19th Annual Scientific Meeting of Asian and Oceanic Society for Paediatric Radiology

- Better Imaging for Children, Better Imaging for the Future -

Date
Seoul Dragon City
Seoul, Korea

Venue

Supported by
Organized by Korean Society of Pediatric Radiology

AOSPR 2019
SEOUL KOREA

Date
September 26 - 28, 2019

Venue
Seoul Dragon City
Seoul, Korea

Abstracts Book
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Welcome Message from AOSPR 2019 President

On behalf of AOSPR 2019 Organizing Committee, together with the Korean Society of Pediatric Radiology (KSPR), it is our greatest honor to welcome you to the 19th Asian & Oceanic Society for Paediatric Radiology (AOSPR) Congress, to be held on September 26-28, 2019 at Seoul Dragon City, Seoul, Korea.

AOSPR was first of its kind originally founded at Tokyo, Japan in 2000 to share the experience and knowledge in the pediatric radiology field in the Asian region. After the second meeting in Adelaide, Australia, the organization was expanded to include Oceanic counterpart. The third meeting which was assembled Seoul, Korea in 2003 has achieved a notable success with 224 participants from 12 countries. Looking back the history of AOSPR, Korea is proud to host the 19th AOSPR for the second time in Seoul.

Under the slogan of “Better Imaging for Children, Better Imaging for Our Future”, various programs will be prepared including plenary lecture, special focused sessions on ‘good clinical practice in pediatric radiology’, ‘future of pediatric imaging’, and ‘skeletal dysplasia’, as well as exhibitions and social programs. The latest achievements, experience and knowledge will be shared, and we expect lively discussions on future of the pediatric imaging. Building an international network will also be a key component of this meeting to provide quality care beyond border. We are sure that AOSPR 2019 will help all members of AOSPR and participants to solidify our friendship as well as professional collaboration.

Seoul, the capital city of Korea located at the heart of the Korean Peninsula has always been the center of the country throughout its long history. Please join us and enjoy all the attraction this city has to offer. Eagerly anticipating your continued cooperation for your active participation in the AOSPR 2019, we look forward to seeing you in September in Seoul, Korea.

In-One Kim
President
AOSPR 2019

Ji Hye Kim
Secretary General
AOSPR 2019
Dear Colleague,

It is with great pleasure that I invite you to join me in Seoul, South Korea for the 19th Asian & Oceanic Society for Paediatric Radiology (AOSPR) Congress. The meeting is planned to cover a broad range of topics that will be of interest to both dedicated paediatric radiologists and radiologists wishing to improve or update their paediatric medical imaging skills. Korean Radiologists will be joined by an international faculty and together they will share their insights into both common and uncommon paediatric medical imaging problems of interest to radiologists practicing in Asia and from around the world.

AOSPR prides itself as a friendly and welcoming organisation set up to encourage the practice of high quality and effective paediatric radiology in an economically and culturally diverse region. The AOSPR congress is an annual opportunity for radiologists and clinicians performing paediatric medical imaging to come together to share knowledge for the benefit of their paediatric patients. Geo-political differences are put aside and cultural heritages celebrated individually and collectively.

South Korea is home to famous cultures both ancient and modern. The modern city of Seoul has something for everyone; from palaces, shrines and gardens that give insight into the past, to shopping malls, restaurants and a modern Asian entertainment scene. The AOSPR Congress is an opportunity to experience a taste of Seoul and Korean culture while engaging with likeminded colleagues from around the world.

I look forward to sharing knowledge and good times with you in Seoul.
## Committees

### AOSPR Board Members

<table>
<thead>
<tr>
<th>Role</th>
<th>Name</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>President</td>
<td>Timothy Cain</td>
<td>Australia</td>
</tr>
<tr>
<td>Vice-President</td>
<td>Bernard F Laya</td>
<td>Philippines</td>
</tr>
<tr>
<td>Secretary General</td>
<td>Ji Hye Kim</td>
<td>Korea</td>
</tr>
<tr>
<td>Treasurer</td>
<td>Kushaljit Singh Sodhi</td>
<td>India</td>
</tr>
<tr>
<td>Past President</td>
<td>Wendy Lam</td>
<td>Singapore</td>
</tr>
<tr>
<td>Webmaster</td>
<td>Jeevesh Kapur</td>
<td>Singapore</td>
</tr>
<tr>
<td>Academic Secretary</td>
<td>Winnie Chu, Hong Kong China</td>
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</tr>
<tr>
<td>Co-opt (banking)</td>
<td>Elaine Kan, Hong Kong China</td>
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<tr>
<td></td>
<td>Kushaljit Singh Sodhi</td>
<td>India</td>
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<tr>
<td></td>
<td>Zhu Ming, China</td>
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<tr>
<td></td>
<td>Shunsuke Nosaka, Japan</td>
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<tr>
<td></td>
<td>Hamzaini Abdul Hamid, Malaysia</td>
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<tr>
<td>Common Members</td>
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<tr>
<td>Ex-officio</td>
<td>Albert Lam, Aus &amp; N.Zealand</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adji Spatogino, Indonesia</td>
<td></td>
</tr>
<tr>
<td>Honorary Members</td>
<td>Mutsuhisa Fujioka, Japan</td>
<td></td>
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<tr>
<td></td>
<td>In-One Kim, Korea</td>
<td></td>
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<tr>
<td></td>
<td>David Stringer, Singapore</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ines Boechat, USA</td>
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### AOSPR 2019 Organizing Committee

<table>
<thead>
<tr>
<th>Role</th>
<th>Name</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>President</td>
<td>In-One Kim</td>
<td>Seoul National University Children’s Hospital</td>
</tr>
<tr>
<td>Secretary General</td>
<td>Ji Hye Kim</td>
<td>Samsung Medical Center, Sungkyunkwan University</td>
</tr>
<tr>
<td>Deputy Secretary General</td>
<td>Ah Young Jung</td>
<td>Asan Medical Center, University of Ulsan</td>
</tr>
<tr>
<td>Treasurer</td>
<td>Hong Eo</td>
<td>Samsung Medical Center, Sungkyunkwan University</td>
</tr>
<tr>
<td>Scientific Program Director</td>
<td>Jung-Eun Cheon</td>
<td>Seoul National University Children’s Hospital</td>
</tr>
<tr>
<td>Scientific Program</td>
<td>Hye-Kyun Yoon</td>
<td>Human Medical Imaging and Intervention Center</td>
</tr>
<tr>
<td>Educational Program</td>
<td>So-Young Yoo</td>
<td>Samsung Medical Center, Sungkyunkwan University</td>
</tr>
<tr>
<td>Publication</td>
<td>Bo-Kyung Je</td>
<td>Korea University Ansan Hospital</td>
</tr>
<tr>
<td>Scientific Exhibition</td>
<td>Young Ah Cho</td>
<td>Asan Medical Center, University of Ulsan</td>
</tr>
<tr>
<td>Registration</td>
<td>Mi-Jung Lee</td>
<td>Severance Hospital, Yonsei University</td>
</tr>
<tr>
<td>Public Relation</td>
<td>Young Hun Choi</td>
<td>Seoul National University Children’s Hospital</td>
</tr>
<tr>
<td>Technical Exhibition</td>
<td>Jae-Yeon Hwang</td>
<td>Pusan National University Yangsan Hospital</td>
</tr>
<tr>
<td>International Promotion</td>
<td>Ji Eun Park</td>
<td>Ajou University Hospital</td>
</tr>
<tr>
<td>Social Program</td>
<td>Yun-Woo Chang</td>
<td>Soonchunhyang University Seoul Hospital</td>
</tr>
</tbody>
</table>
## Committees

### AOSPR 2019 Advisory Board Members

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
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</thead>
<tbody>
<tr>
<td>Kyung Mo Yeon</td>
<td>Korea Teleradiology Clinic</td>
</tr>
<tr>
<td>Ok-Hwa Kim</td>
<td>Woorisoa Children’s Hospital</td>
</tr>
<tr>
<td>Sun Wha Lee</td>
<td>Gil Medical Center, Gachon University</td>
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<tr>
<td>Myung Joon Kim</td>
<td>Severance Hospital, Yonsei University</td>
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<tr>
<td>Young Seok Lee</td>
<td>Dongtan Sacred Heart Hospital, Hallym University</td>
</tr>
<tr>
<td>Kwan Seop Lee</td>
<td>Hallym University Sacred Heart Hospital</td>
</tr>
<tr>
<td>Woo Sun Kim</td>
<td>Seoul National University Children’s Hospital</td>
</tr>
<tr>
<td>Hee Jung Lee</td>
<td>Dongsan Medical Center, Keimyung University</td>
</tr>
<tr>
<td>Choon-Sik Yoon</td>
<td>Gangnam Severance Hospital, Yonsei University</td>
</tr>
<tr>
<td>Gye Yeon Lim</td>
<td>Yeouido St. Mary’s Hospital, The Catholic University of Korea</td>
</tr>
<tr>
<td>Chong Hyun Yoon</td>
<td>Human Medical Imaging and Intervention Center</td>
</tr>
</tbody>
</table>
## Program at a Glance

<table>
<thead>
<tr>
<th>Time</th>
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<th>Sep 28 (Sat)</th>
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- Plenary Lecture: P37
- RC01-14: P41-P140
- Special Focus Session 01-03: P141-170
- MC01-05: P171-210
- Scientific Session: P211-216
- E-Poster: P217-274
Dragon City Floor Guide

- Restaurants & Bars
- Sky Kingdom
- Grand Ballroom
- Meeting Room
- Fitness

[Diagram of Dragon City floor layout]
Meeting Information

- **Title:** 19th Annual Scientific Meeting of Asian and Oceanic Society for Paediatric Radiology (AOSPR 2019)
- **Dates:** September 26 (Thu) – September 28 (Sat), 2019
- **Venue:** Grand Ballroom (Hanra Hall), 3F Seoul Dragon City, Seoul, Korea
  - **Address:** 95 Cheongpa-ro 20-gil, Yongsan-gu, Seoul 04372, Korea
  - **Tel.** +82-2-2223-7000
- **Theme:** Better Imaging for Children, Better Imaging for the Future
- **Website:** www.aospr2019.org
- **Official Language:** English
- **Organized by:** Korean Society of Pediatric Radiology
- **Secretariat** Before & after meeting
  - **Tel.** +82-2-2269-4381  **Email.** aospr@conventionpm.com

Registration

Onsite Registration Fees

<table>
<thead>
<tr>
<th>Registration Type</th>
<th>On-site Registration</th>
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<tr>
<td>AOSPR/ESPR/SPR Member</td>
<td>USD 450</td>
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<tr>
<td>Non-AOSPR Member</td>
<td>USD 500</td>
</tr>
<tr>
<td>Fellow/Trainee</td>
<td>USD 250</td>
</tr>
<tr>
<td>Student (Undergraduate)</td>
<td>Free</td>
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</table>

- Fellow/Trainee/Student are requested to submit a certificate verifying their status at the registration desk.
- Registration Fee includes:
  - Admission to all sessions
  - Access to exhibition area
  - Conference kit
  - Luncheon symposium
  - Coffee breaks and lunches
* Welcome Reception & Banquet are fully booked, so on-site registrant will not be available for welcome reception & banquet.

Registration Desk Operating Hours

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Location</th>
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<tbody>
<tr>
<td>September 26 (Thu) – 27 (Fri)</td>
<td>07:30 – 17:00</td>
<td>Hanra Hall Foyer (3F)</td>
</tr>
<tr>
<td>September 28 (Sat)</td>
<td>07:30 – 11:00</td>
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</table>
**Name Badge**

All participants are required to wear their badge during the conference in order to enter the scientific sessions and E-poster presentations. You may collect your name badge at the registration desk.

**E-Poster Presentation**

<table>
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<th>Date</th>
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<th>Location</th>
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<tbody>
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<td>07:30 – 17:30</td>
<td>Hanra Hall 2 (3F)</td>
</tr>
<tr>
<td>September 28 (Sat)</td>
<td>07:30 – 11:30</td>
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* Please be sure that E-Poster presenters check their files on arrival.

**Case of the Day**

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Location</th>
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<tbody>
<tr>
<td>September 26 (Thu) – 27 (Fri)</td>
<td>07:30 – 17:30</td>
<td>Hanra Hall 2 (3F)</td>
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</table>

* Those who answer the most will be posted next morning. Please pick up the small gift at the registration desk.

**Preview Room**

- All speakers are required to visit the preview room and submit presentation materials at least 1 hour before their session to verify if the data will function properly on the equipment provided.

<table>
<thead>
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<th>Location</th>
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<td>VIP Room (3F)</td>
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<tr>
<td>September 28 (Sat)</td>
<td>07:30 – 11:30</td>
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**Speakers’ Lounge**

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<th>Location</th>
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<tbody>
<tr>
<td>September 26 (Thu) – 27 (Fri)</td>
<td>07:30 – 17:30</td>
<td>Shilla Room 5 (3F)</td>
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<tr>
<td>September 28 (Sat)</td>
<td>07:30 – 11:30</td>
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**Secretariat**

Secretariat is operated during the conference period. For any help or request, please come to the secretariat.

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Location</th>
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<tr>
<td>September 26 (Thu) – 27 (Fri)</td>
<td>07:30 – 17:30</td>
<td>Shilla Room 2 (3F)</td>
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<tr>
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# Meeting Information

## Social Events

### Welcome Reception

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<tbody>
<tr>
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### Congress Banquet

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## AOSPR Meetings

### AOSPR Executive Board Meeting (EBM)

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### AOSPR Annual General Meeting (AGM)

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<td>12:30-13:30</td>
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## Other Meetings

### Meet the Expert Session: Skeletal Dyplasia Case Discussion

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<td>September 26 (Thu)</td>
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### WFPI Conversation

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### Regional Contrast Management Expert Meeting

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<tr>
<td>September 28 (Sat)</td>
<td>14:00-16:20</td>
<td>Shilla Room 1 (3F)</td>
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</tbody>
</table>
General Information

Useful Website

- Korea Tourism Organization: [http://www.visitkorea.or.kr](http://www.visitkorea.or.kr)
- Gateway to Korea: [http://www.korea.net](http://www.korea.net)
- Seoul Metropolitan Government: [http://www.visitseoul.net](http://www.visitseoul.net)
- Korea Immigration Service: [http://www.immigration.go.kr](http://www.immigration.go.kr)
- Ministry of Foreign Affairs and Trade: [http://www.mofat.go.kr](http://www.mofat.go.kr)
- Incheon International Airport: [http://www.airport.kr](http://www.airport.kr)

Electricity

The standard electricity supply is 220 volts AC/60 cycles. Most hotels may provide outlet converters for 110 and 220 volts. Participants are recommended to check with the hotel beforehand.

Emergency Dial Number

- 119: Emergencies for fire, Rescue & Hospital Services, Medical emergency
- 112: Police
- 129: First Aid Services

※ These services are available 24 hours.
## Invited Faculties (alphabetically by last name)

### Overseas

<table>
<thead>
<tr>
<th>Name</th>
<th>Country</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noriko Aida</td>
<td>Japan</td>
<td>Kanagawa Children’s Medical Center and Yokohama City University</td>
</tr>
<tr>
<td>Kimberly E Applegate</td>
<td>USA</td>
<td>University of Kentucky School of Medicine</td>
</tr>
<tr>
<td>Paul S Babyn</td>
<td>Canada</td>
<td>University of Saskatchewan</td>
</tr>
<tr>
<td>Dorothy Bulas</td>
<td>USA</td>
<td>Children’s National Health Systems Washington DC</td>
</tr>
<tr>
<td>Timothy Cain</td>
<td>Australia</td>
<td>The Royal Children’s Hospital Melbourne</td>
</tr>
<tr>
<td>Cheng-Yu Chen</td>
<td>Taiwan</td>
<td>Taipei Medical University</td>
</tr>
<tr>
<td>Winnie Chu</td>
<td>Hong Kong</td>
<td>Prince of Wales Hospital, The Chinese University of Hong Kong</td>
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<tr>
<td>Taylor Chung</td>
<td>USA</td>
<td>UCSF Benioff Children’s Hospital</td>
</tr>
<tr>
<td>Nathan David P Concepcion</td>
<td>Philippines</td>
<td>St. Luke’s Medical Center</td>
</tr>
<tr>
<td>James Donaldson</td>
<td>USA</td>
<td>Ann &amp; Robert H. Lurie Children’s Hospital of Chicago</td>
</tr>
<tr>
<td>Lane F Donnelly</td>
<td>USA</td>
<td>Stanford University School of Medicine</td>
</tr>
<tr>
<td>Monica Epelman</td>
<td>USA</td>
<td>University of Central Florida, Nemours Children’s Hospital</td>
</tr>
<tr>
<td>Marielle V Fortier</td>
<td>Singapore</td>
<td>KK Women’s and Children’s Hospital</td>
</tr>
<tr>
<td>Donald P Frush</td>
<td>USA</td>
<td>Stanford School of Medicine/Lucile Packard Children’s Hospital</td>
</tr>
<tr>
<td>Atsuko Fujikawa</td>
<td>Japan</td>
<td>St. Marianna University School of Medicine</td>
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<tr>
<td>Pilar Garcia-Peña</td>
<td>Spain</td>
<td>University Hospital Materno-Infantil Vall d’Hebron</td>
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<tr>
<td>Christine M Hall</td>
<td>UK</td>
<td>Great Ormond Street Hospital for Children</td>
</tr>
<tr>
<td>Hamzaini Abdul Hamid</td>
<td>Malaysia</td>
<td>University Kebangsaan Malaysia Medical Centre</td>
</tr>
<tr>
<td>Atsuhiko Handa</td>
<td>USA</td>
<td>University of Iowa Hospitals and Clinics</td>
</tr>
<tr>
<td>Manisha Jana</td>
<td>India</td>
<td>All India Institute of Medical Sciences New Delhi</td>
</tr>
<tr>
<td>Blaise V Jones</td>
<td>USA</td>
<td>Cincinnati Children’s Hospital Medical Center</td>
</tr>
<tr>
<td>Nadja Kadom</td>
<td>USA</td>
<td>Emory University and Children’s Healthcare of Atlanta</td>
</tr>
<tr>
<td>Jeevesh Kapur</td>
<td>Singapore</td>
<td>National University Hospital</td>
</tr>
<tr>
<td>Joanna Kasznia-Brown</td>
<td>UK</td>
<td>Vice-President, The World Federation of Pediatric Imaging</td>
</tr>
<tr>
<td>Pek-Lan Khong</td>
<td>Hong Kong</td>
<td>The University of Hong Kong</td>
</tr>
<tr>
<td>Hee Kyung Kim</td>
<td>USA</td>
<td>Cincinnati Children’s Hospital Medical Center</td>
</tr>
<tr>
<td>Tatsuo Kono</td>
<td>Japan</td>
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<td>Korgun Koral</td>
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</tr>
<tr>
<td>Name</td>
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<td>Institution</td>
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<tr>
<td>Rajesh Krishnamurthy</td>
<td>USA</td>
<td>Nationwide Children’s Hospital, Ohio State University</td>
</tr>
<tr>
<td>Supika Fern</td>
<td>Thailand</td>
<td>Songkranagarind Hospital, Prince of Songkla University</td>
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<tr>
<td>Kritsaneepaiboon</td>
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<tr>
<td>Wendy Lam</td>
<td>Hong Kong China</td>
<td>Queen Mary Hospital</td>
</tr>
<tr>
<td>Bernard F Laya</td>
<td>Philippines</td>
<td>St. Luke’s Medical Center</td>
</tr>
<tr>
<td>Edward Y Lee</td>
<td>USA</td>
<td>Boston Children’s Hospital and Harvard Medical School</td>
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<tr>
<td>Mark C Liszewski</td>
<td>USA</td>
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<tr>
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<td>Japan</td>
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<tr>
<td>Zaleha Abd Manaf</td>
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<tr>
<td>Stephen F Miller</td>
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<tr>
<td>Osamu Miyazaki</td>
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<td>Gen Nishimura</td>
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<td>Sunsuke Nosaka</td>
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<td>Than Oo</td>
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<td>Catherine Owens</td>
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<td>Siriraj Hospital, Mahidol University</td>
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<td>Utami Purbasari</td>
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<td>Yutaka Sato</td>
<td>USA</td>
<td>University of Iowa</td>
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<tr>
<td>Stephen Simoneaux</td>
<td>USA</td>
<td>Emory University School of Medicine</td>
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<td>Kushaljit Singh Sodhi</td>
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<td>Postgraduate Institute of Medical Education and Research [PGIMER]</td>
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<tr>
<td>David Stringer</td>
<td>Singapore</td>
<td>KK Women’s and Children’s Hospital</td>
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<tr>
<td>Ajay Taranath</td>
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<td>Abbey J Winant</td>
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<tr>
<td>Shi-Joon Yoo</td>
<td>Canada</td>
<td>Hospital for Sick Children, University of Toronto</td>
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<td>Peng Yun</td>
<td>China</td>
<td>Beijing Children’s Hospital, Capital Medical University</td>
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<td>Yumin Zhong</td>
<td>China</td>
<td>Shanghai Children’s Medical Center</td>
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<tr>
<td>Khin Wai Zin</td>
<td>Myanmar</td>
<td>Institute of Medicine, Mandalay</td>
</tr>
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</table>
## Invited Faculties (alphabetically by last name)

### Koreans

<table>
<thead>
<tr>
<th>Name</th>
<th>Hospital/Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jung-Eun Cheon</td>
<td>Seoul National University Children’s Hospital</td>
</tr>
<tr>
<td>Tae-Joon Cho</td>
<td>Seoul National University Children’s Hospital</td>
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<tr>
<td>Young Ah Cho</td>
<td>Asan Medical Center, University of Ulsan</td>
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<tr>
<td>Young Hun Choi</td>
<td>Seoul National University Children’s Hospital</td>
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<tr>
<td>Hyun Woo Goo</td>
<td>Asan Medical Center, University of Ulsan</td>
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<tr>
<td>Hyun Sook Hong</td>
<td>Soonchunhyang University Bucheon Hospital</td>
</tr>
<tr>
<td>Saeboom Hur</td>
<td>Seoul National University Hospital</td>
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<tr>
<td>Jae Yeon Hwang</td>
<td>Pusan National University Yansan Hospital</td>
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<tr>
<td>Bo-Kyung Je</td>
<td>Korea University Ansan Hospital</td>
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<tr>
<td>Ah Young Jung</td>
<td>Asan Medical Center, University of Ulsan</td>
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<tr>
<td>In-One Kim</td>
<td>Seoul National University Children’s Hospital</td>
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<tr>
<td>Ji Hye Kim</td>
<td>Samsung Medical Center, Sungkyunkwan University</td>
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<tr>
<td>Ok-Hwa Kim</td>
<td>Woorisoa Children’s Hospital</td>
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<tr>
<td>Yong-Woo Kim</td>
<td>Pusan National University Yangsan Hospital</td>
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<tr>
<td>Hyun Gi Kim</td>
<td>Eunpyeong St. Mary’s Hospital, The Catholic University of Korea</td>
</tr>
<tr>
<td>Woo Sun Kim</td>
<td>Seoul National University Children’s Hospital</td>
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<tr>
<td>Hee Jung Lee</td>
<td>Keimyung University Dongsan Medical Center</td>
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<td>Jin Seong Lee</td>
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<tr>
<td>Kwanseop Lee</td>
<td>Hallym University Sacred Heart Hospital</td>
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<td>Mi-Jung Lee</td>
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<td>Gye Yeon Lim</td>
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<td>Young Jin Ryu</td>
<td>Seoul National University Bundang Hospital</td>
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<td>So-Young Yoo</td>
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<td>Gangnam Severance Hospital, Yonsei University</td>
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<tr>
<td>Hye-Kyung Yoon</td>
<td>Human Medical Imaging and Intervention Center</td>
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- SEOUL TOURISM ORGANIZATION
Exhibition

Industry Exhibition

Opening Hours

September 26 (Thu) – 27 (Fri): 08:30 – 17:00
September 28 (Sat): 08:00 – 11:00

Place

Hanra Hall 2 & Foyer (3F)

◆ Floor Plan for Booth

<table>
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<th>No.</th>
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<th>Company Name</th>
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<td>Bayer Korea. Ltd.</td>
<td>33</td>
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<td>Bracco Imaging Korea</td>
<td>24-26</td>
<td>Siemens Healthineers</td>
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<td>WITHHEALTHCARE</td>
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<td>13-16</td>
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<td>27-29</td>
<td>Imaging Solutions Korea Ltd.</td>
<td>AOSPR 2020</td>
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<td>17-20</td>
<td>GE Healthcare</td>
<td>30-32</td>
<td>SAMSUNG</td>
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</table>
Presentation Guidelines

For Oral Presentation

Language: English

Presentation
* All presenters are required to arrive at the session room 20 minutes before the session begins, and take a seat in the first row reserved for the speakers.

Presentation
You will be given the following length of time for each of your presentation and Q&A.

<table>
<thead>
<tr>
<th>No.</th>
<th>Session</th>
<th>Presentation (min)</th>
<th>Q&amp;A (min)</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>RC, SF, Keynote</td>
<td>20 min</td>
<td>10 min (end of session)</td>
</tr>
<tr>
<td>2</td>
<td>MC, Scientific Session</td>
<td>7 min</td>
<td>3 min</td>
</tr>
<tr>
<td>3</td>
<td>Luncheon Symposium</td>
<td>20 min</td>
<td></td>
</tr>
</tbody>
</table>

- Please note that chairpersons are under strict instructions to follow the limited time allotment per presenter for smooth running of the session.
- You will be responsible for controlling/advancing the slides during your presentation.

Presentation Equipment
- Computer: Window OS - PowerPoint version 2010 or upper
- A monitor and a wireless mouse will be set up on the podium, and the presenters operate each slide from the podium using the mouse.
- There will also be an AV technician in each session room to assist you with technical issues.
- We DO NOT recommend using your own laptop computer for your presentation to avoid problems with computer-projector compatibility and to save the time that would otherwise be needed for changing connections.
- If you wish to use your own laptop for your presentation, you have to inform the technician in advance in the preview room.

Presentation File
- Please bring your presentation material on the USB drive.
- It is strongly recommended that all presenters prepare their presentation materials in Microsoft Office PowerPoint (PPT) file format.
- Please use a standard font such as Times New Roman, Arial or Tahoma which be included on the session room computers. If you use any special or unique fonts for your presentation it may not be displayed correctly.
- If you have an external file utilized, e.g., a movie files, save it to the same folder as your presentation file.
- Video clips (other than certain animated gif files) are not embedded in PowerPoint presentations: you will need to bring the separate video files with you and submit them along with your presentation file.
- Screen Ratio: 4:3
Presentation Guidelines

■ Preview Room
- Location: VIP Room, 3F, Seoul Dragon City
- Operating Hours: 07:30-17:30, September 26 (Thu)-27 (Fri)
  07:30-11:30, September 28 (Sat.)
  • Please visit the preview room at least 1 hour in advance of your presentation to verify if the data will function properly on the equipment provided.
  • After you have finished reviewing and/or making changes to your presentation, please notify an A/V technician so that they can review and upload your files onto the PCs connected to each session room.
  • All presentation files will be loaded onto a server (at the preview room) and distributed to the appropriate session room at the appropriate time via network.

For E-Poster Presentation
All the posters will be presented as E-posters, poster submitters do not need to bring a printed copy of their posters. Electronic posters will be presented throughout the whole conference duration on computers based over the conference E-Poster area.

■ Format
• All E-Posters’ file should be prepared in English.
• E-Poster’s file will be accepted in MS-PPT or PPTX format.
• Version: PowerPoint 2013/2010 or earlier
• Screen Ratio: 4:3

■ Contents
• The first slide must include the title and author list.
• The second slide should list disclosures for all authors.
• The third slide should contain 2 or more learning objectives and/or the stated purpose.

■ Font
• Use basic fonts such as Arial, Calibri or Times New Roman
• Recommended minimum font is 12 points.

■ Media & Multimedia
• Pictures, videos (.wmv), graphs and tables can be included in the E-Poster file.
• Approved Image formats: .gif, .jpg, .png, .tiff
• Audio will not be supported.
### Scientific Program

**Day 1  September 26, 2019**

**Room A**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Chairs</th>
<th>Speaker</th>
</tr>
</thead>
</table>
| 08:30-10:00 | RC01. Practical Pearls of Chest Imaging     | Chairs: Young Ah Cho (Korea) / Nathan David P Concepcion (Philippines) | Edward Y Lee  
(Boston Children’s Hospital and Harvard Medical School, USA) |
| 08:30-08:50 | Chest imaging in pediatric emergency room   |                                 |                                               |
| 08:50-09:10 | Imaging of the chest wall                   | Bernard F Laya                  | St. Luke’s Medical Center, Philippines        |
| 09:10-09:30 | Update in childhood interstitial lung disease 2019 | Catherine Owens       | Great Ormond Street Hospital (GOSH) and Institute Child Health, UK |
| 09:30-09:50 | Ultrasound of pediatric chest                | Jeevesh Kapur                  | National University Hospital, Singapore       |
| 09:50-10:00 | Q & A                                        |                                 |                                               |
| 10:00-10:20 | Coffee Break                                 |                                 |                                               |
| 10:20-11:50 | RC03. Oncology Imaging: Body                | Chairs: Gye Yeon Lim (Korea) / Zaleha Abd Manaf (Malaysia) |  |
| 10:20-10:40 | Hepatoblastoma: Comparison of PRETEXT 2005 and 2017 | Osamu Miyazaki      | National Center for Child Health and Development, Japan |
| 10:40-11:00 | Wilms tumor and beyond: A multimodality approach | Stephen F Simoneaux | Emory University School of Medicine, USA      |
| 11:00-11:20 | Imaging of neuroblastoma: Pearls and pitfalls | So-Young Yoo         | Samsung Medical Center, Sungkyunkwan University, Korea |
| 11:20-11:40 | Assessing paediatric tumour treatment response | Timothy Cain         | The Royal Children’s Hospital Melbourne, Australia |
| 11:40-11:50 | Q & A                                        |                                 |                                               |
| 11:50-12:00 | Break                                        |                                 |                                               |
| 12:00-12:30 | Opening Ceremony                             |                                 |                                               |
| 12:30-13:30 | Luncheon Symposium 1. (Sponsored by Geubet Korea) | Chair: In-One Kim (Korea) | Edward Y Lee  
(Boston Children’s Hospital and Harvard Medical School, USA) |
| 12:30-12:50 | Guideline / protocol of using contrast media in pediatric patients |                                 |                                               |
| 12:50-13:10 | Safety of gadolinium based contrast agents in pediatric MR imaging | Jae-Yeon Hwang       | Pusan National University, Yansan Hospital, Korea |
| 13:30-14:30 | MC01. Pediatric Neuro and HN                | Chairs: Hye-Kyung Yoon (Korea) / Pek-Lan Khong (Hong Kong China) |  |
| 13:30-13:50 | [Keynote] Acute evaluation of pediatric stroke: A practical approach | Blaise Y Jones       | Cincinnati Children’s Hospital Medical Center, USA |
| 13:50-14:00 | Monitoring postoperative neurocognitive dysfunction through the use of radiomics based on MRI in children with moyamoya | Shujie Wang         | Children’s Hospital of Nanjing Medical University, China |
### Scientific Program

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Title</th>
<th>Speaker</th>
<th>Institution</th>
</tr>
</thead>
</table>
| 14:00-14:10  | Monitoring cerebral perfusion after indirect revascularization in children with moyamoya disease by using arterial spin-labeling MR imaging | Seunghyun Lee  
(Seoul National University Children’s Hospital, Korea) |                                                                                           |
| 14:10-14:30  | Monitoring cerebral perfusion after indirect revascularization in children with moyamoya disease by using arterial spin-labeling MR imaging | Hyun Gi Kim  
(Eunpyeong St. Mary’s Hospital, The Catholic University of Korea, Korea) |                                                                                           |
| 14:30-14:50  | Coffee Break             |                                                                       |                                              |                                            |
| 14:50-16:00  | MC02. Cardiovascular Imaging | [Keynote] Post-operative cardiac imaging                               | Wendy Lam  
(Queen Mary Hospital, Hong Kong China) |                                              |
|              | Cardiac T2* MR analysis of membranous interventricular septum in assessment of cardiac iron overload in pediatric thalassemia patients: A pilot study | Ishan Kumar  
(Banaras Hindu University, India)  
* AOSPR 2018 Winner |                                              |                                            |
|              | Subclinical left ventricular dysfunction in acute myocarditis: Assessed with three-dimensional cardiac magnetic resonance [CMR] feature-tracking myocardial strain analysis | Ling-Yi Wen  
(West China Second University Hospital, China) |                                              |                                            |
|              | Improving image quality of Aorta and pulmonary artery root for children with high heart rates using second-generation motion correction algorithm | Jihang Sun  
(Beijing Children’s Hospital, China) |                                              |                                            |
|              | Clinical significance of myocardial dysfunction in right ventricular heart disease assessed by cardiac magnetic resonance-based feature-tracking | Akio Inage  
(Sakakibara Heart Institute, Japan) |                                              |                                            |
|              | Diagnostic accuracy of multislice thoracic CT angiography in detecting atrial septal defect, ventricular septal defect and patent ductus arteriosus assessed with conventional cardiac catheterization and/or cardiac surgery as gold standards | Eric Gerard Maglaya  
(St. Luke’s Medical Center, Philippines) |                                              |                                            |
| 16:00-16:10  | Break                    |                                                                       |                                              |                                            |
| 16:10-17:40  | RC05. Cardiac Imaging    | Cardiac CT: No longer just for morphology                             | Hyun Woo Goo  
(Asan Medical Center, University of Ulsan College of Medicine, Korea) |                                              |
|              | How we perform least invasive 320-row pediatric cardiac CT               | Eriko Maeda  
(The University of Tokyo, Japan) |                                              |                                            |
|              | MR in patients with repaired congenital heart disease: Principles in 2019 made easy | Shi-Joon Yoo  
(Hospital for Sick Children, University of Toronto, Canada) |                                              |                                            |
|              | Non sedation application in cardiac CT for congenital heart disease      | Yumin Zhong  
(Shanghai Children’s Medical Center, China) |                                              |                                            |
| 17:30-17:40  | Q & A                    |                                                                       |                                              |                                            |

**Welcome Reception (Sky Beach, 34F)**
### Day 1  September 26, 2019

**Room B**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Chairs</th>
<th>Presenters</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:30-10:00</td>
<td>RC02. Update in Pediatric Neuroimaging: Current and on the Horizon</td>
<td>Chairs: Korgun Koral (USA) / Hyun Sook Hong (Korea)</td>
<td>In-One Kim (Seoul National University Children’s Hospital, Korea)</td>
</tr>
<tr>
<td>08:30-08:50</td>
<td>Encephalopathy of prematurity</td>
<td></td>
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<tr>
<td>08:50-09:10</td>
<td>Diffusion tensor MR imaging of treatment-induced white matter injury in childhood cancer survivors: Clinical and translational studies</td>
<td>Pek-Lan Khong (The University of Hong Kong, Hong Kong China)</td>
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</tr>
<tr>
<td>09:10-09:30</td>
<td>Imaging of encephalopathy in infants and children, challenging diagnosis</td>
<td>Ji Hye Kim (Samsung Medical Center, Sungkyunkwan University, Korea)</td>
<td></td>
</tr>
<tr>
<td>09:30-09:50</td>
<td>Pediatric neuroimaging: What the pediatric intensivists need to know?</td>
<td>Sandy, Cheng-Yu Chen (Taipei Medical University, Taiwan)</td>
<td></td>
</tr>
<tr>
<td>09:50-10:00</td>
<td>Q &amp; A</td>
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<tr>
<td>10:00-10:20</td>
<td>Coffee Break</td>
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<tr>
<td>10:20-10:40</td>
<td>Corpus callosal anomalies</td>
<td>Ajay Taranath (Women’s and Children’s Hospital in Adelaide, Australia)</td>
<td></td>
</tr>
<tr>
<td>10:40-11:00</td>
<td>Cortical malformation of the brain: Imaging and topics</td>
<td>Noriko Aida (Kanagawa Children’s Medical Center and Yokohama City University, Japan)</td>
<td></td>
</tr>
<tr>
<td>11:00-11:20</td>
<td>Posterior fossa malformation</td>
<td>Ah Young Jung (Asan Medical Center, University of Ulsan, Korea)</td>
<td></td>
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<tr>
<td>11:20-11:40</td>
<td>Spinal dysraphism</td>
<td>Winnie Chu (The Chinese University of Hong Kong, Hong Kong China)</td>
<td></td>
</tr>
<tr>
<td>11:40-11:50</td>
<td>Q &amp; A</td>
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<tr>
<td>11:50-12:00</td>
<td>Break</td>
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<tr>
<td>12:30-13:30</td>
<td>Luncheon Symposium 2. (Sponsored by Bracco Imaging Korea)</td>
<td>Chair: Ji Hye Kim (Korea)</td>
<td></td>
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<tr>
<td>12:30-12:50</td>
<td>Pediatric CEUS on vascular application</td>
<td>Young Hun Choi (Seoul National University Children’s Hospital, Korea)</td>
<td></td>
</tr>
<tr>
<td>12:50-13:10</td>
<td>Pediatric CEUS on non-vascular application &amp; safety issue</td>
<td>Mi-Jung Lee (Severance Children’s Hospital, Yonsei University, Korea)</td>
<td></td>
</tr>
<tr>
<td>13:30-16:00</td>
<td>Special Focus Session 01 Skeletal Dysplasia</td>
<td>Chairs: Ok-Hwa Kim (Korea) / Gen Nishimura (Japan)</td>
<td></td>
</tr>
<tr>
<td>13:30-13:45</td>
<td>History of bone dysplasias</td>
<td>Gen Nishimura (Saitama Medical University Hospital, Japan)</td>
<td></td>
</tr>
<tr>
<td>13:45-14:25</td>
<td>What’s in a name? An historical perspective on the nomenclature and classification (Nosology) of skeletal dysplasias</td>
<td>Christine Hall (Great Ormond Street Hospital for Children, UK)</td>
<td></td>
</tr>
<tr>
<td>14:25-14:45</td>
<td>Chondrodysplasia punctata</td>
<td>Stephen F Miller (Le Bonheur Children’s Hospital, University of Tennessee Health Science Center, USA)</td>
<td></td>
</tr>
<tr>
<td>14:45-15:00</td>
<td>Coffee Break</td>
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</table>
# Scientific Program

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Chair/Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:00-15:20</td>
<td>Special Focus Session 01 - Skeletal Dysplasia</td>
<td></td>
</tr>
<tr>
<td>15:00-15:20</td>
<td>Skeletal ciliopathies: A pattern recognition approach</td>
<td>Atsuhiko Handa (University of Iowa Hospitals and Clinics, USA)</td>
</tr>
<tr>
<td>15:20-15:35</td>
<td>Genetic study for skeletal dysplasia</td>
<td>Tae-Joon Cho (Seoul National University Children's Hospital, Korea)</td>
</tr>
<tr>
<td>15:35-15:50</td>
<td>Eponyms in skeletal dysplasia</td>
<td>Ok-Hwa Kim (Woorisoo Children's Hospital, Korea)</td>
</tr>
<tr>
<td>15:50-16:00</td>
<td>Q &amp; A</td>
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</tr>
<tr>
<td>16:00-16:10</td>
<td>Break</td>
<td></td>
</tr>
<tr>
<td>16:10-17:40</td>
<td>RC06. Brain Neoplasms: Diagnostic Pearls</td>
<td></td>
</tr>
<tr>
<td>16:10-16:30</td>
<td>Pediatric neuroimaging in the era of the WHO 4th edition of tumors of the CNS</td>
<td>Blaise V Jones (Cincinnati Children’s Hospital Medical Center, USA)</td>
</tr>
<tr>
<td>16:30-16:50</td>
<td>Pediatric posterior fossa tumors</td>
<td>Yutaka Sato (University of Iowa, USA)</td>
</tr>
<tr>
<td>16:50-17:10</td>
<td>Imaging of supratentorial tumors in children</td>
<td>Nathan David P Concepcion (St. Luke's Medical Center, Philippines)</td>
</tr>
<tr>
<td>17:10-17:30</td>
<td>Current concepts in radiologic assessment of pediatric brain tumor during treatment</td>
<td>Korgun Koral (Cohen Children's Medical Center, Hofstra University School of Medicine at Northwell Health, USA)</td>
</tr>
<tr>
<td>17:30-17:40</td>
<td>Q &amp; A</td>
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<tr>
<td>18:30</td>
<td>Welcome Reception (Sky Beach, 34F)</td>
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</tbody>
</table>
## Day 2  
**September 27, 2019**

### Room A

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Chair(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>08:00-09:30</strong></td>
<td>RC07. How We Do It: Body Imaging</td>
<td>Chairs: Yong-Woo Kim (Korea) / Pilar Garcia-Peña (Spain)</td>
</tr>
<tr>
<td>08:00-08:20</td>
<td>Body CT techniques in children: Tips and tactics</td>
<td>Donald P Frush (Stanford School of Medicine/Lucile Packard Children’s Hospital, USA)</td>
</tr>
<tr>
<td>08:20-08:40</td>
<td>Dynamic CT of pediatric airway</td>
<td>Abbey J Winant (Boston Children’s Hospital, Harvard Medical School, USA)</td>
</tr>
<tr>
<td>08:40-09:00</td>
<td>Practical MRI of the pediatric chest</td>
<td>Kushalijit Singh Sodhi (Postgraduate Institute of Medical Education and Research [PGIMER], India)</td>
</tr>
<tr>
<td>09:00-09:20</td>
<td>Liver elastography</td>
<td>Mi-Jung Lee (Severance Children’s Hospital, Yonsei University, Korea)</td>
</tr>
<tr>
<td>09:20-09:30</td>
<td>Q &amp; A</td>
<td></td>
</tr>
<tr>
<td>09:30-09:50</td>
<td>Coffee Break</td>
<td></td>
</tr>
<tr>
<td><strong>09:50-11:20</strong></td>
<td>RC09. Albert Lam Memorial Session: Practical Pediatric Imaging</td>
<td>Chairs: Timothy Cain (Australia) / In-One Kim (Korea)</td>
</tr>
<tr>
<td>09:50-10:00</td>
<td>Commemorating speech</td>
<td>David Stringer (KK Women’s and Children’s Hospital, Singapore)</td>
</tr>
<tr>
<td>10:00-10:20</td>
<td>The role of imaging in intussusception:</td>
<td>Kimberly E Applegate (University of Kentucky School of Medicine, USA)</td>
</tr>
<tr>
<td></td>
<td>Past, present and future</td>
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<tr>
<td>10:20-10:40</td>
<td>Practical imaging approach to acute right</td>
<td>Mark Liszewski (Montefiore Medical Center and Albert Einstein College of Medicine, USA)</td>
</tr>
<tr>
<td></td>
<td>lower quadrant pain in children</td>
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<tr>
<td>10:40-11:00</td>
<td>Practical imaging approach to urinary tract</td>
<td>Bo Kyung Je (Korea University Ansan Hospital, Korea)</td>
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<td>infection in children</td>
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<tr>
<td>11:00-11:20</td>
<td>Imaging of the pediatric scrotum and ovary</td>
<td>Supika Kritsanepaiboon (Songklanagarind Hospital, Prince of Songkla University, Thailand)</td>
</tr>
<tr>
<td>11:20-11:30</td>
<td>Break</td>
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<tr>
<td><strong>11:30-12:20</strong></td>
<td>Plenary Lecture</td>
<td>Chair: Taylor Chung (USA)</td>
</tr>
<tr>
<td>11:30-12:20</td>
<td>Adapting to the challenging environment in</td>
<td>Shi-Joon Yoo (Hospital for Sick Children, University of Toronto, Canada)</td>
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<tr>
<td></td>
<td>pediatric cardiac imaging</td>
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</tr>
<tr>
<td>12:20-12:30</td>
<td>Break</td>
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</tr>
<tr>
<td><strong>12:30-13:30</strong></td>
<td>Luncheon Symposium 3. (Sponsored by Central Medical Service)</td>
<td>Eung Won Yeon (Central Medical Service, Korea)</td>
</tr>
<tr>
<td>12:30-12:50</td>
<td>Advanced syringeless injector – CT motion</td>
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</table>
### Scientific Program

