin I, dystrophin II, caveolin-3, dysferlin, spectrin, adhalin, merosin and emerin was normal. Mutations in dysferlin, spectrin, adhalin, merosin and facioscapulohumeral muscular dystrophy, Myotonic Dystrophy I and II were excluded by a combination of linkage analysis, direct sequencing and fragment analysis. The family presented here suggests that a yet-unknown genetic defect can give rise to an autosomal dominant myopathy with Paget’s disease but without dementia. This is the first report of a family with autosomal dominant muscular dystrophy, Paget’s disease of bone and rimmed vacuoles on muscle biopsy without a mutation in the VCP gene.
Immediately after that, reproducibility of low back pain with local injection of iodized contrast material was tested under fluoroscopy and CT diskography was performed.

**Results:** In all patients, reproducibility of low back pain was demonstrated by injection of contrast material. The mean amount of the contrast material was 0.87 Å 0.6 ml. Findings of T2 maps were well correlated with grade of annular tear depicted with CT diskograms.

**Conclusion:** Axial T2 mapping provided a more T2-based demonstration of annulus fibrosus of intervertebral disk. It cannot evaluate reproducibility of low back pain, but may be able to detect noninvasively early degenerative changes of annular tear.

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**Inflammatory, Demyelinating and Degenerative Diseases of the Brain**

**P 063**

**Brain MR Imaging in Patients with Infectious Endocarditis**

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**Purpose:** To investigate prevalence of hypointense lesions on T2WI thought to be cerebral microbleeding (CMB) and their activity in patients with infectious endocarditis (IE).

**Materials and Methods:** We retrospectively reviewed brain MRI of 10 patients with IE. The protocol included T1WI, T2WI, T2*WI for all 10 patients with IE. We assessed the number, size and location of hypointense lesions on T2*WI. For the 4 patients who underwent CE-T1WI, we also evaluated association between hypointensity on T2WI/T2*WI and enhancement on CE-T1WI in the surrounding areas of T2*WI-hypointense lesions.

**Results:** All the patients demonstrated hypointense lesions on T2*WI. Out of identified 85 lesions, 82 (97%) demonstrated 10mm or less in diameter. The hypointense lesions on T2*WI were located mainly in a cortical or subcortical area (81%). Lesions surrounded by hypointense area on T2WI/T2*WI were more likely to be enhanced than those without surrounding hypointense area (Fisher’s exact test, p=0.03). Two patients with surrounding hyperintense area on T2WI/T2*WI underwent follow-up studies. One case demonstrated improvement of the enhancement; the other resulted in massive hemorrhage.

**Conclusion:** Our study is compatible with previous reports that indicated correlations between CMBs and IE. CMBs with surrounding hyperintense area on T2WI/T2*WI and enhancement may suggest active cerebral inflammation in IE patients.

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**Neurosarcoidosis: The Radiologic Features in 5 Cases**

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**Purpose:** We report the radiologic features of neurosarcoidosis in 5 patients.

**Object:** Five patients (three men and two females)(24 to 59 years old). These diagnoses of definite neurosarcoidosis were confirmed by biopsy (intracranial lesions in 4 cases, mediastinal lesion in 1 case). Imaging appearance : Meningeal mass formation was seen in 3 cases. On T2-weighted and FLAIR images, these lesions were low intensity in 2 cases, and was iso intensity with gray matter in 1 case. And these lesions tended to be lower intensity on central area and higher intensity on peripheral area on T2-weighted and FLAIR images in all 5 cases.

**Radiological Presentation**

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**Acute Disseminated Encephalomyelitis: Atypical Radiological Presentation**

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Case report: A 26 year-old woman presented to the emergency department with blurred vision and unbalanced gait since the previous day. She also reported non-productive cough and anorexia. On admission, she had worsening of her medical condition with altered consciousness, urinary retention. Subsidiary tests suggested restriction to diffusion.

However, on the apparent diffusion coefficient (ADC) map the lesions had hypersignal consistent with the presence of increased diffusion translating vasogenic oedema (potentially reversible). On the second day of admission a spinal MRI showed two hyperintense lesions on the dorsal region, one at the level D3-D4 and another at D7-D8, associated with slight spinal cord expansion, but without enhancement. The cerebrospinal fluid (CSF) revealed lymphocytosis (with mononuclear predominance), increased proteinorachia and a normal content of glucose.

The serum anti-CMV IgG and IgM antibody levels were positive. Endovascular corticotherapy with 1gr methylprednisolone daily (for seven days) led us to perform a precise diagnosis. Early high-dose corticotherapy leaded to a rapid and complete improvement.

Discussion: ADEM is an uncommon acute demyelinating inflammatory disease of the central nervous system (CNS), being more common in children. Diagnosis is based on clinical and radiological features. Usually presents with a sudden onset of neurological symptoms and signs that occur days or weeks after an infection or vaccination associated to multifocal lesions that typically affect the white matter of brain and spinal cord. On magnetic resonance imaging (MRI) the lesion are hyperintense on T2-weighted images and on FLAIR (fluid attenuated inversion recovery) images. The main differential diagnosis of ADEM is multiple sclerosis.

Introduction: Acute disseminated encephalomyelitis (ADEM) is an inflammatory demyelinating monofocal disorder of the central nervous system (CNS), being more common in children. Anterior encephalitis (CNS), being more common in children. Anterior encephalomyelitis (ADEM) is an inflammatory demyelinating monofocal disorder of the central nervous system (CNS), being more common in children. Diagnosis is based on clinical and radiological features. Usually presents with a sudden onset of neurological symptoms and signs that occur days or weeks after an infection or vaccination associated to multifocal lesions that typically affect the white matter of brain and spinal cord. On magnetic resonance imaging (MRI) the lesion are hyperintense on T2-weighted images and on FLAIR (fluid attenuated inversion recovery) images. The main differential diagnosis of ADEM is multiple sclerosis.

Purpose: When we look into coro- nal MR image at the base of the fourth ventricle, we can find a pair of “quarter note” standing back to back, that consist of the middle cerebellar peduncle (MCP) as the head of the note, and superior cerebellar peduncle (SCP) as the stem of the note.

We evaluated the shape of the “quarter notes” on the coronal image and also made diffusion tensor analysis. Specifically, we assessed the relationship between superior cerebellar peduncle angle (SCP angle: angle between bilateral superior cerebellar peduncle) and following item: sectional area of MCP on coronal plane, the apparent diffusion coefficient (ADC), fractional anisotropy and number of tensor fibers of MCP.

We obtained diffusion tensor images and generated tractographies of middle cerebellar peduncles. Diffusion tensors were computed to construct tractographies using a PC worksta- tion with “dTV II” diffusion tensor im- aging software. The software is based on a single fiber model, in which the eigenvector
associated with the largest eigenvalue is assumed to represent the local fiber direction. Tractographies considered to represent the middle cerebellar peduncle were obtained with the planar seed area traced on the middle cerebellar peduncle on coronal plane at the level of the superior medullary velum. We selected 30 steps in order to cover the tract from midline to cerebellar white matter. ADC and FA along middle cerebellar peduncles and number of tensor fibers of middle cerebellar peduncle were measured, and the relationships between these parameters and SCP angle were investigated.

**Result:** With simple regression analysis, significant correlation between SCP angle and sectional area of middle cerebellar peduncle was found in SCD cases ($r = 0.36$, $P < 0.05$). Statistically significant correlation was found in compound groups including SCD cases and controls between SCP angle and ADC ($r = 0.67$, $P < 0.001$), SCP angle and FA ($r = 0.71$, $P < 0.001$), SCP angle and number of tensor fibers ($r = 0.71$, $P < 0.001$). SCP angle was statistically larger in SCD group than controls. There were statistically significant decrease in FA and number of tensor fibers and statistically significant increase in the clinical practice.

In the clinical practice, it is sometimes difficult to evaluate the degree of atrophy or degeneration of MCP. It is also difficult to perform diffusion tensor measurement in all of the cases in which spinocerebellar degeneration are suspected. SCP angle which is an angle between the stem of the “quarter note” which is assumed to represent the local fiber direction is larger in the SCD case.
MR imagers (Shimadzu SMT-100/Philips Intera Achieva 1.5). In addition, in 3 patients CT scans were available (GE Hi-Speed). A probable diagnosis was made in 1 patient by using established clinical criteria: specific neurologic symptoms in addition to a characteristic EEG and demonstration of the 14-3-3 protein in the CSF. Eight patients were initially examined within 3 months of onset of symptoms, and five were examined 4 months or later. The examinations included T2-W, PD-W, Fluid-Attenuated Inversion Recovery (FLAIR), and DWI. MR images were reviewed for pathologic changes of the basal ganglia, thalamus, and cerebral cortex.

Results: Patients had striatal lesions or cerebral cortical lesions or both. Typical signal intensity abnormalities in the brain were detected most sensitively with DWI, compared with PD-W, FLAIR, and T2-W imaging. Hyperintense lesions at DWI changed in extent and intensity over time. PD-W images and DWI showed better results in the diagnosis of signal intensity changes in the basal ganglia compared with T2-W or FLAIR images; however, in the diagnosis of cortical changes, DWI was clearly superior. A thalamic involvement was better diagnosed on PD-W images and DWI than on FLAIR or T2-W images.

Conclusion: DWI is a fast sequence whereas “conventional” sequences carry a higher risk of motion artefacts. Many reports as well as our data suggest that DWI is the most sensitive MR imaging sequence in the diagnosis of CJD, therefore, should be part of the MR imaging protocol in the examination of patients with dementia, especially if the symptoms progress rapidly.

P 069
Diffusion-Weighted MRI in Creutzfeldt-Jakob Disease: Focus on the Cerebral Cortex and Chronologic Change
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Purpose: To evaluate the high cortical signal intensity and chronologic changes on diffusion-weighted MR image(DWI) in sporadic Creutzfeldt-Jakob disease.

Material and Methods: We retrospectively analyzed DWI in 16 patients with probable CJD by WHO criteria and evaluated distribution, extent and bilaterality of the lesions in the cortex, basal ganglia and thalamus. We reviewed chronologic changes of the lesions on follow-up MR examination in 8 of 16 patients.

Results: Cortical abnormalities were present in 15(94%) of 16 patients. Isolated cortical involvements were present in 6 patients (40%), and combined involvement of cortex and basal ganglia were in 9 patients (60%). Distribution of the lesions was bilateral in 12 patients and predominated on the right side in 8 patients. On follow-up MR imaging, cortical lesions showed progression in extent and signal intensity. Basal ganglia abnormalities were present in 9 of 15 patients. 4 of 6 patients who had no abnormal signal intensity in basal ganglia on initial MR imaging showed abnormal high signal intensity on follow-up MR imaging.

Conclusions: The characteristic high cortical signal intensities on DWI in an elderly patient with rapidly progressive dementia should suggest the diagnosis of early phase of CJD and might be useful for differential diagnosis.

P 070
Brain MRI and CT Characteristics of Patients with Antiphospholipid Antibody Syndrome (APS)
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Learning Objectives: The purpose of this study was to determine the spectrum of neuroradiologic findings of the brain in patients with APS.

Background: The APS is an autoimmune thrombotic condition characterized by the presence of antiphospholipid antibodies. We retrospectively analyzed 8 patients (mean age 29 y.o. range: 19-38 y.o.) with APS who underwent CT or MR imaging. In five patients, APS presented in association with SEL and in 3 patients, as an isolated disorder. A standard MRI protocol was performed with additional DWI in all patients.

Imaging Findings: The CT or MRI findings were normal in 2 patients. The initial involvement was cerebral in 5 cases and cerebellar in one case. Multininfarct atrophy was seen in two patients with dementia. Large infarcts were seen in 5 patients. One patient with large cerebellar and cerebral infarcts, complicated with hydrocephalus, showed hemorrhagic transformation.

Small cortical infarcts and lacunar infarcts were depicted in two patients. T2-weighted images revealed multiple focal areas of increased signal intensity in white matter, in gray/white matter junction, in both cerebellar hemispheres, in cerebellar peduncles and in thalamus. Patients with hyperintense white matter foci had at least one large lesion, and two patients had five or more small foci. One patient with large white matter hyperintense lesions had also prominent well-defined area of increased signal intensity in corpus callosum that could be presumed to represent ischemic lesions of the brain.

Conclusion: Usually large Infarcts and hyperintense white matter foci are the most common abnormalities seen on CT and MRI.

P 071
Ring-Enhancing Lesions in a Patient with AIDS: A Diagnostic Challenge
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Distinguishing lymphoma from infectious and other neoplastic brain lesions in AIDS patients using conventional MR imaging has proven to be difficult and potentially associated with delayed diagnosis. Recent studies argue about the role of new techniques like perfusion-weighted (PWI) and diffusion-weighted (DWI) MR imaging in the accurate differentiation of brain masses in these patients. We report a case of a 29-year-old male patient with AIDS, admitted for dysarthria and broad-based gait, revealing blood and CSF positive EBV (Epstein-Barr virus) serologies, and EBV DNA in CSF. Head CT disclosed several supra and infratentorial hypodense lesions with mild peripheral contrast enhancement and significant mass effect. Brain MRI showed multiple heterogeneous space-occupying lesions with preferential juxta-ventricular distribution located in both cerebral hemispheres and in the left cerebellar hemisphere, demonstrating thick capsular enhancement, along with central core elevated ADC and peripheral restriction on DWLI. Perfusion-weighted MRI revealed reduced rCBV and spectroscopy (MRS) demonstrated a lipid peak. Given the conventional MRI images characteristics and PWI, DWI and MRS results, the diagnosis of either a fungus abscess or toxoplasmosis were presumed and treatment was initiated. However, the patient’s clinical condition started to deteriorate rapidly and he died one month after admission. Post-mortem histological analysis of brain lesions revealed B-cell
lymphoma. Published studies provide contradictory information regarding perfusion in brain lymphomas, probably reflecting histological differences between the evaluated lesions. Recent data report decrease in rCBV in lymphoma lesions. In this case, the reduced rCBV was the only finding among the advanced MRI techniques results that suggested the correct diagnosis. Despite MR imaging newer techniques contribution to differentiate ring-enhancing lesions in AIDS patients, they remain a challenging diagnosis.

Interventional Neuroradiology

P 072

Protocol of Radiation Dose Measurement with Newly Developed Head Phantom and Network with Internet for Interventional Neuroradiology

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Objectives: To evaluate the usefulness of the new head phantom, which has been developed for measurement of the skin dose of X-ray during interventional procedure. To evaluate the effectiveness of multicenter recording and comparison in the same way.

Methods: We developed a head phantom made by urethane elastomer for brain and bone phantom material for skull. These two materials were prepared to have same CT value to the brain and skull. The head phantom has a cylindrical bore for exchange the cylinder to evaluate spatial resolution and visibility of micro-vascular equipments. For evaluate spatial resolution, a chart of spatial resolution was included in the urethane elastomer cylinder. For evaluate visibility, two types of vessel model made by 2 mm and 4 mm diameter tube was included in the urethane elastomer cylinder. The measurements of radiation dose of the skin were performed by three types of dosimeters: Skin Dose Monitor (SDM), PRL-G, and PEMNET. By using an internet network, multicenter recording and comparison system were possible.

Results: SDM and PRL-G measured the skin dose including the backscatter from the skull. SDM has the direction dependency of X-ray. PEMNET calculated only the air dose with the date from DSA system. The simple measured value at the same position in the same condition was different. However, those were able to correct mathematically. The measurement protocol for skin dose was easy to use and evaluate the differences between DSA systems. Accordingly to the comparison data, two DSA systems were replaced to the new FPD system.

Conclusion: To avoid radiation injury during the interventional procedure, the standardized protocol for skin dose measurement should be established. We believe that this newly developed head phantom is useful for the standardized radiation skin dose measurement.

P 073

Intravenous Glycoprotein IIB/IIIa Inhibitor (Tirofiban) Followed by Low-Dose Intra-Arterial Urokinase and Mechanical Thrombosis in Stroke

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Background and Purpose: The purpose of this study was to assess the feasibility, efficacy and safety of intravenous tirofiban combined with mechanical and intra-arterial pharmacologic thrombolysis in patients with stroke.

Methods: We prospectively enrolled 13 patients with an acute ischemic stroke due to major cerebral arteries occlusion and treated with an intravenous bolus of tirofiban followed by mechanical thrombolysis coupled with low dose intra-arterial administration of urokinase.

Results: Ten patients had an anterior circulation stroke (T-siphon internal carotid artery (ICA) = 4; middle cerebral artery (MCA) = 6). Three patients a posterior circulation stroke. Mean NIHSS score on admission was 17 (range, 10 - 25). Immediate recanalization was successful (thrombolysis in myocardial infarction (TIMI) 2-3) in 11 of 13. Mean dose of urokinase was 270,000 U. The following day, 8 of 13 patients improved substantially and complete vessel patency (TIMI 3-4) was confirmed by DSA or CT angiography. Intracranial bleeding occurred in three of thirteen patients (2 symptomatic cerebral hemorrhages and 1 subarachnoid hemorrhage) and was fatal in the case of 2 patients. At discharge, the mean NIHSS was 5.3 (range, 0 - 12). Overall, at 3-month follow up the functional outcome was favorable (modified Rankin Scale score = 0 - 2) in 8 of 13 (61%) patients. Death (including all causes) at 90 days occurred in 3 of 13 (23%) cases.

Conclusions: The combination of intravenous tirofiban with mechanical thrombolysis and low dose intra-arterial urokinase may be successful in re-establishing vessel patency and result in good functional outcome in patients with major cerebral arteries occlusions.

P 074

Intra-Arterial Thrombolysis of Central Retinal Artery Occlusion

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Purpose: Central retinal artery occlusion (CRAO) is an ophthalmic emergency with a severe and irreversible visual loss. Even if visual acuity spontaneously improves less than 10% of patients and spontaneous improvement usually is delayed. The effective treatment regimen of CRAO has not been proven. A number of treatment modalities for CRAO have been proposed and practiced, all with limited success. Conventional conservative treatment options include anterior chamber paracentesis, acetazolamide, aspirin, ocular massage and carbogen inhalation. However, recently several literatures have reported improved vision after super-selective administration of a thrombolytic agent directly into the ophthalmic artery. The aim of this study was to assess effectiveness whether vision and retinal perfusion were improved after ophthalmic artery thrombolytic treatment.

Material and Methods: We retrospectively evaluated recent CRAO patients who underwent selective ophthalmic artery thrombolytic treatment (n=11) in our department. All patients were performed pre-procedural and post-procedural ophthalmological examination, fundus photography, and fluorescein angiography. These patients were divided into two groups. In group I, 4 patients underwent selective intra-arterial thrombolytic treatment within 24 hrs after the onset of symptom. In group II, 7 patients were treated after 24 hrs from symptom onset. All patients underwent pre-procedural and post-procedural ophthalmological examination, funduscopy, and fluorescein angiography. We assessed the improvement in visual acuity and arm to retina (A-R) time before and after the procedure to evaluate patients' outcome.

Results: A visual acuity was completely recovered to the previous state.
Is Plasma Oxidized LDLs or Oxidized LDLs Antibodies Correlate with Acute Stage of Clinical Outcome of Acute Ruptured Intracranial Saccular Aneurysms?

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Background: There are many known risk factors for intra-cranial aneurysms formation include race, family history, gender, age and some connective tissues disorders. Also some predisposing factors for aneurysm rupture such as aneurysm size, locations, aneurysms walls stress force and local aneurysms walls inflammatory process were studied. Oxidized LDLs (oxLDLs) play an important role in the progress of vessel walls atherosclerosis and local inflammatory process. Autoantibodies against oxLDLs may reflect the extent of LDL oxidation in vivo. Our aim was to investigate the correlation between oxLDLs, oxLDL Ab, and the clinical outcome of acute ruptured intracranial aneurysms.