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Chairs</th>
</tr>
</thead>
<tbody>
<tr>
<td>13:30-14:40</td>
<td>MC04. Body Imaging</td>
<td>Chairs: Woo Sun Kim (Korea) / Utami Purbasari (Indonesia)</td>
</tr>
<tr>
<td>13:30-13:50</td>
<td>[Keynote] Chest disease in immunocompromised pediatric patients</td>
<td>Pilar Garcia-Peña (Maternal and Child University Hospital of Vail D’Hebron, Spain)</td>
</tr>
<tr>
<td>13:50-14:00</td>
<td>Analysis of CT features of chest in gaucher disease</td>
<td>Li Di (Beijing Children’s Hospital, China)</td>
</tr>
<tr>
<td>14:00-14:10</td>
<td>Follow up of CT angiographic findings of pulmonary arteriovenous malformations (PAVM) in children and young adults with hereditary hemorrhagic telangiectasia (HHT)</td>
<td>Su-Mi Shin (SMG-SNU Boramae Medical Center, Korea)</td>
</tr>
<tr>
<td>14:10-14:20</td>
<td>Congenital pulmonary airway malformation type 4: CT-pathologic correlation</td>
<td>Seul Bi Lee (Seoul National University Hospital, Korea)</td>
</tr>
<tr>
<td>14:20-14:30</td>
<td>CT-guided percutaneous lung biopsy for diagnosis of fungal infections in paediatric oncology patients: Yield and outcomes</td>
<td>S Murthy Chennapragada (The Children’s Hospital at Westmead, Australia)</td>
</tr>
<tr>
<td>14:40-15:00</td>
<td>Coffee Break</td>
<td></td>
</tr>
<tr>
<td>15:00-16:10</td>
<td>Scientific Session</td>
<td>Chairs: Kushaljit Singh Sodhi (India) / Hamzaini Abdul Hamid (Malaysia)</td>
</tr>
<tr>
<td>15:00-15:10</td>
<td>Quantitatively evaluating fat of progressive muscular dystrophy with mDIXON sequence of MRI in children</td>
<td>Wangjing Bai (West China Second Universal Hospital, China)</td>
</tr>
<tr>
<td>15:10-15:20</td>
<td>Bone marrow and para-spinal muscle fat change in pediatric patients with non-alcoholic fatty liver disease</td>
<td>Salman Albakheet (King Faisal General Hospital, Saudi Arabia)</td>
</tr>
<tr>
<td>15:20-15:30</td>
<td>The quantitative study on value of intrahepatic lipid content in obese children and adolescents by proton magnetic resonance spectroscopy</td>
<td>Xin Wang (Children’s Hospital of Nanjing Medical University, China)</td>
</tr>
<tr>
<td>15:30-15:40</td>
<td>Diagnostic accuracy of lateral abdominal radiographs among pediatric patients in detecting hirschsprung disease</td>
<td>Alexa Edna Mae Jusi (St. Luke’s Medical Center, Philippines)</td>
</tr>
<tr>
<td>15:40-15:50</td>
<td>Ileocolic Intussusception: Demographics and radiological findings associated with patients who failed enema and required surgical reduction</td>
<td>Dhruv Patel (Emory University, USA)</td>
</tr>
<tr>
<td>15:50-16:00</td>
<td>Diagnostic performance of contrast-enhanced ultrasound for acute pyelonephritis in children</td>
<td>Hyun Gi Kim (Eunpyeong St. Mary’s Hospital, The Catholic University of Korea, Korea)</td>
</tr>
<tr>
<td>16:00-16:10</td>
<td>Preparative fasting for contrast-enhanced CT in children: Observational study</td>
<td>Ji Young Ha (Gyeongsang National University Changwon Hospital, Korea)</td>
</tr>
<tr>
<td>16:10-16:20</td>
<td>Break</td>
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</tr>
<tr>
<td>16:20-17:50</td>
<td>RC11. Pediatric MSK Imaging: Must-Knows</td>
<td>Chairs: Choon-Sik Yoon (Korea) / Jeewesh Kapur (Singapore)</td>
</tr>
<tr>
<td>16:20-16:40</td>
<td>Pediatric bone marrow: Normal evolution to pathology</td>
<td>Paul S Babyn (University of Saskatchewan, Canada)</td>
</tr>
<tr>
<td>16:40-17:00</td>
<td>Pediatric hip disorders</td>
<td>Jung-Eun Cheon (Seoul National University Children’s Hospital, Korea)</td>
</tr>
<tr>
<td>17:00-17:20</td>
<td>Imaging of paediatric soft tissue tumour</td>
<td>Hamzaini Abdul Hamid (University Kebangsaan Malaysia Medical Centre, Malaysia)</td>
</tr>
<tr>
<td>17:20-17:40</td>
<td>Advanced MR imaging in pediatric MSK tumors</td>
<td>Hee Kyung Kim (Cincinnati Children’s Hospital Medical Center, USA)</td>
</tr>
<tr>
<td>17:40-17:50</td>
<td>Q &amp; A</td>
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<tr>
<td>18:30</td>
<td>Congress Banquet (King’s Vacation, 31F)</td>
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<tr>
<td>Time</td>
<td>Session</td>
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<tr>
<td>08:00-09:30</td>
<td>RC08. Head and Neck Imaging: Diagnostic Pearls</td>
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<tr>
<td>08:00-08:20</td>
<td>Cranial nerve disease</td>
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<tr>
<td>08:20-08:40</td>
<td>Hearing disorders in children</td>
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<tr>
<td>08:40-09:00</td>
<td>Thyroid disease in children</td>
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<tr>
<td>09:00-09:20</td>
<td>Nontraumatic pediatric head and neck emergencies</td>
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<tr>
<td>09:20-09:30</td>
<td>Q &amp; A</td>
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<tr>
<td>09:30-09:50</td>
<td>Coffee Break</td>
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<tr>
<td>09:50-11:20</td>
<td>MC03. Neuro/Head and Neck Imaging</td>
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<tr>
<td>09:50-10:10</td>
<td>[Keynote] Neurocristopathy</td>
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<tr>
<td>10:10-10:30</td>
<td>Magnetic resonance imaging [MRI] for craniosynostosis, replacing ionising radiation-based computed tomography</td>
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<tr>
<td>10:20-10:30</td>
<td>Atypical and uncommon MR Imaging manifestations of pediatric CNS tuberculosis</td>
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<tr>
<td>10:30-10:40</td>
<td>Multifocal enhancement in fanconi anemia: Manifestation of IRIS and chronic polyoma virus infection?</td>
<td></td>
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<tr>
<td>10:40-10:50</td>
<td>Amide proton transfer-weighted [APTw] imaging of intracranial infection in children: Initial experience and comparison with gadolinium-enhanced T1-weighted imaging and magnetization transfer (MT) imaging</td>
<td></td>
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<tr>
<td>10:50-11:00</td>
<td>MRI and neurosonogram correlation of paediatric brain with dystocia</td>
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<tr>
<td>11:00-11:10</td>
<td>Ectopic intrathyroidal thymus in children: Characteristic sonographic features and long term follow up</td>
<td></td>
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<tr>
<td>11:10-11:20</td>
<td>Sonographic features and pathologic correlation of infectious mononucleosis lymphadenopathy in children</td>
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<tr>
<td>11:20-11:30</td>
<td>Break</td>
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<tr>
<td>12:30-13:30</td>
<td>Luncheon Symposium 4. (Sponsored by Siemens Healthineers)</td>
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<tr>
<td>12:30-12:50</td>
<td>Dual energy clinical application in pediatric imaging</td>
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<tr>
<td>Time</td>
<td>Session</td>
<td>Chairs</td>
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<tr>
<td>13:30-14:40</td>
<td>RC10. Nonaccidental Injury</td>
<td>Chairs: Hee Jung Lee (Korea) / Than Oo (Myanmar)</td>
</tr>
<tr>
<td>13:30-13:50</td>
<td>Abusive head trauma</td>
<td>Nadja Kadom (Emory University and Children’s Healthcare of Atlanta, USA)</td>
</tr>
<tr>
<td>13:50-14:10</td>
<td>Nonaccidental skeletal trauma</td>
<td>Abbey J Winant (Boston Children’s Hospital, Harvard Medical School, USA)</td>
</tr>
<tr>
<td>14:10-14:30</td>
<td>Non-accidental abdominal and chest trauma</td>
<td>Timothy Cain (The Royal Children’s Hospital Melbourne, Australia)</td>
</tr>
<tr>
<td>14:30-14:40</td>
<td>Q &amp; A</td>
<td></td>
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<tr>
<td>14:40-15:00</td>
<td>Coffee Break</td>
<td></td>
</tr>
<tr>
<td>15:00-16:10</td>
<td>MC 05. Informatics and Quality Assessment</td>
<td>Chairs: Jin Seong Lee (Korea) / Sunsuke Nosaka (Japan)</td>
</tr>
<tr>
<td>15:20-15:30</td>
<td>Are academic involvements of radiology trainees in pediatrics enough? Preliminary results of a global perspective</td>
<td>Joanna Marie Choa (St. Luke’s Medical Center Global City, Philippines)</td>
</tr>
<tr>
<td>15:30-15:40</td>
<td>Evaluation of dose reduction by using digital radiography system</td>
<td>Saelin Oh (Korea University Anam Hospital, Korea)</td>
</tr>
<tr>
<td>15:40-15:50</td>
<td>Development of quality-controlled low dose protocols for X-ray examination in NICU using a new mobile digital radiography system</td>
<td>Gayoung Choi (Seoul National University Children’s Hospital, Korea)</td>
</tr>
<tr>
<td>15:50-16:00</td>
<td>The evaluation of a deep learning bone age model in Chinese children based on GP atlas and three different training data</td>
<td>Mei Bai (Children’s Hospital of Fudan University, China)</td>
</tr>
<tr>
<td>16:00-16:10</td>
<td>Automated detection of developmental dysplasia of the hip (DDH) on conventional radiography, using a convolutional neural network(CNN)-based deep learning algorithm</td>
<td>Yeon Jin Cho (Seoul National University Children’s Hospital, Korea)</td>
</tr>
<tr>
<td>16:20-17:50</td>
<td>Special Focus Session 02 Good Clinical Practice in Pediatric Radiology</td>
<td>Chairs: Lane F Donnelly (USA) / Manisha Jana (India)</td>
</tr>
<tr>
<td>16:20-16:40</td>
<td>The image gently alliance: Informed radiation use in children</td>
<td>Donald P Frush (Stanford School of Medicine/Lucile Packard Children’s Hospital, USA)</td>
</tr>
<tr>
<td>16:40-17:00</td>
<td>ICRP publication 135, DRLS in medical imaging: How it helps US image gently</td>
<td>Kimberly E Applegate (University of Kentucky School of Medicine, USA)</td>
</tr>
<tr>
<td>17:00-17:20</td>
<td>Safety issues in pediatric intravenous contrast agent use</td>
<td>Young Hun Choi (Seoul National University Children’s Hospital, Korea)</td>
</tr>
<tr>
<td>17:20-17:40</td>
<td>Strategies to minimize sedation in pediatric body MRI</td>
<td>Rajesh Krishnamurthy (Nationwide Children’s Hospital, Ohio State University, USA)</td>
</tr>
<tr>
<td>17:40-17:50</td>
<td>Q &amp; A</td>
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<tr>
<td>18:30</td>
<td>Congress Banquet (King’s Vacation, 31F)</td>
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### Day 3  September 28, 2019

#### Room A

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Chairs</th>
<th>Speakers</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:00-09:30 (90’)</td>
<td>RC12. Meet the Expert: How to Read It!</td>
<td>Chairs: David Stringer (Singapore) / Peng Yun (China)</td>
<td>[Pilar Garcia-Peña](Maternal and Child University Hospital of Vall D’Hebron, Spain)</td>
</tr>
<tr>
<td>08:00-08:20</td>
<td>How to read a chest radiography in children</td>
<td></td>
<td>[Lane F Donnelly](Stanford University School of Medicine, USA)</td>
</tr>
<tr>
<td>08:20-08:40</td>
<td>How to read an abdominal radiographs in children</td>
<td></td>
<td>[Paul S Babyn](University of Saskatchewan, Canada)</td>
</tr>
<tr>
<td>08:40-09:00</td>
<td>Radiography of pediatric skeletal trauma: Pearls and pitfalls</td>
<td></td>
<td>[Hee Kyung Kim](Cincinnati Children’s Hospital Medical Center, USA)</td>
</tr>
<tr>
<td>09:00-09:20</td>
<td>Radiography of pediatric bone tumors</td>
<td></td>
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<tr>
<td>09:20-09:30</td>
<td>Q &amp; A</td>
<td></td>
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<tr>
<td>09:30-09:50</td>
<td>Coffee Break</td>
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<tr>
<td>09:50-11:20 (90’)</td>
<td>RC14. Neonatal Imaging: Must-Knows</td>
<td>Chairs: Kwanseop Lee (Korea) / Dorothy Bulas (USA)</td>
<td>[Mark C Liszewski](Montefiore Medical Center and Albert Einstein College of Medicine, USA)</td>
</tr>
<tr>
<td>09:50-10:10</td>
<td>Neonatal lung disease: Up-to-date approach to imaging and diagnosis</td>
<td></td>
<td>[Preeyacha Pacharn](Siriraj Hospital, Mahidol University, Thailand)</td>
</tr>
<tr>
<td>10:10-10:30</td>
<td>Imaging of neonatal obstruction</td>
<td></td>
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<tr>
<td>10:30-10:50</td>
<td>Ultrasound imaging of necrotizing enterocolitis</td>
<td></td>
<td>[Monica Epelman](University of Central Florida, Nemours Children’s Hospital, USA)</td>
</tr>
<tr>
<td>10:50-11:10</td>
<td>Easily missed sonographic findings in head ultrasound in neonatal encephalopathy</td>
<td></td>
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<tr>
<td>11:10-11:20</td>
<td>Q &amp; A</td>
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<tr>
<td>11:20-11:30</td>
<td>Break</td>
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<tr>
<td>11:30-12:00 (30’)</td>
<td>Closing Ceremony</td>
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<tr>
<td>12:30-17:10</td>
<td>KSPR Categorical Course Pediatric Chest (Korean)</td>
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</table>
## Scientific Program

### Room B

<table>
<thead>
<tr>
<th>Time</th>
<th>Session Title</th>
<th>Chairs</th>
<th>Presenters</th>
</tr>
</thead>
</table>
| 08:00-09:30   | RC13. Recent Issues in Pediatric Vascular Imaging and Treatment             | Chairs: James Donaldson (USA) / Supika Kritsaneepaiboon (Thailand)     | Rajesh Krishnamurthy (Nationwide Children’s Hospital, Ohio State University, USA)  
08:00-08:20    | Imaging of vascular anomalies in children: State of the art                |                                                                        | Saebeom Hur (Seoul National University, Korea)  
10:50-11:01   | The Future of Pediatric Imaging and WFIP Outreach                            | Chairs: Donald P Frush (USA) / Bernard F Laya (Philippines)            | Taylor Chung (UCSF Benioff Children’s Hospital, USA)  
08:20-08:40    | New endovascular therapy for various lymphatic leakage                      |                                                                        | Marielle V Fortier (KK Women’s and Children’s Hospital, Singapore)  
08:40-09:00    | Complication of liver transplantation: Imaging and treatment                |                                                                        | Shunsuke Nosaka (National Center for Child Health and Development, Japan)  
09:00-09:20    | Congenital portosystemic shunt: What radiologists should know              |                                                                        |  
09:20-09:30    | Q & A                                                                        |                                                                        |  
09:30-09:50    | Coffee Break                                                                |                                                                        |  
09:50-11:20   | SF03. The Future of Pediatric Imaging and WFIP Outreach                      | Chairs: Donald P Frush (USA) / Bernard F Laya (Philippines)            |  
09:50-10:10    | The advance in technology for the future of pediatric radiology            |                                                                        |  
10:10-10:30    | Peer learning systems in radiology                                          |                                                                        |  
10:30-10:50    | Reducing radiation exposures in children: The way forwards                  |                                                                        |  
10:50-11:10    | World Federation of Pediatric Imaging                                       |                                                                        |  
11:10-11:30    | Future of pediatric imaging and WFIP outreach                                |                                                                        |  
14:00-16:20   | Regional Contrast Management Expert Meeting                                 | Moderators: In-One Kim (Korea) / Noriko Aida (Japan)                  |  
14:00-14:10    | Welcome & Opening                                                            |                                                                        |  
14:10-14:30    | Safe use of iodinated contrast media in CECT and way to reduce radiation dose | Atsuko Fujikawa (St. Marianna University School of Medicine, Japan) |  
14:30-15:00    | Panel Discussion                                                             | Bernard Lay, Utami Purbasar, Tatsuo Kono, Akari Makidono, Khin Wai Zin, Young Hun Choi |  
15:00-15:20    | Break                                                                       |                                                                        |  
15:20-15:40    | Gadolinium deposition in the pediatric brain                                | Young Jin Ryu (Seoul National University Bundang Hospital, Korea)      |  
15:40-16:10    | Panel Discussion                                                             | Hamzaini Abdul Hamid, Osamu Miyazaki, Eriko Maeda, Yutaka Sato, Jae-Youn Hwang |  
16:10-16:20    | Closing                                                                     |                                                                        |  

**Panelists**  
Korea: Young Hun Choi, Jae-Youn Hwang  
Japan: Shunsuke Nosaka, Osamu Miyazaki, Tatsuo Kono, Akari Makidono, Eriko Maeda  
USA: Yutaka Sato  
Malaysia: Hamzaini Abdul Hamid  
Philippines: Bernard Lay  
Indonesia: Utami Purbasari  
Myanmar: Khin Wai Zin
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Day 2 - September 27, 2019

11:30-12:20 (50') / Room A

Plenary Lecture

Chair:
Taylor Chung (USA)
Adapting to the Challenging Environment in Pediatric Cardiac Imaging

Shi-Joon Yoo1, Taylor Chung2, Rajesh Kristinamurthy3, Cynthia Rigsby4, Lorna Browne5, Gordon Culham6

1Hospital for Sick Children, University of Toronto, Canada, 2UCSF Benioff Children’s Hospital, USA, 3Nationwide Children’s Hospital, Ohio, USA 4Ann & Robert H. Lurie Children’s Hospital of Chicago, USA, 5Children’s Hospital Colorado Anschutz Medical Campus, USA, 6BC Children’s Hospital, Vancouver, Canada

Cardiac imaging is the most contentious subspecialty in medical imaging where turf battles between radiologists and cardiologists have been widespread throughout the world since its introduction. The background reasons for the turf battles include the genuine nature of cardiac imaging that consists of anatomical, functional and hemodynamic components, the historic ownership of the imaging modalities, the difference in knowledge, academic interests and skills between radiologists and cardiologists, the level of importance of the imaging modality at stake in the specialty area, the referral pattern, the financial productivity, and the available manpower supply. From the management perspective of imaging, cardiac imaging has been confronted with a few major drawbacks including ultrasound as the primary imaging modality mostly not being performed by radiologists, requirement for relatively expensive equipment, long time for examination, post-processing and reporting, frequent requirement for sedation or general anesthesia, and a low rate of reimbursement for the cost of service, which leaves cardiac imaging not as lucrative as other imaging subspecialties. Therefore, cardiac radiologists have long been exposed to dual challenges: increasing interest of clinicians to perform MR and CT on the one hand, and insufficient timely recognition and support for cardiac imaging service from their own department on the other hand. This presentation is to review the past, to identify the current challenging issues and to suggest future directions.

The Past and Now: Cardiac radiologists had made significant contribution in developing and adopting the new imaging modalities. However, the paradigm had gradually been shifted from radiology domain to cardiology domain for the major imaging modalities of the era including x-ray angiography, ultrasound and MRI, and most recently similar change has begun for CT angiography. There has been a rapidly increasing number of scientific papers on outcome assessment using image data as well as imaging itself that are predominantly published by cardiologists’ leadership. The regretful issues of the past include: 1) lost timing for early adoption of the developing technologies at the departmental and societal level, 2) lack of acknowledgement of the labor-intensive nature of cardiac imaging and improper or failed recognition of the cost in the reimbursement plans, 3) insufficient manpower pool for cardiac imaging, 4) insufficient efforts in adapting the changing roles and concept of modern imaging that allows not only anatomical but also functional and hemodynamic assessment, 4) outdated teaching curriculum and evaluation of radiology trainees, and 5) limited ability and initiative of the radiologists in using imaging findings for assessment of the patients outcomes.

The Future: Further paradigm changes are expected due to new technologic development including fast imaging, 4D acquisition, new contrast agents, virtual or augmented reality and 3D printing, growing effect of artificial intelligence in imaging, image interpretation and outcome assessment, and increasing number of cardiologists majoring non-invasive
imaging. The suggested proactive plans should include: 1) timely adoption of the newly developing technologies and concepts not only at the individual radiologists level but also at the departmental and scientific society levels, 2) preemptive firm assignment of the roles to individual radiologists with strong departmental support, 3) active engagement of radiologists in assessment of cardiovascular function and hemodynamics and patients outcome studies, 4) close interaction of radiologists with cardiologists and cardiac surgeons for patient management and research, 5) continuous adaptation to changing technical, academic, economical and societal environment, 6) proactive allocation of departmental budget to the contentious field of imaging, and, most importantly, 7) structured training of all general as well as pediatric radiology trainees with modernized curriculum for competent practice of cardiac imaging. Finally, practicing radiologists including trainees need to familiarize themselves with the patients’ treatment principles and outcomes as well as echocardiograms and angiocardiograms. Cardiac imaging leadership should be shared between radiologists and cardiologists with mutual respect for each other’s expertise in order to optimize patient care and experience. The highly subspecialized centers with established programs need to provide training opportunities and ongoing support. Support may consist of imaging protocols as well as help with study design, and interpretation. The radiologist in a smaller program needs a network of support. This must be available on a daily basis, not an annual update.

In the last few years, there has been a sharp increase in cardiac CT scans throughout the world owing to very low radiation dose and exceptionally high spatial resolution that the modern CT scanners provide. With rapid increase in the number of cardiac CT scans, we will see cardiac imaging financially more sustainable than before. Timely implementation of the plan to secure enough number of competent radiologists is crucially important. As the golden opportunity will never stay long, it is time for us to react.

Although this presentation is focused on pediatric cardiac imaging, similar issues may or will also apply to other specialties.
Day 1 - September 26, 2019
08:30-10:00 (90') / Room A

RC01. Practical Pearls of Chest Imaging

Chairs:
Young Ah Cho (Korea),
Nathan David P Concepcion (Philippines)
In pediatric emergency room, the chest is the most frequently imaged part of the entire body. This presentation focuses on overview of chest imaging in pediatric emergency room. Up-to-date imaging technique, interpretative approach, and commonly encountered clinically important pediatric chest disorders are discussed. The characteristic radiologic features of common pediatric chest emergencies including large airway disorders, vascular abnormalities, and lung parenchymal abnormalities are highlighted. Practical tips on navigating technical and interpretative pitfalls that occur in chest imaging in pediatric emergency room are discussed. In addition, specific clinical and radiologic differentiating features in disorders that can present with similar imaging findings are also provided. Radiologists with up-to-date knowledge of the imaging work-up, imaging protocols, and imaging appearance of pediatric thoracic emergencies can greatly expedite initial diagnosis and follow-up assessment leading to optimal pediatric patient management.
Imaging of the Chest Wall

Bernard F Laya

Department of Pediatric Radiology, St. Luke’s Medical Center, Philippines

The Chest wall protects and encases the vital structures within the thoracic cavity. The various layers of the chest wall consist of the skin, subcutaneous fat, muscle, bone, cartilage and pleura and abnormalities may arise from any of these layers. In children, abnormal conditions that may arise in the chest wall include congenital anomalies, infections, traumatic lesions, benign or malignant tumors, and vascular malformations. Imaging plays a critical role in accurate detection and characterization of these lesions to aid in prompt and appropriate patient management. The overarching goals of this presentation are: a) To briefly present the normal radiologic anatomy of the chest wall, b) Discuss the various imaging techniques for the evaluation of pediatric chest wall, and c) Discuss more common abnormalities chest wall abnormalities in children with emphasis on typical imaging manifestations.
Diffuse interstitial lung disease (DILD) in children differs significantly from interstitial lung disease in adults. The childhood interstitial lung disease (ChILD) classification of 2010 divides these conditions into those more prevalent in infancy and those not specific to infancy, the latter group containing many conditions related to systemic diseases (including connective tissue diseases and depositional / storage disorders) and conditions related to immunocompromise.

In this lecture we will review a classification of ChILD, and some of the radiological appearances of a selection of childhood interstitial lung diseases, illustrated with cases from our institution, in particular the more recently recognised conditions pleuroparenchymal fibroelastosis and filamin A deficiency related lung disease.

Diffuse interstitial lung disease (DILD) represents a heterogeneous group of disorders characterised by restrictive lung function and impaired gas exchange. As these diseases occur on a background of the developing lungs and immune system, the clinical presentation and disease progression is modified by comparison with the adult equivalents. Thus, DILD often differs markedly in presentation, clinical features, and progress from interstitial lung disease (ILD) in adults, and it is not safe to extrapolate from adults to children. It is important to understand the normal growth and development of the lungs in children so as to understand the development of ILD.

We will also address new developments within artificial intelligence which are occurring within adult ILD imaging as the information age has brought about a paradigm shift in humanity’s analytic capabilities, enabling unrivalled predictive powers constructed upon previously unexploited and insurmountable data-sets. The initial potential has been realised in trading markets, creating an industry behind artificial intelligence with the specialised skill requirements in high demand, but is far from a new science. In 1959 an algorithm to play checkers was developed, based on moves made by a human player, coining the term ‘machine learning;’ a method that derives from data, rather than through explicit programming. This has given mankind a quantifiable tool to utilise history, the ability to learn from all previous scenarios and estimate new outcomes. Last year Google created AlphaGo AI, Go - a game far more complex than checkers. Here the machine learnt from moves that it created, (ie ability to learn from scenarios that have never happened). It outperformed all previous algorithms as it was devoid of any bias or preconception of what decisions to make, surpassing the biggest weakness in most data-sets, us. Herein lies the biggest limitation surrounding machine learning, it learns from both the trend and any prejudice within the data. It is not a solution to be used irrespective of the problem context, no ghost from the machine.

Despite the name, it is very difficult and often impractical to extract the learning from the “black box” process, leaving the user at the mercy of the result. This is why the dataset needs to be understood and trusted to represent the population being simulated. This issue is compounded in the subset of machine learning called deep learning, where the iterative process...
is obfuscated between multiple layers, designed to replicate the brains operation, called a neural network. This method is particularly useful for cases when the inputs and areas of interest are vast and variable, such as in radiology. With a proper understanding of the limitations and pitfalls there are a number of medical areas which benefit substantially, including ROI notification, priority ordering, risk assessment radiomics, and survivability.

The impact of these applications will only be fully realised if implemented as tools to enhance diagnosis and education, and not as a solution to efficiency in a health service with dwindling human resources.
US plays a major role in the diagnosis, follow up and management of thoracic diseases in pediatric age group. It is readily available, and usually the first and maybe the only investigation required for assessment of thoracic and lung pathology. It is able to easily distinguish lung collapse from lung consolidation, simple effusion from empyema and can assess peripherally placed mediastinal and thoracic masses. It is an indispensable tool for early assessment of thoracic and diaphragmatic disorders and should always be considered prior to performing a CT study in children.
RC02. Update in Pediatric Neuroimagng: Current and on the Horizon

Chairs:
Korgun Koral (USA),
Hyun Sook Hong (Korea)
Perinatal brain injury is still a major clinical problem leading to a widespread spectrum of functional and behavioral disorders. Perinatal hypoxia-ischemia is the single most important cause of brain injury. Patterns of injury depend on the brain maturity, severity of hypotension, and duration of insult. In mild to moderate hypoperfusion, redistribution of cerebral blood flow ensures perfusion to the metabolically active gray matter structures (immature brain: deep gray matter, esp. thalami & brainstem; term infants: lateral thalami, globus pallidus, posterior putamina, hippocampi, brainstem, and sensorimotor cortex) and results in watershed infarct. In severe hypoperfusion, vulnerable regions such as deep gray matter, myelinated fibers with high neurotransmitter receptors are involved.

Injury in the preterm infants causes long term consequences of educational difficulties, epileptic seizure, visual damage and reduction of IQ, and the biggest problem is the damage to white matter causing PVL, diffuse astrogliosis, loss of myelin-producing oligodendrocyte. Numerous reactive microglia is present in the early stage of injury and reactive astrocytes come in the late stage as gliosis. Major mechanisms of the injury are hypoxic ischemia, glutamate-induced injury, reactive oxygen species (ROS) and reactive nitrogen species (RNS), infection/inflammation, and hemorrhage as GMH. Pathologically, acute neuronal damage will be reflected as gradual developing chronic brain damage. Most severe form is PVL and 1/3 of PVL are associated with neuronal loss and gliosis in BG, cerebellar dentate nucleus, and thalamus. Majority is diffuse periventricular white matter cellular loss without cystic change and diffuse necrosis accompanied by activated microglia and reactive astrocytes. Premyelinating oligodendrocytes (Pre-ODC: degenerating cells in diffuse periventricular white matter injury) are reduced and more resistant microglia, astrocyte, axon remain. Milder forms of injury rather than PVL are initiated through targeted injury to OL lineage with reactive sparing of other glial and axonal elements. Developmental window of highest risk for PWMI ranges 23-32 weeks corresponding with premyelinating ODC suggesting susceptible ODC progenitor (cellular maturation factor) to be more tributable rather than hypoperfusion. Gray matter injury is also a critical component of preterm and term injury.

MR features of HIE in the prematurity are GMH/IVH, Periventricular leukomalacia (focal cystic PVL vs. non-cystic PVL), Neuronal/axonal injury in the thalami, brainstem, and cerebellum (high metabolic activity in the immature brain).

Constellation of PVL and neuronal/axonal disease affecting the cerebral white matter, thalamus, basal ganglia, cerebral cortex, brain stem, and cerebellum is sufficiently distinctive to be termed as encephalopathy of prematurity.

Encephalopathy of Prematurity

In-One Kim

Department of Radiology, Seoul National University Children's Hospital, Korea
Treatment outcome of pediatric malignancies have improved significantly over the past decades but survivors face long term morbidities including neurocognitive impairments. The contribution to these neurocognitive changes are multifactorial and include use of radiation, and it is manifested by MRI primarily in the white matter.

Diffusion tensor MR imaging (DTI) is based on the diffusion of water molecules in the brain, and advantageous for evaluating white matter pathology as the diffusion process in white matter is highly directional (anisotropic) due to axonal fibers running in parallel. We evaluated its novel role as a marker for treatment-induced neurotoxicity in childhood cancer (medulloblastoma and acute lymphoblastic leukemia) survivors, and then performed translational studies using a rat model of radiation-induced white matter injury to elucidate the histological correlates of the diffusion tensor indices. We found DTI indices to be associated with known neurotoxicity risk factors (dose intensity of radiation, younger age at treatment, time period after treatment) and neurocognitive scores in children. In translational studies, the longitudinal changes of DTI indices reflected the histopathological changes of myelination, axonal damage, astrogliosis and necrosis. Changes in axial diffusivity correlated with reactive astrogliosis and radial diffusivity correlated with demyelination. Higher radiation dose induced earlier and more severe histological changes than lower radiation dose, and these differences were reflected by the magnitude of changes in axial and radial diffusivity.

These findings, especially that radial diffusivity reflects demyelination is corroborated by other published studies. Hence, our results support the use of DTI to probe white matter microstructure, and as a biomarker to monitor radiation-induced white matter damage.

However, whilst quantitative metrics of DTI are promising as biomarkers, it’s routine use in daily clinical practice is limited by high variability and lack of protocol standardization. Hence to bridge the translational gap and to impact clinical practice, further work to improve accuracy, evaluate reproducibility, promote standardization and implementation into the clinical workflow are necessary.

References:


The encephalopathy refers global brain dysfunction caused by widely different disorders. Affected patients usually present with seizures, impaired consciousness, and other neurological symptoms. Causes of the pediatric encephalopathy are diverse including hypoxic/ischemic insult, vascular stroke, infection & parainfectious disorders, metabolic & toxic insult, autoimmune disorders, trauma, sudden hypertension, tumors, and seizures. Although childhood encephalopathy is uncommon, it is associated with significant mortality and morbidity in survivors. Early diagnosis of the treatable causes, and appropriate and timely management can minimize further neurological impairment. The clinical presentation of the encephalopathy is often a pediatric emergency with a considerable challenge in diagnosis, and neuroimaging should assist in assessment of the brain lesions in the critical settings. In this talk, I would like to share my experiences of diverse disorders caused childhood encephalopathy, including cases with typical or atypical manifestations, diagnostic difficulty, or recently described disorders, with brief review of pathophysiology and neuroimaging findings, and a few "pearls and pitfalls."
Neuroimaging plays a central role in the diagnosis and offers important information in terms of emergent care of infants and children who have acute neurological diseases under critical care. As the imaging technique continues to improve, the imaging strategies including what modality is chosen and which technique is best applied subject to change with time. This lecture intends to provide neurological intensivists an updated review of diagnostic imaging procedures and typical imaging findings that are related to acute care of small children and young adults.

Beginning in the lecture, a repertoire of consideration in imaging diagnostic procedure such as preparation of neonates for imaging, transfer, sedation, and monitoring. There are pitfalls in imaging findings that are produced by sedated drug such as propofol or supplemental oxygen. A common routine used MR sequence, T2 FLAIR, can reveal artefactual cerebral sulcal high signals which can mimic meningitis or cortical edema. On the other hand, ultrasound in the intensive care unit requires sophisticated operator-dependent technique and is the first line imaging tool in the premature neonate and young infants up to 44 weeks of age. It is particularly important in assessing hypoxic ischemic injury since it is often unclear in clinical presentation. CT, due to its inherent radiation exposure, is limited in intracranial hemorrhage, ventricular dilatation, and, in some instance, calcification detection. MRI is important in surrogating neonatal encephalopathy since it is more often due to prenatal causes such as inborn errors of metabolism, cerebral dysgenesis, or intrauterine infection which often cannot be elucidated by ultrasound or CT.

In this review, a spectrum of acute encephalopathy including coma (acute collapse), status epilepticus, infection, hypoxic ischemic encephalopathy, stroke, and trauma will be introduced by their typical imaging features. The goal is to identify the life threatening but reversible causes to improve patients’ outcome.
Day 1 - September 26, 2019

10:20-11:50 (90’) / Room A

RC03. Oncology Imaging: Body

Chairs:
Gye Yeon Lim (Korea),
Zaleha Abd Manaf (Malaysia)
Hepatoblastoma is the second most common solid tumor in the pediatric population. Since the establishment of the Pretreatment Extent of Tumor (PRETEXT) staging system by SIOPEL for radiological evaluation, various oncology groups globally have used the PRETEXT system for staging malignant liver tumors of childhood over the last 25 years. This system is based on the presence of tumors in four anatomical segments (as in the Couinaud classification; left lateral [S2, S3], left medial [S4], right anterior [S5, S8], and right posterior [S6, S7]). The PRETEXT staging system was established from a surgical viewpoint (i.e., whether the tumor can be resected).

In the last decade, SIOPEL, Children’s Oncology Group (COG), and Japan Children’s Cancer Group (JCCG) conducted trials evaluating children with hepatoblastoma, and all the trials used the same PRETEXT staging system. Since 2011, SIOPEL, COG, and JCCG have been working toward creating a common international study of pediatric hepatoblastoma, and the new Pediatric Hepatic International Tumor Trial (PHITT) has been established. Recently, Alex Towbin et al. published PRETEXT 2017, which is a new set of diagnostic criteria within the PHITT protocol, including the following new rules for portal and hepatic vein involvement, lung metastasis, and other five annotation factors.

This lecture will introduce the new PRETEXT 2017 staging system and elucidate its differences from the previous PRETEXT 2005 staging system as follows:

**<Comparison of PRETEXT 2005 and 2017>**

i) PRETEXT staging system I, II, III, and IV: No change in the basic concept

ii) Annotation criteria:

<table>
<thead>
<tr>
<th>Distant metastasis in PRETEXT 2017 New Rule</th>
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<tr>
<td>One nodule with a diameter greater than (one lesion)</td>
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<tr>
<td>Two or more nodule with a diameter greater than</td>
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Osamu Miyazaki
Department of Radiology, National Center for Child Health and Development, Japan
Comparing guidelines

PRETEXT 2017
Extent of hepatic venous involvement
- Right hepatic vein
- Middle hepatic vein
- Left hepatic vein
- Intrahepatic IVC

Tumor obliterating vein(s) or encasing >50% or 180°
Intravascular tumor thrombus
Thrombus seen in only one hepatic vein

PRETEXT 2005
V3: Involvement of all three hepatic veins and/or the IVC
No rule for obliteration (>50% or 180°) of the IVC

Comparing guidelines

PRETEXT 2017
Extent of portal venous involvement
- Right portal vein
- Left portal veins
- Main portal vein

Tumor obliterating vein(s) or encasing >50% or 180°
Intravascular tumor thrombus
Thrombus seen in only one portal vein

PRETEXT 2005
P-positive: involvement of the main portal vein, its bifurcation, or both of its main branches
Learning objectives:
1. Discuss Wilms tumor:
   a. Clinical presentation
   b. Pathology and imaging characteristics
   c. Treatment and Prognosis

2. Review differential diagnosis of Wilms tumor including:
   a. Mesoblastic nephroma
   b. Clear cell sarcoma
   c. Rhabdoid tumor
   d. Renal cell carcinoma
   e. Medullary carcinoma

Wilms tumor

Clinical considerations
With neuroblastoma, the most common solid tumors in children
90% of all pediatric renal tumors; 500/year in the USA; peak age 2-3; most less than 5 years
Frequently asymptomatic with palpated mass
10% predisposing genetic condition, usually WT1 or WT2 gene deletion/mutation

Pathology and Imaging
Solitary renal mass with heterogeneous appearance; may have calcifications
Anaplastic pathology (10% of WT); worse prognosis
May invade renal vein, IVC, right atrium
Lung metastases frequent (85%); liver (20%); others – rare
Bilateral disease 5% of non-syndromic; 38% syndromic
Treatment and Prognosis

Differences worldwide

USA (NWTSG/COG) – surgery, followed by chemotherapy + radiation therapy
Europe (SIOP) – preoperative chemotherapy, then surgery

Overall 5-year survival now above 90% for abdominal disease; 70% Stage IV
Long-term risks: secondary malignancy, chemotherapy-induced heart failure, renal failure, respiratory failure from radiation therapy, hypertension

Mesoblastic nephroma

Clinical considerations

Rare; 3-6% of renal tumors; most common neonatal renal neoplasm; most by 1 year
Asymptomatic mass is usual presentation

Pathology and Imaging

Two subtypes: classic and cellular; up to 20% mixed
Classic: homogeneous solid mass often involving hilum, but no vein invasion
Cellular: heterogeneous with solid and cystic components
Genetically identical to infantile fibrosarcoma

Treatment and Prognosis

Surgery is mainstay; historically “benign” but has variable biology
5-10% develop recurrence or metastases – most always the cellular form

Clear cell sarcoma

Clinical considerations

Rare; 4-5% renal tumors; 2nd most common malignancy after Wilms tumor in young children
Asymptomatic mass

Pathology and Imaging

Many pathologic subtypes; variable appearance – solid with cystic areas most common
Rare venous involvement
Metastases: lymph nodes and bone most frequent

Treatment and Prognosis

Surgery with chemo- and radiation therapy
5-year survival worse than Wilms tumor, but can reach 80%
Rhabdoid tumor

Clinical considerations
Rare, aggressive tumor; < 2% of tumors; 80% less than 2 years old
15% have synchronous brain tumors (PNET, ATRT, medulloblastoma, ependymoma, etc.)

Pathology and Imaging
Solid tumor, identical to Wilms tumor, but may have subcapsular collection
80% have aggressive disease at presentation; metastases – lung, brain, bone

Treatment and Prognosis
Surgery and chemotherapy; poor prognosis (20% survival)

Renal Cell Carcinoma (RCC)

Clinical considerations
2nd most common renal malignancy in children overall; most common in 2nd decade

Pathology and Imaging
Not adult clear cell RCC – mostly translocation, papillary, and medullary types
Heterogeneous appearance based on type; frequent lymph node involvement

Treatment and Prognosis
Surgery; chemotherapy and radiation not as effective
Overall prognosis depends on stage (low stage 90%; stage 4 - 15% at 5 years)

Medullary Carcinoma

Clinical considerations
Sickle cell trait or heterozygous sickle cell disease
Aggressive tumor with broad age range (5 years to 40 years)

Pathology and Imaging
Central infiltrative mass, expanding kidney; heterogeneous with necrosis
May have caliectasis

Treatment and Prognosis
Surgery; chemo and radiation therapy of limited benefit
Mean survival 4 months
Neuroblastoma which arises from the primitive neural crests, is the most common extracranial solid tumor in infants and children (the median age 22 months), representing approximately 8% of all cases of childhood cancer and about 15% of all cancer deaths in children. Up to 70% of the patients initially have metastatic diseases, the common sites including bones, marrow, lymph nodes and liver. The most common site of neuroblastoma is the adrenal gland (48%), followed by the retroperitoneum (25%), chest (16%), neck (3%), and pelvis (3%).

Imaging plays a crucial role in assessment of localization and extent of tumor, staging, surgical planning, monitoring during treatment, follow-up of residue and detection of relapse. Ultrasound and radiograph are often the first imaging tools performed in the setting of a palpable mass, or for quick screening of the abdomen. Imaging workup and follow-up modalities depend on not only the primary site of the tumor but also clinician's preference and the institutional availability. CT may be preferred for the suprarenal neuroblastoma to evaluate the vascular encasement, while tumors in the paravertebral area can be preferred by MRI to assess the intraspinal extension.

With uncommon primary site lesions or initial extra-abdominal clinical presentation due to metastasis, imaging can be very challenging especially to the radiologists who are not familiar with this tumor. As the most common metastatic sites are the bones and marrow, children may initially present with variable musculoskeletal symptoms such as bone pain, limping or irritability. In infants, patients also can present with subcutaneous nodules, or hepatomegaly by disseminated liver metastasis.

Among the well-known prognostic factors including age, stage, MYCN amplification, DNA ploidy, chromosomal aberration and histologic grade of tumor differentiation, the clinical stage is the most significant factor and, therefore, proper staging is very important. International Neuroblastoma Staging System (INSS) based on surgical and pathological findings has been traditionally used for staging of neuroblastoma since 1988. As this staging system relies on surgical resection which can vary among surgeons, there are difficulties in pretreatment risk assessment of localized disease and comparisons across clinical trials. In 2009, the International Neuroblastoma Risk Group (INRG) created a new staging system that relies on preoperative imaging for staging. The INRG staging system consists of 20 image-defined risk factors (IDRF) across multiple organ systems which determine factors between L1 (localised tumor not involving vital structures and confined to one body compartment) and L2 (local-regional tumor with one or more image-defined risk factors) stages to help predict surgical outcomes/adequacy of resection. The IDRFs vary depending on the primary tumor location; nevertheless, encasement of large vessels, intraspinal extension, airway compression, contiguous organ infiltration, and involvement of the multibody compartment are the main
criteria that should be evaluated by CT or MRI for the surgical planning.

In this lecture, imaging pearls including imaging strategies and IDRFs are discussed along with challenging pitfalls which can be encountered in imaging of neuroblastoma.

**Suggested readings**

Learning Objectives

• Understand the role of imaging modalities in oncology
• Understand the differences between anatomic and metabolic imaging
• Understand the increasing importance of personalised medicine in oncology

There have been significant improvements in the outcome of treatment for, particularly for children. Imaging plays an important role in the diagnosis, treatment, and long term follow-up of patients diagnosed with malignancy. It is important that radiologists have an understanding of their role in patient management. Chemotherapy, radiotherapy and/or surgical treatment regimens are influenced by indicators of response to treatment.

Staging at diagnosis provides a baseline by which a change in tumour size or imaging characteristics can be measured. Imaging modalities have traditionally given information about what a tumour ‘looks like’ with size being an important criteria in tumour assessment. A tumour can be measured in one, two or three dimensions, and it is important to be consistent in selecting the planes for measurement; over or underestimates of surface area or volume can be made if orthogonal measurements are not selected. This is one of the reasons that maximum diameter of a lesion is often a useful parameter to report, and that two dimension in one plane can be more accurate than a volume estimation in an irregular shaped tumour. Slice by slice measurement of a tumour volume is a more accurate method of volume estimation, but this becomes more complicated when there are multiple lesions. Representative target or index lesions may be selected for monitoring when there are multiple lesions.

As a general rule, tumour response should result in reduction in size of a lesion. However, some lesions will show a paradoxical transient increase in size due to inflammation associated with successful treatment. Others will have a significant response to treatment with tumour necrosis, but little change in size. CT or MRI contrast enhancement patterns and MR diffusion restriction can identify a change in tumour characteristics that suggest tumour response to treatment even when there is no significant change in size.

Metabolic imaging is now an important modality in paediatric oncology. For many tumours, the earliest indicator of a response to treatment is a change in their metabolic activity. This can be measured using a generic agent such as 18 F-Fluro-Deoxy-Glucose or with a more specific receptor targeted radiopharmaceutical.
Response to treatment is now frequently classified as complete response, partial response, stable disease or progressive disease, often with reference to metabolic and anatomical parameters. The radiologist’s role is becoming more complex as we learn more about the genetic and phenotypic behaviour of tumours, and seek to improve treatment outcomes. Different tumours have different key assessment parameters that the radiologist must be able to identify to provide clinicians with the required information.
Day 1 - September 26, 2019

10:20-11:50 (90') / Room B

RC04. Congenital CNS Abnormalities Made Easy

Chairs:
Blaise V Jones (USA),
Adji Saptogino (Indonesia)
Corpus Callosal Anomalies

Ajay Taranath

Women's and Children's Hospital in Adelaide, Australia

Commissures are tracts that connect homologous structures on either sides in the central nervous system. There are three commissures in placental mammals – namely the anterior commissure, the hippocampal commissure and the corpus callosum. The anterior and hippocampal commissures cross in the inferior and superior parts of the lamina reuniens, which is the point where the hemispheres are contiguous with each other. Specialized glial structures help the corpus callosal fibres cross the midline at the cortico-septal boundary.

Anomalies of the corpus callosum can be identified on MRI studies and they range from agenesis to dysgeneses. The MRI needs to be thoroughly evaluated for the presence or absence of associated anomalies.
Cortical Malformation of the Brain: Imaging and Topics

Noriko Aida

Department of Radiology, Kanagawa Children’s Medical Center and Yokohama City University, Japan

Learning objectives
1. To learn recent and new classifications of cortical malformations.
2. To become familiar with imaging findings and causal genes of lissencephalies.
3. To learn about tubulinopathies.

Summary
Classification of cortical malformation of the brain has been changing in the recent decades. In this lecture, topics of recent classification scheme, causal genes and relative new disease entity, tubulinopathies, will be introduced particularly focusing lissencephalies (classical lissencephaly and so-called cobblestone lissencephaly).

References
Posterior Fossa Malformation

Ah Young Jung
Department of Radiology, Asan Medical Center, University of Ulsan, Korea

Posterior fossa malformations are more frequently encountered in pediatric neuroimaging with recent advance in imaging. Several classifications have been proposed, based on embryology and/or morphology. To recognize posterior fossa malformations, the assessment of size and morphology of the posterior fossa structures is essential. In this talk, overview of the basic anatomy and brief embryology will be reviewed, followed by illustrative cases of various spectrum of posterior fossa abnormalities ranging from cystic posterior fossa malformation to cerebellar atrophy. Knowledge of these various abnormalities will allow pediatric radiologist to aid in better understand and diagnose posterior fossa abnormalities.
Abstract:
Spinal dysraphisms are approached by first categorizing lesions into open and closed defects.

Open spinal dysraphisms (OSD) have defects in the overlying skin allowing neural tissue with or without its associated subarachnoid space is be exposed to air. Open entities include myelomeningoceles and myeloceles.

Closed spinal dysraphisms (CSD) have components that extend through spinal defects with intact skin overlying neural tissue. Morphologically, CSD are subcategorized based on the presence or absence of a raised lumbar subcutaneous mass. Entities covered in this lecture include: Lipomyelomeningocele and lipomyelocele, Meningocele, Terminal myelocystocele, Diastematomyelia, Tethered Cord Syndrome and filar lipoma, Intradural lipoma and Neurenteric cysts.

A systemic approach of how to classify spinal dysraphism is illustrated with representative MRI images, with the outline as follows:
• (1) Open or Closed Defect
  • Skin defect/ absence of subcutaneous fat
• (2) Any elevated mass
  • = expansion of subarachnoid space
• (3) Cystic / Lipoma-placode interface
  • Inside/ outside spinal canal
• (4) Intraspinal fatty tissue
• (5) Intraspinal cystic lesion
  • Position of the cyst in relation to cord
• (6) Subcutaneous Tract

The importance of identifying the dermal sinus tract is particularly highlighted. Epithelium-lined sinus tract or fistula extends from skin surface inwards, connecting with CNS and its meningeal layers. It is usually presents as midline dimple or pinpoint ostium above gluteal crease. This can serve as a pathway of spread of bacterial infection in CNS resulting in meningitis and abscess formation; therefore early surgical sinus tract resection and correction of associated abnormalities are important during early infancy.
Day 1 - September 26, 2019

16:10-17:40 (90') / Room A

RC05. Cardiac Imaging

Chairs:
Marielle V Fortier (Singapore),
Whal Lee (Korea)
Cardiac CT is increasingly utilized for evaluating congenital heart disease, chiefly assessing its morphologic features. The additional roles of cardiac CT using three-dimensional, high-resolution, and high-quality cardiovascular imaging data in quantifying crucial functional parameters beyond morphology have recently been explored. In this presentation, such special cardiac CT applications in congenital heart disease will be illustrated: (1) cardiac CT can be utilized to confirm the presence of the infarcted myocardium by using myocardial delayed-enhancement CT; (2) differential right and left pulmonary vascularity ratio can be accurately quantified, which has been traditionally assessed with lung perfusion scintigraphy or phase contrast MRI; (3) ventricular volumes and masses can be accurately quantified by using semiautomatic three-dimensional threshold-based segmentation. In conclusion, these functional applications increase clinical value of cardiac CT in congenital heart disease and these functional parameters measured by cardiac CT may be used as important imaging biomarkers in our clinical practice.
How We Perform Least Invasive 320-row Pediatric Cardiac CT

Eriko Maeda
Department of Radiology, Graduate School of Medicine, The University of Tokyo, Japan

The University of Tokyo Hospital has 12-year experience of pediatric cardiac scanning using 320-row CT (Aquilion ONE; Canon Medical Systems Corporation) and recent experience of operating wide-coverage CT (Revolution CT; GE Healthcare Corporation). This lecture intends to give full explanation of how to perform pediatric cardiac CT using these 16 cm-coverage CTs, and some tips radiologists should know when applying 320-row technique to Revolution CT.

I would like to present some key words to understand the basic methodology of pediatric 320-row CT.

1) One rotation, one beat
320-row CT can scan up to 16 cm in one rotation. 16 cm-coverage is enough to cover the whole heart in most adult patients, and the whole chest in many children under 6 years old. One beat scan is sufficient to observe the structures of the heart and great vessels, unless evaluation of coronary stenosis is the issue.

2) Minimal acquisition window scanning
The fastest gantry rotation speed of 320-row CT is 275 ms. In minimal acquisition window scanning (“Target CTA” mode), X-ray is exposed during only one gantry rotation (i.e. 275 ms). Minimal acquisition window scan enables dose reduction compared to conventional prospective scan with wider acquisition window, and improvement of image quality by halfcycle reconstruction. The pitfall of Target CTA is that automatic scan support system for arrhythmia does not work on this mode.

3) Halfcycle reconstruction
Halfcycle reconstruction can be performed in conventional prospective scan, as well as minimal acquisition window scan. Halfcycle reconstruction only uses “180 degrees + fan angle” information to reconstruct a series of images at one phase. This enables seeking the most static phase, and improvement of time resolution. Half cycle reconstruction is also available for Revolution CT.

4) Wide-volume scan, ECG-gated helical scan and variable helical pitch
These methods are selected when the examination requires wider coverage than 16 cm. Wide-volume scan is equal to ECG-gated step-and-shoot scan. ECG-gated helical scan is a narrow-pitch helical scan with ECG gating that enables retrospective reconstruction. When scanning wider area than the whole chest (eg. chest and abdomen), gated narrowed-pitch helical scan can be combined with non-gated wide-pitch helical scan to reduce radiation exposure, and this method is called variable helical pitch. The latter two methods are not available on Revolution CT.
5) New bow-tie filter

The newest Aquilion ONE (Genesis edition) and Revolution CT are equipped with new type bow-tie filter that removes lower energy spectrum of X-ray to reduce radiation exposure that does not contribute to image acquisition. These CTs also have improved detectors with high sensitivity and less signal loss within the circuit. The combination of new bow-tie filter and new detector can reduce radiation exposure of pediatric cardiac CT to < 0.1 mSv in infants.
Most significant congenital heart diseases require surgical treatment. Despite continued improvement of surgical techniques and outcomes, congenital heart surgical procedures are frequently associated with residual lesions or complications that may require timely reintervention. Complicated surgical procedures may require multiple staged procedures to achieve the ultimate goal of biventricular repair. Patients with so-called functionally single ventricle typically require multiple procedures to achieve a palliative status of Fontan circulation.

In the majority of the pediatric institutions, postoperative assessment of congenital heart diseases is the most common indication for cardiovascular MR. MR is preferred to echocardiography as MR not only provides precise anatomical information but also allows quantification of the ventricular volumes and function and the blood flow volumes and velocities through the cardiac valves and blood vessels. MR also enables tissue characterization of the myocardium.

In this presentation, we will discuss the principles and pitfalls in performing MR, post-processing of the image data and reporting by using the commercially available resources in 2019.
Non Sedation Application in Cardiac CT for Congenital Heart Disease

Yumin Zhong

Department of Radiology, Shanghai Children’s Medical Center, P.R.China

Cardiac CT is an important imaging modality to diagnose complicated congenital heart disease in newborns. It can not only display the inner structure of congenital heart disease, but also display the abnormalities of extracardiac great vessels’ anomalies, which is an important supplement to echocardiography. Neonates often can not control their involuntary movement when they are examined by cardiac CT if the sedation is not used. In addition, the newborn’s faster breathing frequency and heart rate often produce more artifacts.

The use of sedatives is an important means to reduce artifacts in CT examination of newborns, but the possible side effects of sedatives on children, especially newborns, can not be ignored. Recent several vivo studies have shown that early use of anesthetics and sedatives can lead to permanent structural and functional changes of CNS; Another study has shown that anesthesia is associated with neurodevelopmental (cognitive and behavioral) impairment. Levels of sedation are categorized into minimal, moderate, deep sedation, and general anesthesia. From the perspective of sedation, cardiac MRI examination requires a high level of sedation and generally requires moderate to deep sedation because of long acquisition time. Due to the advancement of CT technology, widen detector CT has been more widely used in the diagnosis of congenital heart disease in neonates. In contrast to cardiac MRI, cardiac CT requires a short scanning time less than seconds and lighter level of sedation is generally sufficient. The fast scan speed and the widen coverage makes the non-sedation possible.

In conclusion, on the basis of ensuring the image quality of CT scan, non-sedative examination can reduce the examination completion time and avoid the possible side effects of sedative drugs. The completion of the examination can not be separated from the careful help from cardiologists and nurses.
Day 1 - September 26, 2019

16:10-17:40 (90') / Room B

RC06. Brain Neoplasms: Diagnostic Pearls

Chairs:
Ah Young Jung (Korea),
Ajay Taranath (Australia)
Pediatric Neuroimaging in the Era of the WHO
4th Edition of Tumors of the CNS

Blaise V Jones
Department of Radiology, Cincinnati Children’s Hospital Medical Center, USA

The classification of pathology is the foundation upon which radiologists perform the task of identifying and evaluating lesions. As pathology has delved more deeply into the ultrastructural and genetic characteristics of neoplasms, radiology has adjusted and applied its advancing technology to adapt and respond to this changing template.

In 2014, the International Society of Neuropathology gathered in the Netherlands and established guidelines for incorporating genetic features into the diagnoses of CNS neoplasms. In 2016, these guidelines were applied to the 4th Edition of the WHO Classification of Tumors of the CNS. Thus, tumors are no longer grouped together based solely upon their location, or microscopic features, or even immunohistochemical fingerprints, but by their genetic signatures as manifest by characteristic mutations. The classification defines most tumors by a combination of their phenotype/genotype profile, but when these are in conflict, the genotype takes precedence. Absence of genotypic evidence results in a NOS (not otherwise specified) categorization, and grading still relies on histologic features.

It is important for the pediatric radiologist to be aware of the structure and nuances of this classification scheme, and to recognize correlations with imaging phenotypes, correlations that will likely be refined and expanded with the application of machine learning to radiologic analysis. This presentation will review some of these correlations with the more frequently encountered pediatric brain tumors, with recommendations on enhancing communication with our oncology colleagues by incorporating this understanding into our interpretations.
Pediatric Posterior Fossa Tumors

Yutaka Sato

Department of Radiology, University of Iowa, USA

Understanding the embryologic origin and developmental anatomy of the structures of the posterior fossa is essential to correlate imaging and genetic phenotypes of pediatric posterior fossa tumors. In this lecture, we will correlate imaging features of pediatric posterior fossa tumors with developmental anatomy of the tumor progenitor cells.

The developmental anatomy of the brainstem and cerebellum is complex and includes brainstem segmentation, ventrodorsal patterning, multiple germinal zones and diverse migration pathway of the neuronal progenitors.

The anatomic locations of the brainstem glioma predict biologic behavior. Ventral pontine tumors are overwhelmingly malignant, while majority of tegmental and tectal tumors are lower grade.

With medulloblastomas (MB) the anatomical location of the tumor predicts the subtypes and biological behavior of the tumor. Wnt MB (10%) develops from the Wnt-expressing lower rhombic lip at the floor of the fourth ventricle and may be located laterally toward the foramen of Luschka. Because Wnt MB carries a good prognosis de-escalation of traditional treatment has been advocated. Shh MB (20%) arises from the Shh modulated cerebellar cortex and may be located in the cerebellar hemispheres, away from the fourth ventricle. Shh MB is associated with an intermediate prognosis. Group 3 and 4 MB (non WNT/SHH MB) comprise the majority of MB and typically present as fourth ventricular masses originating from the roof of the fourth ventricle. They carry poor (group 3) and intermediate (group 4) prognosis. CSF dissemination is common in both group 3 and 4 MB.

Two major types of posterior fossa ependymomas have been recognized. Posterior fossa ependymomas type A (PF-EPN-A) predominantly affects very young children and are associated with a poor prognosis. Characteristic location of PF-EPN-A is near the foramen of Luschka with extension into the CP angle and prepontine cistern. Posterior fossa ependymomas type B (PF-EPN-B) affects older children and adolescents with an excellent prognosis. PF-EPN-B tends to occur in the midline near the foramen of Magendie.

A developmental and anatomic approach to the pediatric posterior fossa tumors provides a reliable pre-surgical identification of the tumor and of its biologic behavior.
Brain tumors are the second most common cause of pediatric cancer, after leukemias, and the most common cause of cancer mortality in children. The differential diagnosis of brain tumors is primarily and effectively narrowed by age and location of the tumor. Generally, supratentorial tumors are more common in children less than 3 years of age. Posterior fossa tumors are more common in children aged 4-10 years old, and in children older than 10 years, supratentorial and infratentorial tumors occur at equal frequency.

Tumors are further diagnosed by evaluating the appearance on conventional cross-sectional imaging as well as various advanced MRI techniques. Pediatric neuro-oncology has changed tremendously during the past years owing to ongoing genomic advances. The diagnosis, prognosis, and treatment are now highly reliant on the genetic profile and histopathologic features of brain tumors.

In this talk, the salient imaging features of the following common and not-so-common but important supratentorial tumors in children will be presented. The updated 2016 WHO classification of brain tumors will also be discussed but only superficially. The contents of this lecture however, may change without prior notice.

Diffuse astrocytic and oligodendrogial tumors:

Astrocytomas represent approximately one third of all intracranial tumors and are most common in the supratentorial region, although pilocytic astrocytomas (WHO grade I) which are the most common among astrocytomas occur most frequently in the cerebellum. Grade II astrocytomas represent ~15% of pediatric astrocytomas and have a biphasic distribution (2-4 years of age and adolescence). These appear most commonly in the frontal and temporal lobes. Anaplastic astrocytoma (grade III) and glioblastoma multiforme (grade IV) peak at 9-10 years of age.

Mixed neuronal-glial tumors:

Dysembryoplastic neuroepithelial tumors (DNET) are benign (WHO Grade I), slow-growing, mixed neuronal-glial tumors representing ~1% of pediatric brain tumors. Majority arise from the cortical grey matter and are frequently associated with cortical dysplasia. They characteristically cause seizures and typically diagnosed in children or young adults.

Desmoplastic infantile astrocytoma and gangliogliomas were previously considered separate entities but now grouped into one, recognizing the clinical, radiological and pathological similarities of the two entities. Despite their aggressive appearances,
these tumors tend to have a good prognosis (WHO grade I). Majority occurs in children below 2 years of age and are found most commonly in the frontal and parietal lobes.

**Sellar/suprasellar tumors:**
Craniopharyngiomas are relatively benign (WHO grade I) neoplasms that typically arise in the sellar/suprasellar region, accounting for ~1-5% of primary brain tumors. These can occur anywhere along the infundibulum from the floor of the third ventricle to the pituitary gland.

**Ependymal tumors:**
Supratentorial ependymomas account for 30% of ependymomas, and in most instances within or abutting the ventricles. However, these can also be located within the parenchyma, remote from the ventricular surface (~40% of cases). These tumors usually present with headache, seizures and focal neurological deficits compared to infratentorial counterparts which mainly present with features of increased intracranial pressure.

**Embryonal tumors:**
Neuroblastoma is the third most common malignancy in children. Primary central nervous system (CNS) neuroblastoma however is a very rare supratentorial tumor affecting children in the first years of life. Cranio-cerebral metastasis of a non-CNS neuroblastoma is more common, usually involving the calvaria, orbits, skull base and the dura.

**Other gliomas:**
Astroblastomas are glial tumors usually found in the cerebral hemispheres of children more than 10 years old. These have no WHO grade yet, but do have a range of biological behavior ranging from relatively indolent (astroblastoma) to aggressive (anaplastic or malignant astroblastoma).
In this lecture emphasis will be placed on the imaging of the brain and spine after the diagnosis of brain tumor is made. The discussion will commence with a discussion of the early postoperative changes. Subsequently, pearls and pitfalls of brain tumor surveillance imaging will be discussed in cases of residual tumor or no residual tumor. Expected imaging changes and complications of therapy will be reviewed.

In the immediate postoperative period, imaging is performed to assess the extent of the resection and presence of complications. It is important to perform the spine screening prior to the resection/biopsy of a brain tumor as the spinal subdural collections may diminish the detectability of the drop metastasis. These collections generally resolve in several weeks. Gross total resection refers to complete resection of the tumor radiographically.

It is important to use at least 2 previous comparison studies when performing imaging for tumor surveillance. In residual low grade tumors, the importance of the utilization of more remote examinations for comparison cannot be overemphasized as interval change can only be appreciated over long periods of time. The imager should also make a habit of reviewing the preoperative/pretreatment study when performing a tumor surveillance examination.

Following radiation therapy, MR spectroscopy may be useful in differentiating radiation necrosis from tumor progression in patients with high grade neoplasms.

In tumors with a tendency of leptomeningeal dissemination, gadolinium enhanced T2-FLAIR sequence may improve detection. Addition of the steady state sequences (e.g. CISS, FIESTA, BFFE) may be helpful in cases where leptomeningeal or ependymal tumor dissemination is suspected.

Similarly, steady state sequences are becoming an integral part of the spine drop metastasis surveillance protocols given the achieveability of <1 mm slice thicknesses and improved detectability of nodules on the surface of the spinal cord or cauda equina against the hyperintense cerebrospinal fluid.
Day 2 - September 27, 2019

08:00-09:30 (90') / Room A

RC07. How We Do It: Body Imaging

Chairs:
Yong-Woo Kim (Korea),
Pilar Garcia-Peña (Spain)
Introduction:
There are unarguable benefits of CT examinations in children. This cross sectional modality has gained additional value over the past few years as the risks associated with more frequent need for sedation/anesthesia and attendant potential for cognitive deficits and gadolinium deposition with MR imaging are being recognized in the pediatric age group. The benefits of CT, however, are in a background of the potential risks with use of this modality, namely the obligatory radiation exposure as well as intravenous contrast use. Performance, then, of pediatric CT must embrace this dichotomy, while also recognizing there are unique challenges for CT when children are involved as opposed to adults. The following material will outline the practical aspects of patient preparation, scan performance, and practice accountability (including interpretation) for body (chest and abdominopelvis-AP) CT in the pediatric age group. Of note, dose reduction aspects of CT should not be at the expense of other fundamental CT performance tactics which can also impact scan quality and dose.

Preparation:
For pediatric CT scanning, the presence of the parent (hereafter understood to include any caregiver) is a unique and essential dynamic that must be accounted for. This group, as opposed to adult scanning, is making decisions for their child, in a situation where they need to be attending to their child while at the same time dealing with the uncertainty and anxiety of wondering what is potentially wrong, in an unfamiliar medical environment that might be frightening for both, and with some particular urgency particularly in the emergency setting. Attending to the parental needs will be extremely important in terms of maximizing the cooperation of the child and more likely achieving a high-quality examination. Tactics then should be directed at welcoming dialogue, answering questions, and in general reassuring the parent and subsequently their child. To this end, it can be helpful to have the parent in the room during the examination. Preparation should include anticipation of questions related to radiation you some potential risk. Preparation of both parent and child you should include a discussion of IV placement, what will be the experience during the CT examination, especially the sensations during IV contrast administration, the actual length of the examination and even consider when scan results might be available as this is a frequent question that parents have. Information related to radiation during CT and children as widely available, including the Image Gently Alliance (www.imagegently.org) and www.radiologyinfo.org. In younger children and older children with certain disabilities mobilization is important to reduce motion artifact. Infants maybe swaddled and fed. Older children, perhaps under 3 to 4 years of age may need other immobilization tactics. The use of moderate sedation or general anesthesia should be rarely necessary. Medical anxiolysis and topical anesthesia may be helpful for IV placement. Pediatric friendly room design is also a useful tactic.
CT Performance:

Anticipating IV contrast administration, the gauge and location of the IV is important. Patient positioning, particularly in the isocenter of the gantry will optimize tube current modulation. Extremities should be appropriately positioned for the type of examination. The technologist should also be aware of the impact of potential internal support apparatus material as well as external apparatus, such as leads. With dual source CT, there can be a large table translation during high pitch scanning and the child, parent or care team such as with children from the intensive care unit should understand the extent and speed of table translation (including appropriate attention to all support apparatus). Newer recommendations are that shielding outside of the scanning range in general provides little to no benefit for radiation reduction but this may require that carefully designed talking points are available at the point of CT care. Iodinated IV contrast media provide little risk for contrast allergy especially in young children or significant impact from extravasation. It should be used whenever warranted. Moreover, transient thyroid abnormalities have been reported but to date there is no prohibition for contrast administration. Oral (enteral) contrast use varies depending on individual practices but in general the dilution of 1:25 - 1:50 iodinated material in palatable liquid, or a CT barium medium can be helpful in many situations. Enteral contrast media should not be used during CTA or if enhancement of the bowel mucosa is an anticipated need. In addition, even “negative” contrast media such as water, apple juice or other liquid that the child may be more amenable to drink can be beneficial in delineating course and internal features of bowel. In general, enteral contrast is not necessary in the setting of small bowel obstruction. In addition, while in adults there is often a 2 to 3 hour delay after giving enteral contrast to scan the abdomen, transit time especially in young children is often quite fast and the scan can be initiated 30 to 45 minutes administration, such as in the setting to assess for appendicitis. Rectal contrast is very rarely warranted. In general, a dose of 1 – 2 mL/kg of IV contrast media up to the adult dose is standard. The lower amounts can be used in chest CT and CTA. In general, most indications for chest and abdominopelvic CT scanning in kids warrant IV contrast administration. Dose can go up to 3.0 mL/kg if there is a problem with initial administration requiring a second bolus. Rates vary from 1.0-5.0 mL per second depending on the indication, age of child, and IV gauge. Power injector should be used when possible for more predictable and consistent enhancement. For CTA, higher iodine concentration (e.g., 370 mgI/mL) increases contrast to noise ratio. Scan initiation varies between practices but I have found it successful to wait for completion about 10–15 seconds chest and 30 to 35 seconds after completion for AP CT. For CTA bolus tracking particularly in young children is often helpful. Multiphase scanning is rarely necessary (and should be justified), warranted in <2-5% of AP CT, and less with chest CT. Moreover, a dual phase can be performed with the single administration where half of the dose is given and immediately before 30 to 35 seconds performance of the diagnostic scan, the second half administered with an additional five second delay built in yielding portal venous/medullary and arterial information. For neck, chest, abdomen and pelvis IV contrast CT, a single dose of contrast can be given where the neck is scanned superior to inferior about five seconds after contrast administration, the chest 10–15 seconds after completion (raising arms between), and the AP at 30 - 35 seconds. The upper chest images, often part of a neck scan can be extracted from the chest CT. This avoids overlap, which should be a standard dose reduction strategy for all multi region scanning. Scanner settings will vary depending on the size of the child, and scan indication. Techniques are widely available, including through AAPM (https://www.aapm.org/pubs/CTProtocols/default.asp). In general, lower kV of 70, 80, or 100 for chest and CTA in children is appropriate, with AP CT at 80, or 100 kV with occasional 120 kV in older children. For chest scanning, breath hold is helpful in older children and should always accompany the chest scan when the child is old enough to cooperate. High-resolution images may be extracted from the volume acquisition with appropriate reconstruction kernels. In this cooperative population, serial low-dose expiratory slices may be of benefit for evaluation of air trapping.
Practice Accountability:
In general, sagittal and coronal reformations are very helpful in body CT imaging examinations. 3-D reconstructions may be performed from thin slice data sets when warranted, particularly for CT angiography. Large image data sets for review should be avoided to minimize interpreter fatigue; standard display window and level, series sequences, and other parameters are welcomed by interpreting physicians. Protocols should maintain consistency for reconstruction algorithms, sliced thickness, et cetera. Finally, part of a good CT practice includes audits. This would be for dose monitoring purposes, as well as to assure scan quality and consistency avoiding drift of protocols with changes in techniques which can occur often surprisingly over time. A suggested protocol review frequency might be on an annual basis.

Finally, a team approach to pediatric CT is important with all stakeholders, including nurses, technologist/radiographers, medical physicist and health physicist, and radiologists equally invested in optimizing scan quality with informed use of radiation.
Dynamic CT of the Pediatric Airway

Abbey J Winant
Department of Radiology, Boston Children’s Hospital, Harvard Medical School, USA

This talk will review clinical indications for imaging the pediatric airway and approaches to CT imaging of the pediatric airway. Specifically, this talk will focus on 4D Dynamic CT of the airway, including patient preparation, technical parameters, and postprocessing. We will also concentrate on interpretation of dynamic CT airway images, utilizing case examples of pediatric airway pathology.
Lung MRI is an attractive alternative imaging modality that is free from ionizing radiations. However, imaging of lungs by MRI has always been technically challenging due to a number of factors. These factors include poor signal due to low proton density, cardiac and respiratory motion artifacts and susceptibility artifacts. Cost and availability limit its use. Also longer imaging times requiring sedation and monitoring also lead to underutilization of this attractive radiation free imaging modality.

With technological advances in MRI and faster acquisition times, high-quality MRI of the lung is now being developed and used in various clinical applications. Advances in MRI technology have produced higher-resolution images (voxel size less 1 mm) that are less susceptible to motion artifact and allow image acquisition during free breathing, reducing the need for sedation. We shall also discuss in brief various MRI sequences that are used in MR imaging, including single shot fast spin echo sequence, spoiled gradient echo sequence, balanced steady state free precession sequence, motion corrected techniques and others.

MRI is now emerging as a radiation-free alternative to CT, specifically for imaging children with pulmonary infections and compromised immune systems. MRI would be useful in particular for follow-up in children. Applications of lung MRI in children would include evaluation of bronchiectasis and bronchial wall thickening in obstructive airways diseases, lymph nodes, pulmonary nodules and consolidation in infective conditions, airways, interstitial lung diseases and various congenital lesions.
Liver Elastography

Mi-Jung Lee
Department of Radiology, Severance Children’s Hospital, Yonsei University College of Medicine, Korea

Elastography is a functional technique that enables quantification of tissue stiffness that redistribute tissue composition and/or structure, edema, injury, perfusion, etc. The technique provides quantitative or semi-quantitative measurements of the evaluated tissue. We can do elastography imaging using both ultrasonography and MRI.

Liver is the most common organ to be evaluated in elastography studies and has a variety of uses, including staging and rating of fibrosis, diagnosis and treatment evaluation of biliary atresia. Elastography has also been evaluated to assess nonalcoholic fatty liver disease (NAFLD), as well as liver stiffness in patients with congenital heart disease treated by Fontan procedure, and sinusoidal obstruction syndrome after hematopoietic stem cell transplantation.

However, when we use elastography technique in children, special preparation and considerations are needed. In this lecture, we will review the preparation and process of liver elastography in pediatric patients. We will also discuss the clinical utility, diagnostic performance, and limitations of this technique.

Suggested readings
Day 2 - September 27, 2019

08:00-09:30 (90') / Room B

RC08. Head and Neck Imaging: Diagnostic Pearls

Chairs:
Ji Hye Kim (Korea),
Winnie Chu (Hong Kong China)
Cranial nerve disorders are uncommon disease conditions encountered in pediatric patients and can be categorized as congenital, inflammatory, traumatic, or tumorous conditions that involve the cranial nerve itself or propagation of the disorder from adjacent organs.

- Congenital: absence or dysplasia, isolated or in association with other congenital anomalies or syndromes (e.g., mid-facial anomaly, Duane retraction syndrome)
- Inflammatory: primary or secondary neuropathies (e.g., multiple sclerosis, Miller-Fisher syndrome)
- Tumorous: primary tumor or secondary involvement by intracranial or extracranial tumors (e.g., optic glioma, leukemic infiltration)

However, determination of the ordinary course, as well as abnormalities, of cranial nerves in pediatric patients is challenging because of the small caliber of the cranial nerve, as well as the small intracranial and skull base structures. With the help of recently developed magnetic resonance (MR) imaging techniques that provide higher spatial resolution and fast imaging techniques including three-dimensional MR images with or without the use of gadolinium contrast agent, radiologists can more easily diagnose disease conditions that involve the small cranial nerves, such as the oculomotor, abducens, facial, and hypoglossal nerves, as well as normal radiologic anatomy, even in very young children.

If cranial nerve involvement is suspected, careful evaluation of the cranial nerves should include specific MR imaging protocols. Localization is an essential consideration in cranial nerve imaging and should cover entire pathways and target organs as much as possible.

Therefore, radiologists should be familiar not only with the various diseases that cause cranial nerve dysfunction, and the entire course of each cranial nerve including the intra-axial nuclei and fibers, but also the technical considerations for optimal imaging of pediatric cranial nerves. In this article, we briefly review normal cranial nerve anatomy and imaging findings of various pediatric cranial nerve dysfunctions, as well as the technical considerations of pediatric cranial nerve imaging.

In this lecture, we will review the radiological anatomy of the cranial nerves on MRI and various diseases of cranial nerves in pediatric patients.
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<td>3D T2WI with MPR for en face view of IAC</td>
<td>Inner ear structures, IAC, CPA, pontomedullary junction</td>
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<td>CT for bony temporal bone</td>
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<tr>
<td>Glossopharyngeal</td>
<td>3D T2WI for distal segments</td>
<td>Upper and midportion of medulla, lateral medulla, basilar cistern, bulbous canal, hypoglossal canal, carotid space of the neck, target organs</td>
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<td>Vagus</td>
<td>Contrast-enhanced T1WI for brainstem and skull base lesion</td>
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<td>Accessory</td>
<td>Contrast-enhanced neck CT for evaluation of the carotid space</td>
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<td>Hypoglossal</td>
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Hearing disorders in children are quite common and are increasingly diagnosed during infancy. Imaging studies play a crucial role in identifying causes of conductive, sensorineural, or mixed hearing loss, including congenital and acquired causes. This presentation discusses the most common examples of congenital and acquired hearing loss, identifying signs of associated syndromes, reporting surgical risk factors, and determining cochlear implant feasibility.

In general, CT imaging is the primary imaging modality for conductive hearing loss (CHL), while MRI is predominantly used in the work-up for sensorineural hearing loss (SNHL). For infectious disorders, such as otitis or mastoiditis, post contrast CT imaging should be obtained to detect complications other than bone destruction, such as abscess, empyema, or venous sinus thrombosis. MRI imaging should include high-resolution T2 images of the internal auditory canals with reformats perpendicular to the long axis of the canal to assess for absence or hypoplasia of the cochlear nerve. In addition, diffusion weighted imaging of the temporal bones can aid in post-operative differentiation of scar tissue versus recurrent cholesteatoma.

Radiologists may need to provide additional anatomic information in patients with microtia, in patients undergoing surgery, and in patients pre- and post cochlear implant placement.
Thyroid Disease in Children

Tatsuo Kono

Department of Radiology, Tokyo Metropolitan Children’s Medical Center, Japan

1. Congenital thyroid disease

Congenital functional abnormality of the thyroid is theoretically divided into hypothyroidism (permanent and transient) and hyperthyroidism; however, most of them are hypothyroidism associated with dysgenesis and dyshormonogenesis.

a) dysgenesis

The former, dysgenesis, includes aplasia, hemiaplasia, hypoplasia, and ectopy. The primary imaging modality of choice for evaluation of dysgenesis is ultrasonography (US). Total absence of the thyroid gland is rare. Hemiaplasia is most commonly discovered incidentally, and thyroid function is generally normal. On US, the right or left lobe of the thyroid is absent and the contralateral lobe may show hemilobar goiter. In patients with hypoplasia, the thyroid gland can be visualized in the normal position and shows normal or slightly smaller in size on US. Ectopic thyroid tissue can be found anywhere along the embryological migration pathway of the thyroid gland. The most common location is the tongue base, followed by supra- or infra-hyoid lower neck and mediastinum. US may fail to demonstrate an ectopic thyroid because of variety of the location, therefore, 99m-Tc scintigraphy is generally more sensitive. An ectopic thyroid tissue may show round or oval in shape, irregular surface, or heterogeneous in echogenicity.

b) dyshormonogenesis

The latter, dyshormonogenesis, is caused by defective thyroxine synthesis with a structurally normal thyroid gland. Patients with dyshormonogenesis show congenital hypothyroidism, and some of them show diffuse goiter on US in the neonatal period.

2. Acquired thyroid disease

Acquired thyroid diseases are exemplified by diffuse thyroid disease and tumors / tumor-like conditions.

a) diffuse thyroid disease

Diffuse thyroid diseases include a wide spectrum of diffuse thyroid diseases, such as autoimmune thyroiditis, subacute thyroiditis (de Quervain thyroiditis), painless / silent thyroiditis, and acute bacterial suppurative thyroiditis. There are two major causes of autoimmune thyroiditis, Graves disease and Hashimoto thyroiditis. Graves disease is the most common cause of pediatric hyperthyroidism. Patients with Graves disease present diffuse goiter with inhomogeneous decrease in echogenicity and significant hypervascularity. Increased maximal arterial flow velocity of the superior thyroid artery is a useful objective
finding indicative of hypervascular thyroiditis. Patients with Hashimoto thyroiditis present diffuse goiter with a heterogeneous coarse echotexture with multiple hypoechoic micronodules in the acute stage, and then diffuse atrophy in the chronic stage.

b) tumors / tumor-like conditions

The majority of the thyroid tumors / tumor-like conditions in children are benign nodules, including follicular adenoma, multinodular goiter (adenomatous goiter), cyst, hemangioma, and autonomous functioning thyroid nodule. In evaluation of thyroid nodules, US plays an essential and the most important role. The characteristics of the nodule(s) should be carefully observed for multiplicity, size, shape, location, margin, intrallesional echotexture, and calcification in combination of vascularity on color / power doppler study. 99m-Tc scintigraphy may act as another useful diagnostic tool.

Normal structures and variants without clinical significance should not be mistaken for pathologic conditions. A marginal hyperechoic spot or a comet sign is suggestive of colloid cysts / follicles frequently observed especially in adolescence. An intrathyroidal ectopic thymus is a rare normal variation characterized by a well-defined nodule with an intrallesional echogenic lines and dots similar to those of the normal thymus.

Malignant thyroid tumors include thyroid cancers (papillary, follicular, medullary, and anaplastic) and malignant lymphoma. Papillary cancer is the most common type of the thyroid cancer accounting for 90% of all thyroid malignant tumors in children. US shows an ill-defined heterogeneous low echoic nodule with an irregular outline. Microlcalfication, hypervascularity, and marginal cystic degeneration with or without septations are characteristic features. US is the most important modality in evaluation of thyroid nodules, and MR may be useful in some cases. However, the solid diagnosis of the thyroid nodule(s) should not be made by imaging findings alone. It remains undetermined whether adult guidelines for fine needle aspiration can be applied to children. Pediatric radiologists should know that definitive surgery may contribute to child’s health in patients with thyroid nodule(s) of indeterminate categories.
Imaging plays an integral role in the accurate and timely diagnosis of nontraumatic pediatric head and neck emergencies because evaluation is often hampered by a limited history and physical examination which may be complicated by multiple additional disease processes. While ultrasonography still plays a role in the diagnosis of nontraumatic pediatric head and neck emergencies, contrast enhanced computerized tomography is generally the modality of choice given its widespread availability and relative speed. However, with increasing speed of the MR sequences the utility of MRI has increased in this setting. In this presentation the most common imaging findings and pitfalls of nontraumatic pediatric head and neck emergencies will be discussed including but not limited to some of the entities outlined below:

Orbital inflammation: It is important to discriminate the preseptal cellulitis from postseptal (orbital) cellulitis as the latter are more commonly associated with intraorbital and intracranial complications, such as cavernous sinus thrombosis.

Dacryocystitis: Inflammation of the nasolacrimal duct is secondary to stenosis or a dacyrolith.

Paranasal sinusitis: Imaging is not indicated in the diagnosis of acute paranasal sinusitis. However, its complications require imaging. Pott puffy tumor is a subperiosteal abscess secondary to frontal sinusitis. Orbital abscess are commonly secondary to ethmoid sinusitis. It is important to perform imaging of the brain to exclude epidural/subdural empyema in frontal sinusitis and to exclude cavernous sinus thrombosis in ethmoid/sphenoid sinusitis.

Retropharyngeal abscess: Inflammation of the lateral retropharyngeal lymph nodes can manifest as lymphadenitis on imaging. If the inflammation cannot be contained within the lymph node an abscess develops within the retropharyngeal space. Occasionally abscess/inflammation can extend to the prevertebral space and inferiorly to the mediastinum.

Mastoiditis: Bone erosion, coalescence of the mastoid air cells and overlying soft tissue swelling are stigmata of mastoiditis. Imaging is performed to assess complications (e.g. sigmoid sinus thrombosis, epidural/subdural empyema, brain abscess).

Inflamed third/branchial cleft cyst: Unilateral (almost always left-sided) inflammation and/or abscess of the thyroid gland is pathognomonic for this entity.
RC09. Albert Lam Memorial Session: Practical Pediatric Imaging

Chairs:
Timothy Cain (Australia),
In-One Kim (Korea)
The Role of Imaging in Intussusception: Past, Present and Future

Kimberly E Applegate
Department of Radiology, University of Kentucky School of Medicine, USA

Idiopathic intussusception has a non-specific clinical presentation that provides an excellent opportunity for abdominal ultrasound triage in infants and young children. It is the second most common cause of gastrointestinal obstruction in children, after pyloric stenosis, with a mean annual incidence worldwide estimated at 50 -250 per 100,000 live births. Image-guided enema reduction is the standard treatment of patients in stable condition without indications for operative intervention. The trend over the past several decades has been toward greater use of initial enema, delayed repeat enema, and a wider array of enema techniques worldwide (barium, iodinated contrast, water, air, CO2; fluoroscopic vs ultrasound guidance; sedation vs non-sedation; manual compression), without a single standard approach. Regional preferences remain based on education and training. In a recent meta-analysis of 100 publications that included 32,000 children, air enema was superior to liquid enema for intussusception reduction. The mean success rate was higher (83% vs 70%) without a difference in perforation rate (0.4%) or 48-hour recurrence rates (3%). Interesting nuances to the history, variations in practice, and potential areas for future research are presented in this short overview.
In recent years an increased awareness of the potentially harmful effects of ionizing radiation has driven a shift in the approach to imaging children with right lower quadrant abdominal pain. This updated approach aims to decrease the use of ionizing radiation by relying more on ultrasound and MRI and utilizing low-dose CT optimized for pediatric patients, when appropriate.

This talk will:

- Review the differential diagnosis of acute right lower quadrant abdominal pain in children.
- Describe an up-to-date practical approach to imaging pediatric patients with right lower quadrant pain, including the role of ultrasound, MRI and CT.
- Review the imaging findings of entities that cause right lower quadrant abdominal pain in children.
- Review the accuracy of ultrasound, MRI and CT for diagnosis of appendicitis in children.
Practical Imaging Approach to Urinary Tract Infection in Children

Bo-Kyung Je

Department of Radiology, Korea University Ansan Hospital, Korea

Urinary tract infection (UTI) is one of the most common conditions in pediatric radiology, then imaging for and after UTI is frequently asked for pediatric radiologists. This lecture will shortly review the role of imaging, various available imaging modalities, and their respective findings performed in children with UTI.

Although the diagnosis of UTI is based on laboratory findings, such as urine samples and elevated inflammatory markers in blood samples, imaging studies have the important roles in childhood UTI. 1) Imaging can help establishing the diagnosis of UTI, particularly important with equivocal laboratory findings or nonspecific clinical presentation as seen in newborns and infants. 2) Imaging can detect potentially associated genitourinary malformations and prevent long-term damage and ensure proper renal growth and function. 3) Imaging can depict the renal involvement and differentiate upper and lower UTI. As renal damage and associated long-term effects occur only in upper UTI, detection of renal involvement is important for therapeutic implications and follow-up. 4) Imaging can detect atypical or severe UTI, such as lobar nephronia, granulomatous pyelonephritis, pyonephrosis, and necrotizing pyelonephritis, and complications, such as abscess, renal scarring and consecutive impairment of renal growth with secondary renal hypertension or chronic renal insufficiency. 5) Imaging can provide guidance for treatment such as percutaneous nephrostomy or abscess drainage.

There are various available and useful imaging methods for childhood UTI. Principles of imaging are to decrease radiation exposure and to provide combined morphologic and functional imaging. 1) Ultrasonography (US) is the most commonly used imaging modality in childhood UTI and the first orienting step with compulsory additional imaging. The major advances including harmonic imaging, color Doppler US, microvascular US, contrast-enhanced voiding US make US the major and sufficient imaging modality in the diagnosis and the follow-up of childhood UTI. 2) Voiding cystourethrography (VCUG) is the commonly used modality to assess for vesicoureteral reflux. Although indications have become more restricted and the number of studies has significantly decreased, VCUG still remains essential. A standardized technique with pulsed digital fluoroscopy and last image hold documentation should be applied to reduce the radiation exposure. 3) Renal scintigraphy is used for either depiction of acute renal involvement and for follow-up to monitor scarring, renal growth, and function impairment. Although DMSA scintigraphy is not recommended as part of routine evaluation, it can evaluate renal involvement in patients with equivocal US and clinical findings, and differentiate kidney function and scarring when 3–4 months after UTI. 4) MRI enables detailed functional and anatomic evaluation of the urinary system in a single test without radiation exposure. However, functional MR studies are not yet standardized, and many younger children will require sedation or general anesthesia to successfully complete the study. 5) CT is a widely available, because of the fast and easy imaging technique for evaluation of complications of UTI. However, due to its high radiation dose, its use in children should be limited to complicated cases.
In conclusion, imaging by US is recommended for all infants and children with UTI, particularly without previously known urinary tract anomaly. The further work-up using various available modalities is then decided according to these initial findings as well as the clinical presentation, and clinical course; nevertheless, it is a still debated topic with different approaches.
Embryo – In female embryo at 4th week, the ovaries developed from medial genital ridge and later descend in the abdominal cavity with development of 2 ligaments (suspensory and round/ovarian ligaments). The paramesonephric ducts (Müllerian duct) develop into uterine tubes, uterus and upper vaginal canal. In male embryo at 5th week, the testes begin its primary descent. The MIH suppresses paramesonephric duct development. The mesonephric ducts develop into epididymis, ductus deferens and ejaculatory ducts.