Methods: Sixty one acute ruptured intracranial aneurysm patients received endovascular embolization treatment were recruited. The modified Rankin scale was used as patient’s health condition. We present a 62-year-old lady who underwent endovascular treatment for acute subarachnoid haemorrhage due to a giant basilar tip aneurysm and left carotico-ophthalmic aneurysm. Follow-up deployment of two longest available coils, procedure terminated due to sudden change of jet flow within the aneurysm and also unsustainable coil positions in spite of further attempts. Post-procedural follow-up angiograms in day 22 revealed an approximately 90% occlusion of the giant basilar tip aneurysm.

Aims: Pictural demonstration of aneurysmal lumen thrombosis and diversion of flow haemodynamics, even with the use of minimum number of coils in the treatment of haemorrhagic cerebral aneurysms.

Case: 62-year-old female was referred to our institution due to diffuse subarachnoid haemorrhage with the blood load within the interpeduncular and preoptine cisterns and at the level of foramen magnum. No evidence in two patients (2/4, 50%) and the others had partial recovery in group I. There was no change of visual acuity in group II patients. However, the retinal perfusion of all eleven patients was improved and there were no systemic or ophthalmic complications.

Conclusion: Although, the efficacy of intra-arterial thrombolysis for treatment of CRVD remains to be further evaluated in a controlled study, we suggest that ophthalmic arterial thrombolytic treatment may improve visual acuity of patient who is treated within 24 hrs after the onset of symptom. Also, it may improve retinal perfusion, which leads to prevent further progressive complications such as retinal detachment and neovascularization glaucoma.

P 075

Diagnostic and Interventional Management of 14 Patients with Vein of Galen Aneurysmal Malformation (VGAM)

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Purpose: Aim of the work is to show our experience about the management of 14 patients suffering from VGAM, emphasizing the diagnostic work-up preliminary to endovascular treatment, the technical aspects and the transcranial color-doppler sonography (TCDS) as a non invasive examination for the radiological follow-up.

Material and Methods: Since 1995 we have treated 14 patients (7 M and 7 W) with VGAMs (11 choroidal type and 3 mural type), between 2 days and 1 year of age (6 neonates and 8 children). In 10 of 14 cases the diagnosis was made in the prenatal period (abstetric sonography/fetal MR), in 4 cases within the first year of life (CT/MR). At birth, all 10 patients with prenatal diagnosis of VGAM underwent a clinical and instrumental evaluation: chest X-ray, echocardiography, TCDS, abdominal sonography and cerebral MR. In the 6 newborns, we performed endovascular treatment in urgency because of the severe high-output cardiac failure, pharmacologically intractable, to prevent the establishment of multi-organ failure. The 8 children underwent an embolization procedure after the third month of life (or at 6 kilograms of weight), especially to prevent cerebral damage. In all cases endovascular therapy was performed under general anesthesia, by an arterial or venous access (cortid artery and femoral artery or vein), using a 3D rotational monoplanar angiography. Glue (n-butylcyanoacrylate), coils or the combination of two were utilized as embolic agents. We performed from 1 to 7 partial embolization per patient. All patients were evaluated with TCDS immediately after the endovascular therapy and every 3 months, until the cure. At TCDS evidence of VGAM occlusion, we made a diagnostic angiography and afterwards a subsequent MR every 2 years during follow-up. Results: 5 of 6 neonates died within the 13th day of life due to progressive multi-organ failure (Bicêtre neonatal score <8, retrospectively evaluated), in spite of endovascular partial treatment. 1 newborn and 1 child are still in treatment, with no symptoms. 7 of 9 surviving patients show a regular psycho-physical development, in accordance with Lasagnaia’s data about endovascular therapy of VGAMs, at present the most important in Literature. In 2 cases the patients show neurological deficits.

CONCLUSIONS: Endovascular treatment revolutionized the approach to this rare congenital malformation, fatal in 90% of cases within the first month of life, but it is indispensable to recognize the exact therapeutic window, particularly for neonatal critical condition. We propose TCDS as a reliable integration diagnostic examination, non invasive, cost-effective, easily realizable both in the pre- and in the post-treatment imaging work-up and we retain it as the choice exam during follow-up before cure.

P 076

Embolization of a Wide Neck Giant Basilar Tip Aneurysm by Using Two Coils: Case Report

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Background: We present a 62-year-old lady who underwent endovascular treatment for acute subarachnoid haemorrhage due to a giant basilar tip aneurysm and left carotico-ophthalmic aneurysm. Following deployment of two longest available coils, procedure terminated due to sudden change of jet flow within the aneurysm and also unsustainable coil positions in spite of further attempts. Post-procedural follow-up angiograms in day 22 revealed an approximately 90% occlusion of the giant basilar tip aneurysm.

Aims: Pictural demonstration of aneurysmal lumen thrombosis and diversion of flow haemodynamics, even with the use of minimum number of coils in the treatment of haemorrhagic cerebral aneurysms.

Case: 62-year-old female was referred to our institution due to diffuse subarachnoid haemorrhage with the blood load within the interpeduncular and preoptine cisterns and at the level of foramen magnum. No evidence
of intraventricular blood or no hydrocephalus. CT angiogram and preoperative digital subtraction angiogram (DSA) confirmed an approximately 2.5 cm basilar tip aneurysm with a small nipple distally. The origins of both posterior cerebral arteries were incorporating the neck of the basilar tip aneurysm. There was also a 5 mm left carotico-ophthalmic aneurysm. Patient woke up with no deficit. She underwent MRI examinations on post-operative day one and on second week and a DSA on day 22 post operatively. The basilar tip aneurysm were occluded approximately 90% with small neck remnant and both posterior cerebral arteries were preserved. One year follow up MRA shows further thrombosis and reduction in the size of neck remnant.

Coiling: Coils were deployed in the aneurysm lumen. Both flow dynamics by minimum number of coils can achieve significant flow reduction and near complete thrombosis and occlusion of a giant basilar tip aneurysm.

P 078

Migration of a Detached Coil that Assisted the Deployed Stent to Migrate, during Stent Assisted Coiling of a Recurrent Aneurysm

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Background: Studies has shown that stent assisted coiling of cerebral aneurysms is an effective treatment with lower risk of neck recurrence of the aneurysms. There are several complications associated with both coiling and stent deployment. Multiple cases of coil migration and stent misplacement have been described in the literature, coil protrusion through a stent and a single case of delayed coil migration through a deployed stent. In our clinical practice we experienced an unusual case where a migrated coil through a deployed stent and become ensnared onto distal stent struts. This caused stent migration distally with the perhaps the help of the blood flow.

Aims: This poster aims to provide a pictorial case presentation of previously unreported intra-procedural complication as described above. It shows fluoroscopic detail of the migration of stent with the help of migrated coil with subsequent retrieval of coil and deployment of a second stent. It also briefly covers postulated mechanisms for this in the discussion.

Case: A 58 years old man presented with right-sided subarachnoid haemorrhage in December 2008 due to a Posterior Communicating Artery (PCOM) aneurysm on an angiogram. The aneurysm was subsequently coiled. On follow up imaging there was evidence of neck recurrence of the coil PCOM aneurysm. The patient underwent a stent assisted embolisation in November 2009. Initially a 4x20mm stent (Solitaire AB neurovascular remodelling device, ev3) was deployed across the neck of the previously coiled PCOM aneurysm. A 2.5 mm coil was deployed in the current PCOM aneurysm (Axium, ev3). While a second 1.5 mm x 2cm coil was deployed into the aneurysm, the first coil migrated out of the aneurysm into the parent artery and into the distal internal carotid artery (ICA). Meanwhile the last loop of the coil hooked into distal mesh of the stent which prevented further migration of the coil. The patient woke up from the anaesthesia without any complications. A six-month MRA check was planned.

Discussion: There are multiple cases of either coil migration or sent displacement or misplacement. These have either been immediate or delayed. To our knowledge there is only one reported where a coil migrated through a deployed stent however this was of delayed presentation. The case presented here was peri-procedural migration of the coil that facilitated and caused subsequent migration of the stent. With regard to the coil migration it has been suggested that it is possible for small coils (2 to 3 mm) to prolapse through cells of the stent, especially when the stent is at a convexity. Also placing a balloon in the stent has been proposed as a means of protecting the artery from protrusion of smaller coils. It has been suggested that careful need to be taken when using coils smaller than 2-3mm in length that coil-stent system entanglement has not been described either. The poster illustrates that great care must be taken when attempting retrieve the coil from such a complex. Fortunately the retrieval strategy was ultimately successful and provides a possible approach if this is encountered in the future.

Conclusion: We believe this is a rare documented acute case of migrated coil that has assisted stent migration. We suggest caution particularly when small coils needed to be deployed alongside open cell designs. We showed the appearances of this and describe the strategy used to deal with this.

P 079

Comparison of Cone-Beam CT Images between Xper CT and Dyna CT in Interventional Neuroradiology

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Purpose: To evaluate the clinical usefulness of cone-beam CT as a practical tool for various type of neurovascular images such as intracranial stent to follow up and embolised coils in intracranial aneurysm and arterial venous malformation (AVM) with Onyx. Methods: We compared images from angiography with flat detector with two different application of con-beam CT. 1) Xper CT: Philips; Allula Xper FD20/10, 3DRA workstation. 2) Dyna CT: Siemens: Axiom Artis dBA, Leonardo work station. Cone-beam CT images of self-made phantom of intracranial stent with in-stent plaque were evaluated in each different parameters. The embolised coils in intracranial aneurysms were also evaluated to visualize residual space in the aneurysm. To assess those images, we used Image J application to analyze the image quality and visualization capability.

Results: Ring like artifact of the image was more prominent in Xper CT for stent imaging. Dyna CT image demonstrated less artifact of stent material. As overall assessment the Xper CT image with high resolution protocol in 22cm image size was most satisfactory. In embolisation in aneurysm and Onyx in AVM, there were different image resolutions in each conditions.
Aneurysms arising from lenticulostriate artery (LSA) are rare. The majority of reported cases were surgically treated and only 2 were treated with endovascular embolization. We present a case of LSA aneurysm successfully embolized with n-butyl cyanoacrylate (n-BCA) without recurrent in one-year follow up.

Case Report: A 51-year old women experienced sudden onset of headache followed by disoriented speech and general weakness. Computed tomography (CT) scan revealed an intracerebral hemorrhage in left medial temporal region with rupture into the temporal horn of lateral ventricle and moderate hydrocephalus. CT angiography demonstrated an aneurysm in medial temporal region that was anatomically correlated with the intracerebral hemorrhage. Conventional angiography demonstrated an aneurysm 4mm in diameter arising from the distal portion of the left medial LSA. She was referred for endovascular treatment 2 days after admission. A 6F Envoy guidier catheter (Cordis, Miami Lakes, Fla, USA) was advanced into left internal carotid artery (ICA), through which an Excelsior SL-10 microcatheter (Boston Scientific Natick, MA, USA) was advanced over a Transcend-14 microwigide guide (Boston Scientific) with catheter tip into the aneurysm. Superselectively contrast injection was the performed to confirm the catheter position and the aneurysm (Fig.4). After that, 33.3% n-BCA mixture, which was prepared with 0.5-ML n-BCA (Ingenor, Gengeville, France) and 1.0-ML ethiodized oil (Lipiodol Ultra Fluid, Guerbet, Aulnay-sous-Bois, France), was infused to fill the aneurysm. Complete aneurysm obliteration was identified in angiogram immediately after embolization (Fig.5). She had an uneventful postoperative recovery and was discharged from the hospital after 7 days, with no neurological deficit. Follow-up angiography at 12 months after embolization showed complete obliteration of the aneurysm (Fig.6). Patient suffered from mild transient head without neurological deficit for the 21-months clinical follow up.

Discussion: Lenticulostriate aneurysms are rare and there have been a total of 23 cases reported in the literature. Etiological risk factors related to LSA aneurysm include hypertension, moyamoya disease, arteriovenous malformation, infection, systemic lupus erythematosus and substance abuse. Some cases were idiopathic. Most reported cases of LSA aneurysms have been treated surgically. Among the 16 reported surgically treated LSA aneurysms, 2 experienced rebleeding 24 hours after surgery, 9 aneurysms required sacrifice of the feeding LSA, resulting in moderate disability in 2 cases. The surgical challenges of LSA aneurysms include the fragile nature, small size of the parent artery and deep location of the aneurysm. Endovascular management of LSA aneurysms has only been reported in two cases. Larrazabal et al.1,2,3 embolized a ruptured LSA aneurysm and its patent artery with n-BCA. In this case, some n-BCA re- fluxed into MCA and led to moderate disability. Harrel et al.3 occluded a LSA aneurysm and parent artery without significant neurological complication but lacked of long-term follow up. We obliterated the aneurysm in our case while preserving the parent LSA and without recurrence in one year angiographic follow up. The acute angle and small caliber of the parent vessels make endovascular access difficult or impossible and subsequent potential for sacrificing the parent artery. However, the advent of microcatheters, guide wires and embolization agents may enable more endovascular treatment in the future.

References

Materials and Methods: Five patients who failed therapy with HD-MTX based chemotherapy were treated with a R-ICE regimen in a 28-day cycle. Two patients with relapse after R-ICE regimen and two elderly patient relapse after HD-MTX and WBRT were treated with a R-TMZ regimen in a 28-day cycle. BBBD was performed with 20%mannitol infused through a microcatheter selectively placed into the artery of the tumor site at a rate of 3ml per second for 30-60 seconds.

Results: Three complete remissions (CR), one partial remission (PR) and one stable disease were achieved by R-ICE. Two CR in the PR achieved by R-TMZ. Median progression-free survival (PFS) and median overall survival (OS) from first R-ICE were 4 months and 7.7 months, respectively. Median PFS and median OS were 4 months and 7.7 months, respectively. Adverse events related to osmotic BBB opening procedure were observed in two cases. One was minor intracerebral hemorrhage and the other was minor ischemic stroke. Hematotoxicity was prolonged in an elderly patient by R-ICE.

Conclusion: Chemo-immunotherapy regimens with osmotic BBB opening, R-ICE and R-TMZ, resulted in good outcome in recurrent or refractory PCNSL. This result suggested that the delivery of therapeutic agent into the brain by BBBD opening could be a good alternative of therapy for other type of brain tumors.

P 082

Sclerotherapy by Endovenous Laser Therapy in Venous Malformations of the Cervico Facial Area and Upper and Lower Extremities: One Single Center Experience 2002-2009

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Combined Endovascular Deconstructive and Reconstructive Technique for Ruptured Vertebral Artery Dissection (VAD)

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Objective: A ruptured dissecting aneurysm of the vertebral artery (VBA-DA) is a well-known cause of acute subarachnoid hemorrhage (SAH) with a high rate of early rebleeding. Internal trapping of the parent artery, including the dissected segment, is one of the most reliable techniques to prevent rebleeding. We describe our experience in the management of VBA-DA by internal trapping of the parent artery followed by stent placement.

Clinical Presentation: A 47-year-old female was admitted with subarachnoid hemorrhage. Cerebral CT angiography revealed hemorrhagic left vertebral artery dissection with no visible aneurysm. Initial cerebral angiogram demonstrated left vertebral artery dissection at the level of V4 with no aneurysmal formation "string-sign". Follow-up cerebral angiogram was done after 12 days revealing left vertebral artery fusiform aneurysm with vertebral dissection extending below the origin of the left PICA artery "pearl and string sign". We noticed absence of right PICA artery.

Intervention: After a guiding catheter (6 Fr, Envoy, Cordis Endovascular System or Shuttle, Cook, Inc.) was inserted into cervical portion of the affected left VA, a microcatheter was navigated in the distal level of left P1 segment using a guidewire, which was exchanged with a 300-cm-long exchangeable guidewire. Occluding the portion of the V4 segment dissected junction with the vertebral artery was done using eight coils to the distal level of the origin of the left PICA artery. Then, we advanced a stent NeuroForm 2.5 mm x 15 mm over the prepositioned exchangeable guidewire and was activated, covering the entire segment of dissection at the origin of the left PICA. The final control angiogram showed complete occlusion of the distal dissected part and permeability of the stent and left PICA. A loading dose of dual antiplatelet therapy with ASA and clopidogrel was given immediately after procedure. Follow-up control MR and MRA after 3 months showed patency of the left PICA and persistence occlusion of the occluded arterial segment.

Conclusion: Intradural vertebral dissecting aneurysm that occurs with SAH should be treated promptly because of the high risk of recurrent bleeding. Combined deconstructive and reconstructive technique seems to be a feasible and effective treatment option for selected cases of ruptured VBA-DA. Occlusion of the dissection site with detachable coils is a safe and very efficient treatment to prevent subsequent rupture. The use of stent covering part of the dissection site may offer an interesting alternative to preserve the patency of the vital vessel.
Pediatric Neuroradiology

P 084

Venous Sinus Thrombosis an Underestimated Problem in Neonates?

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Introduction: Venous sinus thrombosis (VST) is a rare condition, its incidence is estimated to be 0.6/100,000/year, but more than 40% of cases occur in newborns. About two thirds of these neonates present with seizures.

Material and Methods: Sonographic Doppler examination and magnetic resonance imaging with venous MR angiography (MRV) were performed in 2 newborn girls with seizures and abnormal brain activity on electroencephalogram.

Results: In the first girl turbulent flow with increased velocity was shown in the lower part of the superior sagittal sinus (SSS) on Doppler sonography as well as increased resistance index (RI) in the internal carotid artery (ICA) and anterior cerebral artery (ACA). Brain MRI was normal. On MRV lack of flow was shown in the lower part of SSS, right transverse and sigmoid sinuses and jugular vein. In the second girl a hyperintense focus of unclear significance was found only on diffusion-weighted image (DWI) in the right internal capsule. It resolved in the follow-up MRI. On MRV there was no flow in the left transverse and sigmoid sinuses as well as in the left jugular vein. Follow-up MRI and MRV after therapy showed recanalisation of the sinuses and veins in both cases.

Conclusions: VST should be taken into account in neonates with unexplained seizures. MR venography makes the examination longer but these few minutes allow confirmation of VST and appropriate therapy that improves the outcome of these children.

P 085

Congenital CNS Tumors Diagnosed on Prenatal MRI

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Material and Methods: Material consists of 3 fetuses with congenital central nervous system (CNS) tumors diagnosed prenatally and confirmed with histopathology. Prenatally sonography (US) and magnetic resonance imaging (MRI) were performed. After birth MRI or computed tomography (CT) were carried out.

Results: In one case large intraventricular tumor was diagnosed with solid, cystic and hemorrhagic elements. It turned out to be choroid plexus carcinoma after surgery. In the second case craniopharyngioma arising from the suprasellar region was diagnosed on the basis of prenatal MRI and confirmed. In the third case extra-axial meningioma-like tumor was visualized on fetal MRI. After surgery it turned out to be desmoplastic infantile astrocytoma.

Conclusions: Intracranial teratoma, the most typical CNS congenital tumor, was not diagnosed in our material. Our cases were rarely encountered neoplasms: choroid plexus carcinoma, craniopharyngioma and desmoplastic infantile astrocytoma. The examinations were repeated after birth and did not add significant information. The in utero diagnostics is easier and more safe than postnatal imaging of the sick baby requiring sedation and provides information of equal value.