Imaging technique – US is the primary imaging tool for scrotum and ovary. CT and MRI are preferred to for evaluation of tumor extent and metastases.

Non-neoplastic disorders of scrotum: Hydrocele – residual fluid from testicular descent or non-communicating hydroceles seen in 15% of fetus beyond 28 weeks GA. Most of the processus vaginalis is closed in 1 year of age. The communicating hydrocele develop, if the processus vaginalis fails to close. The congenital hydrocele are classified into communicating and spermatic cord hydrocele. Cryptorchidism – Its prevalence is about 1% beyond 1 year of age. US is the primary tool for localization. MRI (T2WFS or DWI) or laparoscopy is helpful to identify intraabdominal testis. Testicular torsion – Extra-vaginal torsion seen in neonates and intra-vaginal torsion (bell clapper deformity) seen in adolescents. US is the only diagnostic tool to make the diagnosis. Comparison with normal contralateral side is helpful. Surgery within 6 hours leads to 80%-100% salvage. Epididymo-orchitis – It is the most common cause of acute scrotal pain in post-pubescent male and originating from bacterial or viral infection. US shows enlarged epididymis, scrotal thickening, hydrocele, increased flow and +/- hypoechoic testis. Traumatic testicular injuries – uncommon due to mobile testis and laxity skin. Disrupted tunica albuginea indicates testicular rupture and required urgent surgical repair.

Neoplastic disorders of scrotum: Testicular and paratesticular neoplasms

– Primary testicular tumors are uncommon and occurring in children younger than 2 years. Germ cell tumor accounts for 65%-75% of testicular tumors and follows by gonadal stromal cell tumors, gonadoblastoma and tumors of supportive tissues. Secondary testicular neoplasms are rare in children and leukemia or lymphoma are common causes. Paratesticular rhabdomyosarcoma is the most common malignant paratesticular tumors.

Non-neoplastic disorders of ovary: Ovarian cyst – Simple neonatal ovarian cyst and less than 4 cm in size is spontaneously...
reduced in 4-6 weeks. The simple ovarian cyst in pre-pubertal girls can be observed as long as simple cyst, asymptomatic, normal blood test and smaller than 5 cm. The larger cyst increases risk of ovarian torsion. The complex-semisolid cyst in post-pubertal girls should be followed after one menstrual cycle. Ovarian torsion – is mostly occurs in peri-pubertal girls and often associated ovarian/ paraovarian masses or cysts. Specific US finding is unilaterally enlarged ovary with multiple peripheral follicles. Presence of central venous flow increased likelihood of ovarian viability post de-torsion. **Polycystic ovarian syndrome** – is the most common cause of secondary amenorrhea. US shows increased ovarian hyperechogenicity, high numbers of subcapsular follicles 5-8 mm.

- **Ovarian neoplasms** – are divided based on cellular origin into germ cell tumor (60%), epithelial tumor (20%) and sex cord/ stromal tumors. About 1/3 of all ovarian neoplasms are malignant. Of the germ cell tumors, 70% are teratoma, 25% are dysgerminoma and 5% are EST. CT or MRI is helpful to evaluate solid or complex mass, malignant tumor spreading to adjacent organs and metastases.
Day 2 - September 27, 2019

13:30-14:40 (70') / Room B

RC10. Nonaccidental Injury

Chairs:
Hee Jung Lee (Korea),
Than Oo (Myanmar)
Abusive head trauma is a pediatric emergency. Failure to recognize and appropriately manage children who experienced child abuse can result in further morbidity or even death. Radiologists play a significant role in the process by determining the presence of traumatic injury and identifying imaging signs indicative of abusive head trauma. This presentation summarizes CT and MR imaging findings, diagnostic pitfalls, and imaging protocols for CT and MR work-up in patients with abusive head trauma.

Abusive head trauma presents with two major patterns: injuries resulting from focal impact and injuries resulting from shaking. The determination of child abuse is only definite when the perpetrator confesses; in all other instances a multi-disciplinary team, including physicians and law enforcement, collect evidence that results in low or high suspicion for abusive trauma mechanisms. Radiologists can help identify a traumatic etiology in cases where the event was unwitnessed or a wring history was given. The imaging signs of injuries resulting from impact are usually not distinguishable from accidental trauma mechanisms. There are, however, several imaging signs that raise suspicion for a shaking mechanism, such as subdural hemorrhages, the “lollipop” sign, hypoxic injuries, and neck soft tissue injuries.

A false accusation of child abuse can ensue when radiologist misinterpret fluid collections in benign enlargement of the subarachnoid spaces of infancy as subdural collections. Carefull assessment of the course of cortical veins can prevent such misinterpretations.
This talk will review skeletal manifestations of nonaccidental trauma, with a focus on fractures. Although fractures are common pediatric injuries, accurate recognition of injuries suspicious for NAT is critical for preventing more serious, possibly fatal injuries. Imaging technique, injury patterns suspicious for NAT, as well as differential diagnosis for suspicious skeletal findings, including systemic disorders, nutritional and metabolic bone disease, and bone dysplasias, will be reviewed.
Learning Objectives

- Understand the importance of correlating the imaging findings with the offered clinical history
- Understand the role of radiological imaging in suspected abdominal or chest inflicted injury
- Review the radiological presentations where Non Accidental injury to the chest and abdomen should be considered.

Chest and abdominal injury is a less common form of Non Accidental Injury but part of the spectrum of child abuse and neglect. It will usually not occur in isolation, and correlation with additional clinical findings will facilitate timely identification of the inflicted nature of the trauma. There are many factors which are associated with an increased incidence of child harm but it is recognised that while its incidence varies, it occurs within all social classes, and the true nature of the inflicted injury is often hidden or denied by the patient’s carers. Diagnostic imaging therefore plays an important role in the identification of NAI. Correct interpretation of the images including estimation of the mechanism of injury is essential for an optimum outcome. Differentiating common from unusual injuries and recognising inconsistent clinical histories may result in the radiologist being the first to raise the suspicion of NAI.

A radiologist must look all imaging findings as well as the pattern of abnormalities to appropriately consider whether there is any evidence of a predisposition to injury to abdominal or chest organs, or whether there could be an alternate explanation for the radiological abnormality such as an underlying soft tissue lesion, malignancy or metabolic abnormality.

Radiological interpretation may also play an important role in the legal system where the radiologist will have to communicate with lay people following the conventions and rules of the legal jurisdiction. When called to give evidence in a court of law, a radiologist must be able to clearly communicate the radiological findings which indicate inflicted injury occurred, but also remember that it is the court that is charged with the responsibility of determining who is guilty or innocent.
Day 2 - September 27, 2019

16:20-17:50 (90') / Room A

RC11. Pediatric MSK Imaging: Must-Knows

Chairs:
Choon-Sik Yoon (Korea),
Jeevesh Kapur (Singapore)
Pediatric Bone Marrow: Normal Evolution to Pathology

Paul S Babyn

Department of Medical Imaging, University of Saskatchewan, Canada

One of the largest and most dynamic tissues in the body, bone marrow is the main site of hematopoiesis, producing and regulating the supply of erythrocytes, platelets, and leukocytes. The cellular constituents of bone marrow include stem cells, erythrocytes, mast cells, myeloid cells, megakaryocytes and fat cells all supported within a framework of cancellous bone trabeculae. As some bone marrow is visible in every MRI highlighting the importance of recognizing the MRI appearance of normal and abnormal bone marrow. MRI is an excellent technique to evaluate bone marrow because of its high tissue contrast, which can enable earlier assessment of bone marrow infiltration by tumor or other marrow disorders before osseous destruction becomes apparent on X-Ray or CT. MRI may be used to assess focal or diffuse bone lesions found on other imaging tests, or for evaluation of localized signs or symptoms such as pain. In comparison with the more limited sampling by marrow aspirate or biopsy, MRI has the ability to provide an overview of the entire marrow cavity.

This talk will provide a brief overview of normal marrow development and normal physiologic processes in childhood including bone marrow conversion and re-conversion, and MRI imaging techniques. The majority of the talk will illustrate an approach to recognition and differential diagnosis of abnormal marrow lesions encountered on MRI.

ABNORMAL BONE MARROW

Abnormalities of the marrow can be broadly categorized into disorders of marrow hyperplasia and reconversion, disorders with diffuse marrow infiltration and or deposition, and disorders of marrow depletion and failure. MRI has proven to be a sensitive method for detecting focal, multifocal or diffuse bone marrow lesions, including those of neoplastic, infectious, or ischemic origin (see Table 1). Careful consideration of the morphologic signal characteristics of any marrow lesion, its distribution and location will help in the differential diagnosis.
### Marrow Disorders by Distribution

#### Diffuse Marrow Disorders
- Normal variant
- Marrow reconversion
- Marked red cell hyperplasia
- Myelodysplastic disorder
- Myeloproliferative disorders including
  - Chronic myelogenous leukemia
  - Juvenile myelomonocytic leukemia
  - Polycythemia vera
  - Essential thrombocytemia
  - Mastocytosis
  - Transient myeloproliferative disorder of Down syndrome
  - Idiopathic myelofibrosis
  - Idiopathic hypereosinophilic syndrome
  - Acute myelogenous leukemia
  - Acute lymphoblastic leukemia
- Myelofibrosis
- Lymphoma
- Metastases from certain solid tumors including neuroblastoma, rhabdomyosarcoma
- Langerhans cell histiocytosis
- Gauchers
- Iron overload

#### Multifocal Marrow Disorders
- Metastasis
- Lymphoma
- Langerhans cell histiocytosis
- Osteonecrosis

#### Focal Marrow Disorders
- Benign or malignant tumors- primary or secondary
- Radiation
- Trauma including fracture, contusion and stress reaction
- Infection
- Inflammatory arthritis
- Osteonecrosis
Pediatric Hip Disorders

Jung-Eun Cheon

Department of Radiology, Seoul National University Children’s Hospital, Korea

Abstract

Pediatric hip disorders encompass a wide range of pediatric hip problems including developmental dysplasia of the hips, Legg-Calvé-Perthes disease, slipped capital femoral epiphysis, infectious, and noninfectious inflammatory causes. Ultrasonography has an important role to detect developmental dysplasia of the hip in the neonatal period and to evaluate joint effusion in painful hip while plain radiography detects bony abnormalities in patients with suspected hip disorders. MR imaging is indispensable to evaluate pediatric hip disorders especially in children with infectious and non-infectious inflammatory hip disorders. The purpose of presentation is to review the spectrum of imaging features of the principal pathologies of non-traumatic pediatric hip disorders and to discuss the role of radiologic studies in the management of these disorders.

Key Figures

Hip AP view: line and angles
- Hilgenreiner line
- Perkin line
- Shenton line
- Acetabular index (angle)
- Center-edge angle
References

There is a wide range of soft tissue tumours in children. Most of soft tissue tumours are benign in nature. Majority of soft tissue tumour especially superficially located can be diagnose clinically. However, deep seated soft tissue tumour requires imaging to characterize and reach to a diagnosis or narrow down differential diagnosis. Base on the WHO Soft Tissue Tumour Classification 2013, there is a broad spectrum of soft tissue tumors in children which include adipocytic tumour, fibroblastic/myofibroblastic, fibrohistiocytic tumour, smooth muscle tumour, skeletal muscle tumour, vascular tumour and nerve sheath tumour. It is impossible to cover all the tumours in this lecture.

Ultrasonography is the modality of choice for smaller and superficial lesions and it is useful for vascular tumours or highly vascularised tumour with the application of Doppler ultrasound. Magnetic resonance imaging and computed tomography is the modality of choice for the larger and deeper lesions and for those in which ultrasonography is not adequate. Plain radiographs has a very limited role in the evaluation of soft tissue masses. It may demonstrate presence of soft tissue mass with calcification or mineralisation as well as changes of the adjacent bone.

Clinical history and physical examination findings are important information for an appropriate interpretation of the imaging findings. Although certain soft tissue tumour can be confidently diagnosed based on the combination of clinical and imaging findings, tissues biopsy with histology examination is frequently required for a definitive diagnosis. In some cases, the imaging features may not be able to differentiate benign from malignant tumours and remain as challenges in the diagnosis.

In this lecture we will discuss a few selective cases of soft tissue tumour in relation to its clinical presentation and imaging features.
Advanced MR Imaging in Pediatric Musculoskeletal Tumors

Hee Kyung Kim
Department of Radiology, Cincinnati Children's Hospital Medical Center, USA

Suggested reading

After this Lecture
• The audience can understand the role of each conventional MR sequence in the diagnosis of pediatric musculoskeletal tumors.
• The audience can understand the basic concept of advanced MR techniques and their applications in pediatric musculoskeletal tumors.

Conventional MR imaging and roles
MR imaging has been a diagnostic standard in musculoskeletal tumors. MRI provides information regarding tumor origin, tissue characterization, extent of tumors, relationship with adjacent structures, and therapeutic response. For tumor surveillance, MR imaging starts with a large field of view (FOV) including joint to joint using coronal T1 weighted images (WI) and water sensitive sequences (inversion recovery or T2 WI with fat suppression). These studies provide information of epiphyseal extension and skip metastasis. Skip metastasis is defined as tumors present within the bone marrow of the affected bone and is separated by normal marrow. Skip metastasis is associated with an increased risk of local recurrence and subsequent metastasis. T1WI with small FOV provides information about the presence of a fat plane between the tumor and the adjacent neurovascular structures, which is critical for limb salvage surgery. In conjunction of T1WI, water sensitive sequence with small FOV provides tissue characterization. Gradient echo sequence is not routine and if applied it demonstrates blooming artifacts from hemosiderin, calcification and metal deposition. Contrast enhanced MR enables differentiation of high T2 solid tumors from cystic lesion. Presence of local lymph node involvement is important for tumor staging in particular rhabdomyosarcomas, clear cell sarcomas and epithelioid sarcomas, which tend to spread via the lymph nodes.

Advanced MR imaging and clinical applications
Diffusion weighted imaging (DWI) exploits the degree of water diffusion (Brownian motion) around cells. An afferent diffusion coefficient (ADC) value is a quantitative value that measures water molecule movement speed around the cells; a decreased ADC value means there’s restriction of water molecule motion seen in high cellular tumors and intact cell membranes. The strength of the diffusion gradient moment is expressed by \( b \) value. To calculate ADC value, at least two \( b \) values are applied; low \( b \) values are equal to or less than 50 and high \( b \) values are equal to or more than 800. Increase in \( b \) value results in
decrease in signal to noise ratio and resolution and increase in lesion conspicuity. There has been controversy in application of ADC values in differentiation of benign from malignant tumors. The current general agreement is that an ADC value < 1.1x10-3mm²/sec suggests a malignant tumor and ADC values have direct negative correlation with cellularity. Benign tumors such as non-ossifying fibroma and enchondroma have high ADC values ranging from 1.5 to 2.5 x10-3mm²/sec. However, there are exceptions and underlying histology should be counted; chondroid and myxoid tumors do not have significant restrictive diffusion despite their high grade malignancy. Benign tumors with high cellularity do have restrictive diffusion including eosinophilic granuloma and granular cell tumors. Lipoma, abscess and hematoma can have restricted diffusion mimicking solid and high cellular tumors. DWI has been used in determining treatment response; tumor necrosis and increased cell membrane permeability are reflected with an increase in ADC value. As combined with FDG PET scan, ADC values negatively correlate with maximum SUV and provide predictive values for therapeutic response to neoadjuvant therapy in osteosarcoma. In lymph node imaging, an ADC value less than 0.94 x10-3mm²/sec suggests nodal metastasis. In ADC map, fat, calcification and fibrosis decrease ADC value dramatically and should be avoided in placement of ROI.

**Dynamic Contrast Enhanced (DCE) MR** requires high temporal and high spatial resolutions, short intervals (5 - 7 seconds), and a total acquisition time of up to 7 minutes are required. In general 3D T1 WI gradient echo sequences are utilized. Three different analysis methods are utilized in DCE; time contrast enhancement (TCE) pattern, numeric values from TCE curve, and quantitative manners. TCE is classified into three patterns; progressive, delayed plateau, and delayed washout patterns. Rapid enhancement in the arterial phase is often observed in malignant neoplasms, but there is overlap between those of benign and malignant neoplasms. Quantitative analysis utilizes the concept of arterial input function (AIF) by measuring signal intensity changes of the blood vessels and the tissue of interest during the passage of the contrast. From this method, tumor blood volume (Ve and Vp, and contrast permeability (ko, and ktrans) are calculated to reflect the angiogenesis of the neoplasm. Arterial spin labeling (ASL) and blood oxygen level dependent (BOLD) can be used for perfusion analysis without contrast.

**MR spectroscopy** provides a biochemical technique of the neoplasm; elevated choline level reflects excessive cellular turnover and is seen in malignant neoplasms. However, there is considerable overlap between them.

**Whole body MR (WBMR)** imaging has enabled imaging from the head to toes within a reasonable time frame. Typically, coronal STIR and T1 WI are used to scan the entire body and stacked together. WBMR has been widely used in oncologic patients for tumor follow up and screening in high risk groups. Compared to other imaging studies, WBMR proved superior in detection of skeletal metastasis, but it is still controversial in the detection of extra-skeletal metastasis. Currently WBMR is used in neurofibromatosis and cancer predisposition syndrome. Diffusion weighted whole body imaging (DWIB) is applied to increase sensitivity in detection of the lesions.

**MR guided High Intensity Focused Ultrasound (HIFU)** has enabled real time monitoring of the temperature changes during the delivery of targeted ultrasound acoustic energy for coagulation necrosis from tumor heating (more than 60 degrees). Focal spot size of the focused ultrasound beam is very small to avoid causing heating damage to normal tissues. MR thermal imaging is used for real time monitoring of the tissue temperature. In pediatric neoplasm, osteoid osteoma and desmoid tumors are main indications of HIFU.

Advanced MR techniques have enabled exploit tumor cellularity (DWI), perfusion and oxygenation (DCE or BOLD), biochemical information (MRS), and WBMR imaging in patients with neoplasms. These techniques will provide additional information in the management of oncologic patients.
Day 3 - September 28, 2019

08:00-09:30 (90’) / Room A

RC12. Meet the Expert: How to Read It!

Chairs:
David Stringer (Singapore),
Peng Yun (China)
Chest radiography is the most frequent examination performed in majority of pediatric radiology department, representing up to 30-50% of the total workload.

It remains the initial imaging study to evaluate most thoracic diseases in children.

Correct interpretation of the chest radiographs requires trained radiologist and technically adequate images.

A systematic approach to the interpretation of children´s chest radiographs, knowledge of basic radiological findings, and consideration of clinical information, are the key factors for a correct radiological diagnosis.

On the other hand, failure in adequate interpretation can lead to wrong diagnosis and consequently to inappropriate therapeutic management.

Obtaining a technically adequate chest radiograph in small children is particularly challenging due to their lack of cooperation. Potential pitfalls related to suboptimal images have to be considered.

Knowledge of the classical radiological findings as well as of the most frequent technical pitfalls is mandatory to interpret correctly chest radiographs in children and make correct diagnoses.

In this session, we will discuss radiological findings of normal and pathological pediatric chest, and we will read several clinical-radiological cases interactively with the audience, analyzing, in detail, the radiological image to make the correct diagnosis.
How to Read Abdominal Radiographs in Children

Lane F Donnelly
Department of Pediatrics, Stanford University School of Medicine, USA

This presentation is an introduction to how to read abdominal radiographs in children. The following areas will be stressed: using a patterned approach to interpretation of abdominal radiographs, changes in the clinical indications for abdominal radiographs over the past 20 years, and specific imaging issues in some of today’s more common indications for abdominal radiography.

A Structured Approach to Interpretation of Abdominal Radiographs

Like for the interpretation for all imaging studies, having a defined structured approach pattern helps increase the reliability of interpretation. One structure approach is to evaluate the following: support apparatus (lines and tubes), bowel gas pattern, air in other places, abnormal radiodensities, abdominal soft tissues, bones and external soft tissues, and lung bases.

The primary lines and tubes encountered on abdominal radiographs include umbilical catheters, enteric feeding tubes, nasogastric tubes, and gastrostomy or gastrojejunal feeding tubes. The position of such tubes and deviation from expected location should be evaluated. Often, the primary purpose of an abdominal radiograph is evaluation of the bowel gas pattern. Is there a normal distribution of bowel gas or is there disproportionate distention of more proximal as compared to distal bowel, which would indicate a potential obstruction? Excluding free intraperitoneal air, preferably with an included cross-table lateral or decubitus view, is important as is excluding evidence of bowel wall pneumatosis. Evaluation of potential abnormal radiodensities to exclude radiopaque foreign bodies or abnormal calcifications (appendicolith, renal calculi, gallstones) is very important. Evaluation the intra-abdominal soft tissues for evidence of organomegaly or potential soft tissue masses is also important. Finally, missing a non-abdominal finding, such as a bone lesion or lower lobe pneumonia is a classically encountered error so having a systematic check of the bones, soft tissues, and lung bases is an important step prior to completing the diagnostic evaluation.

Changing Indications for Abdominal Radiography

The commonly used clinical indications for abdominal radiographs in children has dramatically decreased over the last 20 years related to increasing advances and indications of other imaging modalities, primarily ultrasound, CT, and MRI. In the 1990s, for example, there were many clinical scenarios in which radiography was the primary imaging modality. Examples include appendicitis, intussusception, potential abdominal mass, bowel obstruction, potential necrotizing enterocolitis, neonatal bowel obstruction, the vomiting infant, potential renal calculi, and many other indications. While radiographs still may play a complimentary role in the diagnosis of all of the above, the primary imaging modalities for most of
the indications have migrated to other modalities. For appendicitis, ultrasound is not the established primary imaging modality with either CT or MRI reserved for cases in which the clinical exam and ultrasound are unclear or complications such as abscess formation are suspected. Radiography now plays a very minor role in the diagnosis and management of appendicitis and is rarely performed. For the diagnosis of intussusception, ultrasound has also become the primary imaging modality. Many abdominal diagnoses during infancy are now also primarily evaluated with ultrasound, including evaluation of necrotizing enterocolitis and even the diagnosis of upper and lower bowel obstruction in neonates. Using ultrasound to avoid radiation dose, especially in clinical scenarios where repeated evaluation is indicated, is even more important in neonates, related to their increased radio-sensitivity. For the vomiting infant, many now are also advocating ultrasound as the primary modality of choice as it can both diagnose hypertrophic pyloric stenosis as well as evaluate for malrotation and midgut volvulus. Renal calculi are now primarily evaluated with ultrasound with non-contrast CT as a complimentary imaging study.

**Interpretation of Radiographs for Today’s Common Indications**

If many of the above indications are no longer primarily evaluated by abdominal radiography, what are the more common indications for abdominal radiographs? These include evaluation of abdominal support apparatus (lines and tubes), evaluation of potentially ingested foreign bodies – and identification of specific foreign bodies that have emergent clinical significance, evaluation for free intraperitoneal air, and the evaluation of constipation. Radiography also still plays a fairly primary role, in addition to ultrasound, in the evaluation of the child with suspected necrotizing enterocolitis and the evaluation of neonates with potential upper or lower bowel obstruction. These indications and their associated findings will be stressed during the discussion of the approach to radiography.

**References**

1. Freedman SB, Thull-Freedman J, Manson D, Rowe MF, Rumantir M, Eltorki M, Schuh S. Pediatric abdominal radiograph use, constipation, and significant misdiagnoses. *J Pediatr* 2014;164:83-88
Radiography of Pediatric Skeletal Trauma: Pearls and Pitfalls

Paul S Babyn
Department of Medical Imaging, University of Saskatchewan, Canada

Pediatric musculoskeletal injuries are very common accounting for a significant proportion of pediatric emergency department visits and overall health care costs. The rate of fractures in childhood ranges from 12-36/1000 per year with a peak encountered in 10-14 year olds with the most common injuries being of the forearm and ankles. Radiography is generally obtained as the first line imaging modality.

This lecture will present imaging pearls that may assist in interpretation along with pitfalls that should be avoided. The current use of clinical and imaging algorithms for radiographic assessment of common childhood injuries will be reviewed. Specific imaging features of some common and uncommon injuries of childhood of the upper and lower extremity will be shown that may be problematic for readers with a focus on stress injuries, physeal injuries, and acute and chronic apophyseal injuries.
Radiography of Pediatric Bone Tumors

Hee Kyung Kim
Department of Radiology, Cincinnati Children’s Hospital Medical Center, USA

Suggested reading

After this Lecture
• The audience can do systemized approaches to bone tumors and classify them into benign and malignant neoplasms based on plain radiograph.
• The audience can provide specific diagnosis of common bone tumors with characteristic findings on plain radiograph.

The plain radiograph is the primary imaging tool and first step the diagnosis of bone tumors. Radiograph demonstrates classic appearances of bone tumors occurring at specific ages, but exceptions always exist, and age approximation is required in diagnosis.

In the pediatric population, aged less than 20 years, bone tumors are categorized into benign and malignant tumors; benign tumors in this age include fibrous cortical defect (FCD), non-ossifying fibroma (NOF), simple bone cyst (SBC), aneurysmal bone cyst (ABC), chondroblastoma, Langerhans cell histiocytosis (LCH), osteoblastoma, osteoid osteoma, osteofibrous dysplasia, chondromyxoid fibroma (CMF), fibrous dysplasia (FD), enchondroma, and giant cell tumor (GCT). Malignant tumors include osteosarcoma, Ewing sarcoma, leukemia, lymphoma, and metastasis (neuroblastoma, retinoblastoma, and rhabdomyosarcoma).

Most bone tumors have a characteristic **location** in the skeleton; epiphyseal/apophyseal, metaphyseal, and diaphyseal in longitudinal and medullary, cortical, and juxta cortical in transverse locations. **Illustrations of tumors in each location will be provided during the lecture.**

The **margin** of bone tumors and the zone of transition between the lesion and adjacent bone are key factors in classifying a neoplasm as benign or malignant. A lesion with sharp margins and a narrow transition zone is non-aggressive, especially when it is associated with sclerotic rim. A focal discrete lesion, as known as geographic lesion (type 1), is subclassified into three categories; well defined border with sclerotic rim (type 1a), well defined border without sclerotic rim (type 1b), and focal lytic lesion with ill-defined border (type 1c). The infiltrative lesion with ill-defined margins has broad zone of transition with moth-eaten (type 2) or permeated bone destruction (type 3). The higher type has more aggressive features and more potential of...
malignant neoplasm. However, osteomyelitis and LCH can have aggressive features despite their benign histologic natures and giant cell tumor can have locally aggressive nature despite its non-aggressive imaging features. ** Imaging findings of tumors of each sub-type and their exceptions will be provided during the lecture.

The periosteal reaction is an important feature in characterizing bone tumors; unilamellated or solid periosteal reaction indicates a slow growing and nonaggressive nature. A multilayered, onion skin appearance suggests intermediate aggressiveness. The presence of interruption of the periosteal reaction suggests an aggressive nature resulting from tumor cells breaking through the periosteum. A speculated, periosteal reaction perpendicular to the cortex (hair on end) or sunburst appearance is the most aggressive process and highly suggestive of malignant neoplasm. A Codman triangle sign is often associated with malignant bone tumors such as conventional osteosarcoma and Ewing sarcoma. ** Imaging findings of tumors with different types of periosteal reaction and their exceptions will be provided during the lecture.

The opacity and mineralization are other features to consider when characterizing bone tumors; osteolytic, mixed, and sclerotic lesions result from reaction of the osteoclasts and osteoblasts stimulated by the lesions in the bone. SBC, ABC, and GCT are osteolytic, adamantinoma has a mixed pattern, and bone islands have sclerotic pattern. The trabecular patterns are occasionally associated with specific bone tumors; Honeycomb or soap bubble appearances are seen in ABC and NOF, polka dot, or corduroy patterns are seen in vertebral hemangioma. Mineralization of the matrix provides tissue characterization; ring and arc shaped mineralization is seen in chondroid matrix forming tumors including enchondroma, chondroblastoma and chondrosarcoma. Osteoid matrix forming tumor, such as osteosarcoma, has fluffy, amorphous, and cloud like calcification. ** Imaging findings of tumors with different opacity, trabeculation, and matrix formation will be provided during the lecture.

The size and number of bone tumors provide clues for specific diagnosis. Osteoid osteoma has a nidus less than 1.5 cm, while osteoblastoma has a nidus more than 1.5 cm in size. Type 1a cortical lesion (well defined margin with sclerotic rim) are confined to the cortex suggests of FCD; NOF has a similar appearance but is larger and has medullary extension. A small intramedullary chondral lesion less than 2 cm in size suggests enchondroma and similar findings with larger sizes (> 4cm) suggest conventional low grade chondrosarcoma. The majority of primary bone tumors have solitary lesion, while multiple bone lesions are associated with specific disease and syndrome; NOFs are associated with Jaffe-Campanacci syndrome/ Neurofibromatosis type I, FDs with McCune Albright, enchondromatosis with Ollier disease or Maffuci syndrome, and osteochondromas are associated with hereditary multiple exostosis. Other diseases with multiple bone lesions include infantile myofibromatosis, LCH, chronic recurrent multifocal osteomyelitis (CRMO), metastasis, and hematologic disorders (leukemia or lymphoma). ** Imaging findings of tumors with different size and number will be provided during the lecture.

The degree of cortical involvement provides clues for different natures of bone tumors. Slow growing nonaggressive tumors arising from the medullary bone expand to cause erosion of the inner surface of the bone; this is known as endosteal scalloping. Aggressive bone tumors have rapid growth and the cortex is completely destroyed and breached by the lesion. Bone tumors arising from the outer surface of the cortex (periosteum or adjacent soft tissue) erode the outer surface of the cortex, resulting in saucerization. Saucerization associated with periosteal reaction and bone formation result in “buttress appearance” and can be seen in both benign and malignant bone tumors. ** Imaging findings of tumors with different spectrum of cortical involvement will be provided during the lecture.
In conclusion, plain radiograph enables definitive diagnosis of bone tumors in conjunction with other pieces of information, such as patient’s age, tumor location, margin, periosteal reaction, opacity, mineralization, size, number, and cortical involvement. Additional imaging studies including MR, CT scan and bone scintigraphy are often required to provide further differential diagnosis, tissue characterization, and to determine the extent of disease.
RC13. Recent Issues in Pediatric Vascular Imaging and Treatment

**Chairs:**

James Donaldson (USA),
Supika Kritsaneepai boon (Thailand)
Imaging of Vascular Anomalies in Children: State of the Art

Rajesh Krishnamurthy
Department of Radiology, Nationwide Children’s Hospital, Ohio State University, USA

This talk focuses on the pathophysiology, clinical presentation, and advanced imaging of hemangiomas and vascular anomalies (VA) in children. Multidisciplinary units have been created to manage patients with complex VA. Although most are diagnosed based on clinical findings, a thorough evaluation often requires additional imaging tests to determine the nature, extent, prognosis, and possible treatment options of these lesions. Different approaches for diagnosis of VA, including CT/CTA, MRI/MRA, and US will be discussed, including imaging findings, current and new approaches, as well as limitations of each approach, and the use of imaging to guide the standard of care for VA treatment and emerging interventional therapy options.

Learning Objectives:
• Introduction and classification of vascular anomalies and tumors in children
• Current understanding of imaging features that influence diagnosis and management in vascular lesions
• Limitations of current US and MR techniques for evaluation of vascular anomalies
• Pros and cons of new techniques: novel contrast agents, 3D SSFP, GRASP, 4D flow
• Optimal imaging algorithm for slow flow and high flow vascular lesions in children
New Endovascular Therapy For Various Lymphatic Leakage

Saebeom Hur
Department of Radiology, Seoul National University Hospital, Korea

1. Introduction
Lymphatic system, consisting of lymphatic ducts and lymph nodes, is an important organ, which plays an important role in immunologic reaction and fat metabolism as well as the body fluid circulation. It presents everywhere in our body. Cisterna chyli is where all the lymphatic system get together and finally return to subclavian vein through thoracic duct (Fig 1).1

Recently, a new breakthrough was made in interventional radiology field in diagnosis and treatment of various lymphatic leakages.
1. inguinal intranodal Lipiodol lymphangiography2
2. thoracic duct embolization3
3. N-BCA glue Lymph node embolization4
4. dynamic MR lymphangiography5

2. Treatment of lymphatic leakages after surgery
① Chylothorax: Efficacy of thoracic duct embolization is well-known.
② Chylous ascites: It is more difficult to diagnose and treat chylous ascites compared to other conditions because the contrast agent used in conventional lymphangiography does not flow into mesenteric lymphatic system where chylous lymphatic fluid is formed (Fig 2). There is a special condition when chylous ascites can be detected and treated, such as chylous ascites developed after retroperitoneal surgery (Fig 3). Mesenteric lymphangiography after open laparotomy is the final solution to visualize mesenteric lymphatic system but too invasive to be used as a primary diagnostic solution (Fig 4).

③ Pelvic lymphocele: Pelvic lymphocele is common complication after radical surgery including lymph node dissection in pelvic area. Recent study showed that the lymphatic intervention including lymph node embolization is superior to conventional sclerotherapy in the management of post-operative lymphocele4,6

Figure 1. Schematic picture of lymphatic system and distinct leakage pattern of lymphatic fluid

Figure 2.
3. Non-traumatic lymphatic leakages

Non-traumatic lymphatic leakages are rare but devastating symptom of various lymphatic dysplasia, which is often related to Noonan syndrome or Gorham’s disease. Lymphatic intervention including lymph node embolization and thoracic duct embolization can stop the leakage only with the understanding of pathophysiology, for which Dynamic MR lymphangiography plays an important role5, 7, 8 (Fig 5). In this lecture, new strategy and techniques to treat various non-traumatic lymphatic leakages in lymphatic dysplasia will be introduced.

4. References


Complication of Liver Transplantation: Imaging and Treatment

Marielle V Fortier
Department of Diagnostic Imaging, KK Women’s and Children’s Hospital, Singapore

A brief overview of liver transplant anatomy will be provided.

The expected imaging features in the early post-operative stage will be reviewed. This will be followed by an in depth discussion of the complications that can be seen post-liver transplant.

Complications can be classified into three categories: vascular, biliary and others.

Early complications include vascular thrombosis, biliary anastomosis leak, infection, haematoma and abdominal compartment syndrome.

Late complications include hepatic artery stenosis/pseudoaneurysm, portal vein stenosis, IVC-hepatic vein stenosis, biliary stenosis, cirrhosis and neoplasm.
Congenital portosystemic shunts (CPSS) are rare vascular anomalies with diversion of portal venous blood into a systemic venous system.

In human, the development of the hepatic venous architecture is extremely complex and is acquired between the 4th and the 6th week of gestation. It involves three groups of embryonic veins namely vitelline, cardinal, and umbilical veins. The portal vein formed from the vitelline veins. The lack of complete involution of one or several of these primordial vessels may give rise to abnormal communications between any vein of the portal system and any vein of the inferior vena cava system, the so-called CPSS.

CPSS can be associated with other anomalies especially cardiac and heterotaxia. The major complications related to CPSS include hepatic encephalopathy, hepatic tumors, pulmonary hypertension, and pulmonary arteriovenous shunts. Because of the lack of specificity of clinical presentation, radiological procedures play a major role to detect and characterize CPSS and screen for related complications.

There are two types of CPSS based on the hepatic portal perfusion either complete shunt (Type I) or partial shunt (Type II). In symptomatic patients with type I shunt, liver transplantation is a definitive treatment. Whereas in symptomatic patients with type II shunt, endovascular embolization or surgical ligation is a choice of treatment. Catheter angiography is essential for proper diagnosis and treatment since definitive evaluation of a small hepatopetal flow is not always possible by ultrasound, CT and MR imaging.

Our catheter angiography protocol includes both arterial and venous approaches. Transarterial portography is performed with femoral arterial puncture. For venous approach to introduce balloon occlusion catheter into the shunt, either internal jugular vein or femoral vein is selected based on location and direction of the shunt demonstrated by prior imaging. Transarterial portography is performed without and with balloon occlusion. Direct portography with balloon occlusion is essential to evaluate hepatopetal flow. In addition, portal venous pressure (PVP) is measured before and during balloon occlusion at 0, 5, 10 and 15 minutes. These procedures are performed under general anesthesia in the majority of cases. Based on our experiences, endovascular embolization is considered as the first-line treatment when the final PVP with balloon occlusion is below 25 mmHg. When the final PVP is between 25 and 30 mmHg, sensitive determination of the indication for shunt occlusion in one-step or two-step is performed.

In this lecture, our own experience of CPSS will be presented mainly focusing on angiographic classification and those cases treated with endovascular embolization. The pros and cons of different types of embolic materials will be discussed as well.
Day 3 - September 28, 2019

09:50-11:20 (90’) / Room A

RC14. Neonatal Imaging: Must-Knows

Chairs:
Kwanseop Lee (Korea),
Dorothy Bulas (USA)
Neonatal lung disease is a common cause for neonatal intensive care unit (NICU) admission. A variety of different diffuse and focal pulmonary disorders may affect the neonate and differentiation between these disorders is often challenging because the clinical and imaging features often overlap. Advances in maternal and neonatal treatment strategies and survival of younger premature neonates has led to changes in the prevalence of various neonatal lung diseases, and has altered the typical imaging findings encountered in modern practice. This talk will:

- Review causes of diffuse lung disease in preterm and full term infants.
- Describe imaging findings and clinical features that can help to differentiate between the diffuse neonatal lung diseases.
- Describe ways that advances in maternal and neonatal treatment have altered the imaging features surfactant deficiency disorder.
- Review causes of focal neonatal lung disease in neonates.
- Describe imaging findings and clinical features that can help to differentiate between the focal neonatal lung diseases.
Intestinal obstructions are the most common causes of surgical emergency in neonates. Prompt and accurate diagnosis is required to avoid potential morbidity and mortality.

Due to the advancement of prenatal imaging, multiple abnormalities are increasingly detected in fetuses. Findings suggested gastrointestinal abnormalities include polyhydramnios, dilated stomach or duodenum as well as non-visualization of meconium in the rectum.

Intestinal obstruction can be classified as “high” or upper gut obstruction and “low” or lower gut obstruction. In upper gut obstruction, the level of obstruction is usually proximal to the ileum. Patients usually presented with abdominal distention, vomiting or increased gastric residuals. In lower gut obstruction, the level is distal ileum and beyond. Symptoms of low gut obstruction include abdominal distention and failure to pass meconium.

Plain radiographs are usually the first imaging of choice in the evaluation of patients with suspected intestinal obstruction. It provides an overview of the level and degree of obstruction. If few dilated bowel loops (usually fewer than 4) were detected, the obstruction is proximal which is classified as upper gut obstruction. Other than the level of obstruction, differentiation between complete and incomplete gut obstruction is also important. If there is no distal gas other then a few dilated bowel loops, the obstruction is likely to be complete obstruction.

Some upper gut obstructions can be diagnosed using plain radiographs only because of unique or classic radiologic findings, such as esophageal atresia with or without distal fistula, duodenal atresia (classic “double bubble sign”) and jejunal atresia. Patients with complete upper gut obstruction usually required surgical intervention without further investigation.

On the other hand, patients with incomplete upper intestinal obstruction will benefit from further investigations. The choices of modality depend on conditions we are looking for. Ultrasonography is the modality of choice in patients with suspected hypertrophic pyloric stenosis (HPPS). In patients with malrotation and midgut volvulus, ultrasound may demonstrate whirlpool sign of the volvulus. However, an upper GI study remains the gold standard and demonstrates the duodenojejunal junction position. Other causes of duodenal obstruction include duodenal stenosis, duodenal web or annular pancreas.
Patients with lower intestinal obstructions usually require further investigation and the modality of choice is contrast enema. Positive findings for Hirschsprung's disease include transitional zone, abnormal contraction of aganglionic segment and delayed evacuation of contrast medium.

Colon with diffusely small caliber is called microcolon. This colon is “unused” in utero due to distal bowel obstruction and there was no meconium passing through. Mainly three conditions in the differential diagnoses should be considered, including meconium ileus, ileal atresia, and total colonic aganglionosis.

Patients with anorectal malformations are usually diagnosed clinically and were sent to surgery to performed colostomy. Distal loopogram will be performed to look for a level of obstruction and the presence of distal fistula.

In conclusion, an understanding of the imaging findings of various causes of neonatal obstruction will lead to the correct diagnosis and be a guideline for further radiological investigation.
Despite ongoing advances in neonatal care, necrotizing enterocolitis (NEC) remains a major cause of morbidity and mortality in infants. Approximately 1-5% of all neonatal admissions and up to 10% of neonates under 1500g are affected. The mortality of NEC ranges between 20-65%, depending on the selected research study. The pathophysiology of NEC remains poorly understood and appears to be multifactorial, ultimately resulting in mucosal damage, loss of bowel wall integrity, vascular compromise leading to necrosis and perforation. Several risk factors have been associated with NEC, including prematurity and most recently an altered intestinal microbiome that activates an uncontrolled inflammatory response. Furthermore, many questions remain regarding optimal preventive strategies, diagnostic considerations, and medical and surgical management.

Management depends upon severity of illness using the Bell's criteria. Medical management is initiated when NEC is suspected and consists of bowel rest, antibiotic therapy and close laboratory and radiologic monitoring. Indications for surgical intervention are quite debated in the literature, with the only universally accepted criteria for surgical intervention being the presence of pneumoperitoneum on abdominal radiographs. However, peritonitis, extensive necrosis, or perforation may occur without evidence of pneumoperitoneum on abdominal radiographs and the validity of the Bell's criteria has been questioned.

The great value of ultrasound (US) in these instances is that it allows the direct visualization of the bowel wall in cross-section with real-time imaging of peristalsis and bowel wall perfusion on color Doppler interrogation. Furthermore, complex peritoneal fluid and focal fluid collections, which presumably indicate perforation, may be clearly seen on US and may potentially prompt early surgical intervention, which may lead to improved outcomes. In synthesis, bowel US is an extremely useful adjunct to abdominal radiographs in infants with clinically suspected NEC as it provides greater information about the bowel wall and peritoneal cavity.


Despite MRI is being increasingly used and has gained widespread acceptance as the study of choice for the evaluation of neonatal encephalopathy (NE) in recent years, MRI costs are high, and access to MRI is sometimes limited for extremely sick neonates. Hence, head ultrasound (US) continues to be the first-line imaging modality for the evaluation of the brain in neonates with NE. Head US is non-invasive, inexpensive, and portable, allowing examinations to be performed without moving the infant. However, many of the head US findings of NE do not appear as conspicuous as they do on MR imaging, and may be easily missed. Recognition and familiarity of these subtle head US abnormalities may allow head US to play an important complementary role to MR imaging in the assessment of neonates with NE. These subtle findings may represent the ‘tip of the imaging iceberg,’ hence guiding further evaluation and improving management of these infants. In this lecture, these subtle signs will be discussed and illustrated.

Day 1 - September 26, 2019

13:30-16:00 (150') / Room B

Special Focus Session 01
Skeletal Dysplasia

Chairs:
Ok-Hwa Kim (Korea),
Gen Nishimura (Japan)
Individuals with skeletal dysplasias were commonly documented in ancient and classic art, because their disproportionate short stature came to artistic attention. For example, affected individuals were drawn in famous pictures painted by Velázquez – a woman with achondroplasia in Las Meninas, and a man with pseudoachondroplasia in Don Sebastián de Morra.

In the 19th century, skeletal dysplasias became the subject of medical research. A French physician, J Parrort, proposed the term achondroplasia for patients with micromelic short stature in his monograph (La syphilis héréditaire et le rachitisme, 1886). He believed that achondroplasia was caused by “fetal rickets” as a consequence of hereditary syphilis. A German pathologist, E Kaufmann, postulated the term chondrodystrophia foetalis in his treatise on “fetal rickets” (Untersuchungen über sogenannte fötale Rachitis, 1892), and divided the disorder into subcategories, chondrodystrophia hypoplastica, and chondrodystrophia hyperplastica. In the beautiful hand-drawn illustrations of his work, we can see that the former subcategory fits to thanatophoric dysplasia, while the latter to metatropic dysplasia.

In the early 20th century, X-rays started to be used in medical practice. Then, the radiological features of achondroplasia were clearly illustrated (Rankin G, Mackay EC: Achondroplasia, Med Chir Trans 89:395-418, 1906). The spread of radiographic technology led to identification of a number of skeletal dysplasia with distinctive bone phenotypes, which include: osteopetrosis (Albers-Schonberg, 1904), dysostosis multiplex (Hunter, 1917; Hurler 1919), diaphyseal dysplasia (Camurati, 1922; Engelmann, 1929), Morquio syndrome (Morquio 1929; Brailsford 1929), dyschondrosteosis (Leri and Weil, 1929), Pyle disease (Pyle 1931), dysplasia epiphysealis multiplex (Fairbank, 1935, 1946) and among others.

Even at this stage, however, individuals with short-limbed skeletal dysplasias tended to be lumped together as achondroplasia, while those with short-trunked skeletal dysplasias as Morquio-Brailford spondyloepiphyseal chondrodystrophy. In fact, spondyloepiphyseal dysplasia congenita (a type 2 collagenopathy) was initially not distinguished from Morquio syndrome (a lysosome storage disease).

In late 50s and 60s, physicians and radiologists who had sharp clinical eyes started to separate new entities from the chaos of “achondroplasia” or Morquio-Brailford chondrodystrophy, which include diastrophic dysplasia (Maroteaux and Lamy, 1960), cartilage hair hypoplasia (McKusick, 1965), spondyloepiphyseal dysplasia congenital (Spranger and Wiedemann, 1966), metatropic dysplasia (Maroteaux, Spranger, and Wiedemann, 1966), trichorhinophalangeal syndrome (Giedion, 1966), and Langer mesomelic dysplasia (Langer, 1967).

The 1992 revision was pivotal. The classification was based on a concept of bone dysplasia families proposed by Spranger (1985, 1988), which refers to a simple hypothesis that phenotypic similarities may indicate common pathogeneses. The prototype of bone dysplasia families was MPS, in which all subtypes manifest as dysostosis multiplex. In addition, Spranger proposed other families: family of achondroplasia (thanatophoric dysplasia, achondroplasia, hypochondroplasia), family of SEDC (achondrogenesis type 2, hypochondrogenesis, spondyloepiphyseal dysplasia congenita), family of Larsen syndrome/otopalatodigital syndrome, and family of Jeune syndrome/Ellis van Creveld syndrome. Later his presumption turned out to be correct. The first family was attributed to gain-of-function mutations of FGFR3, the second to COL2A1 mutations, and the third to FLNB/FLNA mutations, and the fourth was classified into a large group of skeletal ciliopathy.

In the molecular era of the early 21st century, disease-causing genes have been discovered in most skeletal dysplasias. The latest version of the nosology include more than 400 genetic skeletal diseases and more than 350 disease-causing genes. Most recently, the revolution of molecular techniques, particularly the next generation sequencing, has dramatically changed the diagnostic scenario for genetic disorders and genetic skeletal disorders. Whole exome sequencing, now used as a clinical tool, has even led to a “genotype first and phenotype later” approach. However, we should be aware of the fact that molecular results are not always crystal-clear. The clinical categorization is of the prime importance in patient management.

* This talk is largely owing to a lecture by Professor J Spranger (“The shoulder on Which we Stand”, the Skeletal Dysplasia Course Lausanne 2016) and a review article Professor A Superti-Furga and Dr. S Unger (Genetic disorders of bone – An historical perspective. Bone 102: 1-4, 2017).
Terminology: Skeletal dysplasias are developmental disorders of chondro-osseous tissue and are due to mutations of genes that regulate cell structure and/or function and are expressed continuously throughout the life of an individual.

Dysostoses are malformations of single skeletal elements, alone or in combinations. The chondro-osseous morphology is normal.

Disruptions are malformations of bones secondary to non-skeletal causes. Toxic substances, infectious agents or mechanical injury may act on the embryo for limited periods of time. They produce secondary malformations.

Osteolyses are disorders which permanently reabsorb and dissolve pre-existing normal bone.

The earliest classification of skeletal dysplasias (chondrodystrophies) was produced by Maroteaux and Lamy in 1961. It included eight different groups. At this stage, clinically different disorders had been reported under the same name, and individual disorders had been reported with various names. There was confusion!

In 1969 a cohort of experts – many of them Paediatric Radiologists – met in Paris at the instigation of the ESPR and prepared an ‘International Nomenclature of Constitutional Diseases of Bone’, resulting in several publications in the early 1970s. The early classifications were based on a combination of lethality, mode of inheritance and clinical and radiographic findings. Various groups were identified, for example the mesomelic (middle-limb) shortening group, or the epiphyseal (before-growth-plate) group.

The names of the conditions (nomenclature) are largely derived from ancient Greek (even though the names of parts of the skeleton are mostly derived from Latin) but there are also many eponyms and acronyms.

The 1970s and early 1980s saw the first evidence of ‘molecular pathology’ with the collagens (collagen 1 and osteogenesis imperfecta, and col-lagen 2 and chondrodysplasias). The late 1980s saw the discovery of underlying gene mutations. In 1983 a deletion in COL1A1 was identified in lethal osteogenesis imperfecta; and in 1989 a deletion was identified in a family with SEDC.
The concept of *disease families* with mild to severe manifestation arising from mutations in the same gene (collagen 1, collagen 2, **COMP**, and **FGFR3**) was proposed by Spranger in 1988.

We shall review the **diastrophic dysplasia family** of disorders to illustrate the problems of nomenclature and classification. This family comprises **diastrophic dysplasia**, with the severe, lethal achondrogenesis type 1B, slightly less severe, often perinatally lethal atelosteogenesis type II, and at the mild, almost normal end of the spectrum, autosomal recessive **multiple epiphyseal dysplasia**. These widely varying conditions are all the result of mutations in the DTD gene (diastrophic dysplasia gene).

Diastrophic dysplasia was named by Lamy and Maroteaux in 1960 and the name derives from ancient Greek meaning ‘thoroughly twisted’. The *DTD* causative gene was identified in 1994. Atelosteogenesis (meaning ‘without completed bone growth’) was delineated and named by Maroteaux in 1982 and referred to a group of conditions with the common finding of shortening and tapering of the distal ends of the long bones, especially the humeri. Type II was identified as a separate entity in 1987 and the mutation in the *DTD* gene identified in 1995. It had confusingly also been known eponymously as ‘de la Chapelle dysplasia’ and as ‘McAlister dysplasia’ and sometimes referred to as ‘neonatal osseous dysplasia’. Achondrogenesis (meaning ‘without cartilage growth’) was identified as a family of disorders by Spranger in 1974. The common finding was absent ossification of all, or most of, the vertebral bodies. Type 1B, initially defined in 1952 by Fraccaro, was found to have a mutation in the *DTD* gene in 1995. Autosomal recessive multiple epiphyseal (meaning ‘before the growth plate’) dysplasia was delineated in 1968 and the causative *DTD* gene identified in 1999.

Compounding the problems with naming conditions, as described above, there was also a similar story evolving around the nomenclature of genes. Originally named after the phenotypic condition or the molecule they were associated with, genes were then named for the function they performed. The diastrophic dysplasia gene (*DTD* gene) became the *DTDST* gene (diastrophic dysplasia sulphate transporter gene) and later the *SLC26A2* gene (solute carrier family 26, member 2 gene).

In conclusion we have looked at the diastrophic dysplasia family consisting of four clinically and radiographically distinct conditions, all with *SLC26A2* mutations. The names of the four conditions – all with ancient Greek derivations – show little relationship to each other, but historical groupings based on phenotypic (not genetic) similarities explain this.
To paraphrase Dr. Andy Poznanski, chondrodysplasia punctata (CDP) is not a single disease entity. Instead, CDP represents the radiographic phenotype caused by multiple diverse conditions resulting in stippled epiphyses and calcific puncta within various cartilaginous structures. CDP may be due to peroxisomal disorders, disorders of cholesterol synthesis, primary and acquired disorders of vitamin K metabolism, and in various other conditions. The radiographic pattern and clinical history are often diagnostic in evaluating the patient with CDP. Puncta and epiphyseal stippling are most evident radiographically at or shortly after birth and regress during childhood, resulting in growth arrest of affected bones. Although often radiographically subtle, involvement of the cervical vertebrae may result in clinically significant cervical spinal stenosis and instability. Several conditions resulting in CDP also demonstrate significant central nervous system manifestations, including Zellweger syndrome, rhizomelic CDP, and CDP secondary to maternal hyperemesis gravidarum.

The typical imaging appearance of several entities associated with CDP will be demonstrated, including extraskeletal findings when appropriate. It is hoped that the audience will gain a greater appreciation of the diverse conditions resulting in CDP, and that this knowledge will aid in the definitive diagnosis of these patients when encountered.

**Introduction**

- Image and histology of puncta
- Binder facies
- Puncta evolve over time

**Etiology of CDP**

- Peroxisomal disorders
- Cholesterol biosynthesis disorders
- Vitamin K metabolism disorders
- Others, including chromosomal

**Peroxisomal disorders**

- Zellweger syndrome
- Cholesterol ester deficiency (D-bifunctional protein deficiency)
- Rhizomelic CDP (RCDP)
Cholesterol biosynthesis disorders
- CDPX2 (Conradi-Hunermann syndrome)
- CHILD syndrome
- HEM/Greenberg dysplasia
- Smith-Lemli-Opitz syndrome

Vitamin K metabolism disorders
- Primary (genetic)
  - CDPX1 (Brachytelephalangic CDP)
  - Keutel syndrome
- Secondary (acquired)
  - Maternal SLE
  - Maternal MCTD
  - Maternal sickle cell disease
  - Maternal hyperemesis gravidarum
  - Warfarin embryopathy

Others
- Trisomy 9, 18, 21
- I-cell disease (Pacman dysplasia)
- GM1 gangliosidosis

Conclusions
Primary cilia are fine protuberances projecting from the cell body of almost every organ system and play a pivotal role in cell surface functions, such as chemical sensation, signal transduction, and control of organogenesis. The primary cilia do not have the capability of synthesizing proteins; all ciliary proteins are transported from the cell body to the ciliary tip. Impairment of the ciliary protein transport or ciliary stabilization mechanism causes a large group of disorders collectively known as “ciliopathy.” Based on clinical observations, it is thought that the primary cilia are particularly important in the kidney, liver, retina, brain, and bone. Most of the ciliopathies are inherited as an autosomal recessive trait.

“Skeletal ciliopathy” is a subset of ciliopathy characterized by distinctive skeletal changes. The skeletal ciliopathies include the most common prototypic disorder termed Jeune asphyxiating thoracic dysplasia (JATD), as well as Ellis-van Creveld (EvC) syndrome, Sensenbrenner syndrome, and short rib polydactyly syndromes (SRPSs) among others. The latter disorders share common clinical and radiological features with JATD. The clinical hallmarks of skeletal ciliopathies comprise thoracic hypoplasia with respiratory failure, body disproportion with a normal trunk and short limbs, and severely short digits occasionally accompanied by polydactyly. Reflecting the clinical features, the radiological hallmarks consist of a narrow thorax caused by extremely short ribs, normal or only mildly affected spine, modest shortening of the long bones, and severe brachydactyly with or without polydactyly. Other radiological clues include “trident ilia/pelvis” and “cone-shaped epiphysis of the short tubular bones.” Skeletal ciliopathies are commonly associated with extra-skeletal anomalies, such as progressive renal degeneration, liver disease, retinopathy, cardiac anomalies, cerebellar abnormalities and others. These non-skeletal features overlap with those commonly seen in non-skeletal ciliopathies, such as autosomal dominant and recessive polycystic kidney diseases, nephronophthisis, CNS ciliopathies (Joubert syndrome, Meckel–Gruber syndrome, Bardet–Biedl syndrome), and several forms of retinal dystrophy. The prognosis of skeletal ciliopathies is generally favorable, other than exclusively lethal SRPSs.

More than 20 genes that are related to skeletal ciliopathies have been discovered. Ciliary dysfunction as a result of mutations of these genes leads to abnormal Hedgehog and Wnt signaling that contributes to the skeletal abnormalities. The genotype-phenotype correlation is not always clear. Different genes are responsible for the same phenotypes, while the same gene is responsible for two different phenotypes. In addition, the mutation spectrum of a particular gene may create a continuous clinical spectrum of disorders; for example, DYNC2H1 mutations cause JATD and SRPS3/1. Moreover, new genes for skeletal ciliopathies have been increasingly identified.

Skeletal ciliopathy is one of the common “bone dysplasia families.” As Professor Nishimura mentions in his introductory
lecture, the concept of a bone dysplasia family was originally introduced by Professor J. Spranger in Germany in the 1980s. He attempted to lump radiologically similar skeletal dysplasias into the same family or the same group, and predicted that members (disorders) of the same family share common pathogeneses. Regarding skeletal ciliopathies, he brought attention to the radiological similarities between JATD and EvC.

In this lecture, we discuss the radiological pattern recognition approach to skeletal ciliopathies. In the diagnostic approach, radiologists first make broad categorization for a patient’s phenotype among bone dysplasia families. Once we determine that the phenotype belongs to the skeletal ciliopathy family, we can reach a final diagnosis based on distinctive radiological findings, as well as delicate radiological differences among entities of the ciliopathy family. Each disorder has subtle but characteristic radiological findings. Exquisite radiological assessment leads you to the final diagnosis. At the end of this lecture, you should be able to make a diagnosis for common skeletal ciliopathies.

We also shortly review the clinical and genetic features of skeletal ciliopathies, which radiologists should know in order to play an appropriate role in multidisciplinary care and scientific advancement of the complicated disorders. The number of skeletal ciliopathies identified has been increasing, which certainly will continue into the future, and the radiologist can take part in this scientific progress.

I would like to thank Dr. Nishimura in Tokyo and Dr. Grigelioniene in Stockholm for their help in preparing this talk.
Genetic Study for Skeletal Dysplasia

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Skeletal dysplasia (SD) is a group of genetic skeletal disorders comprising more than 450 specific disease entities which are caused by mutations of more than 250 causative genes. As genotypes for majority of the diseases have been identified, genetic study currently provides the definite diagnostic confirmation. However, it is sometimes difficult to correlate between genotype and phenotype because they are not in 1:1 matching. Conventional genetic tests include Sanger sequencing, multiplex ligation-dependent probe amplification (MLPA), karyotyping, in-situ hybridization and so on. They are targeting a specific gene, and relatively expensive. Because a laboratory has to establish a test for each candidate gene, tests for majority of candidate genes are not available except in a centralized big laboratory. However, in many cases of skeletal dysplasia, high expertise is required to determine which gene to test or sometimes it is impossible to determine it. Next generation sequencing (NGS) technology which was established over the last decade shed light on the genetic test of SD. NGS is a group of different technologies developed by several companies or research groups, but shares characteristics of simultaneous analysis of millions or billions of sequencing reactions. It starts with making a library of patient’s DNA fragments, and according to extent of the DNA fragments to be tested, they are categorized as whole genome sequencing (WGS), whole exome sequencing (WES), target sequencing or RNA sequencing. Nowadays, target sequencing is widely used for diagnostic purpose of many genetic disorders including SD. Gene panel can be designed to include genes to test. For example, osteogenesis imperfecta gene panel including 20 causative genes can be used to analyze sequence variation in all 20 genes at the same time.

Genetic study for SD needs to be selected according to the phenotype and estimated genotype. We categorized it into several groups. Group 1 is those showing specific phenotype with a single candidate gene and only a few mutant alleles. Examples are achondroplasia, Caffey disease, and osteogenesis imperfecta type V. A single spot Sanger sequencing is the optimal test. Group 2 is those showing specific phenotype with a single candidate gene but multiple mutant alleles. Examples are type II collagenopathy. Full sequencing of the candidate gene or target sequencing using a gene panel including the specific gene are the optimal test. Group 3 is those showing specific phenotype but multiple candidate genes and multiple mutant alleles. Examples are multiple epiphyseal dysplasia and osteogenesis imperfecta. Full Sanger sequencing of each candidate genes would be too expensive, so target sequencing is the optimal genetic test for this group. Group 4 is those who seems to be a SD case but could not be diagnosed specifically due to ambiguous phenotype, too young or too old age. Because the target gene cannot be specified, WES or comprehensive target sequencing may be the only option. Although NGS dramatically decreased the cost of genetic study for SD and widely expanded the genes that can be tested, judicious correlation between the phenotype and genotype remains mandatory, and radiologic phenotyping along with clinical evaluation remains as the most important part of diagnosis of SD.
An eponym is a person who first produced the object or activity, from whom something is said to take its name. The word is originated from the Greek “eponymos”, meaning giving name. There are numerous eponymic names used in the nomenclature of the diseases. However, over the years many people have condemned the use of eponyms in medical practice, and frequent criticism has been raised using the eponymic names because of the lack of indication of the source of each eponymic disease names and also a tendency towards confused eponymy; not infrequently, there are more names in a conjoined eponym with the condition in question.

Evolution of the nomenclature following relevant references for eponymous disease names has been continued over the long term years. At times, efforts were made to rename the disease, but usage of eponymic names remain despite efforts to change them, partly due to easy to remember than the descriptive long titles of the disease names. When someone identified a new dysplasia or syndrome, an extremely cumbersome descriptive title was usually used in the initial report. The trick is then to use the surname(s) of the initial report as the title of the disease on the following reports. Therefore, a single eponym, if it is harmonious or curious, will stand a better chance of being perpetuated in further publications than a long obscure title.

Many of the individuals whose names are well-known in the world of medical genetics made contributions to the understanding of the condition which bears their eponym. Eponyms are with us whether the personal preponderance is present or not. Surnames are used as the sole eponym and usually the first authors have played a major role in eponymy. Concerning individuals whose names are attached to genetic disorders led to curiosity. The purpose of this lecture is to present biographical and details of the original articles which the eponymic names derived in some skeletal dysplasias and syndromes. The majority of eponymic individuals are dead or long retired, but there are some individuals still active in their careers.

The lecture covers a few skeletal dysplasias and syndromes for which eponyms are still widely used and well known as well as also included a few skeletal dysplasias and syndromes which are recently known and have accepted in the nomenclature of the skeletal dysplasia. Here provided briefly the original articles which are the proof of the eponymous names whose names are generally or solely accepted as designations of skeletal dysplasia and syndromes. This lecture will provide interest and insight into the first articles appeared in the medical literature that sufficiently support the priority to show the history of the eponyms in the skeletal dysplasia.
Day 2 - September 27, 2019

16:20-17:50 (90') / Room B

Special Focus Session 02
Good Clinical Practice in Pediatric Radiology

Chairs:
Lane F Donnelly (USA),
Manisha Jana (India)
The Image Gently Alliance, originally the name Alliance for Radiation Safety in Pediatric Imaging, was created in 2007 by four founding organizations: the Society for Pediatric Radiology (SPR), the American Association of Physicists in Medicine (AAPM), American College of Radiology (ACR), and American Society of Radiologic Technologists (ASRT). This consensus membership proved to be foresightful, serving the Alliance very well in emphasizing the value of multiple stakeholder voices in organizational efforts. The mission of the Alliance is, “…through advocacy, to improve safe and effective imaging care of children worldwide.” The following material will summarize the continued value of the Alliance, discuss the strategy through which the Alliance meets its mission, review the tactics foundational in this strategy, and list some of the ongoing challenges and opportunities.

There is a clearly a continued need for informed use of medical imaging that uses ionizing radiation in children. For example, the lay media is replete with a great deal of misrepresentation of ionizing radiation, and potential risks, especially in children. A familiar and equally unfortunate voice to these ends is one of “harm and alarm”, also generated surprisingly from the medical, including imaging, communities. To mitigate this early and still ongoing attention, the Alliance in its early years focused on radiation reduction during medical imaging. This was in part justified by the fact that there was excessive use of radiation during medical imaging of children. As the Alliance has advanced, the emphasis now includes informed use, as reduction is not always requisite (the aim is to use the necessary amount of radiation for appropriate diagnostic quality). In addition, there has been a greater promotion of the value side of imaging rather than dealing solely with the risk/cost part of this medical dialogue: that is, we all know imaging saves children’s lives and is an essential tool for medical management. This point is often under represented.

The underlying strategy for the Image Gently Alliance is social marketing where ideas are marketed to alter societal attitudes, and the impact benefits the market, not those that market. Moreover, this strategy and ensuing tactics are embedded in a positive advocacy approach. The Image Gently Alliance is at its core an assurance (definition: a positive declaration that is intended to give confidence; a promise) organization. This positive perspective of the Alliance has been one for promoting change, and maintaining an approach of how one can do things better, rather than emphasizing the past deficiencies in pediatric imaging, and the “harm an alarm” attitude. Elements of this positive approach include recognized, simple and resonant branding, balanced efforts (“heads, hands, and heart”= expertise, work effort, and commitment), participation by relevant stakeholders in medical imaging (technologists, medical physicists, health physicists, nurses, and imaging physicians, especially radiologists), with a parity of representation. Additional elements to a successful Alliance include an economy of...
operation (fundamentally through the wealth of volunteerism) as well as maintaining independence from conflicts of interest (the Alliance does not accept contributions from industry save an initial unrestricted educational grant).

Tactics that comprise the Alliance social marketing strategy include three websites (home, for parents, and for providers), eight campaigns (Table), creation of speaker groups aligned for consistent talking points, scientific publications, newsletters, Alliance summit/conferences, presence at other medical specialty conferences, review of regulatory/accreditation/guidance documents such as from the International Atomic Energy Agency, International Commission on Radiological Protection, US Food and Drug Administration, US Environmental Protection Agency, and The Joint Commission, also in the US. Additional ongoing work includes assistant in the development of point of care decision support.

These tactics can be divided up based on a simple taxonomy of the message, messengers, and messaging. The message is simple and resonant: one size does not fit all and imaging needs to take into consideration the wide range of sizes (and radiation vulnerability) in the pediatric population. This is easily understood across groups even outside of medical imaging such as parents, public, and regulatory agencies. Messages include now a total of eight campaigns (Table). The messengers are the Alliance Members, now more than 117 professional societies/organizations (including specialties outside of imaging) of which 60 are international. This collective membership comprises far more than 1 million total medical professionals. These organizations are committed to the mission of Image Gently through a simple pledge, and also benefit the Alliance by serving as oracles for information from the Alliance as well as a liaison between their membership and Alliance expertise on various subjects and projects. This amplification of effort has been beneficial in campaign rollouts in particular.

<table>
<thead>
<tr>
<th>Completed Image Gently Campaigns (through September 2019)</th>
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<tbody>
<tr>
<td><strong>Computed Tomography</strong></td>
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<tr>
<td>Interventional Radiology</td>
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<td><strong>Fluoroscopy</strong></td>
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<td>Nuclear Medicine</td>
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<tr>
<td><strong>Radiography</strong></td>
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<tr>
<td>Dental Imaging</td>
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<tr>
<td><strong>Minor Head Trauma</strong></td>
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<td>Cardiac Imaging</td>
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Although the Alliance is a familiar and highly regarded organization, the attainment of the mission of the Alliance is difficult to measure. Certainly the value of the Alliance model is shared, as the Image Gently Alliance, the first such “campaign”, is now a more global effort with sister organizations including, AFROSAFE (French and English), ArabSafe, Canada Safe Imaging, EuroSafe, Image Wisely, Japan Safe Imaging and LatinSAFE. There have been numerous publications outlining the role of the Image Gently framework in improving imaging care in both individual hospital settings as well as across larger healthcare networks in the United States. Although the scale and scope of the Alliance impact is somewhat elusive, suffice it to see that the Alliance has achieved international recognition for its efforts in improving imaging care in children.

There continue to be challenges. These include (1) staying current (e.g., website), (2) a continued dependency on volunteer efforts, (3) measuring success, as noted above, (4) continued difficulties with the media in terms of a fair and balanced approach to medical radiation use and risk in children, (5) growing demands in coordinated efforts for the advancing global
networks in a radiation safety, and (6) the issue of unintended consequences. That is, there have been ruminations that actually the Alliance is promoting fear by virtue of its very existence. However, the overwhelming majority of medical imaging and other relevant societies take issue with this perspective, if for no other reason than by virtue of being Alliance members.

Notwithstanding the successes of the Alliance, there is a great deal to be accomplished and opportunities for informed use of imaging modalities that depend on medical radiation, especially for children. One of these, would be a more formal partnership with regions represented by the expertise of the AOSPR through development of similar campaigns in this region of the world.
The International Commission on Radiological Protection (ICRP) is a non-governmental charity that provides guidance and recommendations based on its integrated system of radiological protection. The system is governed by three key principles of justification (do more harm than good), optimization (performing the imaging procedure with the lowest needed radiation to answer the clinical question), and dose limits. For individual patients, there are no dose limits. However, the development of diagnostic reference levels (DRLs) at a local, regional, or national level allow a radiology facility to audit their practice and then to compare their practice to these reference levels. This is part of the ongoing optimization process. The ICRP has provided guidance for DRLs in ionizing radiation imaging for both adults and children in its publication 135 (2018) that is a starting point but not an end point for improvement opportunities. Achieving a DRL should be followed by a question of continual assessment of whether the facility can achieve the median reference value, for example. We begin with a description of forming a core team of the medical physicist, radiologist, and radiographer. The core imaging team should engage in ongoing quality audits of the imaging processes, with continuous learning to improve optimization and outcomes.
Contrast media are increasingly used in clinical imaging to provide vital clinical information that is often unclear on unenhanced images. Contrast media, however, can cause side effects just like in other drugs. As an expert in pediatric imaging, we need to be aware of these side effects and take as much precautions as possible. In this presentation, I would like to cover safety issues related to the most widely used iodinated contrast media (ICM) and gadolinium-based contrast agent (GBCA) in pediatric imaging.

Main Contents

- Acute hypersensitivity reaction and its prevention
- Nephrogenic systemic fibrosis (NSF) and recent trends
- Gadolinium deposition in the brain
Strategies to Minimize Sedation in Pediatric Body MRI

Rajesh Krishnamurthy
Department of Radiology, Nationwide Children’s Hospital, Ohio State University, USA

For MRI in children, sedation and general anesthesia (GA) are often utilized to suppress patient motion, which can otherwise compromise image quality and diagnostic efficacy. However, evidence is emerging that use of sedation and GA in children might have long-term neurocognitive side effects, in addition to the short-term procedure-related risks. These concerns make risk-benefit assessment of sedation and GA more challenging. Therefore, reducing or eliminating the need for sedation and GA is an important goal of imaging innovation and research in pediatric MRI. By employing appropriate accelerated and abbreviated approaches based on an understanding of the imaging needs and reporting elements for a given clinical indication, it is possible to reduce sedation and GA for pediatric chest, cardiovascular and abdominal MRI.

Learning Objectives:

1. Cover important physiological and technical considerations for pediatric body MR imaging
2. Discuss MRI techniques that offer the potential of recovering diagnostic-quality images from accelerated scans
3. Introduce the concept of reporting elements for important indications for pediatric body MRI and use this as a basis for abbreviating the MR protocols.
Special Focus Session 03
The Future of Pediatric Imaging and WFPI Outreach

Chairs:
Donald P Frush (USA),
Bernard F Laya (Philippines)
Historically, radiologists have always been early adopters of various technological advances as far back as the beginning of the use of Roentgen rays in medicine with the first clinical radiograph of an injured child’s wrist in 1896 at the School of Engineering at Dartmouth College in New Hampshire, USA. Interestingly, this first clinical radiograph is a pediatric case!(1,2)

Since the advent of Ultrasound, beginning of clinical cross-sectional imaging in the mid 60’s and early 70’ (3), we have seen continuous advancement of technology across all medical imaging modalities. We should expect no less and likely much more in the future. We, as pediatric radiologists, should be adapting these new technologies to improve and advance the imaging care of all our pediatric patients. Can we bring down radiation exposure even more in CT scanners or in Nuclear Medicine / PET imaging? Can MR imaging be even faster to approach the speed and the relative ease of operation as CT imaging and avoid sedation completely? Can we avoid using intravenous contrast agents for CT and MR? Should we advance the use of contrast agent in Ultrasound?

We should also be mindful of how technology can enhance our efficiency as imagers. Already, there are clinical examples of smart PACS systems adapting its user-interface to both the individual radiologist and the particular examination type thereby creating an optimal viewing environment to aid the radiologist user. We should also leverage technology to minimize medical errors not just in the display and interpretation of images but to gain efficiency throughout the entire workflow of a typical imaging department. From the instance when referring physician orders a diagnostic imaging examination, to schedule and triage for urgent examinations, to make decisions on which imaging equipment to use, to determine if sedation is necessary, to set imaging protocols, to the transfer of our interpretation into a smart interactive report, and the delivery of our smart report back to the referring physician, technology, such as Artificial Intelligence, is posed to positively affect all parts of this workflow.

AI stands for Artificial Intelligence but can also stand for “Assistant for Imagers” as in a special session held at the 2019 SPR annual scientific meeting. In this session, the emphasis of AI was not on achieving interpretations and diagnoses but rather on automated acquisition, rapid reconstruction of images, and automated post-processing of imaging data. AI will not replace radiologists but rather significantly enhance our efficiency. We should take advantage of AI to transform the practice of pediatric radiology. With the added efficiency, we can create time during our workflow to interact with patients and their parents, to make our daily work even more enjoyable thereby avoiding burnout, and add value to our product such that pediatric radiology will never be a commodity.
References:
1) https://250.dartmouth.edu/highlights/first-clinical-x-ray-america-performed
2) Radiographics 2008 28(4)  https://doi.org/10.1148/rg.284075206
Peer Learning Systems in Radiology

Lane F Donnelly

Department of Pediatrics, Stanford University School of Medicine, USA

Over the past several years, there has been a movement in radiology from a “peer review” model of performance evaluation to a “peer learning” model of continuous feedback, learning and improvement [1-4]. This movement gained momentum related to the Institute of Medicine’s publication on diagnostic error and the recognition that organizations that embrace error as an opportunity to learn, outperform those who do not [1-3]. In this presentation, key factors in transitioning from a peer review model to one of peer learning, as previously described [1], will be outlined. Factors to be discussed will include: 1) sequestering learning and improvement activities from monitoring for deficient performance, 2) method of case identification: moving from random sampling of cases to active inclusion of identified learning opportunities, 3) replacing numerical scoring of errors with qualitative descriptions of learning opportunities, and 4) organizing the peer learning program [1].

Sequestering Learning and Improvement Activities from Monitoring for Deficient Performance

Over the past 15 years, the most common system used for peer review in the USA has been the RADPEER product of the American College of Radiology (ACR). Although not the initial intent, the 4-point score-based system to evaluate for diagnostic errors has come to be used as a way to measure individual practitioner performance via individual error rates, often for use in evaluating as to whether particular radiologists may be demonstrating outlier performance [1-4]. There are two problems with this approach. 1. It does not work, in the sense that very few radiologists are identified as outliers related to the rare reporting of errors and 2. It leads to underreporting of errors and an inability to use that material to improve, related to the punitive nature [1-4]. The competing frameworks of studying errors to improve performance and learning versus to identify poor performers cannot optimally co-exist in the same process. It is important that these two such frameworks be sequestered from each other in process.

Method of Case Identification: Moving from Random Sampling of Cases to Active Inclusion of Identified Learning Opportunities

Historically, many peer review systems rely on the random selection of cases. This approach has been because of the ability to calculate error rates for individual radiologists. The problem is that the majority of cases where significant errors have occurred, particularly those with learning potential, are rarely identified by random audit. Cases with errors and potential learning potential are much more commonly identified through other mechanisms such as consultation with referring physicians, review of previous comparison studies, pathology / surgical discrepancy reports, discussion at clinical conferences, complaints to radiology leadership, and incident reporting systems. For a peer learning system to be optimal, the emphasis must be on the use of cases in which active identification of cases with learning opportunities has occurred [1-4].
Replacing Numerical Scoring of Errors with Qualitative Descriptions of Learning Opportunities

Historically, peer review systems have relied heavily on numerical scoring systems, such as the one used in RADPEER. However, peer scoring is increasingly be viewed as a nonproductive aspect of peer review. There is a growing movement to abandon peer scoring for classification systems that can facilitate learning. Some have chosen to also sub-divide items identified as learning opportunity into categories such as issues of perception, interpretation, technical aspects / protocol, reporting, communication, radiologist recommendations, or other process-related aspects [2].

Organizing the Peer Learning System

There are many important aspects to organizing a peer learning system to position it for success. Important items that will be discussed include: 1. Defining peer learning leadership and governance, 2. Potential use of a software system for submitting cases, 3. Defining mechanisms for providing confidential feedback to individuals, 4. Conducting effective peer review conferences, 5. Linking peer learning to process improvement, and 6. Meeting regulatory requirements for peer review (OPPE and FPPE in the USA) [1-4].

References

Reducing Radiation Exposures in Children: The Way Forwards

Wendy Lam

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Children are more sensitive to radiation exposure and have a longer life ahead of them in which to manifest the effects of exposure. There were many ways to minimize radiation exposure to kids without sacrificing image quality. This included the use of x-ray equipment specifically developed for pediatric patients; limiting the region of body being scanned; tailored examinations to size of patient; low dose CT etc. The detail imaging and CT protocols could be found on many websites, such as Image gently: www.imagegently.org.

In addition to these measures, the future way to go is to develop a low dose culture among the healthcare workers, referring clinicians, radiologists, technologists, industry, community and family.

The promotion of children medical imaging record may be another way to monitor the radiation dose of children in future.

The practice of pediatric radiology in different countries is very complex. It may uphold a high standard of care in well-developed area. On the other hand, high end CT or MR machines may not be available in low resources area. The applications of US are comparable to other types of imaging, such as MR and CT, but costs are significantly reduced and prices continue to decrease. The use of US, especially the increasing new application of US contrast, may reduce the need of CT scan or fluoroscopy.

In low resources area, portable or hand-held US may be a solution and reduce the need of X-ray or CT scans. The devices can be a small fraction of the cost of traditional ultrasound. There is potential for portable ultrasound to be brought to rural villages by designated healthcare workers clinics or at-home visits. The use of less complicated devices and basic levels of training could have a significant health benefit in low-resource settings and be cost effective.

In high resources area, with the development of new fast MR protocols, MR can help to reduce the need of CT scan and sedation time in pediatric patients. World Federation of Pediatric Imaging (WFPI) has engaged and lined up with three major MR vendors in the development of rapid and minimally required sequences protocols. These simple protocols can be done in low resources area with low end machines. Topics include rapid brain, Chest/abdomen LN screening, infection spine, whole body MR etc. These protocols will be shared among all users after validation.

The other problem is the lack of trained pediatric radiologists in many low resources area. With advances in technology, one of the way forwards is the use of AI to enhance and augment reading of CXR. This can help to streamline workflow and improve access to experts. There may be a lot of collaborations between countries and developments in the future.
The WFPI is a coalition of international pediatric imaging societies including North America (SPR), Europe (ESPR), Latin America (SLARP), Africa (AfSPI) as well as AOSPR. It provides a united platform to address challenges in pediatric imaging, including training, delivery of services, outreach and educational efforts, global child imaging protection and collaboration with other global health organizations. Outreach and education go hand in hand. As a global organization, the WFPI relies on social media to communicate using Facebook (https://facebook.com/WFPIeducation), twitter (https://twitter.com/WorldFederation) and the web (https://www.wfpiweb.org) to distribute information and grow content for those with limited educational resources.

Supporting pediatric radiologists who volunteer to work in low resource environments is an ambitious goal and we believe that working in collaboration with other entities (such as RSNA, Imaging the World, RadAid, WHO) enables us to be more effective. Teleradiology has its limitations but successful partnerships have been established including Laos’ Friends Children’s Hospital in Luang Prabang. A current WFPI initiative is creating on site manpower in low-resource settings. The majority of pediatric imaging, even in advanced societies, is performed by general radiologists. Providing specialized training for those interested in pediatrics is one goal with funds now available for three-month long WFPI scholarships. Fellowships in South Africa, India, and the Philippine’s have been completed with South America to follow. As a global organization, the WFPI is aware of the immensity of the task and of the multiple issues that are part of its mission. With the collaboration of highly qualified pediatric radiologists including AOSPR members, plus association with other organizations, we are on the way to further address the needs for safe, appropriate imaging of children.
The World Federation of Paediatric Imaging brings together Paediatric Radiologists and paediatric imaging societies across all continents. It aims to create the family of doctors involved in imaging children in every corner of the globe. It aspires to be a common platform for education, communication and close cooperation in the field of paediatric imaging, offering support, care and friendship.

Recent developments in imaging techniques and advances in IT technology, give us the perfect tools and opportunities to develop and expand the global network of paediatric radiology involving all countries and all centres. Knowledge and education resources can be now shared and accessible to all members, regardless of the country or income level. Previously, this information was limited to a select group, to those who were able to buy expensive books and access information as fee-paying members of the professional societies. Therefore, the expansion and further development of educational library is one of our main aspirations and goals.

Recorded lectures, presentations, on-line workshops and training material will create valuable sources of information, not only for students and residents, but also experienced radiologists and consultants. Having an international input and multinational teams, will help to cover the wide range of pathologies and various aspects of imaging, relevant to all regions and all geographical locations.

The TB group is an excellent example, with core members from India, the Philippines, South Africa and other associates from Asia, Africa, the Americas and Europe.

The work of the MRI group will also be available on the WFPI website very soon, sharing knowledge on how to perform and optimise MRI scanning techniques, how to choose the best sequences and protocols, among many different options available on the market.

Other important topics and aspects of paediatric imaging, are waiting to be developed, such as CT scanning techniques, radiation protection, clinical referral guidelines, to mention just a few.

Practical knowledge and experience is equally important in our work as paediatric radiologists. Therefore, the WFPI is further expanding this part of our international collaboration. The observership and fellowship programmes will be available in more centres and countries, with more outreach courses and workshops being planned over the next years. Courses will cover a range of topics and components of paediatric radiology, and will be tailored to both local and regional needs, to provide maximum benefits for participants. Involvement of international and local faculties is a must, so we can learn from each
other and share our individual experiences of working in different climate zones and medical systems with differing levels of development and available equipment.

Most Paediatric Radiologists in the world (mainly in low and mid-income countries), work in the very small teams or in isolation: being the only radiologist in the hospital or the sole radiologist with paediatric interests in the imaging department. Support and help in everyday work are extremely important, beneficial, and in many ways essential to provide a high quality imaging service. Sharing and discussing cases and patient scans are not only helpful in managing and treating the individual patient, but also in building the Radiologist’s knowledge and experience.

To meet this urgent need, the WFPI has created the ‘tele-radiology reading’ initiative, provided through the global telemedicine network, in collaboration with Medicines sans Frontiers. The WFPI members offer to report, second read and provide advice on paediatric scans from various hospitals and imaging centres. Currently, this system is used by a number of hospitals in Cambodia, Jamaica, Laos and Mozambique. The platform can be easily expanded and there are plans to extend this valuable resource to other countries and regions. Everyone can be involved in this initiative; both as a reader/reporter and as a person sharing interesting scans or asking for a second opinion.

Working as a Radiologist is not only about reporting scans, performing diagnostic investigations, but also being a part of the multidisciplinary teams in our hospitals, influencing the provision of healthcare, by developing an adequate imaging services, management and leadership. We can achieve this by working together, learning from each other experience and sharing ideas. There are already monthly meetings in place, when the representatives of paediatric societies from all continents attend ‘virtual’ meetings to discuss common needs and current projects run by the WFPI. In the near future, we will be able to expand connectivity to create a range of professional interest and discussion groups, to allow everyone to be actively involved in programmes. MRI or CT imaging committees, neonatal imaging, radiation protection and other groups are possibilities worth exploring.

The World Federation of Paediatric Imaging should become an active network and family for all paediatric Radiologists, regardless of ethnicity or place of work, to promote and develop paediatric imaging services worldwide.
Day 1 - September 26, 2019

13:30-14:30 (60') / Room A

MC01. Pediatric Neuro and HN

Chairs:
Hye-Kyung Yoon (Korea),
Pek-Lan Khong (Hong Kong China)
The last decade of the 20th century was designated *The Decade of the Brain* "to enhance public awareness of the benefits to be derived from brain research". This was a multinational movement, with Japan developing the Riken Brain Science Institute, India the National Brain Research Centre, and China the Chinese Institute of Neuroscience, among others. Caught up in this wave of enthusiasm was a new way of approaching the treatment of people presenting with acute stroke. The traditional approach of supportive care leading to physical therapy was replaced with an aggressive strategy to open blocked cerebral arteries and reverse the damage before it became permanent.

As arterial ischemic stroke is a pathology overwhelmingly seen in older adults, the pediatric specialties lagged in their adoption of these strategies. And while the aggressive treatment of acute stroke was not pressed upon pediatric centers, there was a growing awareness that with the standard of care changing for adults, it would also have to change for children. But how much of the new treatment paradigm for addressing acute stroke in the adult should be translated to children?

There are practical limitations to applying acute stroke care to children; endovascular therapies may be compromised by the small size of affected vessels, the need for general anesthesia, and the limited experience of interventionists with pediatrics. The dominant underlying cause of arterial ischemic stroke in adults, atherosclerotic disease, does not exist in children; how then can the experience in adult patients be accurately translated to children with different pathophysiology? The clinical presentation of cerebral ischemia in children is considerably different than in adults, and it is a greater challenge to recognize for both the family and the gatekeeping health care provider. Finally, and perhaps most importantly, the natural history of stroke in children is drastically different than in adults. There is ready justification for potentially dangerous therapy in a disease process with a dismal outcome when untreated; how much risk can be reasonably borne when the natural history is less severe, or at least more subtle?

This presentation will focus on the approach we take at our large stand-alone pediatric hospital, with a focus on the role of the pediatric neuroradiologist as navigator and facilitator attempting to guide the optimal management of the pediatric patient presenting with an acute neurologic deficit.
Monitoring Postoperative Neurocognitive Dysfunction through the Use of Radiomics based on MRI in Children with Moyamoya

Shujie Wang¹, Ming Yang¹, Meijiao Zhu¹, Rui Zhang², Weihang Sun³

¹Department of Radiology, Children’s Hospital of Nanjing Medical University, Nanjing, China, ²Department of Neurosurgery, Children’s Hospital of Nanjing Medical University, Nanjing, China, ³Department of Biological Science and Medical Engineering, Southeast University, Nanjing, China

Background / aims: To assess the value of radiomics based on MRI in the identification and quantitative evaluation of postoperative neurocognitive dysfunction in Children with moyamoya disease.

Methods: A prospective study was conducted in 13 subjects with moyamoya disease (of whom all underwent direct arterial anastomosis) in Nanjing Children’s Hospital, China in 2018. 14 normal subjects were enrolled as control group. Neurocognition was measured using Wechsler Intelligence Scale for Children (WISC) scale to estimate IQ. Histograms of apparent diffusion coefficient (ADC) and texture features of the whole brain were extracted and correlated to age, time of operation and IQ scores. Diagnostic performance of all features was then evaluated and compared through independent-samples t test and receiver operating characteristics.

Results: In the moyamoya group, the 10th-50th ADC was negatively correlated with the age of the children, the 10th-45th ADC was negatively correlated with the duration of the disease, and the histogram value of 80th-95th was negatively correlated with the operation score of the patients, while the parameter value in the control group was not significantly correlated with the age and intelligence scale scores. In addition, the operation score of moyamoya group was lower than that of the control group, and the difference was statistically significant. The ADC mean, skewness, kurtosis, variance and 25th-95th ADC in the two groups were statistically different, and the histogram value of moyamoya group was higher than that of the control group. Texture analysis results did not differ between the two groups. ROC results showed that the area under the curve of the 75th ADC value was the largest, 0.920.