P 086

A Pediatric Case of Brainstem and Spinal Cord Ganglioglioma

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A 9-year-old boy presented with neurologic symptoms. MRI examination showed diffuse infiltrative, partially enhancing brainstem tumor extending to the cervical cord whose pathologic diagnosis came back as ganglioglioma. Gangliogliomas are rare, slow-growing tumors most commonly encountered in supratentorial location.

The brainstem is an unusual site for ganglioglioma with only 46 reported cases to our knowledge. Involvement of the spinal cord is even more rare. MRI imaging characteristics are often nonspecific, however, our case demonstrates findings consistent with most commonly reported imaging findings in the literature.

P 087

MELAS with Multiple T2 High-Intensity Lesions in Bilateral Cerebellar Hemisphere: A Case Report

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Introduction: Mitochondrial myopathy, encephalopathy, lactic acidosis, and stroke-like episodes (MELAS) is one of the subgroups of mitochondrial encephalopathy, and MR images typically show high-intensity lesions predominantly in the occipital and parietal lobes which mimick infarcts and cerebellar atrophy. We report a rare case of MELAS showed multiple high-intensity lesions in cerebellar hemisphere on T2WI.

Case Presentation: A 8-year-old boy develop with acute onset of fever, cough, left thigh pain, and slowly progressive gait disturbance. At first, he was suspected mycoplasma pneumonia and myositis, because his blood mycoplasma IgM was positive. He was treated with antibiotics and steroid pulse therapy, but he was not recov-
ered and revealed additionally auditory disturbance and rotary vertigo. The brain MR images on T2W/FLAIR se-
quen ce showed multiple high-intensity lesions in the bilateral cerebellar hemis-
sphere as well as scattered lesions in occipital and parietal lobes bilaterally. Later, his serum high level of lactate and pyruvate was revealed, and he was suspected to have MELAS. He was administered with arginine and vitamin group, his neurological deficits and multiple high-intensity lesions on MR images were improved. Based on a point mutation in position 3243 of mi-
 tochondrial DNA, he was diagnosed as having MELAS.

Conclusions: The clinical presenta-
tion of most of MELAS are highly variable. Onset of mitochondrial dis-
orders can be provoked by febrile ill-
ness when there is mismatch between energy requirements and availability. In the diagnosis of herpes encephalitis, MELAS syndrome should be considered.

P 088

Osteopetrosis: A Case with Internal Carotid Arteries Stenoses and Collateral Circulation

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Osteopetrosis refers to a group of diseases that probably result from several genetical or biochemical defects. One of the most commonly seen forms of the disease is autossomal reces-
sive (malignant) osteopetrosis (AROP) which usually has it’s onset in infancy and is characterized by poor osseous growth and remodeling. Patients with AROP have prominent calvarial and skull base thickening resulting in narrowing of foramina and canals. We report a case of a 3-year-old girl with malignant osteopetrosis, whose head CT revealed severe calvaria and skull base thickening and sclerosis with narrow petrous carotid canal. Cer-
ebral digital subtraction angiography (DSA) disclosed diffuse narrowing of both cervical internal carotid arteries (ICA) and severe bilateral petrous carotid artery stenosis, associated to col-
lateral circulation with prominent ex-
tenar carotid and vertebral arteries. In this patient vascular stenoses probably evolved so early and so gradually that collateral pathways were able to develop. Also, according to pub-
lished studies the presence of diffuse narrowing of the cervical ICA could represent the equivalent of a string sign, seen in patients with either proximal or distal high-grade ICA stenoses, reflecting a higher grade or more long-lasting arterial steno-
sis. However, it still remains unclear the clinical relevance of the petrous carotid canal stenosis and ICA stenoses in patients with osteopetro-
sis given the fact that they are mostly asymptomatic from the neurovascular point of view.

P 089

Primary Brain Abnormalities in Syndromic Craniosynostoses

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Introduction: Significant brain ab-
normalities have been reported in all syndromic craniosynostosis. Mechan-
ical abnormalities, resulting brain disor-
tion as a consequence of the skull deformity and chronic tonsillar her-
niation (Chiari I) caused by small size of posterior fossa especially after an early closure of the lambdoid suture, have already been extensively de-
scribed. However, there are a group of abnormalities that selectively involve the white matter (non-progressive ventriculomegaly, callosal agenesis or thinning, agenesis of septum pel-
lucidum, paucity of the antero-mesial temporal white matter, pyramidal hy-
poplasia) that are likely to constitute a primary disorder.

Methods: Case Report . We present 3 cases of syndromic craniosynos-
toses associated with non-mechanical brain abnormalities: Case 1: 1-month old infant with Apert Syndrome. MRI revealed hypolastic cerebellar vermis, thinning of the corpus callo-
sum and T1 and T2 prolongation of the subcortical and periventricular parieto-occipital white matter. Case 2: 6-month old boy with trigonceph-
aly and cryptorchidism, MRI demon-
strated a supratentorial ventriculome-
ygaly and T1 and T2 prolongation in the hemispheric white matter. Case 3: A 2-month old boy with metopic and sagittal craniosynostoses and cryp-
torchidism. MRI showed supratentio-
rial ventriculomegaly, thinning of the corpus callosum and stenosis of the cervicomедullary junction.

Discussion: L1 cell adhesion mol-
ecule (L1CAM) gene plays a major role in the development of the white matter. To operate, LiCAM interacts with FGFs, whose defects cause syndromic craniosynostoses. The association of non-mechanical white matter abnormalities with syndromic craniosynostoses suggests a common genetic defect. Although CT with three-dimensional reconstructions is the preferred technique to evaluate cranial sutures and surgical planning, MRI allows a better assessment of cerebral abnormalities.

P 090

Neuroimaging Features of Angiocentric Glioma

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Introduction: Angiocentric glioma was recently recognized as a distinct new brain tumor type in the 2007 World Health Organization Classi-
fication of Tumours of the Central Nervous System. Angiocentric gli-
omas are slow-growing supratentorial tumors radiographically similar to other low-grade astrocytomas; chil-
dren and young adults affected by this type of tumor often present with seizures.

Case Report: A previously healthy 2-year-old girl presented with gen-
eralized tonic-clonic seizures. Brain magnetic resonance imaging showed a non-enhancing extensive right tem-
poral lobe mass, causing significant mass effect. There was no evidence of calcification, tumor hemorrhage or necrosis. Magnetic resonance spectroscopy demonstrated low NAA (N-acetylaspartate) and elevated choline and myo-inositol suggest-
ing increased membrane turnover: An endoscopy-guided biopsy of the right temporal component revealed an angiocentric glioma. Conservative treatment, with clinical and imaging follow-up was proposed. In a 3-month follow-up MRI study, no interval change was noted.

Discussion: Our description of the imaging features of this angiocentric glioma is consistent with the few pre-
viously reported cases of this novel tu-
mor type in children. In almost cases, the tumor was located supratentor-
ially, unifocal, hyperintense on T2-
weighted images, and non-enhancing after contrast administration. The previously reported cases suggested that, by performing tumor resection, angiocentric gliomas have a more fa-
vorable prognosis compared with sei-
zure-associated gliomas in children.

P 091

Unusual Complications of Subarachnoid Cysts: Subdural Hematomas and Hygroma

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Arachnoid cysts (AC) are benign, congenital, intra-arachnoidal space occupying lesions that are filled with a clear fluid, similar do CSF. They comprise 1% of all non-traumatic intracranial mass lesions, occurring most commonly in the middle cranial fossa (50%). AC are usually asymptomatic however they may present with signs and symptoms of high intracranial pressure due to complications such as cyst enlargement, hemorrhage (intracystic or subdural) and subdural hygroma. The rupture of an AC wall occurs most commonly after head trauma but can also be spontaneous. The pathophysiological mechanism for the occurrence of subdural hematoma is related with the loose attachment between the arachnoid and the dura and the low support of bridging veins as they enter the cyst wall, making them prone to bleeding, especially during trauma. When the disruption of the cyst wall occurs in a relatively hypovascular zone, the result is an hygroma. We report two cases of middle cranial fossa arachnoid cysts in children that presented with infrequent complications: one patient with an acute subdural hematoma after minor trauma and the other with a subdural hygroma.

Patient and Methods: A male with a normal development at the age of 5 showed daily episodes, mostly during sleep, characterized by clonic jerks of the left limbs. Interictal EEG showed right frontal and vertex spikes, constantly synchronous with myoclonic jerks of the left limbs. The ictal discharge was localized at vertex (Pz-Cz). MRI disclosed an intra-axial area of increased signal on T2 and FLAIR images, located in the cortical and immediately subcortical region at the mesial vertex of the right frontal lobe, occupying the most part of the paracentral lobule, extending toward caudal in the centrum semiovale and anteriorly in the pre-frontal lobe. The surface of the brain appeared intensely compressed and swallowed. Carbamazepine was started with reduction of seizure frequency. Five months later a high resolution MRI examination on 3T scanner wasn’t able to distinguish surrounding cortical edge at the vertex from the lesion; diffusion and spectroscopic MR samplings didn’t add differential elements for a correct diagnosis of the nature of lesion. It was suspected a cortical tuberous in a not familiar form of tuberous sclerosis, or a dysplastic cortical area. An intervention was planned for the difficult to obtain a preoperative cortical lesional area, extremely more intense than surrounding areas and the possibility of a tumoral lesion. A fMRI in sedation was planned for the difficult to obtain the pharmacological seizure control, the involvement of motor cortical areas and the possibility of a tumoral etiology of the lesion. A fMRI in sedation was planned. During an EPI-BOLD sequence an acoustic linguistic stimulus was submitted for verifying the correct functional responsibility of the brain in spite of the sedation. The sensitive and passive motor stimuli were performed by an external operator both for the hands and the feet. The fMRI BOLD images were analyzed with AFNI software. Results: On the Talairach reference anatomy, activations for each stimulus were identified. With the stimulations of the right limbs correct activations in the pre and post central contralateral areas were detected. Stimulation of the left side revealed activated areas spared around the lesion and displaced inferiorly and lateralized. For the left foot passive motor stimulus a cluster of activated pixels with a time course statistically correlated was located at the top of the lesion, on the surface of the lesion and the encephalon, in the hypothalamic quadranular lobe. On the basis of fMRI results a complete lesionectomy was considered. The child was operated at the age 10 months and histology revealed a cortical dysplasia type IIb. The complete lesionectomy was demonstrated by post-operative MRI, that included the top of the lesion, in which previously was found the fMRI activated area. A very mild motor deficit of the left limb occurred post-operatively, completely recovered in one month. Three months later the child was able to walk without help. At one year follow-up he was completely seizure free and showed a completely normal motor cognitive development.

A post-operative MRI performed 8 months after surgery demonstrated a vacuum area with no enhancement after contrast medium administration. The fMRI study was repeated and revealed a reorganization of the functional areas in the right operated hemisphere, characterized by an anatomical correct positioning for the hand stimulus. For the left foot stimulus an intense response was identified around and posteriorly to the surgery area, extremely more intense than the pre-operative responses, with the disappearance of the previous activations of the top of the cerebral lesioned region.

Discussion: With passive fMRI stimuli it is possible to detect functional regions of the sensorimotor cortex in sedated children. As lesionectomy could be the most effective technique for control of seizure arising from the sensory motor cortex in pediatric patients, it is fundamental a pre-surgery examination for control of seizure arising from the sensory motor cortex in pediatric patients. In conclusion, in children less 2 years old with sensorimotor neurological signs, passive fMRI stimuli could be the only method for a functional balance.

Introduction: Patients with drug-resistant epilepsy are often candidates for surgical treatment and functional pre-surgical mapping is helpful to avoid resection of eloquent cortical regions. Neurophysiological analysis and stimulations during awakened intervention can allow a good mapping of brain main functions, but it is mandatory patients’ cooperation. This is impossible in very young children or in fancies. Recently fMRI was proposed as functional investigation. We report a case of a 10 months old infancy with a severe epilepsy caused by a lesion that was removed considering fMRI study.

Purpose: The aim of the present study was to review the MR and MRS findings in patients with Leigh syndrome and to compare these with other disease states. We report our results of conventional brain MR imaging, spectroscopy and metabolite studies.
MRI appearances of primary intracranial arachnoid cysts in infants and children.

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Purpose: To present MRI features of developmental intracranial arachnoid cysts in infants and children.

Materials and Methods: 10 lesions with features of arachnoid cyst were revealed in 9 children (6 males, 3 females) who underwent head MRI among a pool of 248 paediatric head MRI scans performed the past 2 years in our institution. Indications for these particular scans included: headache, hyperemesis, autism, trauma, asymmetric skull configuration, speech difficulties, and optic hypoplasia. The mean age of the examined children was 7.5 years (range 4 months -14 years).

Results: The incidence of arachnoid cysts in our paediatric series was approximately 4%. Most lesions were located in the middle cranial fossa (left/right 7/2, 1 bilateral), with one large cyst occupying the quadrigeminal cistern with left ambient and intercerebral cistern extension. CSF-like content was demonstrated in 9/10 lesions whereas evidence of acute intracystic haemorrhage and associated subdural ipsilateral collection was noted in one case. There was a case of acute temporal bone bulging and mild exophthalmus. Two large cysts were treated surgically: the large quadrigeminal cyst and a left middle cranial fossa cyst causing headache.

Conclusion: Arachnoid intracranial cysts represent rarely, usually incidental findings in the paediatric population. Not often they may become symptomatic due to their location and size or if they get complicated.

Discussion: Arachnoid cysts are benign cysts that occur in the cerebrospinal axis in relation to the arachnoid membrane and that do not communicate with the ventricular system. They usually contain clear, colorless cerebrospinal fluid. Most of them represent developmental anomalies, whereas very few are acquired, associated with neoplasms or adhesions occurring post leptomeningitis, hemorrhage, or surgery. They constitute approximately 1% of intracranial masses; 50-60% occur in the middle cranial fossa, more frequently in males and predominantly on the left side. Arachnoid cysts often are an incidental finding on imaging as they are usually asymptomatic, even when they acquire large size. The most commonly associated clinical features are headache, calvarial bulging, and seizures; focal neurologic signs occur less frequently. Their treatment remains controversial; some clinicians advocate treating only patients with symptomatic cysts, whereas others believe that even asymptomatic cysts should be decompressed to avoid future complications. Cystic lesions localized within the arachnoid membrane may be classified according to the location along the neural axis or by the histologic composition of the cyst wall, which is either arachnoid connective tissue or glioependymal tissue. The cysts located along the cerebral convexity and in the spinal cord are mostly arachnoid, whereas cysts found in the supracollicular or retrocerebellar region may be either arachnoid or glioependymal cysts. Microscopic examination of arachnoid cysts shows that the walls are formed from a splitting of the arachnoid membrane, with an inner and outer leaflet surrounding the cyst cavity. The cyst wall consists of fibrous connective tissue slightly denser than normal arachnoid tissue; occasionally, hyaline changes occur. No epithelial lining is present. The outer wall of the cyst adheres loosely to the dura. Arachnoid cysts usually occur in association with normal arachnoid cisterns; such cysts are congenital, arising from arachnoid clefts and arachnoid duplications. Glioependymal cysts are rare; only a few instances of interhemispheric glioependymal cysts are known. Glioependymal cysts may be associated with other anomalies of the corpus callosum, heterotopia, and other dysplasias. Arachnoid cyst expansion most likely occurs when intracranial pulsation pushes CSF through defects (which behave like valves); CSF then becomes entrapped in arachnoid locations. Less likely, expansion occurs when the cyst wall excretes fluid, perhaps along an osmotic gradient. The most common location of arachnoid cysts is in the floor of the middle cranial fossa, particularly anteriorly, followed by the suprasellar cistern, the cerebellolongitudinal fissure, the quadrigeminal plate cistern, in relationship with the vermis and in the preopticine/interpeduncular cistern.

In cases involving larger arachnoid cysts, consideration should be given to the use of serial scans, because such cysts may enlarge over time; patients with such cysts may become candidates for surgery. Arachnoid cysts should be differentiated from epidermoid cysts with use of MRI with diffusion weighted and FLAIR images. Some arachnoid cysts contain proteinaceous fluid or blood; in such cases, signal loss on DWIs may not be marked. Unlike epidermoid cysts, arachnoid cysts containing CSF demonstrate low signal on FLAIR.

Spinal interventions

P 095 Percutaneous aspiration and ozolysis of symptomatic synovial cysts of lumbar spine, a least invasive option.

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Synovial cysts in degenerative spine often presents with back pain and or radiculopathy. When large, these lesions can cause symptoms of spinal canal stenosis. MRI scan is diagnostic and there is a frequent association with degenerative spondylolisthesis. While most of these patients are treated with simple conservative measures, usual treatment of those with unrelenting signs is surgical decompression. We have treated four patients with symptomatic synovial cysts using percutaneous puncture of the cyst under fluoroscopic control and injection of Ozone in the cyst and in the epidural region. There was a total relief of symptoms in all cases without any post procedure worsening.

Conclusion: Percutaneous aspiration with Ozone Injection in the Synovial Cyst is a novel technique. Our observations in these three patient series suggest validity of this minimally invasive intervention despite a small number of cases.
Poster Exhibit 2nd - Thursday, 7 October - Saturday, 9 October from P 001 to P 101

Posters, Neuroradiology Department; Bologna

P 096

Lumbar Disk Hernias: Percutaneous Treatment with DiscoGel in Patients Who Did Not Respond to Oxygen-Ozone Chemonucleolysis.

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Purpose: O2-O3 chemonucleolysis is one of the mini-invasive treatments for disc herniation. With this treatment, from 2003 since now, we obtained good results in 70-75% of patients treated for lumbar disc herniation. The aim of this study is to assess the therapeutic outcome of intradiscal injection of DiscoGel (radiopaque gelfilled ethanol) in patients who did not respond to the previous oxygen-ozone treatment.

Material and Methods: From December 2008 to January 2010, we treated 32 patients, chosen from those who did not respond to the previous O2-O3 chemonucleolysis, by intradiscal injection of DiscoGel. Lumbar discal puncture was performed by extraspinal lateral approach using a 22G x 17.78 cm BD spinal needle, under fluoroscopic guidance. Therapeutic outcome was assessed six months after treatment using a questionnaire and direct patients interview.

Results: Treatment was a success (back pain relief) in 24 out of 32 patients (75%) whereas it was deemed a failure (poor outcome - recourse to surgery) in the remaining 8 patients. No complications occurred in our patients.

Conclusion: Our experience of intradiscal DiscoGel injection has been shown to be safe and effective. In our opinion, DiscoGel intradiscal injection, because of its higher cost, is a useful treatment option to be considered when the O2-O3 chemonucleolysis fails, before recourse to surgery, or when surgery is not possible.

P 097

Spinal Dural Arterio-Venous Fistulas Lacking Spinal Cord Signal Abnormalities: Cases Reports and Literature Review

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Spinal vascular malformation are rare entities that are often undiagnosed and if not correctly identified could evolve to progressive spinal cord symptoms. Spinal dural arteriovenous fistulae (SDAVF) account for 70% of all arteriovenous shunts of the spine. The arteriovenous connection is located inside the dura mater, where a radiculomeningeal artery shunts into a radicular vein. The arterIALIZATION of the vein causes a retrograde venous congestion with edema of the perimedullary venous vessels. These haemodynamic changes lead to spinal cord edema, chronic hypoxia and progressive congestive mielopathy. SDAVF could be suspected on the basis of characteristics MR signs: swollen cord with centrally located T2 weighted hyperintensity, related to edema, perimedullary dilated venous drainage and contrast enhancement due chronic venous congestion. We report three cases of patients affected by SDAVF. The vascular formations were disclosed at Contrast-Enhanced Magnetic Resonance Angiography (CE-MRA) and their spinal cord didn't reveal any signal abnormality nor swelling. This cases will pose some interesting questions about SDAVF pathogenesis and their therapeutic indications.

P 098

Cervical Spinal Cord 1H-Magnetic Resonance Spectroscopy in Amyotrophic Lateral Sclerosis: Preliminary Results


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Purpose: To analyze with magnetic resonance Spectroscopy (1H-MRS) the modifications of cervical spinal cord metabolites in patients affected by amyotrophic lateral sclerosis (ALS). Methods: A 1H-MR point-resolved spectroscopy sequence volume of interest was placed along the main axis of the cord between C2 and C3 levels in a group of 7 patients with clinically definite ALS (6 females and 1 male; range 41-71 years, mean age 58.7 ± 10.6 years). MR spectroscopy data were analyzed by the user-independent fitting routine LC-Model, and relative metabolite concentrations were expressed by the absolute concentration ratios. These results were compared with the values obtained from a control subjects group (4 females and 6 males, range 22-66 years, mean 34.9 ± 12.2 years). The Wilcoxon unpaired two-sample test was used to evaluate the differences between the median values of the ALS group and the healthy subjects, with a statistically significant threshold of p < 0.05.

Results: Between the 7 patients affected by ALS in 6 cases MR morphological sequences didn't display any spinal cord signal abnormality. MRS metabolite quantification revealed a statistically significant increase in myoinositol/Choline (mIns/Cho) and Glutamate-Glutamine/Choline (Glx/Cho) median value in ALS patients compared to healthy controls.

Conclusions: Our 1H-MRS study has demonstrated the presence of subtle metabolic modifications in the spinal cord of patients affected by ALS compared to healthy subjects. This results are preliminary observations, that need to be corroborated with future study to further elucidate pathophysiological mechanisms and metabolite modification over time.

P 099

Retreatment of an Apex Basilar Aneurysm with Intra-Extra Aneurysm Stent Implantation: A “Waffle Cone” Technique

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Wide necked aneurysms present several challenges relating to endovascular treatment, including coil reten- tion in the aneurysm during placement, preservation of parent or branch vessel patency and relatively high recurrence rates. Intracranial stents greatly facilitate the endovascular treatment of wide necked basilar apex stent-assisted-coil embolization of intracranial aneurysms with different applications (anterior unilateral, Y configuration bilateral, “waffle cone” and retrograde) has been reported by many investigators. We present a 54-year-old female with an unruptured complex configuration basilar apex aneurysm. In October 2008 we performed coil embolization with TriSpan device implantation to preserve flow within incorporated branch vessels. Follow-up angio-MR controls showed the progressive increase of blood flow within the aneurysmal sac with dislocation of TriSpan device and coils. Therefore we performed an endovascular retreatment with Solitaire stent intra/extra-aneurysm implantation. Successfull occlusion of the aneurysm with coil packing within and external to the stent was achieved with preservation of flow to the branch vessels. Intraprocedural antiplatelet and
anticoagulant therapy administered (1gr Flecatal and 3000UI Heparin). Double antiplatelet therapy was continued for 30 days. Aspirin therapy was continued indefinitely (6 months). No major postprocedural complications have been observed. A follow-up angiography-MR at 4 month demonstrated complete occlusion of the aneurysm, with preservation of both carotid arteries. Spiral CT scan showed a volume of the intrasaccular coils in the aneurysm cavity. coils can migrate even late in carotid du to an enlargement of the sac and its collar, with possible complications; to remedy these difficulties it can be associated the installation of a stent to cover the pathological portion of the vessel. Litterature emphasizes that coiling statistically cannot avoid the enlargement of the sac and therefore doesn't confer a durable protection from rebleeding. Otherwise most of the blister embolized aneurysms in particular with the use of stent, if enlarged, appeared protected from premature bleeding, at least during the first weeks for the resolution of the vasospasm, probably to reduce the hemodynamic stress on the aneurysmal fragile wall. In case of subarachnoid haemorrhage were is shown a bluster like aneurysm, we believe that it is reasonable to proceed to the endovascular treatment in two subsequent phases, firstly releasing of spirals without strain, using if necessary the implant of a stent to avoid migration, immediate or late, with the goal to reduce the fatal risk of precocious bleeding. After a few weeks, during which it is required to execute a strictly clinical and angiography monitoring, once overcome the acute clinical phase and the possible associated vasospasm, treatment can be completed releasing, if necessary, more spirals into the sac and implanting to cover the pathological area, a flow diverter stent with the double aim to preociously clog the aneurysm and give the structure that can direct the path of recovery of the vessel wall. Here we describe in details a case of BBLA, that we observed after bleeding, for which treatment has been made in two subsequents phases, a first of stent assisted coiling (Boston Neuroform) and a second again with coils and a flow diverter stent(BALT Silk).

The treatment of wide-necked as well as fusiform intracranial aneurysms has always represented a challenge for neurosurgeons and neuroradiologists. Flow-diverting stents (Silk; Pipeline Embolization Device) are new endovascular devices designed to divert the flow in the parent artery, with reduction of inflow in the aneurysm leading to intrasaccular thrombosis and wall release of intrasaccular coils. They are a tubular, bimetallic endoluminal devices with low porosity and the propriety of forming high-coverage mesh once expanded that induced thrombo sis of the aneurysm at the same time as preserving patency of adjacent small vessels. We have been employing these stents in the Neuroradiologic Unit of Bellaria Hospital in Bologna from December 2007 to February 2010: we have treated twenty-three patients with aneurysms of carotid siphon and of two of intracranial posterior circulation.

The Silk stents were deployed through a 4F Balt introducer, which ensured an uneventful and very quick procedure. Control angio-TC or angio MR were typically performed at discharge 1,2,4,12 month after treatment. Post-treatment results were: 14 (56%) complete occlusions, 4 near complete occlusions, 2 treated with a complete occlusion of the neck flow without reduced volume of the aneurysm and 4 (16%) are still open after one year follow-up.

Delayed complications occurred in 6 patients (24%), including 1 fatal SAH, 1 fatal cerebral haemorrhage, 1 obstructive hydrocephalus, 2 early intrastent thrombosis and 1 a perforation of the Percheron artery. There were no symptomatic intrastent steno sis or late occlusion vessel. Silk stent seems a very interesting curative device to treat giant aneurysms with preservation of the parent artery and small adjacent branches. Fatal results are an obligation to check all aspects of a therapeutic device. Indication, technical aspects (i.e., additional coil-ing, telescope technique), anti-aggre gation, etc. have to be put into question and critically analyzed.

References
2 Turowski B, et al.: Early fatal hemorrhage after endovascular cerebral aneurysm treatment with a flow diverter (SILK-Stent) : Do we need to rethink our concepts? Neuroradiology, 2010 Mar 26
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The World Federation of Neuroradiological Societies-WFNRS-was originally conceived by Prof. Derek Harwood-Nash and was established in 1993. The mission statement reads:

WFNRS is an umbrella organization composed of 25 national and regional neuroradiological societies. It fosters international scientific and educational programs in neuroradiology and promotes cooperative projects between its member organizations and those in allied disciplines.

This mission statement is held in very general terms and can be claimed to be non-committing! It is almost 20 years since the WFNRS was established and Radiology and Neuroradiology in particular, has seen a breathtakingly quick technical development not only in our discipline but also in the society in general. Internet and the advent of rapid data communications have redrawn the map and completely changed the conditions for an organisation like WFNRS. Although the social aspects of a scientific meeting can not be underestimated, the traditional way of communicating experiences and scientific ideas during large and small scientific meetings and courses is not fast enough and new types of meeting places are established every day. The WFNRS has an organisation and particularly a constitution of the past and has yet to take the step into the 21st Century.

Whether we like it or not, radiology as a single discipline is unlikely to survive. Future neuroradiologists will probably not need to have general radiology training. Thus it will be necessary to reform the training of neuroradiologist into becoming a neuroscientist with an imaging profile with or without competence in endovascular treatment. It will be necessary to reorganise future departments of radiology in order to support organ or disease process oriented work flow with distributed equipment localised close to the patient and in an intellectual environment with organ-specialised clinicians of various profiles. The nature of neuroradiology today is not a specialty focused on producing an ever increasing number of examinations and reports but rather a clinical specialty in which the neuroradiologist can have an intellectual exchange of knowledge and skills providing added value to patient care with his or her particular competence in imaging interpretation and minimally invasive treatment as applied in patients with diseases of the central nervous system. This is the challenge of the new decade and the early parts of the 21st Century!
It is this understanding of our future that must guide the activities of the WFNRS the next decade. We should not be in the business of arranging courses or meetings. There are other organisations far better equipped and proficient in these tasks. We should not think that we can have a leading role in research or providing networks for exchange of scientific news. This is done anyway! It is for this reason that the outgoing and incoming presidents of the WFNRS has agreed to present the following program for the next four years. It is to realise this program that we ask your approval

1. The future of WFNRS we believe is to a significant degree in cyber space. We are convinced that the most important mode of communication with a world wide membership is over internet.
2. We plan to use the funds remaining from previous contributions to develop a web-site of WFNRS.
3. We propose a nominal fee for society membership in WFNRS for the coming two years-USD 50.00 for annual membership 2010-2011
4. We will perform an inventory of those training charters available in different parts of the world. These charters will be made available on the web-site
5. This inventory should be used to formulate WFNRS guidelines about training in diagnostic and interventional neuroradiology
6. We propose that WFNRS will prepare and formulate Technical and Professional Guidelines in other areas such as:
   a. Continuing medical education/continuing professional development
   b. Quality assurance
   c. Accreditation of training centres
   d. Good medical care in neuroradiology
   e. Good standard of practice in interventional neuroradiology
   f. Postgraduate training-examination
7. Support subspecialisation within neuroradiology
   a. Support preparation of Technical and Professional Guidelines
   b. Invite subspecialisation societies to join WFNRS
8. Provide a discussion forum for the future of neuroradiology
   a. Future training of neuroradiologists
   b. Relationship with neuro science
   c. Foster exchange of ideas within neuroscience
   d. Future training of neuroscientists with imaging profile

It is our conviction that WFNRS could play an important role in the coming decade provided that the activities of the Federation “add value” to the membership societies, and their members. Should we fail in this concept, and you are the judges about our success, it is possible that the world of neuroradiology would do well without a World Federation.

Sincerely yours

Luc Picard
President WFNRS

Olof Flodmark
President Elect WFNRS
Lello Esposito, lives and works between Naples and New York. A sculptor and painter for almost thirty years, Lello Esposito focuses on the city of Naples and its symbols - Pulcinella, the mask, the egg, the skull, the volcano, San Gennaro and the horn - in their various stages of metamorphosis. Over a period of time he has been able to experiment with sculpture and painting and evolved different meanings, dimensions and artistic techniques. He uses various types of materials - bronze and aluminum - for his sculptures and installations - and paints large canvases. Lello Esposito likes to call himself a “cult artist” because of his work on the archetypes and symbols of the city and cultural imagination that come to the surface from below, are restored and take on new forms and representations thus making a significant contribution to the new interpretations of tradition that are essential to all new forms of artistic and cultural experimentation. He has combined an all-embracing passion for art and Naples to become an emblematic artist with his own unique style. His work is well known throughout Italy and abroad where he participated to a number of exhibitions.
Maurizio Bottarelli was born in Fidenza (Parma) in 1943 and received his Diploma in Painting from the Accademia di Belle Arti di Bologna in 1965. He began his teaching career in 1969 at the Accademia di Belle Arti di Bologna and is currently on the Faculty at the Accademia di Belle Arti di Brera in Milan. In 1971-1972 he spent time in London and in 1976-1977 he was invited to teach at Brighton Polytechnic and Goldsmith College of Art, sponsored by the British Council. In 1992 he was called to Austria’s Atelier Des Stadt im Salzburger Kunsterhaus and in the Fall of 1996 he was invited to give a series of lectures in the Studio Art Departments of various campuses of the University of California. In the Summer of 1998 he taught Advanced Painting at the University of California at Santa Barbara, under the auspices of the Education Abroad Program. Summer 2000 saw him invited to Monash University in Melbourne where he was appointed Artist in residence and invited to hold a solo exhibition in the Department of Art and Design. In Spring 2004 he visited the Art Practice Department of the University of California, Berkeley as Faculty Exchange Professor through the Education Abroad Program and presented his work at the Italian Cultural Institute in San Francisco. Bottarelli has been active in the Italian and international art community since the early sixties with solo and group exhibitions. He lives and works in Bologna.
FELLOWSHIP IN NEURORADIOLOGY
TUESDAY, 5 OCTOBER 2010
White Hall 2

08.00-13.00 Tutor: C.F. Andreula

Diagnostic Brain
08.00-08.10 8’ Fast Magnetization Transfer Imaging of the Brain
Meritxell Garcia
08.10-08.20 8’ Arterial Spin Labeling (ASL) Perfusion: Basic Principles and Clinical Applications in Neuroradiology
Joana Ramalho
08.20-08.30 8’ Neuroimaging in FXTAS. Can We Predict Conversion of Premutation Carriers?
Esther Granell Moreno
08.30-08.40 8’ Evaluation of Apparent Diffusion Coefficient in Prion Encephalopathies
Maria Reyes Garcia de Eulate
08.40-08.50 8’ Advanced Brain Imaging Procedures and Neurodegenerative Disorders
Ingrid Inches
08.50-09.00 8’ Acute Excitotoxic Brain Injury: Different Neurologic Acute Conditions, Same Mechanism.
Victoria Vazquez
09.00-09.10 8’ Rheumatoid Arthritis in the Brain - Diagnosis of Exclusion
Suzanne O’Leary
09.10-09.20 8’ Osmotic Demyelination Syndrome and Cortical Laminar Necrosis Caused by Severe Hypernatremia
Following Hypertonic Peritoneal Lavage for Ruptured Hydatid Cyst of the Liver
Miklos Szolics
09.20-09.30 8’ Pseudotumoral MS: Case Report and Review of the Literature
Marjan Acou
09.30-09.40 8’ A Practical MRI-Dementia Protocol and Structured Reporting of MRI Scans in Dementia
Georgios Karas
09.40-09.50 8’ Spontaneous Intracranial Hypotension: An Imaging Review.
Daniel J Warren
09.50-10.00 8’ MRI in the Diagnosis of Intracranial Hypotension Syndrome
Alessta Catalucci
10.00-10.10 8’ MRI in Temporal Lobe Epilepsy
Valentina Calistri
10.10-10.20  S'  MRI of Central Nervous System Tuberculosis: Experience of 50 Cases from Central India
Devarti K Khurjekar

10.20-10.30  S'  MRI Study of Evolution of Convexal Subarachnoid Haemorrhage in Cerebral Amyloid Angiopathy
Victor Cuvinicue

10.30-10.40  S'  Classification of Non-Aneurysmal Subarachnoid Haemorrhage: CT Correlation to the Clinical Outcome
Sanjeev Nayak

10.40-10.50  S'  Multiparametric Imaging of Brain Tumors.
Frank E. De Belder

10.50-11.00  S'  The Value of Perfusion MRI in Differentiating Recurrent Metastases from Radiation Injury Following Stereotactic Radiosurgery
Annika Kits

Head & Neck
11.00-11.10  S'  The Jugular Bulb Diverticulum vs. the High Riding Jugular Bulb
Dieter Goettmann

11.10-11.20  S'  Comparison Study between FIESTA MR and HRCT in Evaluating the Superior Semicircular Canal: Do We Still Need CT?
P. Browaeys

Paediatrics
11.20-11.30  S'  MR and Diffusion Tensor Imaging (DTI) Findings in Septo-Optic Dysplasia (SOD)
Maria Savina Severino

11.30 - 11.40  S'  Decreased Cerebellar Myo-Inositol and N-Acetylaspartate Concentrations in Paediatric Attention/Deficit Hyperactivity Disorder
J.C. Soliva

HIGHER QUALIFICATION IN INTERVENTIONAL VASCULAR NEURORADIOLOGY
Tutor: C.F. Andreula
11.40-11.50  S'  23 Endovascular Treatment of Carotid Near-Occlusion
Luis Concepción Aramendía

11.50-12.00  S'  Communication of the Results

FELLOW IN NEURORADIOLOGY
Tutor: C.F. Andreula
12.00-12.10  S'  Rescue, Combined and Standalone Thrombectomy in Large Vessel Occlusion Using the Solitaire™ FR Device
K. Lobotesis

12.10-13.00  ESNR AWARDS

Chairs: J. Wilmink, M. Leonardi

ESNR - Appel Research Award
Stefan D. Roosendaal
*Resting State Networks Change in Clinically Isolated Syndrome

ESNR - Founders Award for Diagnostic Neuroradiology
Marc-André Weber
*Biopsy Targeting in Gliomas: Do Functional Imaging Techniques Identify Similar Target Areas?