Conclusions: Postoperative neurocognitive dysfunction exists in patients with moyamoya disease, radiomics has excellent performance in the identification of impaired cerebrovascular reactivity in patients with moyamoya disease, and it has the potential to serve as a noninvasive imaging analysis tool to monitor cerebrovascular reactivity in patients with moyamoya disease.
Monitoring Cerebral Perfusion after Indirect Revascularization in Children with Moyamoya Disease by Using Arterial Spin-labeling MR Imaging

Seul Bi Lee, Seunghyun Lee, Young Hun Choi, Gayoung Choi, Yeon Jin Cho, Jung-Eun Cheon, Woo Sun Kim, In-One Kim

Department of Radiology, Seoul National University Children's Hospital, Seoul, Korea

Background / aims: To assess the role of arterial spin-labeling (ASL) magnetic resonance (MR) imaging in identifying perfusion changes after indirect revascularization in children patients with moyamoya disease (MMD).

Methods: From January 2016 to December 2018, 38 children with Moyamoya disease (15 boys and 23 girls; mean age 6.6 ± 2.9 years) underwent encephalo-duro-arterio-synangiosis (EDAS) surgery. We compared the absolute cerebral blood flow (CBF) in the vascular territory at the operative side between preoperative and postoperative ASL MR. We also assessed the change of the relative CBF and time-to-peak value at the EDAS area regarding the cerebellum at the ASL MR and the dynamic susceptibility contrast-enhanced (DSC) perfusion MR, respectively. We also evaluated the collateral and parenchymal blood flow using arterial transit artifact (ATA) scoring with a 3-grade scale (no, mild, or strong ATA) and 4-grade scale (no perfusion, mild, moderate, or good revascularization) using the Wilcoxon-signed rank test. The correlation between the quantitative and qualitative parameters was evaluated using Spearman’s correlation test.

Results: There was no difference between the preoperative and postoperative absolute and relative CBF values in the EDAS area (79.6 vs. 84.4 ml/100g/min and 1.594 vs. 1.649, P = .144 and P = .483). The value of TTP delay at the postoperative MR was improved compared to that of preoperative MR (0.14 vs. 0.07, P = .003). The collateral scores at the EDAS area decreased from the grade of 1.49 to 1.00 (P < .001), which means the replacement from the delayed abnormal flow into the normalized arterial flow in the EDAS area. The parenchymal perfusion scoring at the EDAS area also improved from the grade of 2.16 to 3.09 (P < .001) after revascularization surgery. There was significant correlation between the perfusion status scores and relative TTP values (P < .001, r = .497).

Conclusions: ASL MR can be used for the monitoring cerebral perfusion status with collateral and parenchymal perfusion, and the perfusion status scoring might correlate with the relative TTP values in children with MMD after indirect revascularization.
Myelination and Cerebral Perfusion Change in the Developing Brain

Hyun Gi Kim
Department of Radiology, Eunpyeong St. Mary’s Hospital, The Catholic University of Korea, Korea

- Concept of brain maturation
- Brain maturation and MRI
  - Myelination: DTI, MT, APT, MWF, QSM
  - Cerebral Perfusion: ASL

Brain maturation is a complex process including following changes: (1) Decrease in water content of the brain tissue, (2) Increase in the number and size of astrocytes and oligodendrocytes, (3) Myelination and vascularization processes, and (4) Development of neurons and new dendritic connections.

Myelination is important because the spatiotemporal developmental process of myelination is thought to be associated with adequate function and behavior in children. Numerous developmental and psychiatric conditions showed an association with the myelination of the white matter. There are various aspects of brain development that can be evaluated with MRI apart from myelination. Still, the degree of myelination was the key component to be assessed using MRI since 1988.

Functional activity and brain maturation can be indirectly measured by the cerebral metabolic rate. Therefore, attempts have been made to measure CBF regarding brain development. In the past, PET-CT and xenon-enhanced CT were used to estimate CBF even in neonates. However, since arterial spin labeling has been developed, it became a useful tool to measure CBF in children. This sequence is a non-invasive method for evaluating CBF. However, there are factors that we have to consider when applying arterial spin labeling in neonates.
Day 1 - September 26, 2019

14:50-16:00 (70') / Room A

MC02. Cardiovascular Imaging

Chairs:
Shi-Joon Yoo (Canada),
Yumin Zhong (China)
Improvements in surgical techniques and medical treatment over the past two decades have increased the life span of patients with cyanotic congenital heart diseases more than ever. An understanding of the surgical procedures used to treat patients with cyanotic congenital heart diseases and of their postoperative appearances on MR images is a basic requirement for radiologists to be able to differentiate normal postoperative findings from complications.

The postoperative complications that appear in connection with cyanotic congenital heart disease constitute a new diagnostic challenge for the radiologist, requiring familiarity with the anatomic and functional complexities of palliative and corrective surgical procedures.

Cardiac MRI is an ideal technique for evaluating postsurgical morphology and function in these patients. Contrast-enhanced 3D MR angiography (MRA), in turn, can be used to effectively assess the extracardiac aspects of surgery. Cine MR is now generally recognized as the most accurate and reproducible technique for assessing global ventricular function. It was ideally for serial assessments of RV & LV function that had undergone therapeutic interventions.

MR can also calculate the pulmonary flow and assess the severity of pulmonary regurgitation. MR is useful for the assessment of post-operative changes of coarctation of aorta and pulmonary artery anatomy. The measurement of collateral flows in descending aorta can give an estimation of severity of the residual coarctation of aorta after operation. Late Gd-enhanced MR can also be used to assess the transmural fibrosis in RV & LV in post-operative cases of congenital heart disease.

The disadvantage of MR compared to CT was its relatively long imaging acquisition time and the need of longer sedation in infant and small children. Breath holding was required in cardiac imaging. The spatial resolution of MR angiogram was inferior to CT angiogram, and CT was superior to MR in coronary artery imaging. However, MR cardiac imaging was less dependent on the heart rate compared to CT.

This lecture will include some common surgical palliation and repair procedures performed in patients with cyanotic congenital heart diseases and aims to contribute to that understanding. Examples of postoperative complications after palliative procedures such as in patients with cyanotic congenital heart disease and the surgery performed to correct tetralogy of Fallot and dextroposed transposition of the great arteries (D-TGA) will be shown.
References:


2. XC Liang, WWM Lam, Eddie Cheung et al. ‘Restrictive right ventricular physiology and right ventricular fibrosis as assessed by cardiac magnetic resonance and exercise capacity after biventricular repair of pulmonary atresia and intact ventricular septum’ Clin Cardiol 2010 33, 2,104-110


5. PC Chow, XC Liang, Eddie Cheung, WWM Lam, et al. ‘Novel Two-dimensional global longitudinal strain and strain rate imaging for assessment of systemic right ventricular function’ Heart online 29 Jan 2008 (10.1136/hrt.2007.131862)


Abstract _Oral_

**MC02_01**

**Cardiac T2* MR Analysis of Membranous Interventricular Septum in Assessment of Cardiac Iron Overload in Pediatric Thalassemia Patients: A Pilot Study**

Ishan Kumar¹, Priyanka Aggarwal², Ashish Verma¹, Ram C Shukla¹, Vineeta Gupta²

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**Background / aims:** To assess whether the T2* matrices of membranous interventricular septum (MIVS) produced different sensitivities in evaluating cardiac iron overload, in comparison with the traditionally obtained muscular interventricular septum (IVS) and to evaluate relationship of the myocardial T2* at these two locations with MRI estimated liver iron concentration (LIC) and electrocardiographic parameters.

**Methods:** Cardiac and Liver MRI of 16 consecutive pediatric cases of transfusion dependent Thalassemia major within a year were done to calculate liver iron concentration and T2* time of membranous and muscular interventricular septum. ECG parameters of these patients were charted and correlated with MRI parameters.

**Results:** No significant correlation between muscular IVS and membranous IVS T2* value was observed with significantly lower mean T2* of membranous IVS (9.8 ms) than that of muscular IVS (26.9 ms). Higher correlation between T2* of MIVS was observed with LIC in comparison with muscular IVS. Significantly higher mean QTc value (439.86 ms) was seen in the group with cardiac iron overload (T2* IVS < 20ms).

**Conclusions:** Addition of T2* analysis of membranous interventricular septum to current MRI protocol consisting of muscular IVS analysis, may offer a more sensitive estimation of cardiac iron overload.

**MC02_02**

**Subclinical Left Ventricular Dysfunction in Acute Myocarditis: Assessed with Three-Dimensional Cardiac Magnetic Resonance (CMR) Feature-Tracking Myocardial Strain Analysis**

Ling-Yi Wen, Hang Fu, Ran Sun, Ying-Kun Guo

Department of Radiology, Key Laboratory of Birth Defects and Related Diseases of Women and Children of Ministry of Education, West China Second University Hospital, Sichuan University, Chengdu, China

**Background / aims:** The diagnosis of acute myocarditis with atypical CMR sign is challenging. This study aimed to assess the subclinical left ventricular dysfunction in acute myocarditis with normal ejection fraction and without early or delayed enhancement by 3.0 T three-dimensional cardiac magnetic resonance feature-tracking, comparing with myocarditis patients with early or delayed enhancement and normal control.

**Methods:** Study population consisted of 3 groups. Group 1 included 18 consecutive acute myocarditis patients with normal ejection fraction and without early or delayed enhancement. Group 2 included 20 consecutive acute myocarditis patients with normal ejection fraction and with early or delayed enhancement. Group 3 concluded 15 normal controls. All patients underwent CMR examination within 5 days after their admission. Three-dimensional myocardial feature-tracking strain analysis was performed according to AHA myocardial segmentation and compare among groups.
Results: There were no significant difference in age (14.0±7.0 vs 14.4±4.7 vs 17.8±5.1 years, p=0.45) and ejection fraction (61.8±7.0 vs 69.6±24.3 vs 65.6±3.2%, p=0.18) among three groups. Acute myocarditis patients with normal ejection fraction and without early or delayed enhancement demonstrated significantly lower peak circumferential displacement (PCD) (-1.6±3.8 vs 2.3±3.5 vs 4.8±1.7 mm, p=0.015), peak longitudinal displacement (PLD) (1.9±7.2 vs 9.1±1.8 vs 10.0±2.1 mm, p=0.002) and peak longitudinal systolic velocity (PLSV) (10.8±52.7 vs 61.7±18.5 vs 67.8±30.8 mm/s, p=0.008) in basal segment, lower PCD(2.6±2.8 vs 5.7±1.3 vs 6.5±1.3 mm, p=0.028) and PLD(7.1±40.1 vs 45.2±16.4 vs 49.4±24.7 mm, p=0.003) in middle segment, lower PCD (0.27±3.2 vs 3.3±2.0 vs 4.7±1.4 mm, p=0.01), PLD (1.7±4.1 vs 5.7±1.2 vs 6.4±1.4 mm, p=0.003), peak circumferential systolic velocity (PCSV) (-4.2±36.8 vs 33.0±29.3 vs 53.7±23.5 mm/s, p=0.022) and PLSV (13.5±32.4 vs 44.2±15.4 vs 48.0±23.9 mm/s, p=0.013) in global when compared with group 2 and 3, while there is no significant difference between group 2 and 3 in those parameters.

Conclusions: In patients with acute myocarditis with atypical MRI sign, three-dimensional CMR feature-tracking myocardial strain analysis appears to be a useful tool for diagnosis, since it seems to be able to identify subclinical myocardial deformation in early stage of acute myocarditis.
Improving Image quality of Aorta and Pulmonary Artery Root for Children with High Heart Rates Using Second-generation Motion Correction Algorithm

Jihang Sun¹, Haoyan Li¹, Darin Okerlund², Yun Peng¹

¹Department of imaging, Beijing children's hospital, Beijing, China, ²Department of ct department, GE Healthcare, Milwaukee, United States

Background / aims: To evaluate the effectiveness of a second-generation, whole heart motion correction algorithm (SSF2) in improving image quality of Aorta and pulmonary artery root in cardiovascular computed tomography angiography (CCTA) for children with high heart rates.

Methods: 42 consecutive symptomatic cardiac patients with high heart rates were enrolled. All patients underwent CCTA on a 256-detector row CT using prospective ECG-triggered single-beat protocol. Images were reconstructed with the state-of-the-art first-generation coronary artery motion correction (SSF1), and SSF2. The image quality of Aorta and pulmonary artery root was assessed by two experienced radiologists using a 4-point scale (1: nondiagnostic; 2: detectable; 3: measurable and 4: perfect). Cases were further divided into the very high heart rate (VHHR) group and high heart rate (HHR) group using 120bpm as a cutoff for analysis.

Results: The average patient age was 1.2±1.3 years (5 day-6 year), and the average heart rate was 122.6±18.8 (78-151) bpm. The overall image quality scores were improved to 3.3±0.6 with the use of SSF2 from 2.5±1.0 with SSF1 for the Aorta, and to 3.0±0.8 with SSF2 from 2.6±0.9 with SSF1 for the pulmonary root (all p<0.05). In HHR group, image quality scores were improved to 3.1±0.9 with SSF2 from 2.8±1.0 with SSF1 for the Aorta, and to 3.4±0.5 from 3.0±1.1 for the pulmonary artery root. But the improvement was not statistically significant (all p>0.05). The bigger image quality improvement happened for the VHHR group where the quality scores were improved to 3.2±0.6 with SSF2 from 2.1±0.8 with SSF1 for the Aorta, and to 3.1±0.6 from 2.6±0.9 for the pulmonary artery root (all p<0.05).

Conclusions: A second-generation, whole-heart motion correction algorithm significantly improves CTA image quality of Aorta and pulmonary artery root for pediatric cardiac patients with high heart rates, especially with heart rates higher than 120bpm.
Clinical Significance of Myocardial Dysfunction in Right Ventricular Heart Disease Assessed by Cardiac Magnetic Resonance-based Feature-Tracking

Akio Inage¹, Naokazu Mizuno²

¹Department of Pediatric Cardiology, Sakakibara Heart Institute, Fuchu-city/Tokyo, Japan, ²Department of Radiology, Sakakibara Heart Institute, Fuchu-city/Tokyo, Japan

Background / aims: The objective of this study was to evaluate the clinical significance of right ventricular (RV) strain in RV heart disease by cardiac magnetic resonance-based feature-tracking (CMR-FT).

Methods: Steady-state free precession images were acquired in 15 subjects; 5 had pulmonary arterial hypertension (PAH) (age: 27.6±14.2 years; group A), 5 had repaired tetralogy of Fallot without PAH (age: 29.4±10.3 years; group B), and 5 were normal subjects (age: 32.7±8.6 years; group C). RV end-diastolic and end-systolic volumes, stroke volume, and ejection fraction (RVEF) were calculated as conventional functional parameters. A developing CMR software was used to obtain the global longitudinal strain (GLS) and strain rate from the 4-chamber view of the heart, and global circumferential strain (GCS) and strain rate (GCSR) at the RV mid-cavity from the standard short-axis view of the heart.

Results: Group A had larger and more hypertrophied right ventricles compared to groups B (p<0.05) and C (p<0.05). The RVEF was significantly impaired in group A compared to groups B (p<0.05) and C (p<0.05). The strain values were lower in group A than in groups B (0.01<p<0.05) and C (0.01<p<0.05). The GLS was lower in group B than in group C (p<0.05), while GCS and GCSR had no significant differences between the groups. The strain values correlated with the increasing RV volume and decreasing RVEF in all cases (r=0.41 to 0.52 and r=-0.32 to -0.55, respectively).

Conclusions: The quantification of RV strain values was feasible in most patients by CMR-FT, suggesting that this approach could have clinical relevance in understanding the myocardial mechanics in RV heart disease. The preservation of circumferential strain was important in maintaining the RV function in group B.
Diagnostic Accuracy of Multislice Thoracic CT Angiography in Detecting Atrial Septal Defect, Ventricular Septal Defect and Patent Ductus Arteriosus Assessed with Conventional Cardiac Catheterization and/or Cardiac Surgery as Gold Standards

Eric Gerard Maglaya, Bernard Laya, Mariaem Andres, Nathan David Concepcion
Institute of Radiology, Section of Pediatric Radiology, St. Luke's Medical Center - Quezon City, Philippines

Background / aims: To determine the diagnostic accuracy of multislice thoracic CT angiography and contrast-enhanced thoracic CT in the detection of atrial septal defect (ASD), ventricular septal defect (VSD), and patent ductus arteriosus (PDA) among pediatric patients assessed with conventional cardiac catheterization and/or cardiac surgery as gold standards.

Methods: This is a retrospective, cross-sectional study of 24 pediatric Filipino participants who underwent contrast-enhanced thoracic CT due to presence of CHD. Data for CHD detected by CT compared, conventional cardiac catheterization and/or cardiac surgery were analyzed to determine their diagnostic accuracy (sensitivity, specificity, positive and negative predictive values) for ASD, VSD and PDA were obtained. Two-by-two tables were derived each for the three CHD.

Results: Statistical analysis yielded that CT and conventional cardiac catheterization and/or cardiac surgery have 100% agreement in detecting both positive and negative ASD, VSD and PDA. Results of the Fisher’s Exact Test at 5% level of significance reveal that CT and Cardiac Catheterization/Surgery findings are significantly related (p-value of <0.001) to each other in detecting ASD, PDA, and VSD. In fact, they have a perfect relationship with a 100% Sensitivity, Specificity, True Positive Rate, and True Negative Rate.

Conclusions: Multislice CT provides a clinically viable means to assess subjects for CHD determination, specifically ASD, VSD and PDA. Future studies can use these data to describe and compare the CT findings of CHD including the additional extracardiac findings that CT scan has to offer. The researchers believe that the superior spatial and temporal resolution of CT are cornerstones for diagnosis, surgical planning and management.

| Table 1. Diagnostic Accuracy: CT Angiography on Atrial Septal Defect (ASD) |
|---------------------------------|--------------------|-----------------|-----------------|
| **ATRIAL SEPTAL DEFECT** | **GOLD STANDARD** | **p-value** | **Diagnostic Measurement** |
| CT ANGIOGRAPHY | Positive | Negative | Total | Fisher’s<0.001** |
| Positive | 4 | 0 | 4 |
| Negative | 0 | 20 | 20 |
| Others | 4 | 20 | 24 |

| Table 2. Diagnostic Accuracy: CT Angiography on Patent Ductus Arteriosus (PDA) |
|---------------------------------|--------------------|-----------------|-----------------|
| **PATENT DUCTUS ARTERIOSUS** | **GOLD STANDARD** | **p-value** | **Diagnostic Measurement** |
| CT ANGIOGRAPHY | Positive | Negative | Total | Fisher’s<0.001** |
| Positive | 3 | 0 | 3 |
| Negative | 0 | 21 | 21 |
| Others | 3 | 21 | 24 |

| Table 3. Diagnostic Accuracy: CT Angiography on Ventricular Septal Defect (VSD) |
|---------------------------------|--------------------|-----------------|-----------------|
| **VENTRICULAR SEPTAL DEFECT** | **GOLD STANDARD** | **p-value** | **Diagnostic Measurement** |
| CT ANGIOGRAPHY | Positive | Negative | Total | Fisher’s<0.001** |
| Positive | 14 | 0 | 14 |
| Negative | 0 | 10 | 10 |
| Others | 14 | 10 | 24 |

Tables of Diagnostic Accuracy of CT on ASD, VSD and PDA
Day 2 - September 27, 2019

09:50-11:20 (90') / Room B

MC03. Neuro/Head and Neck Imaging

Chairs:
Yutaka Sato (USA),
Jung-Eun Cheon (Korea)
The neural crest is an important transient structure that develops during vertebrate embryogenesis. Neural crest cells are multipotent progenitor cells that migrate and develop into a diverse range of tissues and cells throughout the body. Although neural crest cells originate from ectoderm, they can differentiate into mesodermal-type or endodermal-type cells and tissues. Some of these tissues include the peripheral, autonomic and enteric nervous system, chromaffin cells of the adrenal medulla, smooth muscles of intracranial blood vessels, melanocytes of the skin, cartilage and bones of the face, parafollicular C cells of the thyroid among many others.

Neurocristopathies are a group of diseases caused by abnormal generation, migration or differentiation of neural crest cells. They often involve multiple organ systems in a single patient, are often familial and can be associated with the development of neoplasms. As understanding of the neural crest has advanced, many seemingly disparate diseases such Treacher Collins syndrome, 22q11.2 deletion syndrome, Hirschsprung disease, neuroblastoma, neurocutaneous melanocytosis and neurofibromatosis among many others are now recognized as neurocristopathies. Neurocristopathies can be divided into three major categories: dysgenetic malformations, neoplasms and combined dysgenetic and neoplastic syndromes.

Over the course of this talk, we will review neural crest development and several representative dysgenetic, neoplastic and combined neurocristopathies. Neurocristopathies often have clinical manifestations in multiple organ systems and radiologists are in a unique position to play significant roles in initial diagnosis, evaluation of subclinical associated lesions, creation of treatment plan and follow-up of patients.
Abstract_Oral

MC03_01

Magnetic Resonance Imaging (MRI) for Craniosynostosis, Replacing Ionising Radiation-Based Computed Tomography

Ai Peng Tan
Department of Diagnostic Imaging, National University Hospital, Singapore

**Background / aims:** “Black bone sequence” have been successfully utilised in various pathologies of the cranial vault. These sequences have been used in our institution for a number of years, and is slowly finding its place in routine imaging. We report our experience of utilising “black bone sequence” in children with craniosynostosis, both at diagnosis and for subsequent follow up. We will also present our MRI brain protocol for the imaging of craniosynostosis, targeted at the demonstration of cranial vault anatomy as well as intracranial anomalies and potential complications associated with craniosynostosis.

**Methods:** Using the departmental database, patients who underwent “black bone” imaging in the preceding 3 years were identified and their imaging studies were retrieved. As these imaging sequence forms part of our routine clinical practice, ethical approval for this study was not required. All included imaging studies were reviewed by a pediatric neuroradiologist.

**Results:** We present eight cases illustrating the reliability and potential benefits of magnetic resonance imaging (MRI) in pediatric patients with craniosynostosis, utilizing our proposed MRI brain protocol for craniosynostosis, of which the “black bone” sequence was included.

**Conclusions:** Our proposed MRI brain protocol has the potential of replacing computed tomography (CT) as the modality of choice for the diagnosis and surveillance of patients with craniosynostosis. Aside from the fact that MRI does not utilise harmful ionising radiation, it has excellent soft tissue resolution and hence is superior to CT in the detection of associated intracranial anomalies and potential complications (such as hydrocephalus and tonsillar herniation). The prior has prognostication value while the latter may affect management decision, specifically the timing of surgical intervention.

MC03_02

Atypical and Uncommon MR Imaging Manifestations of Pediatric CNS Tuberculosis

Ishan Kumar, Shashank Shekhar, Prashant Nath Gupta, Ashish Verma, Ram C Shukla, Priyanka Aggarwal

1Department of Radiodiagnosis and Imaging, Institute of Medical Science, Banaras Hindu University, Varanasi, India, 2Department of Pediatrics, Institute of Medical Science, Banaras Hindu University, Varanasi, Varanasi, India

**Background / aims:** The purpose of our study was to describe the atypical and uncommon MRI features of tuberculosis affecting the central nervous system in the pediatric age group.

**Methods:** This was a prospective observational study carried out over two-years. MRI of pediatric brain who were diagnosed with tubercular etiology were analysed and cases showing findings other than the commonly encountered (“typical”) hydrocephalus, leptomeningitis, basal enhancing exudates, and parenchymal tuberculomas were charted and included in this study. In spine, findings apart from spondylodiskitis, epidural abscess, involving the spinal canal were charted and included in this study.

**Results:** A total of 27 cases were included with 21 cases of Brain tuberculosis and 6 cases of non-osseous spinal canal involvement. Most common atypical feature in brain was tubercular vasculitis (n=9) with varying pattern of involvement. Various other atypical manifestation of cranial tuberculosis included abscess (n=3), miliary tuberculosis (n=1), focal pachymeningitis (n=1), cerebritis (n=3), tubercular...
encephalitis (n=1), choroid plexitis (n=1), sellar/parasellar tuberculosis (n=2). Atypical manifestations of spinal tuberculosis included perineural spread along nerve roots (n=3), sacral plexitis (n=1), intramedullary tuberculoma (n=1), subdural granuloma (n=1).

Conclusions: Tuberculosis involving central nervous system has a wide spectrum of atypical and uncommon manifestations on MRI. Knowledge of the variety of imaging features, identification of key diagnostic features, combined with high degree of suspicion can help the radiologist in identifying the disease.

Multifocal Enhancement in Fanconi Anemia: Manifestation of IRIS and Chronic Polyoma Virus Infection?

Blaise Jones¹, Valeria Onofri¹, Alison Bartlett², Stella Davies²

¹Department of Radiology, Cincinnati Children's Hospital Medical Center, Cincinnati, United States, ²Fanconi Anemia Comprehensive Care Center, Cincinnati Children's Hospital Medical Center, Cincinnati, United States

Background / aims: To present a constellation of brain imaging findings in patients with Fanconi anemia that may be characteristic of immune reconstitution inflammatory syndrome (IRIS) in reaction to chronic polyoma virus infection.

Methods: Review of neuroimaging studies in a cohort of 40 teenagers and young adults with Fanconi anemia followed at our institution identified 7 subjects with multiple enhancing intracranial lesions with calcifications, all with relatively limited neurologic symptoms in association.

Results: The index case in this group is a 20 year old female with Fanconi anemia presenting 10 years out from autologous bone marrow transplant with an episode of numbness in her right arm, hip and tongue lasting for 20 minutes. MRI showed multiple small enhancing lesions in the cerebellum, brainstem, thalami, and periventricular white matter. The patient declined further evaluation until 2 years later when she presented with vision loss. Repeat MR imaging showed marked increase in size of a lesion in the right occipital pole, with a peripheral pattern of enhancement indicative of necrosis, and overall stability of the multiple other lesions. CT demonstrated punctate calcification in association with a minority of the lesions. Surgical resection and viral immunohistochemistry demonstrated a necrotizing inflammatory process with no neoplastic elements and scattered nuclei positive for JC virus. Clinical and imaging features of all 7 cases will be presented, with a brief discussion of the proposition that these lesions represent IRIS in response to chronic polyoma virus infection, and the unique features of Fanconi anemia that put these subjects at risk for this condition.

Conclusions: The success of bone marrow transplantation (BMT) in the treatment of Fanconi anemia has led to a cohort of long-term survivors whose immune function has largely been restored, but the inherent genetic defect of the condition continues to cause altered immune response to some pathogens. We propose that this cluster of patients are manifesting a chronic inflammatory response to polyomaviruses, a response that is augmented by the renewed function of their immune system after BMT. Recognition of this pattern can help in the management of these patients, and provides insight into previously unknown consequences of successful treatment of this genetic condition.

Axial T1 C+ image in a 14 yo with Fanconi anemia show multiple lesions in the periventricular white matter.
Amide Proton Transfer-weighted (APTw) Imaging of Intracranial Infection in Children: Initial Experience and Comparison with Gadolinium-enhanced T1-weighted Imaging and Magnetization Transfer (MT) Imaging

Hong Zhang¹, Jinyuan Zhou², Yun Peng¹

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Background / aims: To demonstrate the feasibility of using amide proton transfer-weighted (APTw) imaging to detect intracranial infection in children at 3 Tesla.

Methods: Twenty-eight patients (15 males and 13 females; age range 1-163 months) with intracranial infection were recruited in this study. The patients underwent MRI scans including APTw and conventional MR sequences. Magnetization-transfer (MT) spectra over an offset range of ± 6 ppm and the conventional MT ratio (MTR) at 15.6 ppm were acquired. The APTw imaging signal was quantified using the MTR asymmetry (MTRasym) at the offset of 3.5 ppm.

Results: In twelve patients with brain abscesses, the enhancing rim of the abscesses on the Gd-T1w images were consistently hyperintense on the APTw images. The average APTw signals were significantly higher in the gadolinium-enhancing rim of the lesions than in the perifocal edema and contralateral normal-appearing brain tissue (CNABT) (P<0.001). MTR values between gadolinium-enhancing rim and perifocal edema showed no significant differences. APTw values in the gadolinium-enhancing rim and perifocal edema decreased after treatment. MTR values in all tissue types stayed stable. In eight patients with viral encephalitis, three encephalitic lesions showed slight spotted gadolinium enhancement, while the APTw image also showed slight spotted high signal. Five encephalitic lesions showed no enhancement on Gd-T1w and iso-intensity on the APTw image. The average APTw and MTR values were not significantly different between viral encephalitis and normal control groups (P>0.05). In eleven patients with meningitis, increased APTw signal intensities were clearly visible in gadolinium enhancing leptomeninges.

Conclusions: These initial data show that APTw MRI is a noninvasive technique for the detection and characterization of intracranial infectious lesion. APTw values show potential as early response biomarker after treatment for brain abscess.

(a) Measured MTRasym spectra of the gadolinium-enhancing rim (GE), perifocal edema (PE) and CNABT. The chemical exchange saturation transfer effect in GE increased in the offset range of 2–5 ppm compared with the perifocal edema and CNABT. MTRasym(3.5 ppm) showed the largest increase. (b–d) Measured MTRasym spectra of the GE, PE and CNABT among three MRI scans. Among three MRI scans, a decrease was shown in the MTRasym(3.5 ppm) in the GE (b) and PE (c) after treatment. MTRasym(3.5 ppm) values in the CNABT (d) stayed stable.
MRI and Neurosonogram Correlation of Paediatric Brain with Dystocia

Dhananjaya Kotebagilu Narayana Vamyanmane, Balakrishna P Shetty, Sindu P Gowdar, Nidhi Leekha

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Background / aims: Evaluation of all the paediatric brain conditions related to dystocia with MRI and Neurosonogram. Correlation of complementary findings in early neonatal period. Assessment and evaluation of prognostic response in each conditions

Methods: Paediatric brain MRI evaluation in all suspected cases of dystocia. Over 40 cases were studied with MRI and followed by Neurosonogram correlation. Both findings were evaluated separately and followed up for prognosis. Conditions related to birth trauma are assessed and tabulated as superficial and deep injuries. Standard MRI sequences are used along with 3D high resolution sequence. Followed by Neurosonogram using high and low frequency probes.

Results: There are a wide range of conditions related to birth trauma, ranging from superficial and minor injuries through to fatal injuries. Most common superficial injuries were cephalohematoma and Caput succedanum. Fracture skull was not so common. Periventricular leukomalacia, parenchymal hemorrhage, subdural and extradural hemorrhage were seen and follow-up. Germinal matrix hemorrhage and intraventricular extension. Hypoxemic ischemia is most common deep injuries.

Conclusions: MRI evaluation of neonatal brain with dystocia gives you sufficient information related to brain injuries. Neurosonogram is adjuvant technique helps in confirming the MRI findings and also helps in identify new lesions undetected in MRI. Neurosonogram being a dynamic study helps in identifying inconspicuous findings which are not detected in standard MRI sequences.
had lesions on the right, 20 on the left. There were 33 lesions in superior 2/3 portion of the gland and 8 in the lower thirds. 23 (56.1%) lesions were detected in the anterior 2/3 portion of gland, and 18 (43.9%) in the posterior 1/3 against posterior surface. During the follow-up period, 20 patients were stable in size, but in 5 patients were decrease in size. Eight patients were changed to unclear margin and six patients changed to hyperechogenic pattern. Three of them had no size change and 3 of them were slightly decreased in size.

**Conclusions:** As increasing use of thyroid sonography in children, intrathyroid ectopic thymus could be found in the thyroid gland and should be differentiated from thyroid nodules in children and adolescents. On follow-up sonography, intrathyroid ectopic thymus could be decreased in size or changed to hyperechoic mass. Knowledge of the characteristic sonographic features of intrathyroid thymus in children should help avoid unnecessary surgery and investigations.

**MC03_07**

**Sonographic Features and Pathologic Correlation of Infectious Mononucleosis Lymphadenopathy in Children**

Hee Jung Lee¹, Jin Young Kim¹, Hae Ra Jung²

¹Department of Radiology, Keimyung University School of Medicine, Daegu, Korea, ²Department of Pathology, Keimyung University School of Medicine, Daegu, Korea

**Background / aims:** To demonstrate ultrasonographic features of cervical lymph adenopathy in children with infectious mononucleosis (IM) and to correlate with pathologic findings

**Methods:** Sonographic features of 38 cervical lymphadenopathy in children (mean, 6.7-year-old, range, 2 - 21 years) with IM were retrospectively evaluated. All patients were serologically diagnosed and 17 lymph nodes were pathologically confirmed. Sonographic analysis included size, shape (elliptical/round), hilum (present/absent, central/eccentric), echogenicity (homogeneous/heterogeneous), internal architecture (necrotic/follicular) and vascularity (centrifugal/centripetal/mixed). Other ancillary findings include presence of conglomeration and perinodal edema. Pathologic correlation was performed in surgically excised nine nodes.

**Results:** The mean size was 37 mm in the longest diameter (range, 24 - 46 mm). The shape of nodes was elliptical (27, 70%) or round (11, 30%). Hilum was present in 37 (97%). Parenchymal echogenicity was heterogeneous (38, 100%) with follicular internal architecture (30, 79%). All of the nodes revealed centrifugal vascularity (100%). Thirty two (84%) were conglomerated and revealed perinodal infiltration. Pathologic findings consisted of follicular, sinus, diffuse or mixed patterns of reactive lymph node hyperplasia.

**Conclusions:** Ultrasonographic features of cervical lymphadenopathy in children with IM were relatively constant and well correlated with pathologic findings.
Day 2 - September 27, 2019

13:30-14:40 (70') / Room A

MC04. Body Imaging

Chairs:
Woo Sun Kim (Korea),
Utami Purbasari (Indonesia)
Chest Disease in Immunocompromised Pediatric Patients

Dr. Pilar García-Peña
Radiology Department
Hospital Universitario Materno-Infantil
Vall d’Hebron
Barcelona, Spain

Chest Disease in Immunocompromised Patients

Lung disease is common in children with immunodeficiencies

- Examination techniques
- Specific diseases with thoracic manifestations
- Radiological findings

Examination Techniques

- Plain radiography/computed radiography
- US: pleural disease
- Computed tomography
- Magnetic resonance (necrotizing pneumonia, hemorrhage, chest wall, perfusion, ventilation)
- Nuclear medicine. Functional texts

Plain Radiography

Computed Tomography

- Chest X-Ray remains the first most common imaging study of the chest
- They can underestimate the detection of diffuse or subtle lung disease (59-65%)
Lung disease can be very subtle in children


**Computed Tomography**

Sensitivity/specificity higher than chest radiography (90%)

- To better evaluate radiographic abnormalities / to assess the presence and extent of the suspected disease
- Can show parenchymal abnormalities when chest radiographs / function tests are normal
- Additional information is of value to clinicians because of the increasing therapeutic options in immunosupressed patients with lung disease
- This results in a marked increase in the number of CTs requested


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**CT: Technique**

- Examination technique must be carefully planned to minimize radiation exposure while maximizing image quality
- Low-dose techniques have been applied to both Helical CT and sequential HRCT
- Helical HRCT is the method of choice for the evaluation of lung disease in immicosupressed patients

The least aggressive CT technique should be used!!


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**Value of HRCT in Expiration**

**Case 1: 6 y**

HRCT in inspiration: normal

HRCT in expiration: mosaic pattern

**Case 2: 10 m**

HRCT in lateral decubitus, checking for air trapping

Usual CT protocol in non-collaborating patients


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**MR Perfusion**

**Ventilation:**

He-3, Xe-129

He-3

Xe-129

Lost of perfusion in LII, Killian bronchiectasis

Ventilation defects in different patients

More defects with Xe


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**Immunodeficiencies**

- The term immunodeficiency applies to a set of diseases due to a more or less severe failure of the immune response
- Due to the development of the molecular bases of the autoimmune and immunogenetic systems, the pediatric radiologist now faces relatively rare new syndromes and diseases
- Close communication with the pediatrician is very important when evaluating the images of these children, to be able to adjust the diagnosis as much as possible

They can be Acquired and Congenital

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**Chest in Immunodeficiencies**

The lungs are directly expose to infectious agents and are frequently infected in all immune deficiencies

- Defenses againts infection include:
  - Physical barriers
  - B cells
  - T cells
  - Natural killer cells
  - Phagocytes
  - Compliment proteins

Defects of any of these elements results in increased infections

Chest in Immunodeficiencies

Patients are susceptible to:
- Multiple, frequent and recurrent infections (common, opportunistic and fungus infections)
- Lymphoproliferative syndromes
- Benign and malignant neoplasms
- Others

Infection is the most frequent and important cause of morbidity and mortality
The lungs are directly exposed to infectious agents

Primary Immunodeficiency Disease

Immunodeficiency Syndromes (ID Sd.)
- B cell disorders
  - Selective Ig A deficiency
  - X-linked agammaglobulinemia (Bruton)
  - Common variable immunodeficiency
- T cell Disorders
  - Thymic hypoplasia (DiGeorge’s syndrome)
  - X-linked immunodeficiency with hyper-IgM
- B and T cell combined disease
  - Severe combined immunodeficiency
  - Hyper-IgE syndrome (Job Syndrome)
  - Combined immunodeficiency (Nelson’s syndrome)
  - Wiscott-Aldrich syndrome, Ataxia telangiectasia
- Phagocytic cell and adhesion molecule disorders: Chronic granulomatous disease

Chest in Immunodeficiencies

The radiologist has an important role in suspecting the disease
- Frequent infections (recurrent pneumonia)
- Unusual patterns of disease
- Slow resolution infection
- Radiological appearance of the lesion
- Location of the lesion
- Aggresiveness of the lesion
- Unusual pathogens
- Presence/no presence of the thymus
- Lymphadenopathy
- Noting features characteristic of a specific immunodeficiency
- Detecting malignancies that can occur as complication of certain immunodeficiencies

Can guide bronchoscopy / biopsy

PID

Case 1: 10 y
Selective IgA Deficiency

Lower lobes bronchiectasis
signet-ring bronchitis, bronchial wall thickening

Case 2: 5 y
Brother
Left lower lobe: light bronchial wall thickening, air trapping

PID

15 y
Common Variable Immunodeficiency

Cystic bronchiectasis *
Peribronchial thickening
Centriobular nodules
Tree-in-bud
Air trapping *

Bronchiectasis

PID

Hyper-IgE Syndrome
Recurrent Staphylococcus infections

Multiple cystic formation in middle lobe, lingula and lower lobes
Cyst in lingula occupied by a fungus ball

AOSPR 2019

Acquired Immunodeficiencies (AID)

Are common in children on:
- Chemotherapy for malignancies
- Therapy following solid organ transplantation
- Hematopoietic stem cell transplantation (HSCT)
- Immunosuppressive therapy for autoimmune disorders
- Human immunodeficiency virus (HIV) infection
- Malnutrition

Yin E. et al. 2001, AJR 176:1341-1352

Acquired Immunodeficiency

- Pulmonary infection is the most common cause of death
- Has decreased due to the highly active antiretroviral therapy (HAART), HIV infection
- More number of pathogens, including fungal infections
- Bacterial pneumonia tends to be more severe
- More risk of progression of disease (prompt diagnosis)
- Higher incidence of abscesses, empyema, fistula
- Nonspecific findings: bronchoalveolar lavage, culture, cytology, galactomannan

Gona P et al. JAMA 2006; 296:292-308

Invasive Fungal disease

Angio-Invasive Aspergillus flavus infection
5 y./ Leukemia/Chemotherapy

Nodule/halo sign
Nodules/abscesses
Pleuroparenchymal effusion
Necrotizing myocardiitis


Tumors

Lung Tx Multiple well-defined solid masses MIP
Epstein-Barr virus Lymphoproliferative Sd.??
Cystic Hygroma Intrabronchial lesion: leiomyomas

HCT


Non-Infective Pulmonary Disease

- Alveolar hemorrhage
- Pulmonary edema
- Drug reaction
- Immune reconstruction inflammatory syndrome (IRIS)
- Graft-versus-host disease
- Organizing pneumonia
- Bronchiolitis obliterans
- Lymphoproliferative disease
  - Lymphocytic interstitial pneumonitis
  - Lymphoma
- Benign and malignant neoplasm
  - Leiomyoma, Leiomyosarcoma, Kapasi sarcoma

Conclusions

- Respiratory tract infection is the most common cause of disease in immunocompromised children and continues to be a major cause of morbidity and mortality.
- Chest X-ray is generally the initial study technique for acute pulmonary infection.
- However, in known immunocompromised patients, CT plays an important role in the evaluation of acute infection and also in the evaluation of the follow-up of acute and chronic complications.
- Characterizing the lesion may reduce the D.D.
- Bronchiectasis are common in PID (middle/lower lobes).
- Knowing the time of immunosuppression helps in the etiological diagnosis.
- BAL biopsy is needed for etiological diagnosis and early treatment.
- Early recognition of disease will lead to prompt treatment that may be beneficial in improving progression of the disease.
Analysis of CT Features of Chest in Gaucher Disease

Li Di, Tao Xiaojuan, Shen Hongwei, Zhang Ningning, Liu Yong, Peng Yun

Department of Radiology, Beijing Children's Hospital, Capital Medical University, Beijing, China

Background / Aims: To investigate the abnormal manifestations of chest CT in patients with Gaucher disease (GD), and to provide objective basis for clinical diagnosis and evaluation of therapeutic effect of GD.

Methods: We have collected 43 GD patients with genetic diagnosis, including 25 males and 18 females, aged from 10.7 to 34.7 years, with an average age of (20.9±5.9) years. All the patients underwent routine chest CT examination, and their imaging data were analyzed, and descriptive statistics were made.

Results: Among the 43 GD patients, 20 cases with abnormal chest CT findings: 10 cases (23.3%) showed diffuse interlobular septal thickening, mainly distributed in the middle and lower lobes of both lungs; 5 cases (11.6%) showed ground glass signs in the single or multiple lobes of the lung, one of which was located in the dorsal segment of the right lower lobes, the posterior basal segment and the dorsal segment of the left lower lobes; 1 case was located in the middle lobes of the right lung. Segment and anterior-medial basal segment of the left lower lobes, 1 case located in the dorsal segment of the left lower lobe; 1 case was located in the posterior basal segment of the bilateral lower lobe; and another case was located in the anterior-medial basal segment of the left lower lobe. There were 2 cases (4.7%) of small nodules, which showed round-like nodules of different sizes. 1 case (2.3%) of pulmonary fibrosis, especially in the left upper lobe. Other manifestations: 3 cases (7.0%) of bullae, one of which was multiple, distributed along the right intervertebral pleura, the other 2 cases were single, located in the upper lingual segment of the left middle lobe and the anterior segment of the left upper lobe respectively; 2 cases (4.7%) had localized pleural thickening, 1 case was confined to the basal segment of the left lower lobe, the other was confined to the dorsal segment of the bilateral lower lobe; 1 case was pneumothorax (2.3%), located in the right upper lobe apex, left upper lobe apex posterior subpleural; pulmonary hypertension in 1 case (2.3%); thymus enlargement in 12 cases (27.9%).

Conclusions: The manifestations of the lungs are diverse, and most of them are diffuse interstitial lesions. The main signs are interlobular septal thickening and ground glass opacity reduction, which are consistent with the pathology of Gaucher cell infiltration, but not specific.

Fig. 1. (A) In a 20-year-old male patient, diffuse transparency of both lungs was reduced, with a small amount of pneumothorax on the left. (B, C) A 31-year-old female patient had a reduced left lung volume with abnormal banding. (D, E) Diffuse interlobular septal thickening was seen in both lungs of 11-year-old male patient. (F) In 14-year-old male patient, the thymus has not yet degenerated.
Follow Up of CT Angiographic Findings of Pulmonary Arteriovenous Malformations (PAVM) in Children and Young Adults with Hereditary Hemorrhagic Telangiectasia (HHT)

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Background / aims: Hereditary hemorrhagic telangiectasia (HHT) is a rare genetic disorder and pulmonary arteriovenous malformation (PAVM) is common in HHT. We reviewed chest CT angiography (CTA) findings of PAVM in children with HHT with positive transthoracic contrast echocardiography (TTCE), and their follow up CTA to determine the progress of disease and contributing factors, and morphological measures of lung vasculature.

Methods: Forty-three patients with HHT underwent initial CTA and TTCE. Among 43 subjects, 19 patients (16.6±8.3 years, 8-male/11-female) underwent follow up CTA. On the initial and follow up CTA, following variables were evaluated; distribution (focal vs. diffuse), grading (0-6), accumulated grading, total number, size, and volume of PAVM and compared (2-way ANOVA test). Lung vascular geometries were reconstructed in 8/19 patients for morphometric analysis from the initial and follow-up CTs. Total blood volume (TBV) and BV5/TBV, a measure of small vessel (cross-sectional area < 5mm2) volume fraction were measured (additional data will be added for presentation).

Results: Total 63 PAVMs were identified on initial CTA in 19 subjects. On initial CTA, the median size and volume of PAMV were 3.7mm (range 1.2 – 17.2 mm) and 26.5mm3 (range 0.9 - 2,441.7 mm3), respectively and peripherally located in 56 (88%). On follow-up CTA, 71 PAVMS were identified and the median size and volume were 4.3mm (range 1.3 – 26.7 mm) and 41.6mm3 (range 1.2 - 10,453.1 mm3), respectively. The duration between two CTAs was 31.0 months (range 9 - 94 months). GGO or nodule with single (grade 3) or two vessels (grade 4) was the most common finding seen in two thirds of cases in both initial and follow-up CTAs. Lung vascular geometries were reconstructed in 8/19 patients for morphometric analysis from the initial and follow-up CTs. Total blood volume (TBV) and BV5/TBV, a measure of small vessel (cross-sectional area < 5mm2) volume fraction were measured (additional data will be added for presentation).

Conclusions: In pediatric patients with HHT, almost half of patients demonstrated progress of disease on CTA. Quantitative measures of vascular morphometry will be helpful for monitoring disease progression and treatment planning.
Congenital Pulmonary Airway Malformation Type 4: CT-pathologic Correlation

Seul Bi Lee, Young Hun Choi, Gayoung Choi, Yeon Jin Cho, Seunghyun Lee, Jung-Eun Cheon, Woo Sun Kim, In-One Kim

Department of radiology, Seoul National University Hospital, Seoul, Korea

**Background / aims:** The purpose of the study was to evaluate the CT finding of pathologically confirmed CPAM type 4 after operation.

**Methods:** This retrospective study was conducted in children with CPAM type 4 who received resection operation from February 2014 to February 2019. All preoperative CT findings were reviewed by two board-certified radiologists. Pathologic findings were reviewed by one board-certified pathologist. Clinical findings of the patients including age, sex, clinical symptom and prenatal diagnosis were also reviewed. CT findings are categorized to lesion location, overall size, largest cyst size, margin, presence of discernible peripheral hyperdensity (>1mm). If there were multiple preoperative exams in same patient, recent exam was selected.

**Results:** Seven children (2 boys and 5 girls, median age 2yrs and range 1~6yrs) was included in this study. Only one children has fever and underwent chest CT for fever evaluation. CPAM with combined pneumonia was suspected at chest CT. Others were asymptomatic and among them, 4 children were diagnosed by prenatal exam. Location of lesions were RUL (n=1), RML (n=1), RLL (n=3), LUL (n=1) and LLL (n=1). Median lesion size was 52.3mm (range 26.42~88.87mm). Discernible peripheral hyperdensity with well-defined margin was found in 4 patient, which was corresponding with fibrous capsule at histology review.

**Conclusions:** CT findings of CPAM type 4 in children are different with other type of CPAM and mimicking other congenital cystic pulmonary lesions such as complicated bronchogenic cyst, intrapulmonary lymphangioma or tumorous condition such as PPB type 1. Discernable peripheral hyperdensity, corresponding to the fibrous capsule at histology can be clue of CPAM type 4 diagnosis.

CT-guided Percutaneous Lung Biopsy for Diagnosis of Fungal Infections in Paediatric Oncology patients: Yield and Outcomes

S Murthy Chennapragada, David J Lord

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**Background / aims:** Invasive fungal infections in patients undergoing chemotherapy and following bone marrow transplantation are associated with high mortality. The diagnosis is often difficult and may require multiple modalities including image guided biopsy and histological examination. Aim: To evaluate the yield and the outcomes of CT guided percutaneous lung biopsy in paediatric oncology patients with high risk of pulmonary fungal infections.

**Methods:** A retrospective review was done of medical records of all children that underwent CT guided lung biopsy for suspected fungal lesions. The following data were recorded: demographic details; primary diagnoses; details of therapy, clinical symptoms, blood counts and chest CT scan findings at the time of the procedure; technical details of the procedure; complications; histopathology examination (HPE) and microbiology outcomes.

**Results:** Between October 2006 and December 2018, thirty seven children with suspected fungal lesions underwent 40 biopsy procedures. 31/40 were core biopsies, 7/40 only fine needle aspiration (FNA), and 2/40 core and FNA. 12/40 (25%) were diagnosed as fungal infection on histological examination, and 1/40 as PTLD; 7/40 showed necrosis and organising pneumonia, 13/40 were nonspecific and 4/40 were deemed nondiagnostic samples. All positive diagnoses for fungi were made on core biopsy samples; all FNA samples were negative for fungal elements. Only one (2.5%) was positive on fungal culture; blood cultures were negative in all patients. 9/12 (75%) of those positive
for fungi on HPE showed CT scan features of ground glass haze and/or cavitating nodules. Procedure related complications occurred in 4/40 - SIR Class B in 2/40 (5%), and SIR Class C in 2/40 (5%) [including pneumothorax requiring chest drain (1/40) and haemoptysis requiring ICU admission (1/40)].

**Conclusions:** Based on our experience, CT guided percutaneous lung biopsy is a relatively safe procedure to perform in high risk paediatric oncology patients. However the histological diagnostic yield for fungal infections remains low, thus limiting its utility. Core biopsy samples have better yield for fungal elements than fine needle aspiration.
Day 2 - September 27, 2019

15:00-16:10 (70’’) / Room B

MC05. Informatics and Quality Assessment

Chairs:

Jin Seong Lee (Korea),
Sunsuke Nosaka (Japan)
The Evolution and Growth of Pediatric Interventional Radiology

James Donaldson
Department of Medical Imaging, Ann & Robert H. Lurie Children’s Hospital of Chicago, USA

Pediatric IR has had a pretty short history—There has been an amazing change in the care of children through the development of Pediatric IR. It has also become a key element of pediatric radiology.

Pediatric IR followed in footsteps of adult IR. It should have been easy to take very innovative procedures developed by the IR pioneers and adapt them to children. But why was PIR 20 to 30 years behind adult IR?

In the early IR years it was all about innovation. Seldinger deserves much credit as an IR founder in the 1950’s with the idea that a catheter could be advanced over the outside of a wire instead of through the center of a large trocar.

But it really was Charles Dotter who was the true pioneer - changing the mindset of angiographers of the day. Charles believed that the angiographic catheter could become more than a tool for diagnostic observation; he believed it could become a surgical instrument. The radiologists who heard him make this statement were stunned at the time – they had never thought of an angiogram as anything other than a diagnostic tool. It was in 1963 that Charles Dotter successfully dilated a femoral artery stenosis with a rigid dilator. Interventional Radiology was born.

IR grew into the specialty it is today. In 2010 celebration of 35 year anniversary the SIR made this statement that “In 40+ years Interventional Radiology has become a subspecialty that affects patient care on a global scale” IR is now recognized by the American Board of Medical Specialties. In the US IR is now a separate residency sharing the first three years of training with diagnostic radiology then separating for the final two years of IR training.

Pediatric IR’s evolutionary process started late and moved slowly. Children represent a small population that is very diverse in age, size, disease processes. Children’s hospitals can be isolated unaware of advances on the outside. Even diagnostic pediatric radiologists weren’t very supportive of the development of pediatric IR. Early pioneers in IR weren’t trying to solve pediatric problems.

Eventually Pediatric IR began to develop. There were pioneers like: Phil Stanley, Laurent Garel, Rich Towbin, Frances Brunelle, Pat Burrowes, Danielle Pariente, Bairbre Connoly. But PIR faced many obstacles.
Despite some early advances – Peds IR didn’t become mainstream even in the large children’s hospitals until the turn of the century. And there are many medical centers in the US and elsewhere across the globe where there is still very little pediatric IR even today.

Pediatric IR has evolved through many stages of development. Early PIR procedures were very basic: image-guided biopsies, drainages and vascular access. With the development of better and smaller catheters, wires, embolic materials PIR took on a more central role in the care for children. Today PIR can function as a clinical service getting referrals of patients directly from other specialists including many surgical specialties. Procedures such as lymphatic interventions, radiofrequency and laser ablations, primary closure of Abernethy malformations, treatment of diverse vascular lesions have become the procedure of choice and are recognized as such by many pediatricians and surgical colleagues. PIR has become an integral part of the healthcare team in many children’s hospitals.

The evolution of PIR was delayed and slow to catch up to our adult colleagues. There continue to be sites where PIR is still far behind and children do not have the benefits of many innovative and minimally invasive procedures. It takes support of the pediatric radiologists, department and hospital leaders to advocate for the development of a PIR program. Pediatric IR should be recognized as key part of pediatric radiology supporting and enhancing the healthcare delivered to children.
Are Academic Involvements of Radiology Trainees in Pediatrics Enough? Preliminary Results of a Global Perspective

Joanna Marie Choa1, Federica Vernuccio2, Dina Haroun3, Estefania Terrazas Torres4, Bayarbaatar Bold5, Monika Arzanauskaite6

1Institute of Radiology, St. Luke's Medical Center Global City, Taguig, Philippines, 2PROMISE, University of Palermo, Palermo, Italy, 3Diagnostic and Interventional Radiology Department, Kasr Al Ainy School of Medicine, Cairo, Egypt, 4Radiology Department, American British Cowdray Medical Center, Mexico City, Mexico, 5Department of Radiology, Faculty of Medicine Siriraj Hospital, Bangkok, Thailand, 6Radiology Department, Liverpool Heart and Chest Hospital, Liverpool, United Kingdom

Background / aims: To assess the involvement in research and teaching of radiology trainees who are interested in pediatric imaging as well as to identify the challenges and difficulties they encounter.

Methods: A 35-item survey was distributed online to radiology trainees worldwide through social media and with participation from 14 radiologic societies. We included multiple questions investigating the academic activities of trainees as well as the barriers they encounter. Responses from those trainees with interest in pediatric imaging were obtained. Data were then analyzed with appropriate statistics.

Results: A total of 94 respondents (31 men, 61 women, 2 undisclosed) were gathered wherein only half were engaged in research (51%, 48/94) and only a quarter were involved in teaching activities (26%, 25/94). Three out of 5 trainees (63%, 59/94) have no allocated time for research and teaching activities during training. Respondents also agree that doing research (66%, 62/94) and teaching (74%, 70/94) activities contribute to improving their clinical competency. Several likewise believe that both research (45%, 42/94) and teaching (40%, 38/94) should be part of training. In line with this, half of trainees (51%, 48/94) did not publish any material during residency and only half were able to present a poster or paper in conferences (59%, 55/94). Different factors were identified by trainees as difficulties they encounter in doing academic activities. Most trainees report lack of time (60%, 56/94), lack of mentorship (44%, 41/94), lack of support from faculty/senior radiologists (43%, 40/94) as well as lack of teaching experience (34%, 32/94) as challenges they face.

Conclusions: The lack of allocated time, support from faculty, mentorship and teaching experience contribute to the low involvement in academic activities of pediatric imaging trainees. Institutions and societies should give additional importance to research and teaching in training programs as these are keys to the continuing development of radiology.
**Evaluation of Dose Reduction by Using Digital Radiography System with Upgraded Image Post-processing Engine in Pediatric Patients**

Saelin Oh¹, Ji Hye Kim², So-Young Yoo², Tae Yeon Jeon²

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**Background / aims:** To evaluate whether the upgraded image processing engine (IPE) installed in digital radiography (Samsung GC85A X-ray system) provides more achievable dose reduction than the old IPE in pediatric patients.

**Methods:** A total of 270 clinical images were retrospectively collected consisting of 9 sets of images classified by protocol and age-group. To avoid repeated exposure of the patients to obtain images with different dose levels, low dose image sets were generated using simulation tool, after quantitative and qualitative validation using phantoms. Each 30 images in raw-data format per each set were source images, being used to generate low dose images with new and old IPEs. Three experienced pediatric radiologists were asked to pick the “optimum dose” in perspective of ALARA. Comparison and test groups were randomized and blinded. Entrance Skin Exposures (ESE) was approximately calculated with the given values of kVp and mAs, assuming a standard body depth for each age group.

**Results:** Dose reductions in baby, child, and adolescent were estimated as 45.0%, 27.3%, and 24.3%, respectively (mean 32.8%) in abdomen (p < 0.001), and all evaluation sets were proved to have achievable dose reductions using the new IPE (p< 0.001). The average dose reduction over all age-groups for abdomen, chest, and skull readings were 32.8%, 12.9%, 23.2% each (p value < 0.001). Calculated ESEs survey showed that the read optimum dose levels with both old and new IPE were less than the routine clinical exposures.

**Conclusions:** The upgraded IPE can help to optimize the image quality with more reduced radiation dose than old IPE, which is acceptable for use in a pediatric age group.

**Development of Quality-Controlled Low Dose Protocols for X-ray Examination in NICU using a New Mobile Digital Radiography System**

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**Background / aims:** The aim of this study was to develop low-dose radiography protocol in NICU using a new Mobile DR system with advanced denosing image processing.

**Methods:** Institutional review board approval was obtained. In this prospective randomized study, 40 neonates in NICU underwent X-ray examination of the thorax and abdomen using two different mobile X-ray units: reference technique using DRX-Revolution (50 kV, 1.6 mAs and no additional filtration) and a new techniques using mobile X-ray unit of Samsung GM85 [54 kV, 0.1 mmCu filtration, a new advanced denosing process, protocol A (100% equivalent dose), protocol B(80%), and protocol C (64%)]. Three radiologist (reader 1, 2 and 3 with 24, 13, and 6 years of experience in pediatric radiology, respectively) independently evaluated image qualities of each protocol. To test the feasibility of low dose protocol, several anatomy landmarks, which usually serve in chest radiography were evaluated as quality criteria.

**Results:** Forty patients each obtained 3 pairs of X-ray examination [protocol A- standard protocol, protocol B - standard protocol, and protocol C-standard protocol] except one patient who did not obtained 1 standard examination. The reliability of the agreement among 3
readers was 91% (p <0.001). Protocol B (80% equivalent radiation dose) and protocol C (64% equivalent radiation dose) were determined to be statistically noninferior to standard protocol with respect to overall image quality (the lower bound of the confidence interval is above the prospectively established noninferiority limit of ∆-1.0). Protocol B shows better depiction of low-contrast area (carina, thoracic vertebrae) compared to the standard protocol.

Conclusions: Based on the technique and acquisition factors of a new DR system, it is possible to lower the radiation dose without any significant effect on image quality by adding filtrations and a new denosing technique.

The Evaluation of a Deep Learning Bone Age Model in Chinese Children Based on GP Atlas and Three Different Training Data

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Background / aims: To compare the performance of a deep-learning bone age assessment model based on three different training data with Chinese radiologists. The three data were RSNA data from the 2017 Radiological Society of North America (RSNA) Pediatric Bone Age Machine Learning Challenge, the CHFDU data from Children’s Hospital of Fudan University (CHFDU) data and the Mixed data.

Methods: 538/607 clinical hand radiographs and corresponding radiological reports respectively were obtained from Children’s hospital of Fudan University in China to test the model with RSNA data / CHFDU data and Mixed data. The bone age estimates difference between the model from three different data and the radiology reports from Chinese children’s hospital was evaluated by comparing the root mean square (RMS) and mean absolute difference (MAD). The difference of normal, advanced and delayed bone age assessment between the model and the radiologists was evaluated to assess the clinical significance in diagnosis change. The data were statistically analyzed by Independent-Sample T test and Chi-square test.

Results: It showed difference between AI model with RSNA data and radiology report in bone age estimates (AI model with RSNA data vs radiology report: 10.66 years vs 10.25 years, p=0.02). The mean difference between bone age estimates of model and Chinese radiologists was 0.41 years, with a MAD of 0.78 years, and a mean RMSE of 1.10 years. The analysis of different clinical diagnosis between AI model with RSNA data and radiology report showed significant difference (p<0.05). However, there was no difference between AI model with CHFDU data / Mixed data and radiology report in bone age estimates (AI model with CHFDU data / Mixed data vs radiology report: 9.74/9.69 years vs 9.62 years, p=0.55/ p=0.73). The mean difference between bone age estimates of model with CHFDU data / Mixed data and Chinese radiologists was 0.11 and 0.07 years, with a MAD of 0.48 years and 0.49 years, and a mean RMSE of 0.67 years and 0.68 years, respectively. There were no difference in clinical diagnosis between AI model with CHFDU data / Mixed data and radiology report (p=0.54/0.92).

Conclusions: Compared with bone age estimates of Chinese radiologists, AI model with RSNA data slightly overestimate bone age. The difference may affect clinical diagnosis in China. However, AI model with CHFDU data / Mixed data can estimate skeletal maturity with accuracy similar to that of radiologists and the clinical diagnosis were similar.
Convolutional Neural Network for Diagnosis of Pediatric Developmental Dysplasia of the Hip on Conventional Radiography

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Background / aims: The purpose of this study was to develop a convolutional neural network (CNN)-based deep learning algorithm for the automated detection of developmental dysplasia of the hip (DDH) on conventional radiography and to assess its feasibility and diagnostic performance.

Methods: From 2,601 hip AP radiographs obtained in three different hospitals January 2011 and June 2018, 5,076 hip images were used to construct the dataset. Two invited radiologists were asked to label hip images as normal or DDH and all 5,076 patched images were divided into training (n = 4,050), validation (n = 513) and test sets (n = 513). Images underwent preprocessing, including cropping and histogram equalization, and were input into a convolutional neural network. To investigate diagnostic performance of the deep learning algorithm, we calculated the receiver operating characteristics (ROC) and precision recall (PRC) plots, accuracy, sensitivity, specificity, positive predictive (PPV) and negative predictive value (NPV) of the deep learning algorithm and they were compared with performances of two human readers with different levels of experience.

Results: The area under the ROC plot of deep learning algorithm and three radiologists were 0.988 and 0.988-0.919, respectively. The AUC of PRC plot of deep learning algorithm and three radiologists were 0.979 and 0.495-0.857, respectively. The accuracy, sensitivity, specificity, PPV and NPV of the proposed deep learning algorithm were 98.4, 94.0, 98.9, 90.4 and 99.4%. In McNemar's test, there was no significant difference between algorithm and experienced radiologist in diagnosis of DDH. On the other hand, the proposed model showed significant difference (P = 1.000) with higher sensitivity, specificity and PPV, compared to inexperienced radiologist. There were three false negative and five false positive cases in 513 test sets by using deep learning algorithm.

Conclusions: The proposed deep learning algorithm provided an accurate diagnosis of developmental dysplasia of the hip on hip AP conventional radiographs, which was comparable to an experienced radiologist.
Day 2 - September 27, 2019

15:00-16:10 (70min) / Room A

Scientific Session

Chairs:
Kushaljit Singh Sodhi (India),
Hamzaini Abdul Hamid (Malaysia)
Quantitatively Evaluating Fat of Progressive Muscular Dystrophy with mDIXON Sequence of MRI in Children

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Background / aims: Progressive muscular dystrophy (PMD) is a kind of hereditary skeletal muscle degeneration disease. The MRI feature of PMD is fat replacing muscular. However, routine MRI examination can not quantitatively assess the extent of fat replacement. With mDIXON sequence, fat fraction (FF) can display the ratio of fat. So the aim of this research is to quantitatively evaluate fat of PMD with mDIXON sequence of MRI in children.

Methods: 12 patients with PMD (Group A, age 5-13 years, 9 males and 3 females) and 10 healthy volunteers (Group B, age 6-12 years, 8 males and 2 females) were enrolled. The total of 22 children were underwent MR scans on a clinical 1.5T system (Philips Healthcare, Archieva, Dutch) with a 16-channel body coil. The mDIXON protocol was performed using 3D T1-FFE sequence with traverse position in hipshot and bilateral legs (TR=5.7ms, TE1=1.8ms, TE2=4.0ms, FA=15, FOV=235mm*167mm*25mm, matrix=180*97, voxel size=1.3mm*1.7mm*2.5mm, SENSE=2, NSA=1). 4 phase images of water phase, fat phase, in-phase and out-phase (shown in figure 1-4) were obtained from mDIXON scanning. In the right side of ectogluteus, region of interests (ROIs) of 20mm² were set by two blind observers (shown in figure 5) and Kappa values were calculated. Then the signal intensity of water SI (W) and fat SI (F) were measured. Fat fraction (FF) was calculated by FF= SI(F)/( SI(W)+SI(F))*100% [5]. Sample t test was made in FF between Group A and Group B.

Results: In Group A, SI (W) was 327.14±2.17 and Kappa=0.76. SI (F) was 168.97±2.11 and Kappa=0.73. In Group B, SI (W) was 352.67±1.51 and Kappa=0.82. SI(F) was 93.63±1.98 and Kappa=0.79. FF was 34.06% in Group A and 20.98% in Group B, (P=0.000).

Conclusions: The mDIXON sequence of MRI can be used to quantitatively analyse fat in the children of PMD. FF can be used to distinguish normal and abnormal.

The measurement way of SI(W)

The measurement way of SI(F)
SS_02

Bone Marrow and Para-spinal Muscle Fat Change in Pediatric Patients with Non-alcoholic Fatty Liver Disease

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Background / aims: To investigate the change of bone marrow (BM) and para-spinal muscles (PSM) fat content associated with age, body mass index (BMI) and the degree of fatty liver in pediatric patients with known or suspected non-alcoholic fatty liver disease (NAFLD).

Methods: Institutional review board approval was obtained for this retrospective study. Consecutive fat quantification liver MRI examinations including proton density fat fraction between June 2015 and April 2019 to evaluate NAFLD in children were reviewed. Not only hepatic fat, but also BM and PSM fat were quantitatively evaluated on axial images of the fat map at the mid-levels of T11-L2 vertebral bodies for BM fat and at the mid-level of L2 for PSM fat. Age, height and weight at the time of MRI were recorded and BMI was calculated. And Pearson correlation analysis was performed.

Results: Total 149 patients (114 male) were included with the mean age 13.4 ± 3.0 years (range 7-22 years). The mean fat fractions were 24.1 ± 13.0 % (2-53%) in liver, 37.8 ± 9.1 % (17.3-67%) in spinal BM, and 2.7 ± 1.1 % (1.0-6.9%) in PSM. Age, height, weight, and BMI were not correlated with liver fat or BM fat. However, weight (ρ=0.165, p=0.044) and BMI (ρ=0.231, p=0.005) were positively correlated with PSM fat. Liver fat showed positive correlation with BM fat (ρ=0.252, p=0.002), but not with PSM fat. There were also positive correlation between BM fat and PSM fat (ρ=0.233, p=0.004).

Conclusions: BM fat was positively correlated with liver fat, but not with age or height in pediatric NAFLD patients. PSM fat was not associated with liver fat, but correlated with weight and BMI.

SS_03

The Quantitative Study on Value of Intrahepatic Lipid Content in Obese Children and Adolescents by Proton Magnetic Resonance Spectroscopy

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Background / aims: To quantitatively evaluate the clinical significance of intrahepatic lipid (IHL) content in obese children and adolescents by proton magnetic resonance spectroscopy (1H-MRS).

Methods: One hundred and fifty-four obese children and adolescents were enrolled in this study. Anthropometric data, liver function, serum lipids, oral glucose tolerance test (OGTT) and insulin related parameters were measured. IHL content was quantified by 1H-MRS. Patients were classified as simple obesity (n= 82) and obesity with metabolic syndrome (MS) (n=72). Twenty healthy children and adolescents served as a control group. The differences of IHL content among the three groups were compared. The relationship of IHL content with clinical parameters were analyzed.

Results: IHL content measured by 1H-MRS was 0.69% (0.37%-0.98%), 5.38% (0.91%-19.02%) and 22.76% (7.08%-59.71%) respectively in the control, simple obesity and obesity with MS groups. There were significant differences in IHL content among the groups. Univariate correlation analysis demonstrated that IHL content was positively correlated with age, height, weight, body mass index,
waist circumference, hip circumference, waist-to-hip ratio, diastolic blood pressure, alanine aminotransferase, aspartate aminotransferase, triglyceride, OGTT 2-hour plasma glucose and OGTT 2-hour insulin. Multivariate linear regression analysis demonstrated four independent risk factors were correlated with increased IHL content: increased waist-to-hip ratio, 2-hour plasma glucose levels, alanine aminotransferase and aspartate aminotransferase.

Conclusions: IHL content were increased in the early stage of simple obese children and adolescents, and it was significantly increased in the obesity with MS group. There is a significant correlation between some clinical parameters and IHL content. Among them, increased waist-to-hip ratio, 2-hour plasma glucose levels, alanine aminotransferase and aspartate aminotransferase were independent factors influencing IHL content. IHL content can be used as a sensitive index for clinical evaluation of obese children and adolescents.

SS_04

Diagnostic Accuracy of Lateral Abdominal Radiographs Among Pediatric Patients in Detecting Hirschsprung Disease

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Background / aims: To determine the diagnostic accuracy of the lateral abdominal radiographs among pediatric patients in the radiographic detection of Hirschsprung disease using rectal biopsy as gold standard.

Methods: This retrospective cross-sectional study included 43 pediatric (5 years old and below) patients with clinical consideration of Hirschsprung disease who had lateral abdominal radiographs and subsequent rectal biopsy at St. Luke’s Medical Center-Quezon City from January 2011 to December 2017 and at St. Luke’s Medical Center – Global City from January 2010 to December 2017. Presence of a transition zone and / or reversal of the rectosigmoid index on a lateral abdominal radiograph were interpreted as “positive” for Hirschsprung disease. The radiographic findings were correlated with the rectal biopsy results.

Results: Subjects were mostly males (70%) with average age of 0.65 years (8 months) old. The most common indication noted was “consider Hirschsprung Disease” (42%). 23 patients (54%) were suspected to have Hirschsprung Disease on the lateral abdominal radiographs, while 40 patients (93%) were confirmed to have Hirschsprung Disease on biopsy. Of these 40 patients, 22 were “positive” on the radiograph. Overall, the diagnostic accuracy of the lateral abdominal radiograph was 55.8%. Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were 55%, 67%, 96% and 10%, respectively.

Conclusions: The diagnostic accuracy of the lateral abdominal radiograph among pediatric patients in the detection of Hirschsprung disease may be average, at 55.8%, however, the positive predictive value is high at 96%, indicating that if a transition zone or reversal of the rectosigmoid index is appreciated, there is also high likelihood that the patient has Hirschsprung disease.

Lateral abdominal radiographs of a biopsy proven Hirschsprung disease in a pediatric patient.
Ileocolic Intussusception: Demographics and Radiological Findings Associated with Patients who Failed Enema and Required Surgical Reduction

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Background / aims: Intussusception is the most common cause of intestinal obstruction in children less than 3 years of age. Image-guided intussusception reduction is the initial treatment of choice. Surgery is required for patients who fail image-guided intussusception reduction. The goal of this study was to assess the demographic and imaging findings in patients failing image-guided intussusception reduction and need for surgery.

Methods: An IRB approved, retrospective review of pediatric patients with an attempted therapeutic enema for intussusception between September 2012 and August 2017 was performed. Medical records were reviewed for the presence of symptom length, fever, bloody stool, and surgical intervention. Radiographs were reviewed for the presence of bowel obstruction. Location of the leading edge of intussusception, trapped fluid, and poor blood flow were evaluated on ultrasound. Odds ratios (OR) and confidence intervals were calculated to determine the association of these parameters with the need for surgical reduction.

Results: 214 therapeutic enemas met initial criteria for inclusion. Poor flow on ultrasound and obstruction on radiographs had the highest eventual surgical intervention, with odds ratios of 11.2 (95% CI: 5 – 21.4) and 9.6 (95% CI: 3 – 30.3) respectively. Additional findings such as trapped fluid (OR 10.3; 95% CI: 5 – 21.4), leading edge beyond splenic flexure (OR 4.6; 95% CI: 2.4 - 9), and bloody stool (OR 2; 95% CI: 1.1 – 3.7) also had a high prevalence in patients requiring surgical intervention. Other findings including duration of symptoms > 1 day (OR 1.6; 95% CI 0.9 – 2.9) and fever (OR 1.4; 95% CI: 0.7 – 3) were less likely to be associated with enema failure.

Conclusions: Imaging findings of intussusception, specifically poor blood flow, bowel obstruction, trapped fluid, and leading-edge location, have increased association in patients requiring surgical intervention. Early surgical involvement is important in pediatric patients with one or more of these findings.

Diagnostic Performance of Contrast-enhanced Ultrasound for Acute Pyelonephritis in Children

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Background / aims: Acute pyelonephritis (APN) is a relatively common consequence of urinary tract infections in children. Contrast-enhanced ultrasound (CEUS) is a non-radiating imaging modality. The purpose of our study was to evaluate the diagnostic performance of CEUS for APN in children.

Methods: A retrospective review was done in children who underwent imaging studies for urinary tract infections. Both dimercaptosuccinic acid (DMSA) and CEUS were performed in 31 children (age: 3 months–13 years; mean 2 years). There were 12 children (age: 4 months–13 years; mean 3 years) who underwent both computed tomography (CT) and CEUS. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were determined for CEUS.
**Results:** Using DMSA as the gold standard, CEUS had a sensitivity of 84.8%, a specificity of 69.0%, a PPV of 75.7% and an NPV of 80.0% for the detection of APN. Using CT as the gold standard, CEUS had a sensitivity of 84.6%, a specificity of 72.7%, a PPV of 78.6%, and an NPV of 80.0% for the detection of APN. The mean interval between ‘DMSA and CEUS’ and ‘CT and CEUS’ were 6.8 and 5.6 days, respectively. There was one case of a renal abscess that was revealed on CEUS but not on other modalities.

**Conclusions:** CEUS can be used for the evaluation of children with APN without ionizing radiation.

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**Preparative Fasting for Contrast-enhanced CT in Children: Observational Study**

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**Background / aims:** To evaluate the evidence on value of preparative fasting for pediatric patients undergoing computed tomography (CT) with intravenous administration of low-osmolality iodinated contrast media (ICM).

**Methods:** All consecutive children who underwent contrast-enhanced CT examinations from April 2017 to July 2017 were included in this study. According to our departmental guidelines, children aged less than 12 months were recommended to fast for 2 hours, children aged 1 to 4.9 years fast for 3 hours, and children aged 5 years or older fast for 4 hours, regardless of the type of CT. In case of emergency, CT scan was conducted under the supervision of the doctor regardless of NPO times. When children were sedated using intravenous sedatives, water was restricted for 2 hours, breast milk for 4 hours, and other formulas and solid foods for 6 hours. Trained pediatric nurses monitored the children during CT examinations and recorded any adverse events such as nausea, vomiting or aspiration pneumonia on electric medical charts. Incidences of adverse events were calculated. The NPO time, types of the last food ingested, use of sedation, types of contrast media and patient’s underlying disease, the presence of GI symptom before CT scan were reviewed. Their association with adverse events was evaluated using univariate and multivariate Firth’s logistic regression analysis.

**Results:** Total 354 children (median age, 7.8 ± 5.9 years; range, 0 – 19.3 years old) were evaluated. The average of NPO time for all patients was 8.0 ± 3.5 hours (range, 0 – 24 hours). Only 11 pediatric patients (3.1 %, median age 10.6 ± 4.2, range, 3.3 – 14.8) had nausea only (n=1) or nausea with vomiting (n=10). None of them developed aspiration pneumonia. The mean NPO time for patients had emesis was 8.36 ± 2.4 hours (range, 3 – 21 hours). Four out of 11 patients (36.4 %) were on chemotherapy at the time of CT scan. Development of adverse events showed no significant association with age, gender, NPO times, types of the lastly ingested food, sedation status and the presence of GI symptom before CT examination. Univariate regression analysis revealed that CT frequency and chemotherapy were associated with nausea and vomiting (p = 0.048 and 0.024, respectively). Only, chemotherapy shows marginal significance (p = 0.050) on multivariate regression analysis.

**Conclusions:** Only small portion (3.1 %) of children experienced nausea or vomiting after exposure to low-osmolality ICM. Chemotherapy could potential risk factor of emetic complication in pediatric patients.
E-Poster Presentation
Colonic Hemangioma: an Uncommon Cause of Gastrointestinal Bleeding in Pediatric Patients

Birgitta Yan Wing Li

Objectives: We endeavour to raise awareness of the uncommon entity of colonic hemangioma. Recognition of its unique imaging features will facilitate early diagnosis of this disease, which if left untreated, could result in massive hemorrhage and significant morbidity to the patient.

Case Presentation: An 8-year old boy presented to our hospital for passage of fresh blood in his stool for one day. One day before, he had allegedly sustained a blow to his stomach by another child while playing. On admission, per-rectal examination revealed old melena. Blood tests showed a mild drop in hemoglobin levels to 9.6 g/dL. Initial plain abdominal radiograph revealed multiple phleboliths projected over the right flank region (Fig. 1). Abdominal ultrasonography found a heterogeneously hypoechoic ill-defined mass over the right abdomen with intrinsic vascularity and slow venous flow detected (Fig. 2). Computed tomography (CT) scan of the abdomen and pelvis showed an irregular lobulated mass at the hepatic flexure of colon with multiple phleboliths (Fig. 3). Serpiginous enhancement was seen on post-contrast images. Magnetic resonance imaging (MRI) of the abdomen revealed a T1-weighted hypointense, T2-weighted hyperintense lobulated mass with heterogeneous contrast enhancement (Figs. 4, 5). Scattered hypointense nodular lesions in the mass were noted to correspond to known phleboliths. With a preliminary diagnosis of colonic hemangioma on hand, the patient was started on a course of oral steroids (prednisolone 25mg twice daily) and underwent a follow up CT scan of the abdomen around three months after the initial CT, which showed an interval decrease in size of the colonic hemangioma (Fig. 6). The patient subsequently underwent open laparotomy with a colonic hemangioma found over the antimesenteric side of hepatic flexure and a partial right colectomy with end-to-end anastomosis was performed. Histological examination of the mass showed ectatic vascular channels which infiltrated the submucosa and muscularis propria into the subserosa. The final pathology report came back to be venous hemangioma.

Unique Teaching Points: Colonic hemangioma is an uncommon disease that primarily affects young adults. It was first reported in 1839 and presented with hematochezia. Young patients presenting with lower gastrointestinal tract bleeding frequently suffer from hemorrhoids or inflammatory colitis; however, we should be aware of less common causes. Despite having multiple cases of colonic hemangioma reported worldwide, the diagnosis is commonly delayed. Up to 80% of patients with colonic hemangioma have undergone unnecessary surgical procedures such as hemorrhoidectomy, and the average delay in diagnosis is 19 years.

A Rare Case of Giant Meconium Pseudocyst without Calcification: A Case Report

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Objectives: Meconium peritonitis is caused by intrauterine bowel perforation with spillage of meconium into the peritoneal cavity. Meconium pseudocyst develops if the extruded meconium is walled off. The characteristic radiographic finding of a meconium pseudocyst is a fluid-filled mass with peripheral curvilinear calcifications. Here we report an unusual case of giant meconium pseudocyst formation without peritoneal calcification in a full-term infant.

Case Presentation: A full-term infant born at 38 weeks of gestation via elective caesarean section was noted to have grossly distended abdomen with visible dilated vein at birth. At 10 minutes of life, she was intubated due to persistent grunting with respiratory distress. Meconium pseudocyst develops if the extruded meconium is walled off. The characteristic radiographic finding of a meconium pseudocyst is a fluid-filled mass with peripheral curvilinear calcifications. Here we report an unusual case of giant meconium pseudocyst formation without peritoneal calcification in a full-term infant.
Fluid level occupying almost the entire abdominal cavity, measuring 8.3 x 11.7 x 8.7 cm (APxWxCC). In both ultrasound and CT, no wall calcification was noted which is commonly seen in typical meconium pseudocyst. Emergency exploratory laparotomy and excision of cyst with bowel anastomosis was performed on day one of life. Intra-operatively, a large meconium pseudocyst encasing a segment of the small bowel noted. The ruptured cyst was sent for histopathological examination. The histopathological findings were consistent with meconium pseudocyst. Unfortunately, the infant passed away on day two of life due to disseminated intravascular coagulation.

**Unique Teaching Points:** Meconium pseudocyst is an uncommon condition with high mortality rate. In cases of large meconium pseudocyst, presence of calcifications may be difficult to be appreciated sonographically. A contrast enhanced CT may depict an intra-abdominal mass with calcifications. It can also be used to demonstrate communication between the cystic lesion and the bowel loops. Formation of calcifications may also take weeks to be seen radiographically. Therefore, meconium pseudocyst should always be one of the differential diagnoses for congenital intra-abdominal mass, even in the absence of typical radiological features.

**Attach Files 1:** Transverse view of the ultrasound abdomen showing the large hypoechoic mass with echogenic debris within (black arrow). Apparent communication with the adjacent bowel loop noted (red arrow).

**Attach Files 2:** Sagittal (A), coronal (B) and axial (C) images of CT abdomen showing a large well-defined intra-abdominal mass with air-fluid level within (blue arrow) displacing the surrounding structures.

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**Pancreatoblastoma in an Ectopic Pancreatic Rest**

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**Objectives:** To report a rare case of a pancreatic blastoma in an ectopic pancreatic rest in a 5-month old male presenting with an abdominal mass.

**Case Presentation:** Patient presented with an upper abdominal mass. CT scan showed a well-defined, heterogeneously enhancing mass in the upper abdomen just anterior to the body and tail of the pancreas and abutting liver. It measured 7.0 x 7.4 x 9.2 cm without areas of calcification. Areas of non-enhancement were seen relating to necrosis. It appeared to be supplied by the gastric or gastro-duodenal branch and not by the hepatic artery. Subsequent surgery showed a normal-appearing pancreas and a solid tumor closely related to the caudate lobe, left portal vein and retrohepatic inferior vena cava. The caudate lobe and the tumor were removed. On histopathology, liver margins were clear and the mass was found out to be a pancreatoblastoma.

**Unique Teaching Points:** Pancreatoblastoma is a rare primary neoplasm of childhood which should be considered as differential in young children with an upper abdominal mass. Ectopic pancreas or pancreatic rest is even more rare in which pancreatic tissue is located outside the normal location of the pancreas and can present in any location in the abdominal cavity. It usually is clinically silent and is found incidentally during surgery. However, as seen in this case, pancreatoblastoma in a pancreatic rest may occur. It may present as an intraabdominal mass in a child wherein the discrete origin may not be delineated or may present as a diagnostic dilemma on imaging.

**Attach Files 1:** Well-defined heterogeneously enhancing mass in the left hemiabdomen, just anterior to the body and tail of the pancreas, with areas of non-enhancement relating to necrosis.
Fetiform Teratoma (Homonculus): A Rare Highly Differentiated and Organized Form of Ovarian Mature Cystic Teratoma Resembling Malformed Fetus

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Objectives: To present and describe the imaging findings of fetiform teratoma; a rare form of highly organized and differentiated form of ovarian mature cystic teratoma resembling a malformed fetal-like structure.

Case Presentation: We report a case of an 11-year-old premenarcheal girl who was referred to our centre for progressive and painless abdominal distension for 3 years and was found to have a large non-tender pelvic mass extending to the right hypochondrium. Serum alpha-fetoprotein and beta-human chorionic gonadotrophin (beta-hCG) were normal. Ultrasound and subsequently contrast enhanced CT abdomen and pelvis revealed a large cystic right ovarian mass containing smaller encapsulated solid component of soft tissue and fat surrounding central bony structures resembling recognizable malformed fetal parts. A large right ovarian teratoma containing cystic and solid components of sebum, hair and bony like structures was found at laparotomy and right salpingo-oophorectomy. The diagnosis of right ovarian mature cystic teratoma was confirmed histologically.

Unique Teaching Points: This case describes the distinguishing radiological characteristic of fetiform teratoma from fetus-in-fetu; a parasitic monozygotic twin usually found inside the body of a newborn or infant.

Hepatoblastoma with Invasion to the Right Atrium in 3 Year Old Boy

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Objectives: Hepatoblastoma is the most common primary liver tumor of childhood and third most common pediatric abdominal malignancy after wilm tumor and neuroblastoma. Hepatoblastoma mainly affects children from infants to about 5 years. Most cases appear during the first 18 months of life. There we present case studies to document the presence a rare case Hepatoblastoma with Invasion to the right atrium.

Case Presentation: We are reported A 3 year-old-boy was admitted to Wahidin Sudirohusodo Hospital, South Sulawesi, Indonesia with complaints enlargement of abdomen since 2 months ago. Complaint accompany with abdominal pain. Defecation and urination normal. No history of the same disease in the previous family. At physical examination there was a large solid mass in his right upper abdominal quadrant. Laboratory result showed elevated SGOT and immunoserrological examination showed the alpha-fetoprotein (AFP) tumor markers elevated > 400 IU/ml. Abdominal ultrasound showed heterogeneous mass in the liver extends to the right atrium. CECT abdomen showed solid heterogeneous mass with contrast enhancement, well defined, lobulated 14.5 x 8.08 x 14.1cm in the liver, involved the inferior vena cava and extended to the right atrium. Bilateral pleural effusion was reported, no pulmonary nodules were found. The patient underwent liver biopsy and histopathologic findings confirmed the diagnosis hepatoblastoma. This patient started to get chemotherapy treatment, but a few days after chemotherapy the patient's condition worsened with dyspneu and anemia, that he was transferred to the intensive care unit, four days later the patient was declared dead.
Unique Teaching Points: Ultrasound is especially useful in children that can assign the tumor to the liver and define its relationship to the vein. CT scan for initial staging of the tumor and for assessing its resectability. It is also used to monitor tumor response to preoperative chemotherapy, search for tumor recurrence ad metastasis. In hepatoblastoma, the invasion of the right atrium via the inferior vena cava is rare case. This condition places the patient in a high-risk group and makes the treatment approach more complex with poor prognosis.

Hepatic Venous Complication Post Living Donor Liver Transplantation

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Objectives: To review spectrum of the imaging appearances of hepatic venous complication after living donor liver transplantation. To understand diagnostic and treatment for hepatic venous complication.

Case Presentation: Girl 21 months old with biliary atresia coming to our institution after 3 months post living donor liver transplantation with ascites. We reviewed using ultrasound and was found stenosis in the hepatic vein. Confirmation diagnosis using digital subtraction angiography was found obstruction at the level of hepatic vein and increase pressure gradient. Treatment of the patient by dilating the stenosis using a balloon. The result was successful, and that the first case of hepatic vein stenosis in our institution. The second case is a girl 13 months old with biliary atresia coming to our institution after 18 months post living donor liver transplantation with massive ascites. We reviewed using ultrasound and was found parenchyma heterogenous with vascular liver graft within normal and the hepatic vein with triphasic doppler wave. The patient keeps producing ascites. We decide to evaluate using angiography percutaneous after CT angiography was found the diameter of the hepatic vein was small. During angiography, we found the diameter of the hepatic vein was small but without different pressure gradient. We try to dilate the hepatic vein using a balloon, but the caliber of vein did not significantly larger. After the procedure patient condition better with decrease the bilirubin level. After one week, the patient keeps producing ascites and we decide to do a liver biopsy and the result is chronic rejection.

Unique Teaching Points: Ultrasound is the first modality without radiation to evaluate post living donor liver transplantation and it can evaluate vascularity of liver graft more precise than using CT scan angiography. We need to evaluate the vascularity of liver graft before we make a conclusion of rejection because it is the most common complication in liver transplant.

Hepatoduodenal and Hepatocolic Fistula – A Rare Complication of Hepatic Abscess

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Objectives: AIM: The causative agents of hepatic abscess are bacterial, parasitic or fungal agents. Fungal hepatic abscess is rare and occur mostly in immunocompromised patients. The complications include thrombosis of IVC, portal and hepatic veins, rupture of abscess into subphrenic space, peritoneum, pleural cavity and GIT.

METHODS: Ultrasound abdomen is done using both low and high frequency probe of GE LOGIQ P9 followed by CECT abdomen in 16 slice GE CT. The radiological findings were confirmed in surgical exploration. Post operative fluoroscopy contrast study obtained for evaluation of peritoneal leak.