ESNR - Founders Award for Interventional Neuroradiology
Zsolt Kulcsar
*Intra-Aneurysmal Thrombosis as a Cause of Rupture after Flow Diversion Treatment
HIGHER QUALIFICATION IN INTERVENTIONAL VASCULAR NEURORADIOLOGY

WEDNESDAY, 6 OCTOBER 2010

08.00-13.00  Tutor: C.F. Andreula

08.00-08.10  8’  Treatment of Acute Middle Cerebral Artery Occlusion with Solitaire AB Stent-Preliminary Experience.  
   Sanjeev Nayak

08.10-08.20  8’  Course and Treatment of a Giant Haemangioma of the Tongue  
   Dieter Goettmann

FELLOW IN NEURORADIOLOGY

Diagnostic Brain

08.20-08.30  8’  Neuroimaging in Dementia: Practical Guide for a Standardized and Reproducible Image Reading Procedure  
   Mike P. Wattjes

FELLOW IN NEURORADIOLOGY

Paediatrics

08.30-08.40  8’  The Role of MRI in Perinatal Anoxic Ischemic Brain Injury  
   Andrea Boghi

Interventional

08.40-08.50  8’  Endovascular Treatment of Wide-Neck Intracranial Aneurysms Located on Arterial Bifurcations  
   Julio Palomino

08.50-09.00  8’  How to Start Neurointerventional Procedures. My Experiences in Iran  
   Hussein Khanate

09.00-09.10  8’  Cerebral Vasospasm after Subarachnoid Hemorrhage - Imaging with CT Angiography and CT Perfusion  
   Maria Schmook

09.10-09.20  8’  Diagnostic Imaging on Intracranial Atherosclerotic Stenosis  
   Eduardo Freire Mello

09.20-09.30  8’  Endoluminal Approach with Flow-Diverter Stents for Treatment of Intracranial Aneurysms  
   Vittorio Civelli

09.30-09.40  8’  Flow Diverter Stents: The Ultimate Solution for Untouchable Aneurysms or a Weapon Too Dangerous to Use?  
   Cagin Senturk

09.40-09.50  8’  Abciximab Treatment Modalities for Thromboembolic Events Related to Aneurysm Coiling  
   M. Aggour

09.50-10.00  8’  MRA versus DSA in Follow-Up of Coiled Intracranial Aneurysms  
   Stefan Celedin

10.00-10.10  8’  MR Angiography at 3T in the Follow-Up of Coiled Cerebral Aneurysms: To Use Gadolinium or Not?  
   Paolo Vezzulli

10.10-10.20  8’  Acute Ischemic Stroke: Typical Findings and Pitfalls in Modern Neuroimaging  
   Gry Behzadi

10.20-10.30  8’  Scotty Dog: The Spinal Interventionalist’s Best Friend  
   Øivind Gjertsen

FELLOW IN NEURORADIOLOGY

Paediatrics

10.30-10.40  8’  Neuroimaging of Phakomatoses in Children  
   Daniela Longo
10.40-10.50 8’ Pivotal Role of Imaging Work-Up in the Assessment of Spinal Cord Infarction Due to Compression of a Lumbar Artery by the Right Diaphragmatic Crus. Report of a Case and Literature Review
Federico Di Maria

10.50-11.00 8’ Functional Assessment and DTI-MRI Correlates of Congenital Emiplegia
Francesco Randisi

11.00-11.10 8’ Cerebral Palsy. What to Expect, How and When to Image
Nathan Demeyere

11.10-11.20 8’ Pediatric Head Trauma
Pedro Soares Pinto

11.20-11.30 8’ Pediatric Posterior Fossa Tumors: Diagnosis and Follow-Up
Esther de Luís

11.30-11.40 8’ Pilocytic Juvenile Astrocytomas: A Difficult Diagnosis?
Annapaola Bocchio

Head and Neck

11.40-11.50 8’ Imaging of Disease Spread through the Skull Base
Eufrozina Selariu

11.50-12.00 8’ “Something New”: A Purposive Guide for Practical Diagnostics in Midfacial Trauma
Jan E.W. Zajaczek

12.00-12.10 8’ Anatomic Variants of the Sphenoid and Ethmoid: CT-Based Recognition of Surgical Risk of Neurological Injury.
Edgar Friman Loewenthal

12.10-12.20 8’ MR in the Differential Diagnosis of Chronic Otitis Media
Mario Prenafeta

Diagnostic Spine

12.20-12.30 8’ Biomechanic Reflections in Spine Pathology Using Up-Right MRI
Alessandra Splendiani

12.30-12.40 8’ CT Scan and MRI Spinal Imaging Findings in Intracranial Hypotension: a Case Report
Sérgio Cardoso

12.40-12.50 8’ Posttraumatic Syringomyelia
Andreas Grillhoesl

12.50-13.00 8’ Metastatic Disease of the Spine and the Spinal Canal
Roberto Schubert
J.C. Soliva

HIGHER QUALIFICATION IN DIAGNOSTIC NEURORADIOLOGY

13.00-13.10 8’ Volumetric MR Analysis of the Caudate Nucleus: a Proposal for a Diagnostic Test in Paediatric Attention/Deficit Hyperactivity Disorder
J.C. Soliva

13.10-13.20 8’ Advanced Neuroradiological Studies of Brain Tumors: From Morphology to Physiology.
Andrés Server Alonso

HIGHER QUALIFICATION IN PAEDIATRIC NEURORADIOLOGY

Andrés Server Alonso

13.30-13.40 Communication of the Results
Palazzo della Cultura e dei Congressi - White Hall 2  
Tuesday, 5 October - 08.00-13.00

FELLOW IN NEURORADIOLOGY

Diagnostic Brain

Tutor: C.F. Andreula
08.00-08.10 8'

Fast Magnetization Transfer Imaging of the Brain

Meritxell Garcia

Magnetization transfer (MT) reflects the exchange of magnetization between protons bound to macromolecules and protons found in free liquid. Although not used in the daily clinical routine, MT has been reported to show increased sensitivity for the characterization of pathologic brain tissue (1, 2). MT effects are commonly assessed by the so-called MT ratio (MTR), reflecting a rather qualitative measure as it additionally depends on sequence parameters. In contrast, quantitative MT (qMT) parameters, such as the rate of magnetization transfer (kf) and the fractional size (F) between bound and free protons can be drawn from a tissue model, in addition to relaxation times (T1, T2). It is evident that in contrast to a simple MTR analysis drawn from two MT scans, any quantitative MT analysis requires more extensive data acquisition (3), hampering its clinical applicability. Only recently, the assessment of whole-brain, 3D high-resolution quantitative MT data has been demonstrated to be feasible within 10 minutes using a fast acquisition technique based on a MT-sensitized balanced steady-state free precession (bSSFP) protocol (4-7). MT-sensitized bSSFP provides a reliable assessment of quantitative parameters even for very small brain structures, such as the hippocampus, with a low standard deviation (8). This new framework provides a promising tool for the fast acquisition of quantitative MT parameters within the clinical routine, and especially for brain pathologies including, but not limited to: Brain tumours and metastases: An ongoing study performed on patients with different kinds of brain tumours (glioblastomas (GBM), meningeomas), and metastases demonstrates that in the different pathologies, contrast enhancing (CE) tissue and surrounding edema, which appear similar in signal intensity on conventional MRI, show differences in F, kf and relaxation times (Figure 1). Despite similar MTR for the CE areas in GBM and meningeomas, kf tends to result in higher and relaxation times in significantly lower values compared to GBM, despite similar F. Multiple Sclerosis (MS): The quantification of MTR in MS lesions with 3D-bSSFP reflects the values observed with standard 2D-GRE methods (9). In addition the i) high isotropic spatial resolution, ii) whole brain coverage, iii) stronger contrast between grey and white matter, and iv) fast and robust quantification of MTR provided by the 3D-bSSFP technique appeared advantageous over the 2D-GRE approach. Preliminary results of fast quantitative MT-based bSSFP imaging in patients with MS reveal significant differences in F and/or kf between different MS lesions behaving very similar in signal intensity on conventional MRI (Figure 2). Ischemia: Sequential MT-based bSSFP imaging in patients suffering from acute and subacute stroke showed a high linear correlation between relative MTR and the age of ischemia, indicating that MT-based bSSFP might be a promising tool for giving information about ischemic damaged brain and corresponding infarct age (range: 4 hours to 10 days) (10). Due to the unique properties of bSSFP-based qMT imaging (fast imaging, high resolution, 3D whole-brain coverage, and excellent reproducibility), this new method might be a useful sequence for tissue characterization beyond conventional MR with increased pathologic specificity for CNS lesions.


Figure 1  FLAIR and T1-CE sequences, and MT parametric maps of a patient suffering from GBM. The heterogeneous MT effect is clearly visible in the contrast enhancing areas.

Figure 2. Patient with MS and two plaques in the left hemisphere. A significant difference in the F-value between the two plaques is observed, despite similar MTR, relaxation times, and kf.

Arterial Spin Labeling (ASL) Perfusion: Basic Principles and Clinical Applications in Neuroradiology

Joana Ramalho

Arterial spin labeling (ASL) perfusion is a magnetic resonance imaging (MRI) technique for measuring tissue perfusion which has been utilized mostly in the brain. There are two main MRI perfusion techniques: bolus tracking after the injection of an exogenous endovascular tracer and ASL, which uses magnetically labeled water protons as an endogenous tracer. Over the last decade, the ASL method has moved from the experimental field to the clinical environment. Its noninvasive nature and ability to quantitatively measure tissue perfusion make ASL ideal for research and routine clinical practice. This presentation focuses on the background, normal patterns and common findings using ASL perfusion in clinical neuroimaging.
**08.20 - 08.30 8’**

**Neuroimaging in FXTAS. Can We Predict Conversion of Premutation Carriers?**

Esther Granell Moreno

**Background:** Fragile-X-associated Tremor/Ataxia Syndrome (FXTAS) is a late onset neurodegenerative disorder occurring in carriers of a premutation expansion (65 to 200 repeats) of the Fragile X Mental Retardation (FMR1) gene. Some FXTAS patients develop cognitive decline and eventually dementia, this having been mainly described in men. Up to date, it remains unknown which carriers will develop FXTAS and cognitive decline late in life.

**Purpose:** To investigate if 3T MRI markers can differentiate FXTAS from non-FXTAS subjects, and thus be potentially useful in predicting conversion of premutation carriers to FXTAS. To evaluate the relationship between MRI markers and cognitive-neuropsychological disturbances.

**Methods:** Prospective, cross-sectional study of 44 subjects (30 premutation carriers, aged 33-80, and 14 controls), matched for age and sex. 3T (Philips Intera 2.1) MRI included 3D FLAIR and T1-weighted imaging applying triple gradient echo (MPRAGE) sequences in the qualitative and quantitative analysis of the white matter hyperintensities (WMH). An automated segmentation was also performed.

**Results:** The use of diffusion sequences in the qualitative and quantitative (ADC) diagnosis of prion encephalopathies allows automated evaluation, simple and reproducible for any radiologist, regardless of his experience. Diffuse cerebral involvement in prion encephalopathies without respect of cortical areas was also confirmed.

**08.30 – 08.40 8’**

**Evaluation of Apparent Diffusion Coefficient in Prion Encephalopathies**

María Reyes García de Eulate

Prion encephalopathies (PE) bring together a number of entities with a low prevalence and fatal prognosis. Among them, the most common is Creutzfeldt-Jakob disease. There are a number of classical clinical, analytical, electroencephalographic (EEG) and histopathological diagnostic criteria. However, magnetic resonance imaging, and advanced imaging techniques such as Diffusion weighted sequences (DWI), increase the sensitivity and specificity in the pre-mortem diagnosis.

**Material and Methods:** We performed a retrospective case-control study in 7 patients with PE, 6 diagnosed with Creutzfeldt-Jakob disease (CJD) and one with fatal familial insomnia (FFI). 9 controls were randomly collected. The study protocol includes T2 weighted TSE and Fluid attenuation inversion recovery (FLAIR) sequences. Diffusion weighted imaging applying triple gradient b0, b500 and b1000 and Apparent Diffusion Coefficient (ADC) maps, were also obtained. Two blinded radiologists, one experienced and other not, less so read the images and obtained the ADC in cortex (superior frontal gyrus, supramarginal gyrus and primary motor and sensory cortices), subcortical gray matter (caudate, putamen, globus pallidus and thalamus) and in both semi-ovale centres. In addition, ADC ratios were obtained from precentral cortex-superoor frontal gyrus and postcentral cortex-supramarginal gyrus in order to evaluate the extension of the disease.

**Results:** The statistical analysis shows a trend towards decreased values of ADC in patients with PE among controls, being statistically significant (p>0.05) in the majority of cases. In the evaluation of ADC ratios, statistical analysis shed no significant differences according to the diffuse alteration of the disease (p>0.05). The inter- and intraobserver correlation was excellent (CCI>0.8).

**Conclusions:** The use of diffusion sequences in the qualitative and quantitative (ADC) diagnosis of prion encephalopathies allows automated evaluation, simple and reproducible for any radiologist, regardless of his experience. Diffuse cerebral involvement in prion encephalopathies without respect of cortical areas was also confirmed.

**08.40 – 08.50 8’**

**Advanced Brain Imaging Procedures and Neurodegenerative Disorders**

Ingrid Inches

The impact of advanced brain imaging procedures in the field of neurodegenerative disorder is reviewed, with particular emphasis on current and potential applications that may impact upon the diagnosis and management of memory-disordered patients. Both advanced structural, resting physiological and functional physiological brain imaging procedures have been applied to conditions where memory disorder is a major feature. In the case of applications in treatment settings, advanced brain imaging procedures may help to monitor neural correlates of spontaneous recovery or progression of memory function, and may also help in the planning and monitoring of therapeutic intervention.

**08.50 – 09.00 8’**

**Acute Excitotoxic Brain Injury: Different Neurologic Acute Conditions, Same Mechanism**

Victoria Vazquez

To describe excitotoxic mechanisms in various acute neurologic conditions. Such conditions include infarction, hypoxic ischemic encephalopathy (HIE), the early phase of wallerian and transneuronal degeneration, shaken baby syndrome, status epilepticus, a corpus callosum lesion related to either seizures or anti-epileptic drugs, diffuse axonal injury, toxic or metabolic, leukoencephalopathy, the acute phase of multiple sclerosis, and Creutzfeldt-Jakob disease (CJD).

**Subject:** Edema and diffusion restriction in reversible brain lesions have been attributed to excitotoxic mechanisms, without brain ischemia. Excitotoxic brain edema is a form of cytotoxic edema due to increased extracellular glutamate, which has a variety of different causes and mechanisms. Excitotoxic edema has been considered an edema of glial cells and myelinic sheaths might preserve ions from in-
tracellular edema and non reversible damage. This could explain why this kind of edema is reversible in many cases. Excitotoxic edema is also involved in several types of nonreversible acute brain damage due to both energy failure and excitatory mechanisms. Conclusion: Excitotoxic mechanisms play an important role in cellular damage in various diseases, and glutamate excitotoxicity is the final common pathway resulting in brain injury for many seemingly unrelated diseases. Excitotoxic amine receptors are present in neurons, axons, glial cells, and myelin sheaths. Astrocytes and myelin sheaths, which protect synapses and axons, swell after absorbing excessive glutamate. Such excitotoxic edema seems to be transient and resolves on follow-up MR imaging.


**Rheumatoid Arthritis in the Brain - A Diagnosis of Exclusion.**

Suzanne O'Leary

Rheumatoid arthritis is a systemic inflammatory disorder, usually affecting the joints. However, there can be many extra-articular sites affected, including skin, lungs, eyes and blood vessels. When the blood vessels are involved, it is medium and small vessels of the skin and peripheral nervous system which are more commonly affected. There are case reports of it affecting the brain, causing a cerebral vasculitis. It can also rarely cause meningitis or pachymeningitis. This is often a diagnosis of exclusion, and brain biopsy may be required. We present a case of a 58-year-old female patient who presented to our Emergency Department with a sudden onset of severe headache, which had persisted for 2 weeks. At the time of admission, the patient was confused and her history of well-controlled rheumatoid arthritis was not reported. The diagnostic dilemma of the imaging appearances on MR, CT and catheter angiography will be discussed in this case of biopsy proven pachymeningitis and cerebral vasculitis due to rheumatoid arthritis.

**Osmotic Demyelination Syndrome and Cortical Laminar Necrosis Caused by Severe Hypernatremia Following Hypertonic Peritoneal Lavage for Ruptured Hydatid Cyst of the Liver**

Miklós Szádics 1, Hashim A. Samir 2, Farrukh Chaudry 2, Milos Ljubisavljevic 1 1Division of Neurology, Departments of 2Clinical Imaging and 2General Surgery, Tawam Hospital, in affiliation with John's Hopkins Medicine, Al Ain, Abu-Dhabi, UAE. 2Department of Physiology, Faculty of Medicine and Health Sciences, UAE University, Al Ain, UAE.

**Introduction:** Osmotic demyelination syndrome (ODS) refers to central pontine myelinolysis (CPM) and extrapontine myelinolysis (EPM). Cortical laminar necrosis (CLN) has been rarely reported in association with ODS. It was shown in animal experimental studies and several cases in neonates that the rapid and sustained hypernatremia might induce brain myelinolysis. However, ODS is not recognized as a complication of hypernatremia when arising from a normonatremic baseline. Here we report a case of the ODS associated with extrapontine myelinolysis and cortical laminar necrosis following severe hypernatremia consequent to hypertonic peritoneal lavage after a ruptured hydatid cyst of the liver (HCL).

**Clinical Case:** A 30-year-old male was treated by peritoneal lavage with hypertonic saline following inoculation of a ruptured HCL. In the early post-operative period the patient remained drowsy. Ten hours after the surgery he became unresponsive and eventually comatose. Repeated laboratory work-up showed sodium level at 183-mg/dl. Sodium correction at a rate of 1 mmol/h (20 mmol/l in the first 24 h) led to sodium level drop to 168 mmol/l after 24 h and at this point the patient had generalized tonic-clonic epileptic seizure. The brain CT showed extensive fronto-temporal gyral effacement, decreased gray/white matter differentiation and decreased attenuation area in a frontal and temporal lobes especially in a temporo-mesial regions involving hippocampus bilaterally. MR imaging revealed extensive diffusion restriction and T2 WI/FLAIR hyperintense signal predominantly in frontal, insular, temporo-polar and mesio-temporal cortices as well as in adjacent white matter, neostriatum, posterior thalamus and cerebellum. ADC map findings were consistent with mixed type (cytotoxic, vasogenic) edema in above-mentioned regions. Subsequent electrolyte correction normalized sodium level at the upper normal limit within 5 weeks and at this point the patient had gradual improvement in a mental status. On awaking the patient suffered from a temporary speech apraxia for a next two weeks with preserved comprehension and writing and amnestic syndrome. The patient's clinical condition gradually improved within next five months. Two- and five months MRI followed revealed normalization of the diffusion restriction signal. residual hyperintense signal on T2WI /FLAIR images in the fronto-temporo-mesial cortex associated with patchy gyaal GD-enhancement predominantly in the anterior part of the temporal lobes and significant parenchymal volume loss in temporal and temporo-mesial regions.

**Conclusion:** The case demonstrates that cortical laminar necrosis and extrapontine osmotic demyelination syndrome may occur due to severe hypernatremia. Despite gradual clinical improvement, results of the serial MRI studies revealed a persistent residual brain-blood barrier dysfunction, reactive gliosis and selective parenchymal loss of volume in previously affected brain regions.

**Pseudotumoral MS: Case Report and Review of the Literature**

Marjan Acou

Infrequently, MS presents as a single focal brain lesion that may be radiographically indistinguishable from a brain tumour. In this talk, a case of pseudotumoral MS is illustrated with conventional MRI, as well as MR perfusion (DSC and ASL), MR spectroscopy and PET imaging. These findings are compared to data from the literature.

**A Practical MRI-Dementia Protocol and Structured Reporting of MRI Scans in Dementia**

Georgios Karas

Department of Radiology, Saint Lucas-Andreas Hospital; Amsterdam, the Netherlands

In order to facilitate consistent communication with the clinicians it is necessary to convey the findings of an MRI...
examination in a manner which is consistent and unambiguous. This philosophy is applied in structured reporting of dementia scans. First the study protocol is described and whether the scan is of diagnostic quality. Sequences used are: axial T2-weighted, axial FLAIR, axial T2* (gradient echo), diffusion-weighted (DWI) and high-resolution T1-weighted. Patterns of hippocampal atrophy, lobar/cortical atrophy and infratentorial atrophy are reported. Standardized rating scales are used for consistency, for example left hippocampal atrophy grade II and right hippocampal atrophy grade III. Vascular changes are mentioned and grouped according to NINDS-AIREN criteria. Amyloid angiopathy is explicitly ruled out. Diffusion-weighted images are used to rule out Creutzfeld-Jacobs disease. Finally, other findings or (rarely) an alternative diagnosis is found, for example subdural collections or tumor. The findings are summarized in the conclusion, and when possible a diagnosis or differential diagnosis is proposed.


09.40-09.50

Spontaneous Intracranial Hypotension: An Imaging Review

Daniel J. Warren
Sheffield Teaching Hospitals NHS Trust, Sheffield, UK.

Spontaneous intracranial hypotension characteristically presents with orthostatic headache and commonly results from spontaneous spinal cerebrospinal fluid (CSF) leakage. The diagnosis can be made with a combination of low CSF pressure and characteristic imaging findings. This presentation will review the characteristic imaging findings of spontaneous intracranial hypotension.

09.50-10.00

MRI in the Diagnosis of Intracranial Hypotension Syndrome

Alessia Catalucci

The intracranial hypertension (IH) syndrome is a rare condition mainly consisting on postural headache; it could be spontaneous (SIH) or secondary to trauma (with or without obvious CSF leak), lumbar puncture or overdraining CSF ventricular shunts. SIH is almost invariably a consequence of spontaneous CSF leaks: CT myelography or iodium-111 cisternography may demonstrate the CSF leak; MR myelography (Myelo-MRI), however, can be proposed, being a non invasive diagnostic method to detect CSF leak. Despite these techniques, however, it is not always possible to demonstrate the leak. Whatever the cause, the CSF leakage through small dural defects results in increased CSF volume and pressure. The diagnosis for spontaneous intracranial hypotension is good: symptoms usually subside after bed rest and fluid replacement; epidural saline infusion or epidural blood patch may be useful if conservative treatment fails. The demonstration of a low CSF pressure by lumbar puncture (lower than 60 mm H2O) allows the diagnosis; nevertheless, lumbar puncture should be avoided because it may cause worsening of the patient’s condition by further reducing the CSF volume.

Head and spine MRI has dramatically changed the diagnosis of intracranial hypotension, leading to the identification of more cases than ever before. Intracranial MRI findings in case of intracranial hypotension include diffuse dural thickening and enhancement, also along the internal auditory canal walls; it could be seen in the spine too; frequently it is associated to subdural fluid collection and enlargement of both the pituitary and the cavernous sinuses, the "venous distension sign", caudal brain displacement, swelling of diencephalic-mesencephalic structures, with a decreased angle formed by the vein of Galen (vG) entering the straight sinus (SS). As the symptoms are the consequence, in various degree, of the caudal brain displacement, all MRI signs depend on the CSF volume depletion. The main MRI features in case of intracranial hypotension are reported, and their usefulness for differential diagnosis and in case of atypical presentation.

10.00-10.10

MRI in Temporal Lobe Epilepsy

Valentina Calistri

Temporal lobe epilepsy (TLE) is the most frequent form of refractory epilepsy in adults.

The hippocampus is the most frequently involved and vulnerable structure in patients with TLE. While numerous pathological processes involving the temporal lobe may induce seizures, such as focal cortical dysplasias, vascular malformations and tumors, the majority of cases of temporal lobe epilepsy are associated with hippocampal sclerosis. Whether an epileptogenic focus can be localized, surgery to remove that focus usually leads to good outcome. In patients with hippocampal sclerosis, lobectomy of the anterior temporal lobe cures epilepsy in majority of patients. Both conventional and advanced MRI techniques play a critical role in detecting focal lesions responsible for seizures, thus identifying potential candidates for surgical cure. MRI protocols must be suited for evaluation of temporal lobe structures with TLE specific protocols. MRI is also used to guide the placement of depth electrodes or subdural grids when no epileptogenic focus hasn’t been found with standard techniques and it is necessary in the immediate postoperative follow-up to assess the extent of resection and to detect potential complications of surgery, including hematomas, infection or infarction. MRI conventional and advanced techniques are fundamental tools in order to detect focal epileptogenic temporal lesion and to find those patients candidates to surgery.

10.10-10.20

MRI of Central Nervous System Tuberculosis: Experience of 50 Cases from Central India

Devari K. Khurjekar

Background: Central Nervous System Tuberculosis (CNSTB) continues to be a common problem world-wide and particularly in India. With the wide spread availability of Magnetic Resonance Imaging (MRI), it is increasingly used for the diagnosis and follow up of CNSTB. This study presents a review of 50 cases of CNSTB seen in Central India.

Material and Methods: Between 2006 and 2009, 50 cases of CNSTB (28 Spinal, 22 Cerebral) were diagnosed and followed up. MRI was performed using either a 0.2 T or 1.5 T unit using a standard protocol. Contrast study was needed in 32 cases. The diagnosis was later confirmed either by histopathological or microbiological examination in most cases and by a positive treatment response in some cases. All patients underwent routine radiograph of the chest to look for associated pulmonary tuberculosis, haematological tests and in some cases CT scan guided aspiration / biopsy and CSF analysis.

Results: There were 20 male and 30 female patients with age range of 4 to 65 years. Most common spinal lesion noted was the typical paraspinal involvement followed by skip lesion and posterior element lesion. The lesion was extradural in 19 and intradural in 3 cases. The most common cerebral lesion was menin gitis followed by tuberculosis, abscess and obstructive hydrocephalus. Response to treatment was assessed using MRI in 30 cases.

Conclusion: MRI has revolutionized
the imaging of CNSTB. The diagnosis can be made with reasonable certainty, obviating the need for an invasive procedure both for diagnosis and treatment. This was confirmed by the resolution of brain and spinal cord pathological changes after anti-tubercular chemotherapy. MRI also allows for monitoring the response to treatment with CNSTB. However, in some cases confirmation of diagnosis by needle aspiration and histopathological analysis may be indicated when the imaging findings are not conclusive.

10.20-10.30 8’

MRI Study of Evolution of Convexal Subarachnoid Haemorrhage in Cerebral Amyloid Angiopathy

Victor Cuvinciuc

Background and Purpose: cSAH is increasingly recognized to be associated with CAA, but little is known about its evolution and the mechanisms involved. We present a MRI study of initial features and evolution of cSAH in CAA.

Materials & Methods: study of 17 patients with acute non-traumatic symptomatic convexal subarachnoid haemorrhage (cSAH) which predicts patients discharge clinical outcome and helps in prioritising appropriate patient management.

Methods & Materials: A 5-year retrospective two-centre study was carried out on 1486 patients presenting with SAH. 190 patients with non-aneurysmal SAH were included in this study. Initial admission Cranial CT findings were correlated with patients discharge outcome measured by the Modified Rankin Scale (MRS). A CT based classification system (type 1 to type 4) was devised based on the topography of the initial haemorrhage pattern.

Results: 75% of the patients had type 1 haemorrhage and all these patients had a good clinical outcome with a discharge MRS of ≤ 1. 8% of the patients presented with type 2 haemorrhage, 62% of which were discharged with MRS of ≤ 1 and 12% of patients had MRS 3 or 4. Type 3 haemorrhage was found in 10%, of which 16% had good clinical outcome but 53% had moderate to severe disability (MRS 3 & 4) and 5% were discharged with severe disability (MRS 5). 6% of patients presented with type 4 haemorrhage of which 42% of the patients had moderate to severe disability (MRS 3 & 4), 42% had severe disability and one sixth of the patients died. Highly significant differences were found between type 1 (a & b) and type 2 (p=0.003); type 2 and type 3 (p=0.002); type 3 and type 4 (p=0.001).

Conclusion: The Type 1 category of haemorrhages are usually benign and do not warrant extensive battery of clinical and radiological investigations. Type 2 haemorrhage have a varying prognosis and need to be investigated and managed in similar lines to that of an aneurysmal haemorrhage with emphasis towards radiological investigation. Type 3 and Type 4 haemorrhages need to be extensively investigated to find an underlying cause.

10.40-10.50 8’

Classification of Non-Aneurysmal Subarachnoid Haemorrhage: CT Correlation to the Clinical Outcome

Sanjeev Nayak

Background: We propose a new CT based classification system for non-aneurysmal Subarachnoid haemorrhage (SAH) which predicts patients discharge clinical outcome and helps in prioritizing appropriate patient management.

Materials & Methods: A prospective two-centre study was carried out on 1486 patients presenting with SAH. 190 patients with non-aneurysmal SAH were included in this study. Initial admission Cranial CT findings were correlated with patients discharge outcome measured by the Modified Rankin Scale (MRS). A CT based classification system (type 1 to type 4) was devised based on the topography of the initial haemorrhage pattern.

Results: 75% of the patients had type 1 haemorrhage and all these patients had a good clinical outcome with a discharge MRS of ≤ 1. 8% of the patients presented with type 2 haemorrhage, 62% of which were discharged with MRS of ≤ 1 and 12% of patients had MRS 3 or 4. Type 3 haemorrhage was found in 10%, of which 16% had good clinical outcome but 53% had moderate to severe disability (MRS 3 & 4) and 5% were discharged with severe disability (MRS 5). 6% of patients presented with type 4 haemorrhage of which 42% of the patients had moderate to severe disability (MRS 3 & 4), 42% had severe disability and one sixth of the patients died. Highly significant differences were found between type 1 (a & b) and type 2 (p=0.003); type 2 and type 3 (p=0.002); type 3 and type 4 (p=0.001).

Conclusion: The Type 1 category of haemorrhages are usually benign and do not warrant extensive battery of clinical and radiological investigations. Type 2 haemorrhage have a varying prognosis and need to be investigated and managed in similar lines to that of an aneurysmal haemorrhage with emphasis towards radiological investigation. Type 3 and Type 4 haemorrhages need to be extensively investigated to find an underlying cause.
small part of the treated metastases a desired effect is not seen and lesions grow. Lesion growth does not always indicate tumor progression but may be radiation injury. Distinguishing between these two entities is not usually possible with conventional contrast-enhanced MR imaging. For the individual patient it is of high importance to clarify the nature of lesion to select the subsequent treatment. Perfusion MRI, providing information related to the microvascular properties of the lesions, has shown potential to more accurately distinguish metastatic tumor recurrence and radiation injury.

Head & Neck

11.00-11.10

The Jugular Bulb Diverticulum Vs. the High Riding Jugular Bulb

Dieter Goettmann

Besides the relatively common high jugular bulb are rare anomalies in the petrous bone like the jugular bulb diverticulum and the high “riding” jugular bulb. These seem to have more clinical impact than the common variant form. The purpose of the presentation will be to show their characteristics in order to recognize and to distinguish them from each other.

11.10-11.20

Comparison Study between FIESTA MR and HRCT in Evaluating the Superior Semicircular Canal: Do We Still Need CT?

P. Browaeys, T. Larsson, M. Wong, U. Patel

Patients with vertigo and symptoms of semicircular canal dehiscence are currently studied initially by both CT and MR imaging (MRI). Due to economic constraints favoring the ordering of one examination as well as concern for radiation exposure, we undertook this study to determine if MRI by itself would be sufficient.

Materials & Methods: One hundred twelve consecutive patients (224 ears) underwent concurrent MRI and high-resolution CT of the temporal bones between Oct 2007 and Oct 2009. MRI protocol included an axial FIESTA acquisition (0.8 mm slice thickness, 0.4 mm spacing) covering the temporal bone (either on 3 T or 1.5 T). CTs were performed on a 64-row MDCT (0.625 mm axial and coronal). Patient data was anonymized. Dehiscence of superior and posterior semicircular canals (SSC and PSC) were evaluated, in consensus by two neuroradiologists, utilizing multiplanar reformation tools. FIESTA evaluation was performed for all patients on both ears. High-resolution CT evaluation then was performed at least 2 weeks after, resulting in a blinded comparison of FIESTA MRI to CT.

Results: For SSC dehiscence, FIESTA sensitivity was 100%, specificity was 96.5%, positive predicted value (PPV) was 61.1% and negative predictive value (NPV) was 100% in comparison to CT. For PSC dehiscence, FIESTA sensitivity was 100%, specificity was 99.1%, PPV was 33.3% and NPV was 100% in comparison to CT.

Conclusion: FIESTA MR acquisition, with sensitivity and NPV of 100%, is able to conclusively exclude SSC or PSC dehiscence. A negative MRI study predicated the need for CT imaging to detect semicircular canal dehiscence. Only patients with a positive MRI study should have further CT evaluation.

Paediatrics

11.20-11.30

MR and Diffusion Tensor Imaging (DTI) Findings in Septo-Optic Dysplasia (SOD)

Maria Savina Severino

U.O. Neuroradiologia, Istituto G. Gaslini, Genova

A constellation of malformations has been identified by magnetic resonance imaging (MRI) in Septo-Optic Dysplasia (SOD), including ocular bulb abnormalities (anophthalmia, microphthalmia), structural pituitary-hypothalamic abnormalities, olfactory aplasia, and brain abnormalities such as cortical malformations (schizencephaly, polymicrogyria, focal cortical dysplasia), and agenesia of the corpus callosum (Barkovich A. J., Birkebaek NH).

Thus, input data from MRI are essential not only to confirm the diagnosis of SOD, but also to characterize a subset of patients with (i) isolated SOD: hypoplastic optic nerves/ichiasms, pituitary abnormalities, morphologically normal brain presenting with pituitary dysfunction; (ii) SOD-plus: associated morphological brain abnormalities (cortical/commissural malformations), presenting with seizures; and (iii) septo-commissural dysplasia (absent septum pellucidum and midline fusion of the fornix) presenting with psychomotor delay. Up to the present, application of diffusion tensor MR imaging (DTI) to the evaluation of SOD has been exclusively limited to (Yamada K et al.) and focused on analysis of optic radiations (Miller SP et al.; Salmela MB).

However, DTI can also be used to study the microanatomy of white matter in SOD beyond the optic pathway, exploring the structure of other tracts, including the fornices and corpus callosum which are frequently abnormal on conventional MRI.

11.30-11.40

Decreased Cerebellar Myo-Inositol and N-Acetylaspartate Concentrations in Paediatric Attention/Deficit Hyperactivity Disorder

J.C. Soliva

Introduction: As we had found decreased gray matter volume in the right prefrontal region and the left cerebellar hemisphere in a previous voxel-based morphometry study conducted in an independent ADHD sample, we tested the hypothesis that these regions show neurometabolite abnormalities.

Methods: We designed a case-control proton magnetic resonance spectroscopic study of the cerebellar and prefrontal regions between a group of 17 ADHD (attention deficit/hyperactivity disorder) medicated children and a group of 17 laterality, gender and age matched control children.

MRI (magnetic resonance imaging) was performed with a 1.5 T system; spectral acquisition was performed with a single-voxel technique and a PRESS sequence. Two volumes of interest were selected in the right prefrontal region and the left cerebellar hemisphere. NAA (N-acetylaspartate), Cr (creatinine), Cho (choline), MI (myo-inositol) and Glx (glutamate-glutamine) resonance intensities were absolutely quantified.

Results: In the left cerebellar hemisphere, ADHD children showed significant decreased MI and NAA absolute concentrations with high effect sizes (p = 0.004, ES = 1.184; p = 0.001, ES = 1.083).

Discussion: The diminished absolute concentration of the NAA could be related to a gray matter volume decrease in the same cerebellar region found in a previous voxel-based morphometry MRI study, while the reduced MI absolute concentration could express a decreased glial density.

Conclusion: This is the first proton MR spectroscopic study examining the cerebellum and it provides additional support for the role of cerebellum in the ADHD neurobiology.
Higher Qualification in Interventional Vascular Neuroradiology

11.40-11.50

Endovascular Treatment of Carotid Near-Occlusion

Luís Concepción Aramendía
Unidad de Neurroradiología
Diagnóstica y Terapéutica; Hospital General Universitario de Alicante; Spain

Carotid revascularization is recommended for high-grade carotid symptomatic and asymptomatic stenosis for better stroke prevention against conservative treatment with best medical therapy. Carotid near-occlusion or pseudoocclusion is a subset of patients who some authors feel benefit from revascularization is muted.

Objectives: Review and discuss of the appropriate literature regarding the topic. Present the results of a retrospective audit of our center results in the endovascular treatment of this type of patients.

11.50-12.00

Communication of the Results

ESNR Awards

12.00-13.00

Chairs: J. Wilmink, B. Appel, M. Leonardi

ESNR - Appel Research Award

Resting State Networks Change in Clinically Isolated Syndrome


Task-functional magnetic resonance imaging studies have shown that early cortical recruitment exists in multiple sclerosis, which can partly explain the discrepancy between conventional magnetic resonance imaging and clinical disability. The study of the brain ‘at rest’ may provide additional information. We questioned whether functional changes exist at rest in the early phase of multiple sclerosis, and addressed this question by a network analysis of no-task functional magnetic resonance imaging data. Fourteen patients with symptoms suggestive of multiple sclerosis (clinically isolated syndrome), 31 patients with relapsing remitting multiple sclerosis and 41 healthy controls were included. Resting state functional magnetic resonance imaging data were analysed using multi-subject independent component analysis and individual time-course regression. Eight meaningful resting state networks were identified in our subjects and compared between the three groups. Additionally, quantitative measures of structural damage were obtained. Patients with clinically isolated syndrome showed increased synchronization in six of the eight resting state networks, including the default mode network and sensorimotor network, compared to controls or relapsing remitting patients. No significant decreases were found in patients with clinically isolated syndrome. No significant resting state synchronization differences were found between relapsing remitting patients and controls. Normalized grey matter volume was decreased and white matter diffusivity measures were abnormal in relapsing remitting patients compared to controls, whereas no atrophy or diffusivity changes were found for the clinically isolated syndrome group. Thus, early synchronization changes are found in patients with clinically isolated syndrome that are suggestive of cortical reorganization of resting state networks. These changes are lost in patients with relapsing remitting multiple sclerosis with increasing brain damage, indicating that cortical reorganization of resting state networks is an early and finite phenomenon in multiple sclerosis.

ESNR - Founders Award for Diagnostic Neuroradiology

Biopsy Targeting in Gliomas: Do Functional Imaging Techniques Identify Similar Target Areas?

Marc-André Weber1, 2, M. Henze3, J. Tüttenberg1, B. Stießl1, M. Meissner1, F. Zimmer1, I. Burkhöfer1, A. Kroll1, S.E. Combs1, M. Vogt-Schaden1, F.L. Giesel1, 2, S. Zoubaa1, U. Haberkorn1, H.-U. Kauczor1, M. Essig1
1 Department of Radiology, German Cancer Research Center (dkfz), Heidelberg; 2 Department of Diagnostic and Interventional Radiology, University Hospital Heidelberg; 3 Department of Nuclear Medicine, University of Heidelberg; 4 Department of Neurosurgery, University Hospital Mannheim; 5 Department of Biostatistics, German Cancer Research Center (dkfz), Heidelberg; 6 Department of Medical Physics in Radiology, German Cancer Research Center; 7 Department of Radiation Oncology, University of Heidelberg; 8 Department of Neuro-Oncology, University of Heidelberg; 9 Department of Pathology, Technical University of Munich; Germany

Due to the heterogeneous nature of glioma, biopsies performed should be targeted at the most anaplastic region. Several functional MRI or PET techniques have been proposed for identifying the most anaplastic tumor area. However, it is unclear whether the recommended biopsy targets based on these various functional imaging modalities correspond with each other. Thus, the purpose was to evaluate whether they identify similar target areas.

Materials and Methods: Sixty-one patients with suspected glioma were assessed within 2.3 ± 3.5 days by MRI, 18F-fluorothymidine (FLT)- and 18F-fluorodeoxyglucose (FDG)-PET. Thirty-five patients underwent gross total resection and 26 were stereotactically biopsied. MRI was performed on a 1.5 Tesla broadband transmit/receive system using a double-resolution birdcage coil. The MRI protocol comprised of sodium (23Na)-MRI (3D-radial projection imaging), proton spectroscopic imaging (1H-MRSI, point-resolved spectroscopy), arterial spin-labeling (ASL) perfusion MRI, dynamic contrast-enhanced (DCE) MRI and dynamic susceptibility-weighted (DSC) perfusion MRI after a single dose each of gadobenate dimeglumine. Also, apparent diffusion coefficient (ADC) maps were processed from diffusion tensor images. Image analysis comprised a detailed semiquantitative region of interest analysis of the different parameter values as well as visual identification of the most conspicuous tumor areas on parameter maps, e.g. areas with maximum tumor perfusion, highest metabolite ratios of choline-containing compounds/N-acetylaspartate, or lowest ADC values within tumor tis-
drug treatment.
resistant to intravenous thrombolytic
institution with acute stroke who were
tomy in 14 patients presenting to our
vice in performing cerebral embolec-
Neurovascular Remodelling Stent De-
08.00-08.10  8'

Sanjeev Nayak

Initial experience with Solitaire AB Neurovascular Remodelling Stent De-
vie in performing cerebral embole-
tomy in 14 patients presenting to our
stitution with acute stroke who were
istant to intravenous thrombolytic
drug treatment.

Methods and Materials: Main inclu-
dition criteria were: National Institutes of
Health Stroke Scale score (NIHSS) ≥
0; treatment performed within 8 hours
from symptoms onset and no large hy-
podensity on computed tomography;
and occlusion of a major cerebral ar-
tery on the CT angiogram. Admission
and a post interventional NIHSS score
was calculated on all patients by two
different neurologists. Efficacy was as-
sessed radiologically by post treatment
Thrombolysis in Myocardial Infarction
(TIMI) scores and clinically by a 30-day
MRS score. The procedures were per-
formed with a Solitaire AB Neurovas-
cular Remodelling Stent Device.

Results: The mean duration of neu-
reinterventional treatment was 84 min-
utes. All interventions were successful
with TIMI scores of 2 and 3 achieved
in 100% of cases. There was one proce-
dural complication in our series due to
a self detached stent and one patient
had a small asymptomatic basal gan-
ghia hemorrhage. There was improve-
ment of more than 4 points on NIHSS
score in 5 (72%) of the patients follow-
ing treatment of which 4 (57%) patients
had 30-day MRS of ≥2.

Conclusion: The use of a Solitaire
Stent in acute stroke was safe, time
efficient and encouraging, however
a larger sample size will be required
toe further evaluate the use of this de-
vice which could benefit a significant number of stroke patients.

08.10-08.20  8’

Course and Treatment of a Giant Haemangioma of the Tongue
Dieter Goettmann

Case report of a patient suffering from a big hemangioma of the tongue, developing to a giant form. Besides massive recurrent bleedings the mass effect led to obliteration of the airways requiring tracheostomy. At the beginning the patient was treated from peripherical approaches. After a series of direct puncture embolisations the hemangioma could be reduced and the patient get rid of tracheostomy and of the recurrent bleedings.

FELLOW IN NEURORADIOLOGY

Diagnostic Brain
08.20-08.30  8’

Neuromaging in Dementia: Practical Guide for a Standardized and Reproducible Image Reading Precedure
Mike P. Wattjes
Dept. of Radiology, VU University Medical Center, Amsterdam, The Netherlands

The diagnosis of dementia is based on clinical findings within a multidisciplinary diagnostic setting. Clinical neuromaging is increasingly being used in the diagnosis of neurodegenerative diseases and has become one of the most important paraclinical tools in the diagnosis of dementia. According to current guidelines, neuromaging should be performed at least once during the diagnostic work-up of patients with suspected or neurodegenerative disease and particularly in patients with suspected or definite dementia. Initially, neuromaging was used to identify or exclude potentially treatable causes of dementia which accounts only for a small proportion of all causes of dementia. Currently, the role of neuromaging goes far beyond these purposes. Computed tomography (CT) and magnetic resonance imaging (MRI) are able to identify and quantify the amount regional/global cortical atrophy, hippocampus atrophy as well as detect vascular damage. On structural MRI or CT, we are able to identify certain atrophy patterns which can substantially aid diagnosis in dementia. Standardized imaging protocols and image reading procedures are crucial for an easy, fast and reproducible evaluation of patients in a memory clinic setting. Visual rating scales are well established methods in order to assess the presence and degree of global/focal cortical atrophy and white matter damage. The presentation based on this abstract will give a brief overview how to analyze CT and MRI scans in the context of neurodegenerative disorders in a standardized and reproducible way.

Paediatrics
08.30-08.40  8’

The Role of MRI in Perinatal Anoxic Ischemic Brain Injury
Andrea Boghi
SSD Neuroradiology, Dept Radiodiagnostic, S. Croce Hospital, Cuneo, Italy

Hypoxia-ischaemia is the most common cause of perinatal brain injury in both term and preterm newborns. MRI is the most important technique to identify brain lesions and their extent; conventional sequences, such as spin-echo and turbo spin-echo T1 and T2, have their best sensitivity between the 1st and 2nd week after birth, whereas diffusion-weighted imaging can add some information in the first week of life. The MRI of the neonatal brain requires hardware (i.e. coil) and sequences optimization to compensate for head size and high water content of newborn patients. The gestational, perinatal and postnatal clinical details are very useful in image interpretation because they are correlated to the pattern of brain lesions and, for this reason, should always be available. Different MRI lesional pattern are, in turn, correlated to neurodevelopmental outcome. MRI plays an important role when a brain injury in a neonate is suspected because it allows to identify and characterize brain lesion(s) and to predict clinical outcome.


Interventional
08.40-08.50  8’

Endovascular Treatment of Wide-Neck Intracranial Aneurysms Located on Arterial Bifurcations
Julio Palomino

Nowadays, in many countries the endovascular treatment of cerebral aneurysms is the first option. Multiple techniques have been developed since the appearance of this therapy, all of them in parallel with the emergence of various technological advances. Two groups of occlusive techniques for endovascular treatment of cerebral aneurysms had been described: the endosaccular and the endoarterial approach. This variety of types of treatment arises from the attempt to overcome the inherent difficult of anatomical, location and geometry diversity that is manifested in multiple shapes, sizes and location of aneurysms. This situation occurs because of impaired repair mechanisms of the affected vessel wall associated with direct and indirect mechanisms according to its etiology and also affecting the therapeutic outcome. Two decades of appearance of coils as a therapeutic tool and important strategic changes in the method have emerged such as the detachable coils, availability of multiple designs with two- and three-dimensional structure, diversity in the coil coating as well as coils of solid and semi-solid materials. Balloon assistance and stents as scaffold assistance to the coiling and stent flow diverters have increased the number of susceptible aneurysms to endovascular treatment. Endovascular procedures of cerebral aneurysms has shown low morbidity and mortality, an excellent cost-effectiveness ratio when complete occlusion is achieved and retreats are not required, however in the literature there is a strong variability of angiographic results of occlusion resulting in multiple radiological controls and retreatments. Wide-neck intradural saccular aneurysms located on the arterial bifurcations are a complex group which continues to be an issue without an acceptable solution by endovascular procedure and many of these aneurysms require surgical treatment or surgical treatment assisted by endovascular approach or inversely in some cases. This presentation describes a vascular interventional neuroradiological method with a therapeutic concept that differs from the explanations previously mentioned and also makes a description of a device that is intended to achieve the benefits of single endovascular procedure and aims to achieve a comparable result such as anatomical surgical clipping. The device is in the process of prototyping and manufacturing. In vitro studies, animal models and clinical
How to Start Neurointerventional Procedures. My Experiences in Iran

Hussein Khanate
Associate Professor of Radiology, Tehran University of Medical Sciences; Iran

Neuro Intervential techniques deeply changed approach to treatment of diseases. In each country, neuro interventional radiology practice establishment varies according to local factors, but following a standard strategy seems better to set up this facility. According to above mentioned points, I decided to establish this specialty in our hospital since 1996 as the pioneer center in interventional radiology in Iran. At first the procedures included percutaneous laser disc decompensation (PLDD), and vertebroplasty followed to vascular procedures such as endovascular aneurysm treatment. The following items will be discussed: 1. Prepare step by step strategies for establishing neurointervention; 2. Solving issues regarding interventional procedures; 3. Modified techniques for lowering costs to cover interventions in poor people; 4. Setting of fellowship courses; 5. Cooperation with dedicated and pioneer international centers such as using Neocryst for treatment of brain aneuryms in conjunction with UCSD for the first time on human. During presenting our experience we want to review how we should start neurointerventional radiology in developing countries.

Diagnostic Imaging on Intracranial Atherosclerotic Stenosis

Eduardo Freire Mello
Service of Interventional Neuroradiology, Hospital Espanhol; Salvador - BA, Brazil

Atherosclerotic disease in major intracranial arteries is an important and often under-recognized cause of stroke. Many patients with symptomatic intracranial stenosis are at high risk for recurrent stroke1. Intracranial atherosclerotic stenosis accounts for 6%-10% of ischemic strokes in whites and may be responsible for 22% to 26% brain ischemia in Asians2,3. With recent advances in clinical management, and in severe cases, angioplasty and stenting, the radiological diagnosis became crucial as well as an accurately quantification of intracranial steno-occlusive disease.

Diagnostic Methods: Digital Subtraction Angiography (DSA) is recognized as the gold-standard for the diagnosis of intracranial steno-occlusive disease, but it is the most expensive, invasive and time consuming, and carries a stroke risk of 0,7% with permanent disability 4. Non-invasive exams are required for the evaluation of intracranial arterial stenosis. Transcranial Doppler (TCD) is the least invasive and expensive test, but it is highly operator-dependent and not technically feasible in all patients. If the bone window is not favorable, it is not possible to evaluate every vessel, limiting its value as a reliable diagnostic test. Recent studies have been comparing CT Angiography (CTA) and MR Angiography (MRA), alone or combined, to DSA5,6,7. Hirai et al. demonstrated that the diagnostic performance of MRA alone was significantly inferior to the combination of MRA and CTA. Toghter, they had an accuracy equal to DSA in measuring stenosis and detecting occlusion of the major intracranial arteries4. MRA alone has a lower spatial resolution as compared with CTA and DSA, and can cause overestimation of stenosis. Bash et al. revealed that CTA has a higher specificity, sensitivity and positive predictive value for the evaluation of intracranial stenosis and occlusion, using DSA as the gold-standard7. Furthermore, CTA is less susceptible to motion artifacts and less dependent on the effects compared to MRA. It is possible to approach all proximal portions of the intracranial vasculature with a proper CTA examination and processing them. Meanwhile, its advantages are radiation exposure, time and skill involved in image processing, use of contrast material, possible venous contamination in a region of interest, and no significant flow information.

In conclusion, CTA seems to be more accurate than MRA to detect and evaluate intracranial stenosis. It can be relatively comparable to DSA and presents fewer risks, less costs, is more frequently available and is highly accurate. CTA can be considered as the primary study in the setting of suspected intracranial atherosclerotic stenosis.

Endoluminal Approach with Flow-Diverter Stents for Treatment of Intracranial Aneurysms.

Vittorio Civelli
U.O.C. Neuroradiologia Diagnostica ed Interventistica, Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico; Milano, Italy

Despite a significant evolution in endovascular therapy of intracranial aneurysms, some important limitations remain, especially in the treatment of wide-necked or fusiform aneurysms. These lesions can frequently be difficult to treat with simple coiling, often requiring additional devices like balloons (“remodelling technique”) or a combined approach with self-expanding intracranial stents. Nevertheless, even when complete or near-complete occlusion has been achieved at the end of the procedure, these aneurysms frequently recur, following coil compaction, requiring 1 or more re-treatments. The best packing densities that can be obtained with conventional embolization coils ranges between 20% and 30% in clinical human aneurysm treatment, leading the majority (70%-80%) of the aneurysm volume not filled with embolic material. Moreover, is also difficult to continuously cover the aneurysm neck with coils, particularly when handling with wide-necked aneurysms, leaving gaps between coils in the region of the neck that allow persistent inflow and impair the endoelastization and neointimal growth over the aneurysm neck, which are required to achieve definitive embolization. Nevertheless, the presence of an intravascular stent provides several specific advantages in addition to physically support the endoluminal exclusion of the aneurysm. Stent implantation by itself may modify local flow dynamics and provide a scaffold to support neointimal overgrowth across the aneurysm neck. Some experimental tests demonstrated that the reduction of flow within the aneurysm, the corresponding increase of intra-aneurismal circulation time and modifications of momentum exchange between the sac and the parent vessel are a function of their mesh attenuation and of the geometry of the stent. Traditional intracranial stents have a limited metal surface area coverage (6.5 to 9.5%) that, if may be enough to improve the durability of aneurysm occlusion after coil embolization and may, in selected cases, induce the remodeling of very small blister-like and dissecting pseudoaneurysms, do not represent a reliable stand-alone therapy for the great majority of intracranial aneurysms. The flow-diverter stents represent an important technical advance for the endovascular aneurysm treatment on the way of the endoluminal “remodelling strategy”. They provides approximately 30% metal surface area coverage and, unlike covered stents, the gap between the strands of the mesh are designed to preserve flow to both large branch vessels as well as to small perforators eventually covered by the stent. They are the first device primarily designed to hemodynamically exclude the aneurysm from the parent artery and to provide sufficient scaffolding to support neointimal healing of the vessel defect. The curative reconstruction induced by these stents occurs over a period of weeks to months. Thus, the therapeutic indications as well as the expected angiographic findings at the end of the procedure are different from those for traditional coil techniques. Residual aneurismal filling at the end of the procedure are a matter of concern, although with a modified pattern of inflow. In particular, the transit of contrast material into the aneurysm is usually transformed from an organized in-flow jet to a slower “wash in” of contrast material during the arterial and early capillary phase of angiography, often lasting as persistent stagnation of contrast material within the aneurysm. Attempts to completely occlude the aneurysm at the time of the original procedure by placing a number of telescoping devices could result in an unnecessary increase of the thromboembolic risk related to the procedure. This reason as well as the need of dual antiplatelet prophylaxis limits the use of these stent in the clinical setting of acute subarachnoid haemorrhage, that at the moment represents the main (relative) contraindication to flow-diverter stent implantation, even if a recent publication (Kolcsar et coll, J. Neurosurg. 2010) propose the use of flow-diverter stent as a treatment option in SAH due to rupture of very small aneurysms. At the moment only three clinical series have been published, together with few case-reports. In the first clinical series (Lylyk, Fiorella and coll, J. Neurosurg. 2009) the authors report that fifty-three patients and 63 intracranial aneurysms were treated with a single type of flow-diverter stent. Complete angiographic occlusion was achieved in 56%, 93%, and 95% of aneurysms at 3, 6, and 12 months, respectively. No aneurysms demonstrated recanalization during the follow-up period. No major complications (stroke or death) were encountered during the study period. In a second study (Suzuki et coll, AJNR 2010) 19 wide-neck aneurysms were treated in 18 patients: in this study are confirmed the good results in terms of aneurysm occlusion at 12 months (91%) but also described also some complications related to the procedure. In particular of the 28 side branches covered by 1 device, the ophthalmic artery was absent immediately in 1 and at 6 months in another 2 cases. One patient experienced abrupt in-stent thrombosis resulting only in a transient neurologic deficit thanks to good haemodynamic support from collateral circulation, and 1 patient died due to rupture of a coexisting internal carotid artery aneurysm. In the first retrospective, study, were evaluated twelve patients with an aneurysm of the basilar artery that was treated by implantation of a flow-diverter stents. In this series there was 1 acute basilar artery occlusion a few hours after stent implantation. During a mean follow-up of 16 weeks, 3 patients experienced a symptomatic neurologic event related to perforation occlusion. In two case reports are described infarcts related to perforation occlusion after stent implantation. In one case report is described a massive SAH 20 days after stent implantation for treatment of a giant aneurysm. In our experience (ongoing publication) were treated 50 patients and 57 aneurysms with a single type of flow-diverter stent. Three patients suffered from previous SAH. At 3-months follow-up we observed complete or near-complete (>90%) occlusion in 85% of the treated aneurysms. At 9 months the stenosis or occlusion of the aneurysm in >90% of the cases. We had 2 cases of stent displacement at the end of the procedure, that in 1 case required sacrifice of the parent vessel, without clinical consequences. Two of the three patient treated in an emergency setting for SAH, with an oral load of antiplatelet drug (clopidogrel 600 mg), died for acute stent occlusion within the first 24 hours after treatment. We lost two patients due to massive intraparenchimal haemorrhage happened, respectively, during and within 48 hours after the stent deployment. Two patients had asymptomatic stent occlusion diagnosed, respectively after 7 days and after 3 months. One patient suffered of a massive SAH 20 days after stent implantation for treatment of a giant aneurysm of the sovranoclid ICA. In conclusion endoluminal approach with flow-diverter stents represents a durable and curative treatment of selected wide-necked cerebral aneurysms. There are limitations with respect to the clinical settings and anatomic locations in which the device can be effectively used. Further studies are required to better define the clinical impact and indications of treatment.
Cagin Senturk, Alfredo Casasco, Leopoldo Guimarães
Endovascular and Percutaneous Therapy Service, Hospital Nuestra Señora del Rosario, Madrid, Spain

Giant partially thrombosed aneurysms and dissecting fusiform aneurysms continue to be one of the most difficult pathologies to treat for the neurovascular specialists. Both endovascular and open surgical techniques lack sufficiently good results in the management of these aneurysms. In the last two years flow diverter systems like Pipeline or Silk stents brought a new armament to treat these complex aneurysms. Although there are encouraging reports in the literature, we still need long term follow-up results. Recently some reports documented unexpected complications after a satisfactory occlusion of the aneurysm. This presentation aims to review the use of flow diverter systems for very complex aneurysms and present our preliminary experience with Pipeline and Silk systems in addition to a new stent called Merlin Aneurysm Occlusion Device.

9:40-9:50

Abciximab Treatment Modalities for Thromboembolic Events Related to Aneurysm Coiling
M. Aggour, L. Pierot

Thromboembolic complications are the most common cause of peri-procedural morbidity associated with the endovascular treatment of intracranial aneurysms with detachable coils. We performed the present study to estimate the safety and efficacy of using combined intra-arterial and intravenous abciximab to treat thromboembolic complications complicating endovascular cerebrovascular aneurysm coil embolization.

Methods: In a retrospective analysis of 380 aneurysmal coiling procedures, we identified 39 patients (10.0%) with thromboembolic events related to the procedure. As the first line of treatment in 23 of these patients, abciximab was administered intraarterially as a bolus followed by intravenous infusion over a 12-hour period. Eleven of the 23 patients were treated for ruptured aneurysms, nine for unruptured aneurysms and three for aneurysmal recanalization. In cases of initial neck remnant and uncovered a larger neck remnant and adjacent structures, often resulting in a loss of signal intensity that is greater than the aneurysm itself. Potentially, the susceptibility effects at 3T are greater than those at 1.5T, despite the fact that the smaller voxel sizes achievable at 3T compared with 1.5T would tend to mitigate against greater susceptibility. In this regard, Anzalone N. et Al. recently showed no relevant differences in susceptibility for 3D TOF MRA acquisitions at 3T compared with 1.5T. A benefit of MR imaging at 3T compared with 1.5T is an increased baseline signal intensity-to-noise ratio (SNR) and hence improved vessel tissue contrast. However, the gain in signal intensity at 3T is largely offset by a loss of SNR when parallel imaging techniques are applied. A standard means of maintaining adequate vessel tissue contrast with parallel imaging techniques combined with dedicated CE-MRA sequences is to increase the SNR through the use of increased doses of gadolinium contrast material.

10:00-10:10

MR Angiography at 3T in the Follow-Up of Coiled Cerebral Aneurysms: To Use Gadolinium or Not?
Pablo Vezzulli

The goal of coiling a cerebral aneurysm is to exclude it from circulation. Occlusion is commonly used as a measure of the success of therapy. However, even in cases of initial total occlusion, aneurysm recurrence is not uncommon. Imaging follow-up of patients with intracranial aneurysms treated with Guglielmi detachable coils (GDCs) is necessary to assess the need for further treatment, because of the risk of coil compaction and/or filling of a residual aneurysm neck or body remnant (aneurysm reconfiguration) with time. MR angiography has been used as an alternative non-invasive imaging technique to assess the occlusion of coiled intracranial aneurysms. Non enhanced 3D time-of-flight (TOF) MRA sequences on 1.5T scanners are frequently satisfactory for the follow-up of coiled aneurysms, but 3D-TOF MRA on 3T scanners offers improved depiction of both treated and untreated aneurysms. The greater spatial resolution on 3D-TOF MRA at 3T has been shown to permit improved image quality and better visualization of small cerebral arteries and better depiction of cerebrovascular disease, particularly intracranial aneurysms compared with 1.5T. Potential benefit for 3D TOF MRA at 3T has been shown for the follow-up of intracranial aneurysms after embolization with GDCs. However TOF techniques are prone to saturation effects at areas of slow or complex flow and to susceptibility artifacts due to coil packing, and this could interfere with the evaluation. The use of appropriate first-pass CE-MRA techniques allows pure enhancement of only arteries and are less influenced by susceptibility artifacts, and consequently, parent arteries are more easily assessed. Susceptibility artifacts are inherent in all metallic coil masses and may potentially obscure small neck remnants and adjacent structures, often resulting in a loss of signal intensity that is greater than the aneurysm itself. Potentially, the susceptibility effects at 3T are greater than those at 1.5T, despite the fact that the smaller voxel sizes achievable at 3T compared with 1.5T would tend to mitigate against greater susceptibility. In this regard, Anzalone N. et Al. recently showed no relevant differences in susceptibility for 3D TOF MRA acquisitions at 3T compared with 1.5T. A benefit of MR imaging at 3T compared with 1.5T is an increased baseline signal intensity-to-noise ratio (SNR) and hence improved vessel tissue contrast. However, the gain in signal intensity at 3T is largely offset by a loss of SNR when parallel imaging techniques are applied. A standard means of maintaining adequate vessel tissue contrast with parallel imaging techniques combined with dedicated CE-MRA sequences is to increase the SNR through the use of increased doses of gadolinium contrast material.

Recently Wallace R.C. et Al. stated that in their experience 3D-TOF MRA without contrast is generally accurate and closely correlates with the findings of contrast-enhanced techniques for follow-up of coiled aneurysms, but in several cases contrast enhancement aided the visualization of small remnants and uncovered a larger neck remnant or filling of the coil pack that was not anticipated on the non-contrast MRA technique. In a personal series we evaluated fifty-two patients with a total of 54 cerebral aneurysms using unenhanced 3D TOF MRA and CE-MRA at 3T, performed during the same imaging session in each patient. Of the 54 aneurysms evaluated, 53 were classified...
Acute Ischemic Stroke: Typical Findings and Pitfalls in Modern Neuroimaging

Gry Behzadi
University Hospital of Stavanger; Stavanger, Norway

Acute ischemic stroke is the third leading cause of death and affects 160-240 people/100,000/year. It is the leading cause of disability in the developed world.

The goals for neuroimaging in acute stroke are to establish a diagnosis as soon as possible, to detect contraindications for intravenous and intraarterial thrombectomy, to evaluate the intracranial and extracranial arteries. This is mandatory to select the appropriate treatment. In some cases, the cause of the stroke can be found on acute imaging. The imaging methods routinely used for evaluation of ischemic stroke are computed tomography (CT) with CT angiography and CT perfusion and magnetic resonance imaging (MRI) with diffusion weighted imaging, perfusion imaging and MR angiography. This lecture will give an overview over typical findings and some pitfalls of these diagnostic methods.

10.20-10.30

Scotty Dog: The Spinal Interventionalist’s Best Friend

Olivind Gjertsen
Osel University Hospital; Oslo, Norway

In order to perform spinal interventions with the highest precision and safety, it is important to understand the radiographical anatomy when performing fluoroscopy guided interventions. With the "Scotty dog" working projection and a "down the barrel" needle technique it is possible to perform all types of spinal intervention such as facet joint puncture, transpedicular access for vertebral body biopsy and vertebroplasty, transfemoral nerve root block and steroid deposition, discography as well as facet joint rhizotomy. I will explain the radiographic anatomy and target points on the Scotty dog projection for the different interventions by using 3D CT datasets and 3D volume rendering technique. The scotty dog will be seen on the image as a fluoroscopy-like image and as an opaque image as well as MPRs in order to best demonstrate the anatomy seen on fluoroscopy.
Von Hippel-Lindau (VHL) syndrome is an autosomal dominant disorder with an incidence of around 2 to 2.5 per 1000 live births. With no curable therapy at hand it is important to implement a supportive therapy as early in life as possible in order to improve the skills to overcome the developmental disabilities. Brain imaging modalities are important tools to determine the site and extent of the injury. The different lesions concomitant with Cerebral Palsy will be illustrated regarding their relation with the gestational age, their location, aspect and the evolution in time. Subsequently the presentation will review the different imaging techniques with regard to their diagnostic and prognostic value. Finally an update will be given of the guidelines dealing with the timing of the acquisition in relation to the age of the newborn and infant.

Pediatric Head Trauma

Pedro Soares Pinto

Traumatic head/brain injury (TBI) is a leading cause of death and life-long disability in children. The unique biomechanical properties of the child’s brain and skull, the size of the child, the age-specific activity pattern, and higher degree of brain plasticity result in a unique distribution, degree, and quality of TBI compared to adult TBI. A detailed knowledge about the various types of primary and secondary pediatric head injuries is essential to better identify and understand pediatric TBI. The goals of this presentation are (a) to discuss the unique epidemiology, mechanisms, and characteristics of TBI in children and (b) to summarize the anatomical and functional imaging features.
of common and rare pediatric traumatic brain injuries and their complications.

11.20-11.30  8'

Pediatric Posterior Fossa Tumors: Diagnosis and Follow-Up
Esther de Luis

Describe the posterior fossa tumors in children and their imagining findings (MR and CT) and the importance of diffusion and spectroscopy in the differential diagnosis of these tumors. Review the most common complications that occur during treatment and the importance of the radiologic follow up. The most common posterior fossa tumors in children are: astrocytoma, medulloblastoma, brainstem gliomas, ependymoma and atypical teratoid rhabdoid tumors. These tumors show different growing patters, location and dissemination. It is important to be familiar with the imaging findings of the lesions to do a correct diagnosis and to know when it is necessary to perform other imaging techniques to exclude dissemination (spinal MR). New imaging techniques (diffusion and spectroscopy) are helpful in the diagnosis and follow up of these pathologies. It is also important to be familiar with the complications that may occur during the treatment: hemorrhage induced by chemotherapy, cystic transformation after radio or chemotherapy, leptomeningeval dissemination or herniation. Conclusions: Radiologists play an important role not only in the diagnosis but also in the follow up of children with posterior fossa tumors. It is important to know the best imaging technique and be familiar with the most common complications that occur during and after treatment.

11.30-11.40  8'

Pilocytic Juvenile Astrocytomas: A Difficult Diagnosis?
Annapaola Bocchio

Atypical presentation of pilocytic juvenile astrocytoma, mimica a granulomatos or a vasculitic disease.

Materials and Methods: Male, 14 years old, accurs to emergency for pulsating headache,right hemiparesis and right VII cranic nerve deficit (May 2006). CT: nodular left parasellar-perisylvian mass with unhomogeneous contrast enhancement. Transcranial Doppler: acceleration of blood flow in left carotid siphon and M1. MR: multiples nodules of solid tissue, appearing extraparenchimal, in left perisellar cistern and sylvian scissure, involving branches of intracranial arteries (C7, A1, M1); diffusion weighted images (DWI) reveal left ischemic capsulo-ventricular and omolateral radiate crown lesions. Serologic tests and liquor: normal. During hospitalization, progressive spontaneous remission of sintomas is observed. Patient is discharged with corticosteroid therapy, in suspect of inflammatory-granulomatous process involving intracranial branches of left carotid artery as cause of stroke. MR controls: in follow ing 9 months, show slow increasing of number and volume of perisylvian lesions. Angiography (November 2006): only minimal stretching and narrowing of A1, M1 e C7. Surgery (February 2007): subradical resection; histologic diagnosis of pilocytic astrocytoma (WHO I). Follow-up: stationary till January 2009, when some small subependimal enhancing nodules appeared, increasing in number at the following controls (October 2009 - May 2010).

Results: Pilocytic astrocytoma is the most common pediatric glioma. Classic appearance is of a cystic mass with enhancing mural nodule. Cerebellum, optic nerve-chiasm and hypothalamic region are the most common locations. Most optic pathway pilocytic astrocytomas (75%) arise in children less than 12 years old; clinical symptoms and signs are usually of several months duration. Differential diagnosis of chiasmal/hipotalamic astrocytomas includes craniopharingiomas, germ cell tumors, hypotalamic gangliogliomas and granulomatos diseases such as tuberculosis and sarcoidosis. Association with NF1 favours the diagnosis. Recently a new group of tumors, whose most common location is the hypothalamic-chiasmatic region has been identified: the pilomyxoid astrocytomas (PMAs). They were previously classified as PAs but they have unique histological features and aggressive behaviour (WHO grade II). They occur in significantly younger population and are usually associated with shorter progression-free survival and shorter over all survival when compared with typical PAs. Increased recognition of these lesions could affect the prognosis and treatment of pediatric astrocytomas.

Conclusions: Pilocytic juvenile astrocytoma, characterized by classic "cystic mass with enhancing mural nodule" imaging appearance, is easily recognised in most circumstances and has, after surgery, an excellent outcome. In our case, stroke-like clinical presentation, location (parasellar), extention of lesion (beside sylvian fissure), imaging appearance (multiple small nodules, with peripheral contrast enhancement) were unusual and complicated the diagnosis. Despite the low grade, the quite aggressive behaviour shown at the follow-up and the early CSP spreading rised the suspect of a pilomyxoid astrocytoma.
Some anatomic variants of the sphenoid and ethmoid are briefly presented, with emphasis on those that are surgical risk factors for neurological injury. The topographic and descriptive anatomy of these variants is reviewed, based on their presentation on CT-scans. The mechanisms of surgical injury as well as the ensuing clinical implications are discussed. The frequency of these variants is described based on both a review of published data and the author’s personal database.

MR in the Differential Diagnosis of Chronic Otitis Media
Mario Prenafeta
To illustrate the different MR features of several pathological conditions which may be related to middle ear inflammatory diseases, to make a differential diagnosis, and assess under which circumstances MR is an adjunct to and/or better than CT studies.

Material and Methods: Retrospectively reviewed patients with clinical documentation of recurrent otitis media where MR is prescribed based on both review of published data and the author’s personal database.

Discussion: Usually, CT studies are the first radiological examinations to be performed when suspecting complications of otitis media in a patient having undergone surgery. But in those patients with a non-conclusive CT and/or because otoscopic findings suffice for the diagnosis of chronic otitis media in a patient having undergone surgery but in those patients with a non-conclusive CT and/or because otoscopic findings justify it, an MR examination is very useful.

The use of conventional sequences suffices for the diagnosis of cholesteatoma granuloma and encephalocele, whilst diffusion and T1-weighted images with IV contrast enhancement are especially useful for the differential diagnosis between granulation tissue and cholesteatoma, both in unoperated and operated patients.

Conclusions: MR provides very useful information for the differential diagnosis of potential complications of chronic otitis media, especially with regard to cholesteatoma, cholesterol granuloma and encephalocele, as well as in determining the potential recurrence of cholesteatoma in post-operative patients.

Diagnostic Spine
Alessandra Splendiani
The introduction of MRI units dedicated to the upright study of the rachis has allowed the neuroradiologist to better understand the status of the spine under physiological condition. Many symptomatic patients with degenerative disease of the lumbo-sacral spine have normal or minimally abnormal findings on standard supine Magnetic resonance imaging (MRI) or Computered Tomography (CT) studies. It is known from dynamic myelography that thecal sac and nerve compression is often unmasked only in the erect position. Weight-bearing MRI can help in the detection and identification of disc herniation, modifications and real dimensions and can highlight pathologies not clear in the recumbent examination. Magnetic resonance imaging using commercial systems has, until recently, been limited to acquiring scans with patients in the recumbent position. It is a logical observation that the human condition is subject to the effects of gravity in positions other than that of recumbence.

The objective was to facilitate imaging of the body in any position of normal stress, across the limits of range of motion, and in the specific position of the patient’s clinical syndrome. Under optimised conditions it was hoped that a specific imaging abnormality might be linked with the specific position or kinetic manoeuvre that produced the clinical syndrome. In this way imaging findings could potentially be meaningfully linked to patients’ signs and symptoms. Furthermore, it was anticipated that radiologically occult but possibly clinically relevant weight bearing- and/or kinetic-dependent disease not visible on the recumbent examination would be unmasked by the positional-dynamic imaging technique.
history of previous lumbar puncture, surgery or trauma, presumably due to an occult CSF leak. The clinical presentation is variable, but postural headache is the most common manifestation. There are several reports on MRI brain studies in SHI, but the role of CT scan and MRI spinal findings is not so well established. We report a case of a 34 year old female, with an atypical clinical presentation, characterized by severe cervical pain, without headache, fever or other relevant clinical manifestations. In the initial imaging study, spinal CT showed epidural dense collections, and spinal MRI confirmed fluid collections with dilated epidural veins and contrast dural enhancement. The first brain MRI was normal. An angiogram was performed to exclude an epidural hematoma, secondary to a venous malformation and the result was normal. The more typical brain imaging findings of SHI will be apparent only two weeks after the initial clinical presentation. CT myelography confirmed the CSF leakage. A trial of conservative therapy had no clinical relief and the patient was successfully treated with site-specific red blood patch. With this case we intend to emphasize the importance of spinal manifestations, that can precede brain findings, on SHI diagnosis.

Posttraumatic Syringomyelia

Andreas Grillhoesl
Neuroradiological Department, Klinikum Grosshadern, University of Munich; Germany

Posttraumatic syringomyelia develops in up to 28% of patients months to years after spinal cord injury, only half will improve after treatment. Effective treatment is unlikely without an understanding of the underlying etiology. Reversible enlargement of the spinal cord and parenchymal T2 prolongation may be a presyrinx state (1). The pathogenesis of syringomyelia formation is unclear, although several theories have been proposed: rupture and coalescence of microcysts, egress of fluid from damaged axons, resorption of blood and necrotic tissue, secretion of cystic fluid, infarction, ependymal proliferation causing closure of the central canal and passage of CSF into the injured central cord (2). Intramedullary pulse pressure theory (3): Syringomyelia is caused by repetitive mechanical distension of the spinal cord syrinx formation occurs by the accumulation of extracellular fluid in the distended cord Hemley (4) demonstrated a prolonged structural and functional disruption of the blood-spinal cord barrier, this may contribute to initial cyst formation. All recent theories have focused on the role of sub-arachnoid obstructions: Subarachnoid obstruction is the sine qua non condition for posttraumatic syrinx formation and extension. Etiological treatment is more adequate than symptom, or cyst, management. So arachnoidalysis as an attempt to eliminate the causes of cyst formation allowed Aghakhani et. al. (5) to obtain better clinical outcomes compared with shunting procedures. CSF flow analysis by MRI provides information concerning the pathogenesis of posttraumatic syringomyelia and patient follow-up (6). Because post-traumatic syringomyelia is due to perturbed CSF flow caused by spinal deformation and narrowing, arachnoiditis and a tethered cord and considering the fact that surgical treatment of syringomyelia results in symptom stabilization rather than improvement in most cases, Neurosurgeons must think about what they can do to prevent the formation of posttraumatic syringomyelia.


Metastatic Disease of the Spine and the Spinal Canal

Roberto Schubert
Radiologie am Europa-Center; Berlin, Germany

MRI is considered the procedure of choice for the work-up of all spinal tumors, whether primary or secondary. It directly depicts the affection of the nerve tissue by a neoplastic process, which may occur by continuous infiltration, hemogenic spread or intracanicular seeding (drop metastasis). CT is mainly used as an adjunct procedure, when bone stability is at stake. However, it may also contribute to the differentiation of benign lesions, e.g. hemangiomas, lipomas or bony islands. MR and CT imaging characteristics are influenced in several ways by the histogenesis of the primary tumour, the presence of pathologic fractures, and the nature of, and response to treatment. In this talk, examples of extradural, intradural extramedullary, and intramedullary manifestations of metastatic disease to the spinal cord as well as some important differential diagnoses are presented and discussed.
Conclusion: We propose the rCBV/bCBV ratio to assist in the diagnosis of ADHD in the pediatric population.

13.10-13.20 8’

Advanced Neuroradiological Studies of Brain Tumors: from Morphology to Physiology.
Andrés Server Alonso
Section of Neuroradiology, Department of Radiology and Nuclear Medicine, Oslo University Hospital-Ullevål, Oslo, Norway.

Neuroimaging of brain tumors has evolved from a morphology-based discipline to one that encompasses functional, hemodynamic, metabolic, cellular, and cytoarchitectural alterations. This communication will focus on the clinical applications of 3 types of physiologic-based MR imaging: diffusion-weighted imaging (DWI) and diffusion tensor imaging (DTI), proton MR spectroscopy (MRS), and perfusion-weighted imaging in the tumor diagnosis and the preoperative treatment planning, as well as the presentation of our own results. DWI and DTI are indicators of tumor cell density and microstructural organization. The higher the tumor cellularity, the lower the apparent diffusion coefficient (ADC) reflecting more restricted diffusion with increasing tumor cellularity. DTI tractography can demonstrate the orientation and integrity of white matter fibers in vivo, and promise to provide much needed information for preoperative planning for brain tumors and around eloquent white matter tracts. MRS provides neurochemical information about tumor and normal-appearing brain tissue. MRS can be used in tumor grading, biopsy guiding, and to differentiate gliomas from metastases. Perfusion-weighted imaging measures the degree of tumor angiogenesis and capillary permeability, both of which are important biologic markers of malignancy, grading, and prognosis, particularly in gliomas. The 3 major techniques used to study and quantify brain tumor vasculature are a T1-weighted steady-state dynamic contrast-enhanced MR imaging (DCE MR imaging) method, a T2*-weighted first-pass dynamic susceptibility contrast-enhanced MR imaging (DSC MR imaging) method, and arterial spin labelling (ASL). We will focus on DSC MR imaging and the microvascular leakage expressed as the leakage coefficient K2 to characterize astrocytoma grading, guide biopsy, differentiate peritumoral edema of primary gliomas and metastatic brain tumors.

In conclusion, quantitative physiological MRI allows non-invasive insights into metabolic and physiological processes associated with tumor growth, blood flow and ultrastructure.

Higher Qualification in Paediatric Neuroradiology
13.10-13.30 8’

Neonatal Hypoxic-Ischemic Encephalopathy: Neuroradiological Findings.
Andrés Server Alonso
Section of Neuroradiology, Department of Radiology and Nuclear Medicine, Oslo University Hospital-Ullevål, Oslo, Norway.

Diffuse hypoxic-ischemic brain injury in the neonate results in neonatal hypoxic-ischemic encephalopathy (HIE). Magnetic resonance imaging (MRI) has become an essential tool in the diagnosis of HIE, helping guide case management in the acute setting and providing valuable information about prognosis. Appropriate radiologic diagnosis of HIE requires familiarity with the many imaging manifestations of this injury. Factors such as brain maturity at time of insult, duration and severity of insult, and timing of imaging studies all influence findings in HIE. In preterm neonates, mild hypotension causes periventricular white matter injury; severe hypotension results in infarction of the deep gray matter, brainstem, and cerebellum. In term neonates, mild hypotension causes parasagittal cortical and subcortical injury, particularly in the intervascular boundary zones; severe hypotension causes characteristic injury of the lateral thalami, posterior putamina, hypocampi, and corticospinal tracts.

New diagnostic tools, such as diffusion-weighted MR imaging (DWI) and proton MR spectroscopy (MRS) allow detect early brain injury. DWI can show early changes at the cellular level that are not detectable by any other imaging modality. There are four patterns of brain injury that can be identified on acute neonatal DWI: boundary zone injury pattern, total cortical injury pattern, basal ganglia injury pattern, and total brain injury pattern. MRS has further opened up the possibilities to study the underlying metabolic mechanisms that define the pathophysiological events that take place in neonatal brain injury. In the first 24 hours after injury, MRS is probably the best technique, because it shows marked lactate elevation. This communication will focus on the application of different MR techniques including conventional structural MR imaging technique and the more advanced MR techniques, such as DWI and MRS in the study of perinatal brain injury.

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13.30-13.40
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