Case Presentation: Here we present a 9 year old immunocompromised child (B-Cell Acute Lymphoblastic Leukaemia) with air filled hepatic abscess causing multiple rare complications and discuss in detail about the hepatic abscess complications. On sonological evaluation of abdomen, there was an air filled cavity in the right lobe of liver. Complete extent of the cavity could not be made out sonologically. So, CECT abdomen was suggested and it revealed air filled cavity in right lobe of liver surrounded by a non enhancing hepatic parenchyma, communication of the cavity with duodenum and ascending colon, rib involvement and renal vein invasion causing renal infarction. Exploratory laparotomy / debridment of hepatic necrosis + duodenal repair, ascending colostomy, gastrostomy and jejunostomy was done.

Unique Teaching Points: Rupture of hepatic abscess into the pleural and peritoneal cavities is a relatively common phenomenon. Rupture of hepatic abscess into gastrointestinal tract & renal vein invasion is uncommon, and only a handful of cases are reported in literature for GIT involvement. Mowji et al. described the first case of liver abscess with hepatoduodenal fistula with radiological confirmation in 1987. Complications of hepatoduodenal fistulas include sepsis, debilitation, and electrolyte imbalance. Early diagnosis and complete
radiological evaluation significantly reduces the mortality rate, especially in immunocompromised patients.

**Unique Teaching Points:** Patients with ureterocele may have varied symptoms such as urinary tract infections, obstruction, or incontinence. We report this case with various symptoms and images such as protruding ureterocele through the urethra, bilateral duplex collection system, mild hydronephrosis of the right kidney with drooping lily signs, incomplete bilateral double ureters with unilateral megaureter and right giant ureterocele, extremely rare in same patient. Radiological imaging has an important role in obtaining an early diagnosis of ureterocele to avoid severe complications.

**Attach Files 1:** Picture 1. A,B BNO IVP Showing bilateral duplex collecting systems with drooping water lily sign appearance, bilateral double ureter with unilateral megaureter and right giant ureterocele. C. protruding mass of ureterocele. D. Pus in ureterocele.

**Attach Files 2:** Picture 2. Ultrasonography and CT Scan which was carried out one weeks after the procedure confirmed a bilateral duplex collecting systems, mild hydronephrosis of the right kidney, bilateral double ureter with unilateral megaureter and giant right ureterocele.

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**CP_ABD_08**

Bilateral Duplex Collecting System, Incomplite Bilateral Double Ureter with Drooping Water Lily Sign Appearance and Unilateral Megaureter with Right Giant Ureterocele in a Female Infant

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**Objectives:** Ureterocele is a cystic dilatation in the terminal section of the ureter that is located inside the bladder, the urethra, or both. It may be unilateral or bilateral and may be associated with a single or duplex system in some cases. Ureteroceles are birth defects that occur in approximately 1:5,000 babies. They occur most often in Caucasians. A ureterocele is 10 times more common in girls than in boys. The aim of this report is to describe clinical manifestation, laboratory, and radiological characteristics of Ureterocele in our patient and the need to increase the awareness regarding this rare case.

**Case Presentation:** This is a unique and rare case, we are reporting a five month female infant with an intermittent protruding mass from urethra, accompanied by dysuria, fever and recurrent urinary tract infection. Inspection of the external genitalia revealed a protruding mass from the urethra which could be reduced manually. Further examination was attended to make an accurate diagnosis, included Intravenous pyelography, Ultrasonography and CT Scan. Intravenous pyelography showed bilateral duplex collecting systems, mild hydronephrosis of the right kidney with drooping water lily sign appearance, incomplite bilateral double ureter with unilateral megaureter and right giant ureterocele.
Imaging of Biliary Atresia With Polysplenia Syndrome : a very rare case report

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Objectives: To anticipate of functional abnormalities and interventions that may deemed necessary in biliary atresia with polysplenia syndrome.

Case Presentation: A-3 months old female was admitted to our hospital presented high fever for 5 days before admission. History of jaundice since birth. On physical examination, hepatomegaly appreciated. Transaminase enzyme and gamma GT elevated. CT scan revealed the following findings: fundus of stomach in the left with duodenum extending to left upper abdomen, head and part of the body of the pancreas and tail was absent, portal vein across at the anterior of the duodenum, suggestive choledochal agenesis, left lobe of liver fill the right compartment of the abdomen overlapping the spleen, gallbladder in the midline and the neck of gall bladder disappeared behind the portal vein causing mild compression on it. With guidance of previous imaging, laparotomy all of the imaging finding pictured were confirmed which the midline liver with six spleens located behind. All spleens were almost equal size. Colon on the left side which include appendix. Ligament of treitz, duodenum, jejunum, and ileum were on the right side. Only pancreatic head and a small part of the body were visible. Bilary atresia found on MRCP and proved by surgery. Above the short pancreas, portal vein was crossing the duodenum. This type of arrangement of thoracic and abdominal organ is called situs inversus. Her postoperative period was uneventful.

Unique Teaching Points: Radiologists should become familiar with these rare and peculiar anomalies of this syndrome and present valuable report to aid surgeons deciding optimal treatment for the patient.

Radiological-Immunohistochemical Study of Inflammatory Myofibroblastic Tumor in a child with Reference to Anaplastic lymphoma Kinase Expression

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Objectives: We wish to highlight the Radiological-Immunohistochemical Study of Inflammatory Myofibroblastic Tumor in a child with Reference to Anaplastic lymphoma kinase expression.

Case Presentation: A 6-year-old girl presented with complaints of abdominal pain for three months. On per abdominal examination, a firm lobulated mobile mass was palpated. Ultrasound revealed a heterogenous mass lesion measuring 9.6x9x6 cm in the mesentery displacing the bowel loops. Contras enhanced(CECT)CT abdomen showed a multilobulated soft tissue mass in the mesentery with areas of necrosis.No fat, calcification or air was seen in the mass. PET-CT was acquired 60 min after i.v. injection of 150 MBq of 68Ga-DOTATATE. Mildly increased somatostatin receptor expression was seen in the soft tissue mass (SUVmax 2.3; ~ 12.3 x 7.8 cm). Ultrasound guided FNA was done and a diagnosis of desmoplastic small round cell tumor was offered. The child was started on chemotherapy with vincristine, doxorubicin and cyclophosphamide, and underwent surgical resection of the tumor after 6-cycles of chemotherapy. Intraoperatively, a large mass was seen arising from the mesentery which was excised, along the resection and end-to-end anastomosis of the surrounding ileal loops. Histopathology showed a well circumscribed tumor composed of spindle cells arranged in short intersecting fascicles in a collagenous matrix. These spindle cells were accompanied by dense mixed inflammatory cell infiltrate composed of plasma cells and mature lymphocytes with admixed eosinophils. The spindle cells were positive for desmin, pancytokeratin and Anaplastic lymphoma kinase.
lymphoma kinase (ALK). A final diagnosis of Inflammatory myofibroblastic tumor (IMT)-ALK positive was made.

Unique Teaching Points: Inflammatory myofibroblastic tumor (IMT) commonly occurs between 2-16 years in the pediatric age group; however, it is also known to occur in adults. The commonest organ involved is lung, and the most prevalent extrapulmonary site is abdominal cavity where mesentery is usually involved. IMT presents with diverse clinical symptoms, physical signs, and laboratory findings, depending on the organ involved which makes it difficult to differentiate from other neoplasms. Similarly, the radiological appearance is also variable and non-specific making it difficult to make a correct diagnosis. Percutaneous biopsy along with immunohistochemical analysis contributes to confirmation of diagnosis. Most of the IMT express actin, vimentin, and keratin, while ALK has been described to a specific marker for this tumor. ALK immunohistochemistry is a useful diagnostic aid in the appropriate clinical and histomorphologic context.

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**Hepatic Subcapsular Hematoma in Very Low Birth Weight Neonates: Series of 5 Cases and Review of Literature**

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Objectives: Hepatic hematoma of the liver rarely occurs in neonates and the diagnosis is often missed or delayed. We describe the ultrasonographic and MR findings of hepatic subcapsular hematoma of the liver in preterm neonates with very low birth weight.

Case Presentation: We present five patients who had intrahepatic subcapsular hematoma. All patients were preterm patients with very low birth weight. They were delivered by cesarean section between 25 to 28 weeks gestational age with birth weight ranging from 680g to 1.52kg. One patient underwent surgery due to bowel perforation due to meconium plug and the other patient underwent surgery due to bowel perforation due to necrotizing enterocolitis. Three patients were hemodynamically unstable due to oliguria, metabolic acidosis and post resuscitation status. All five patients had germinal matrix hemorrhage. Ultrasonography was the investigation of choice in diagnosing hepatic subcapsular hematoma. Well defined hypoechoic lesion was noted at subcapsular portion of the liver without internal vascularity on Dopper images. All cases were treated with conservative care and four patients survived without sequelae.

Unique Teaching Points: Ultrasonography is the investigation of choice in evaluating hepatic subcapsular hematoma. It can delineate the lesion well, differentiate it from neoplasm and can be used for serial follow up. Conservative treatment is performed and subcapsular hematoma is naturally absorbed without definite sequelae.

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**Incidental Findings of Counterclockwise Mesenteric Whirlpool Sign in a Case of Left Paravertebral Neuroblastoma with Left Artery Pseudoaneurysm**

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Objectives: We choose to report this case to understand this rare condition better to avoid unnecessary additional investigations and mismanagement.

Case Presentation: A 2 year old girl, presented with fever, left eye bruising and swelling for 4 days. CT Brain and Abdomen noted to have enhancing mass in middle cranial fossa and large left paravertebral mass adjacent to left kidney. Image guided biopsy of the left paravertebral mass was done and proven to be neuroblastoma. Upon reassessment with CT Abdomen after completion of chemotherapy, noted the large left paravertebral mass have reduced in size but there are incidental findings of counterclockwise mesenteric vessels whirlpool sign and left artery pseudoaneurysm.

Unique Teaching Points: Normally the SMV lies to the right of SMA and its tributaries course anteriorly to the SMA in a clockwise fashion. The clockwise whirlpool sign is highly specific and sensitive in representing malrotation/volvulus. However, counterclockwise rotation of SMV around SMA can be a normal variant. Up til this date, there have been only seven reported radiological descriptions of counterclockwise twisting of the SMV about the SMA with four of it proven to be negative for malrotation or volvulus. 22% of the cases were found to be associated with intra-abdominal pathologies with 31% of them was due to left renal mass. It occurs due to a proximal jejunal branch of the SMV which before joining the main SMV circles in a counterclockwise fashion between SMA and aorta.
Mediastinal Langerhans Cell Histiocytosis Masquerading as Pneumonia

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Objectives: To describe the imaging features of the rare presentation of Langerhans Cell Histiocytosis as an anterior mediastinal mass

Case Presentation: Langerhans cell histiocytosis (LCH) is a rare multisystem disease with diverse clinical presentation. Mediastinal involvement has rarely been reported. We report a 16-month-old girl presenting with chronic cough and fever for 1 month. Pneumonia was diagnosed based on chest X-ray (CXR) finding of left upper lobe opacity. Two months later, she presented with symptoms of superior vena caval obstruction. Repeat CXR showed persistent left upper lobe opacity. CT thorax showed an anterior mediastinal mass with calcifications and vascular and airway encasement. She also had right ear discharge and symptoms of diabetes insipidus for 3 months. HRCT temporal bone revealed a mass in the right ear with extensive bone erosion which proved to be LCH on histopathological examination. MRI brain revealed absent T1 hyperintensity of the posterior pituitary gland. Whole body MRI added liver and osseous involvement to the picture.

Unique Teaching Points: LCH should be kept in mind as a differential for anterior mediastinal mass, albeit rare.

Attach Files 1: Figure 1: Frontal CXR showing left upper lobe opacity without air bronchogram. This was initially mistaken for consolidation.

Attach Files 2: Figure 2: Contrast enhanced CT thorax in axial mediastinal window showing an anterior mediastinal mass with coarse calcifications. The left upper lobe was collapsed, and left pleural effusion was present.

Neonatal Congenital Diaphragmatic Hernia: A Case Report

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Objectives: To discuss a case of neonatal Congenital Diaphragmatic Hernia in a baby born in a peripheral hospital.

Case Presentation: Congenital Diaphragmatic Hernia is caused by an anatomical defect of the diaphragm. This will allow protrusion of abdominal structures into the chest, causing serious pulmonary and cardiac complications. In this report, a case of a 38weeks old baby boy presented with congenital diaphragmatic hernia at birth is discussed with his radiological findings, management and outcomes.

Unique Teaching Points: It is important that an early pregnancy booking is done and detection of this disease can be done earlier. It is suggested that if the disease can be detected in prenatal period, the prognosis of the disease can be improved.
Lung Teratoma In Newborn: A Case Report

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Objectives: To recognize the clinical and radiological features of mediastinal teratoma in newborn.

Case Presentation: A 3-day-old baby presented with tachypnea at 40 minutes of life and inability to maintain saturation. Urgent chest X-ray (CXR) showed a total white out of bilateral hemithoraces with multiple calcifications over the left middle and lower zones. Serial CXRs showed no improvement. A computed tomography (CT) scan of the thorax noted a large cystic mass with enhancing septae occupying the entire left hemithorax. Multiple calcifications noted within, some of which have a tooth-like configuration. Fat components were also noted within the mass. The mass caused leftward deviation of the trachea and heart as well as the collapse of the left lung. Consolidations were noted at the right upper and lower lobes. The mass was surgically removed. Histopathology examination confirmed the radiological diagnosis of a mass which was composed of mature tissues representing all three of germ layers in keeping with teratoma.

Unique Teaching Points: Early recognition of mediastinal teratoma in the newborn is important to prevent further complications such as lung hypoplasia. The presence of fat component and calcification are highly suggestive of the diagnosis.

A Case of Esophageal Perforation: A Rare Cause of Respiratory Distress in Prematurity and their Radiological Findings

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Objectives: To present important radiological findings of perforated esophagus in neonate from plain radiograph and contrasted study.

Case Presentation: A case of a 33 week premature newborn with an initial findings of abnormal course of feeding tube into the right lower zone with lucency at right cardiophrenic angle on chest radiograph. The ultrasound findings shows stomach is at the normal location with no feeding tube visualised within, thus ruling out diaphragmatic hernia associated with situs inversus position of stomach or gastric volvulus. Upper gastrointestinal study demonstrate contrast extravasation from the right lateral esophagus at T3 level with opacification outlining the right pleural space. Subsequent chest radiographs shows worsening right pneumothorax with chest tube insertion and pleural effusion. New feeding tube was inserted into the true esophageal lumen via fluoroscopic guidance and the newborn was treated conservatively. Upper gastrointestinal study 2 weeks later showed no contrast extravasation in keeping with healing esophageal perforation and child was discharged well soon after.

Unique Teaching Points: This case described the case of esophageal perforation in neonate with its salient radiological findings.

Imaging Spectrum and Temporal Evolution of Necrotizing Pneumonia among Children: A Case-Series and Review of Literature

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Objectives: To present the imaging spectrum and temporal evolution of necrotizing pneumonia in children

Case Presentation: Necrotizing pneumonia is a suppurative complication of pneumonia that is characterized by destruction and cavitary necrosis of the underlying lung parenchyma. Its incidence worldwide is estimated to be at less than 1% of children with community acquired pneumonia. Pneumococci and Staphylococcus aureus are the most common pathogens. Despite low incidence, significant morbidity and mortality are of concern especially in children. Cornerstone management is use of antibiotic based on local susceptibility patterns. In refractory cases, surgical management can be done. Timely utilization of imaging studies such as chest radiographs and contrast-enhanced computed tomography can greatly contribute in the diagnosis and disease characterization which can be beneficial as several medical and surgical interventions can be used in different presentations of the disease. In this case series, we will show three hospital-based pediatric cases of necrotizing pneumonia highlighting the spectrum
and temporal evolution of the imaging appearance. Review of literature focusing on the etiology, pathophysiology, imaging findings and management of necrotizing pneumonia in children will also be presented.

**Unique Teaching Points:** This aims to present and discuss the imaging spectrum and temporal evolution of necrotizing pneumonia in children which can potentially benefit medical and surgical management.

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**Beneath the Unusual: A Case of Thoracic Neuroblastoma**

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**Objectives:** To report the classic radiographic, CT, MRI and nuclear medicine features of Thoracic Neuroblastoma as well as provide an informative teaching source for trainees and Radiologists.

**Case Presentation:** This is a case of a 3-month old male infant born term to a Filipina mother who was admitted to the intensive care unit due to persistent circumoral cyanosis and desaturation. Initial examination done was a chest radiograph which revealed a large soft tissue opacity in the left hemithorax. This finding prompted further evaluation using contrast enhanced chest CT which showed a large, soft tissue mass with irregularly shaped, coarse, bulky calcifications at the left paravertebral region from the thoracic inlet down to the level of T9. It measures approximately 5.6 x 5 x 6.3 cm (AP x T x CC). The mass extends medially to displace the mediastinal structures towards the right. There is an extradural extension into the neural canals from C6 down to T8 level, most severe at the upper thoracic levels. The canal at this level has a widened anteroposterior diameter and the corresponding C6-T5 neural foramina appear splayed. Suggestive beginning erosions are also seen in the medial portions of the left 1st to 3rd ribs. Pleural-based, lobulated soft tissue masses are likewise noted adjacent the left 4th to 9th ribs with an aggregate measurement of 5.6 x 1.2 x 5.9 cm. The patient underwent exploratory thoracotomy with partial excision of the mass. Histopathology revealed a posterior mediastinal neuroblastoma. Since approximately two-third of patients with neuroblastoma have abdominal primaries, an MIBG scan with SPECT-CT was done which revealed MIBG-avidity in the cervicothoracic paravertebral mass and in the left chest lesions. No MIBG uptake was demonstrated in the abdomen. Follow up chest MRI after cycles of chemotherapy showed regression in the overall size of the posterior mediastinal mass, however the tumoral extension to the upper thoracic spinal canal appear unchanged.

**Unique Teaching Points:** Although neuroblastoma is the most common type of malignancy in infants, Thoracic Neuroblastoma account for minority of all neuroblastoma cases (11-26%). It is a rare tumor which can present in an unusual manner. Preliminary imaging is targeted at addressing the symptom, however multimodality assessment is required to assess the extent of the disease. Early recognition through imaging is critical to patient outcome.

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**Spontaneous Resolution of A Thorn-Like, Costal Osteochondroma Presenting as Pneumothorax**

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**Objectives:** Although costal osteochondroma is a rare condition, it is important to recognize because of its potential to cause serious complications such as pneumothorax, hemothorax, and diaphragmatic rupture. Traditionally, patients with a symptomatic costal osteochondroma undergo surgical resection to remove the lesion and prevent further complications. However, the appropriate timing of surgical excision and natural history of costal osteochondromas have not yet been clearly defined.

**Case Presentation:** Here, we present an interesting case of a thorn-like, costal osteochondroma arising from the anterior arc of the left fourth rib in a 12-year-old girl presenting with small pneumothorax. After declining corrective surgery, the patient was symptom-free and without recurrence at the 1-year follow-up. At the 18-month follow-up, the osteochondroma had resolved.

**Unique Teaching Points:** We suggest that if a costal osteochondroma is first detected near puberty without severe symptoms, conservative treatment via observation and yearly
radiologic examination could be an option because of the potential for spontaneous lesion resolution.

**Thoracoabdominal Duplication Cyst Masquerading as Empyema**

Rekha Gupta

**Objectives:** Anomalous endodermal-neuroectodermal adhesion with persistence of canal of Kovalevsky in the 3rd week of embryonic life leads to varying degree of abnormalities, extent of abnormality depends on eventual persistence of this tract. Extreme forms show anterior and posterior spina bifida with split notochord, associated intraspinal cyst. Vertebral anomalies, gut cysts, bowel duplication, the presence of keratin markers and mucin-secreting cuboidal or columnar intestinal epithelium in their walls confirm their entodermal origin. We are presenting the case of a two year old child with large thoraco-abdominal communicating type of jejunal duplication cyst with associated vertebral anomalies masquerading as empyema.

**Case Presentation:** Two year old neurodevelopmentally normal child born out of nonconsanguinous marriage, second in order was referred for second opinion from pulmonary department with complaints of recurrent respiratory compromises since the age of three months. He was investigated at outside hospitals and diagnosed as right side empyema. Aspiration done outside from the right hemithorax lesion detected E.coli. Thorough investigation with CECT Chest revealed multiple vertebral segmentation and fusion anomalies at cervicodorsal junction with a lobulated cystic lesion in right hemithorax extending superiorly in right paramediastinal region upto the cleft in the vertebral body at cervicodorsal junction. Opacification of this cystic lesion with oral contrast lead to diagnosis of diaphragmatic hernia with herniation of jejuna loops in right hemithorax upto cervicodorsal junction. Due to association with vertebral anomalies at cervicodorsal junction, possibility of neurenteric cyst was considered. MRI Spine was advised to look for intra-spinal component. Patient was lost to follow up. However, he reappeared more than one year later with complaints of failure to thrive and repeated episodes of vomiting after meals. MRI spine revealed normal cord with no abnormal intramedullary signal, cord compression or any other intraspinal component. Neurosurgery consultation was normal. Routine investigations were noncontributory. Patient was referred to Pediatric Surgery department in tertiary care hospital. Communicating type of thoracoabdominal tubular jejunal duplication cyst extending superiorly through diaphragmatic defect from the duodeno-jejunal junction to cervico-dorsal junction was found at surgery. Histopathology revealed intestinal type lining mucosa with gastric metaplasia at places. Follow-up at six months was uneventful.

**Unique Teaching Points:** Vertebral anomalies particularly at cervico-dorsal junction with thoraco-abdominal cystic lesion should warn clinician and radiologist to thoroughly investigate the patient for any intraspinal component and extent of endoderm-neurectoderm dysjunction. Imaging can guide proper management and help avoid inadvertent intervention which can be harmful for the patient.

**Attach Files 1:** Chest computed tomography (CT): axial scan show a bony spicule (short arrow) protruding from the anterior arc of the left fourth rib near the costochondral junction, with an adjacent speculated parenchymal soft tissue attenuation lesion (long arrow).

**Attach Files 2:** Chest CT at the 18-month follow-up: the bony spicule at the left fourth rib is resolved (arrowhead) and the parenchymal lesion is smaller, with a minimal parenchymal scar (arrow).
Peroral Extrusion of Distal Ventriculoperitoneal Shunt Catheter via Upward Transdiaphragmatic Migration into Tracheobronchial and Upper Airway in a Child: A Case Report

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Objectives: To present an extremely rare case of peroral extrusion of a distal ventriculoperitoneal (VP) shunt catheter via upward transdiaphragmatic migration into tracheobronchial and upper airway in a child.

Case Presentation: A 2-year old child with an underlying hydrocephalus on VP shunt was referred to our center for peroral extrusion of VP shunt catheter. He was brought to medical attention after the mother noticed presence of a foreign body inside the child's throat which turned out to be a catheter, once extruded out of the mouth on the same day. It was preceded by a month history of chronic cough and hoarse cry with absence of pneumothorax or pleural effusion. On examination, a distal VP shunt catheter was seen extruded perorally. There were no signs of meningitis or inflammation along the subcutaneous shunt tract. No stridor or signs of respiratory distress. Abdominal examination was unremarkable. Chest radiograph revealed upward migration of distal VP shunt catheter from the right upper abdomen through the right hemidiaphragm, right lower lobe lung parenchyma, into the right lower lobe bronchus and trachea. There was subsegmental atelectasis in the right lower lobe of lung along the VP shunt catheter tract with absent of pneumothorax or pleural effusion. Lateral skull including neck radiograph showed the migrated distal VP shunt catheter was located within the pharyngeal airway with its tip exited through the mouth. Computed tomography (CT) brain and contrasted CT neck, thorax and abdomen confirmed the distal intraperitoneal VP shunt catheter had migrated upward along the right perihepatic region, punctured the dome of right hemidiaphragm and right lower lobe lung parenchyma; subsequently entered into the right lower lobe bronchus, right main bronchus, trachea, hypopharynx and oropharynx and exited through the mouth. No vascular or intraabdominal injury. Externalization of VP shunt catheter was successfully performed without any complications and the child was subsequently planned for revision of VP shunt.

Unique Teaching Points: Peroral extrusion of a distal VP shunt catheter via upward transdiaphragmatic migration into tracheobronchial and upper airway is an extremely rare complication of VP shunt. A shunt radiograph series as well as CT play an important role for preoperative planning to ensure successful surgical outcome, particularly in a complicated case of VP shunt migration as highlighted in this case.

Class III Incomplete Pentalogy of Cantrell

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Objectives: Pentalogy of Cantrell is a rare congenital disorder first described in 1958. We present a case of incomplete pentalogy of Cantrell with exomphalos major, patent ductus arteriosus (PDA) with mesocardia, bilateral superior vena cava (SVC), pulmonary hypertension and absent body and xiphoid process of sternum.

Case Presentation: A female baby was born via emergency LSCS due to pre-eclampsia and fetal oomphalocele at 33 weeks with birth weight of 1.265 kg. Abdominal examination revealed oomphalocele with intact sac. Bowels and liver were exteriorized. Cardiovascular examination revealed an end systolic murmur at the left upper sternal edge. Lungs were clear with equal breath sounds. Musculoskeletal examination revealed bilateral congenital talipes equinovarus (CTEV). Echocardiogram on day three of life showed...
mesocardia with a large PDA (3mm), small patent foramen ovale (PFO) with left to right shunt, dilated four chambers and bilateral SVC. Repeat echocardiogram at three and a half months of life confirmed mesocardia with bilateral SVC. The PDA had closed. The pulmonary artery pressure was elevated at 33mmHg. She also had chronic lung changes requiring nasal prong oxygen. The chromosome study showed a normal female karyotype (46, XX). Serial chest X rays done from birth till six months of life showed a predominantly right sided heart with reticular opacities in both lung fields. A CT thorax at nine months of age showed mediastinal shift to the right with left sided aortic arch. The right lung volume was reduced and atelectatic changes were seen in both lungs. The left kidney and stomach were splinting the left hemidiaphragm. Liver and some bowel loops were herniated. There was also lower sternal defect with absent body and xiphoid process. These features are in keeping with class III incomplete pentalogy of Cantrell. She is currently under multi-disciplinary follow-up under paediatric medical and surgical units.

Unique Teaching Points:

i. Pentalogy of Cantrell consists of deficiency of the anterior diaphragm, a midline supraumbilical abdominal wall defect, a defect in the diaphragmatic pericardium, congenital cardiac abnormalities, and a defect of the lower sternum.

ii. Few variants of this syndrome have been described: Class I is when diagnosis is certain and fulfils all five defects. Class II is probable diagnosis with four defects including cardiac and ventral abdominal wall defects. Class III is incomplete diagnosis with variable combinations however always includes a sternal abnormality.

Attach Files 1: Babygram showing right-sided heart, mediastinal shift to the right, reduced right lung volume and omphalocele.

Attach Files 2: A. Coronal CECT thorax in soft tissue window: Mediastinal shift to the right with reduced right lung volume. The apex of the heart is pointed downward and to the centre in keeping with mesocardia. Omphalocele seen at the left side of the abdomen. B. Sagittal CECT thorax in bone window: The manubrium of sternum is present, but the body and xiphoid process of the sternum is absent.

Non-Invasive Retrieval of a Retained Foley Catheter with Non-Deflatable Balloon in a Neonate: A Case Report and Brief Review of Literature

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Objectives: Foley catheter insertion is a common procedure in paediatric patients, but occasionally the catheter balloon cannot be deflated and the Foley catheter cannot be removed. We describe a case of retrieval of a retained Foley catheter with non-deflatable balloon in a neonate using non-invasive techniques. Possible causes of a non-deflatable balloon and alternative techniques of catheter retrieval are also discussed.

Case Presentation: A 6-day old Chinese female neonate was admitted to the neonatal intensive care unit for meconium aspiration syndrome complicated with pulmonary hypertension and bilateral pneumothoraces. A 6-French Foley catheter was inserted for monitoring of urine output but subsequently the catheter balloon could not be deflated and the catheter could not be removed despite cutting the catheter shaft. The interventional radiology team was consulted for ultrasound-guided needle puncture of the catheter balloon. We decided to attempt retrieval by non-invasive guidewire method first. Pre-procedural ultrasound confirmed inflated catheter balloon within the empty urinary bladder. The balloon channel was cannulated by the plastic cannula component of a 22 Gauge angiocatheter. Sterile distilled water was injected into the plastic cannula hub for lubrication. A 0.46mm nitinol guidewire was inserted into the balloon channel through the cannula hub and water leaked out from the balloon channel. Repeat ultrasound showed a deflated catheter balloon and the Foley catheter slipped out spontaneously.

Unique Teaching Points: Some potential causes for failure of the Foley catheter balloon to deflate include a faulty valve mechanism, blockage of the inflation channel by debris, or crystallisation of fluid within the balloon. In our case, we suspected obstruction of the balloon channel due to catheter kinking. Inserting a fine guidewire into the balloon channel can help to straighten a kinked catheter segment or dislodge intraluminal crystals so that the luminal patency of the balloon channel can be restored. The opening of the balloon channel of a Foley catheter is very small for insertion of the floppy end of the J guidewire but this can be facilitated by inserting the plastic cannula component of an angiocatheter first so that the guidewire can be inserted into the angiocatheter hub subsequently. Cutting the Foley catheter close to the patient is also preferred to minimise the working length of
the guidewire. We review the various techniques and potential complications for removal of a retained Foley catheter. The goal of successful management is threefold: to remove the catheter intact, to minimise patient discomfort, and to be as efficient as possible.

**Attach Files 1 :** Pre- and Post-Procedural Ultrasound Images

**Attach Files 2 :** Guidewire Method Diagram

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**Prenatal Diagnosis of Intestinal Volvulus with Meconium Ileus by Fetal MRI: Report of Four Cases**

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**Objectives:** Fetal segmental volvulus is a rare disease, with high risk of potentially life threatening fetal complications. Delay in diagnosis or treatment can increase mortality and morbidity. More rarely, midgut volvulus is caused by meconium plug.

**Case Presentation:** Four fetal cases of midgut volvulus with meconium ileus were assessed from January 2015 to February 2017. Small bowel dilatation was found in all fetuses (4/4). "Whirlpool sign"(4/4), "banana sign"(3/4) and "coffee bean sign"(1/4) were observed as well. The dilated small bowel contained some dependently layered material which was bright on fast inversion recovery motion insensitive in a magnetic resonance imaging sequence called FIRM, possibly indicating the presence of meconium ileus (4/4). Besides, bright intestinal contents on FIRM with unchanged or dark signals on single-shot fast spin-echo which called SSFSE likely indicated complications by a hematocoele from the necrotic intestine (2/4). The two fetuses were terminated and another two fetuses were born, and surgery was performed, confirming segmental volvulus with meconium ileus. The two newborns recovered well after surgery.

**Unique Teaching Points:** A suggestive diagnosis of volvulus can be made, if "coffee bean sign", "banana sign" and/or "whirlpool sign" are present. In addition, fetal MRI is useful for diagnosing meconium ileus, and may even reveal complications with intraluminal hemorrhage.

**Attach Files 1 :** Fig.1 Midgut volvulus with meconium ileus in the fetus [case 1]. Fig.1.a Fetal US at 33+6 weeks of gestation. Transverse view of the fetal abdomen showed numerous dilated bowel loops (arrow). Fig.1.b-1.5 Fetal MRI at 33+6 weeks of gestation. Fig.1.b Axial SSFSE image showing the dilated bowel loops contained dependently layered high signal intensity materials (arrow). Fig.1.c. Axial FIRM image showing numerous dilated bowel loops containing dependently layered high signal intensity materials (arrow). Fig.1.d. Coronal SSFSE image showing the

**Attach Files 2 :** Fig.2 Midgut volvulus with meconium ileus in a fetus at 34 weeks of gestation (case 2). Fig.2.a Axial FIESTA image showing the dilated bowel loops (arrow). Fig.2.b. Axial SSFSE image showing the dilated intestinal signal was heterogeneous, some of which was bright (arrow). The bowel-wall thickened and showed hyperintensity (white arrowhead). Fig.2.c. Axial FIRM image showing the intestinal signal was homogeneous and bright (arrow). Fig.2.d. Axial DWI image showing homogeneous and dark intestinal signal (arrow). The bowel-wall was thickened and showed hyperintensity (white arrowhead). Fig.2.e Axial SSFSE image showing some dilated bowel (arrow) and small mesenteric vessel (black arrowhead) revolved around the mesenteric root—
The Role of Postnatal Imaging in Conjoined Twins

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Objectives: Conjoined twin cases are rare occurrence, with thoraco-omphalopagus (thoracic and abdominal fusion) being the commonest variety. These cases bring challenge to the pediatric radiologist.

Case Presentation: We report our latest two conjoined male twins, born in September 2018. We performed postnatal imaging examinations with various modalities obtained in a period of 6 months (September 2018 – March 2019). The first case is a thoraco-omphalopagus twin delivered by caesarean section. The x-ray shows ventral fusion in the thoraco-abdominal region without sternal fusion. The ultrasound shows lobar holoprosencephaly with septum pellucidum and corpus callosum agenesis in one of the baby. The contrast meal studies show no evidence of gastrointestinal tract sharing between babies. The CT and MRI show cardiac connection (bi-directional inter-atrial shunt) between two babies. In baby number 1 there are AVSD and PLSVC. In baby number 2 there are stenosis of the RVOT and VSD. Fusion of ventral side of the livers were visualized, with few connections between distal branches of the portal venous system. The extra-hepatic biliary system and gallbladder were separated. There are no significant anomalies on other intra-abdominal organs. The second case is an omphalopagus twin with similar delivery route. The x-ray shows ventral fusion in the abdominal region. Cranial ultrasounds were both normal. The contrast meal studies show no evidence of gastrointestinal tract sharing between babies. The CT and MRI show fusion of the ventral side of the liver, with quantitative (manual) estimation of liver parenchyma dominant on baby number I (196.9 cc vs 112.8 cc). Suggestive of partially-extrahepatic porto-portal uni-directional connection from baby II to I. Hepatic arteries, main portal veins were separated. There is cross-vessel between medial hepatic veins on baby I which drains to inferior cava vein on baby II. The extra-hepatic biliary system and gallbladder were separated. There are no significant anomalies on other intra-abdominal organs. Both conjoined twins remain healthy and were in the process of waiting the meticulous preparations of the surgeries. Several limitations of our study are: CT-angiography was performed at 3 and 4 days old, that we would need to repeat the scans prior to the surgery plans; and further evaluation of the heart anomalies would need a gated cardiac magnetic resonance imaging.

Unique Teaching Points: Imaging have important role in this rare case, to delineate the internal structures, define anatomic fusion and shared viscera, and vascular anomalies (non-invasively using CT-angiography and time-resolved 3D MRA technique).

Antenatal Presentation of Blue Rubber Bleb Naevus Syndrome: A Case Report

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Objectives: Blue Rubber Bleb Naevus Syndrome (BRBNS) is a rare condition characterized by multifocal venous malformations, predominantly in the skin and gastrointestinal tract. We reported
a case of a 2-year-old girl presented antenatally with facial mass and initially diagnosed as congenital haemangioma. Subsequent emergence of new symptoms, further imaging and pathological findings lead to revision of the diagnosis to BRBNS. An early correct diagnosis will guide towards proper treatment and improvement in patient’s quality of life.

**Case Presentation:** An antenatal ultrasound performed on a 38-year-old lady at 35 weeks of gestation showed large mass at the fetal face. Fetal MRI at 38 weeks of pregnancy revealed a large mass at the forehead extending down to midface with small tubular flow void signals within. Upon clinical examination at birth, a pedunculated bluish mass was noted on the right forehead extending to the right upper eyelid. The child was treated for congenital haemangioma and started on oral propranolol. However, the mass increased in size disproportionately to the child’s growth and the child developed symptoms of per rectal bleeding. MRI Brain and Face done at four months old showed increasing lesion size with intralesional haemorrhage. Cerebral angiogram demonstrated slow flow vascular malformation with multiple venous lakes. The appearance of multiple bluish papules and nodules in the child’s right thigh and sole prompted a biopsy of the lesion. Histopathological examination (HPE) results was consistent with venous malformation and the diagnosis was revised to Blue Rubber Bleb Naevus Syndrome. Treatment with Sirolimus, an anti-angiogenic agent, was commenced and the child responded well as evidenced by reduction in lesion size in the repeated MRI at one year old.

**Unique Teaching Points:** BRBNS or Bean Syndrome is classified under venous malformation in the International Society for the Study of Vascular Anomalies (ISSVA) classification of vascular anomalies. The typical manifestations are gastrointestinal bleeding and anemia with cutaneous lesion of BRBNS generally presents as multiple, small bluish lesions. The most common vascular lesion diagnosed antenally is congenital haemangioma, therefore, in our case the large facial mass was diagnosed as congenital haemangioma. Nevertheless, an enlarging facial lesion despite on propranolol, appearance of new cutaneous lesions and development of per rectal bleeding instigated a need for biopsy and additional imaging. The diagnosis of BRBNS was ultimately made based on clinical, radiological, histopathological findings and further supported by the child’s positive response towards sirolimus.

**Attach Files 1:** Coronal BTFE-BH SENSE sequence of MRI fetus at 38 weeks of gestation: exophytic facial mass (arrow)

**Attach Files 2:** Lateral view of right internal carotid angiogram in venous phase: venous lakes [blue arrow] within the facial mass [red arrow]
Kaposiform Hemangioendothelioma of the Long Bones in Infant: A Rare Disease with Atypical MRI Features

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Objectives: To highlight the atypical imaging findings of a rare disease of kaposiform hemangioendothelioma (KHE) of the long bones in infants and the importance of identification on imaging to achieve early diagnosis and treatment commencement.

Case Presentation: We reported a case of a one year three months old child with primary long bone KHE complicated with Kasabach-Merritt phenomenon (KMP). The child was presented with left upper limb swelling associated with bluish skin changes. The lesion has grown disproportionate to the child’s growth. Examination revealed swollen left forearm with bluish discolouration. The blood parameters showed persistent thrombocytopenia, hence raised the possibility of KMP. Initial imaging findings which was not done in our centre suggest vascular malformation. The child was treated as bone KHE on the clinical ground without proven tissue biopsy. Chemotherapy regime of weekly intravenous Vincristine and oral Prednisolone was commenced and completed after five months. The left upper limb swelling gradually improved post chemotherapy but had never resolved. The symptoms recurred few weeks post chemotherapy. Follow up imaging done in our centre showed extensive bone involvement of the left upper limb with associated abnormal dilated vessels in the subcutaneous and intramuscular compartment. An open biopsy of left radius was performed and revealed bone KHE. The child is now waiting for the next treatment modality.

Unique Teaching Points: KHE of long bone is a rare entity. To our knowledge, this case highlighted an unusual, never been reported imaging findings of long bone KHE which showed extensive abnormal dilated vessels in the subcutaneous and intramuscular compartment, mimicking vascular malformation with bone angiomatosis.

Kaposiform Hemangioendothelioma of Left Upper Limb with Kasabach Merritt Phenomenon: Multimodality and Serial Imaging

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Objectives: Kaposiform Hemangioendothelioma (KHE) is a rare disease and when it goes hand in hand with Kasabach Merritt Phenomenon (KMP) the diagnosis and management can differ immensely. This case report the demonstrates the role of imaging at diagnosis and to assess treatment response.

Case Presentation: A two-month-old baby boy presented with progressive left upper limb swelling. Blood results showed microcytic hypochromic anaemia and thrombocytopenia. Plain
radiograph of the left humerus showed generalised soft tissue swelling and two lucent lesions with narrow zone of transition at the midshaft of the humerus with associated cortical defect. Ultrasonography revealed soft tissue thickening and oedema with loss of normal muscular striations at the left chest wall and left arm. Left humerus and muscle biopsies showed features compatible with KHE of left upper limb. His treatment plan included weekly administration of Vincristine for 6 months (dosage: 0.025 mg/kg).

After the third week of chemotherapy, an MRI of the left upper limb was performed which showed heterogeneously enhancing soft tissue thickening involving the left upper limb extending to the left lower mandible and lateral chest wall proximally and the proximal radius and ulna region distally. It demonstrated T1WI hypointensity and T2WI hyperintensity with patchy areas of restricted diffusion. Large dilated disorganised veins were also present. Enhancing marrow which was hyperintense on the T2WI/ STIR sequences with small anterior cortical defect seen at the left humerus. There was also external lateral compression onto the left rib cage with intrathoracic extension. Follow-up MRI after the 10th week of chemotherapy showed persistent swelling but no further enlargement, reduced muscular oedema soft tissue enhancement with scarcer primary vascular supply and dilated disorganised veins. The marrow involvement at the midshaft of left humerus and mass effect to the left hemithorax was unchanged. Upon completion of 24 weeks of treatment, the tumour size, enhancement and degree of intrathoracic extension was significantly reduced.

Unique Teaching Points:
- Kaposiform hemangioendothelioma (KHE) is a rare, locally invasive vascular tumour that arises from the vascular endothelial cell lining. KHE can also present with Kasabach Merritt phenomenon (KMP), which includes thrombocytopenia, microangiopathic haemolytic anaemia and mild consumptive coagulopathy. Although tissue diagnosis and biochemical marker are the hallmarks for diagnosis, imaging plays a pivotal role to determine the extent of disease involvement and optimise treatment. Serial imaging using MRI in the beginning, midst and upon completion of treatment provides a contemporaneous imaging reference to ensure the efficacy of the treatment.

Case Presentation:
A 6-month-old male child born out of a non-consanguineous marriage, second in order presented to the pediatric emergency with the complaints of fever and cough for 2 days, and difficulty breathing for 1 day. The child was a term, hospital delivered, 3kg birth weight with no antenatal risk factors and an uneventful perinatal history. He was exclusively breast fed for 2 months, following which top feed was started. The three-generation family history was also normal. There was a history of hospital admission at 5 months of age, where child was operated for left inguinal hernia. Gross motor and fine motor delay was limited range of motion and a protuberant abdomen. The trunk was disproportionately smaller in comparison to his height. The length for age, weight for age and weight for length were all less than the 3rd centile as per WHO growth charts, with an US:LS ratio of 1.0. At admission child had signs of severe respiratory distress. He was managed as a case of bronchopneumonia. Anterioposterior X-Ray showed multiple asymmetric vertebral segmentation defects of thoracolumbar and sacral vertebrae, normal cervical vertebrae, posterior fusion of ribs that flared anteriorly in fan like pattern giving crab chest deformity pattern with intrinsic
abnormalities of fusion and bifurcation of ribs. Few areas of patchy consolidation were noted in lung fields. Visualised epiphyseal centres appeared normal. MRI brain and spine done which revealed normal brain parenchyma and spinal cord. USG KUB was also suggestive of left gross hydronephrotronephrosis. Child was given I.V antibiotics for 14 days and discharged thereafter. Screening ECHO was noncontributory.

**Unique Teaching Points:** Diagnosis of spondylothoracic dysplasia is based upon identification of characteristic symptoms, a detailed patient and family history, a thorough clinical examination and imaging characteristics. It can be confirmed through molecular genetic testing. However, same could not be done in our patient due to financial constraints.

**Attach Files 1:** Anterioposterior X-Ray shows asymmetric vertebral segmentation anomalies involving dorsal, lumbar and sacral region with posterior fusion of ribs showing anterior fanning. Visualised epiphyseal centers are normal for age

**Attach Files 2:** Sagittal MRI shows normal spinal cord

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**A Rare Entity of Spondylodiscitis in Infancy: The Importance of Early Diagnosis and Treatment**

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**Objectives:** Childhood spondylodiscitis (SD) is a rare entity that refers to an infection of the intervertebral disc and the adjacent vertebral endplates. Diagnosis is often difficult and delayed because the symptoms are unspecific and due to the children’s inability to describe the symptoms or site of discomfort. This results in significant clinical problems, including spinal deformities and potentially life-threatening complications. Hence prompt diagnosis and treatment are crucial. We discussed two cases of SD in infants which might be useful for pediatric approaches to children with SD.

**Case Presentation:** We report on two infants of approximately 2 and 3 months old who were born prematurely. The former child was admitted for pneumonia complicated with lung abscess whereas the latter was due to septicemia. In both children, the laboratory tests showed persistently high C-reactive protein and positive blood cultures with Methicillin-resistant Staphylococcus aureus (MRSA). After several days of admission, the clinician noticed vague paravertebral swelling over the posterior trunk. Spine radiographs revealed gibbus deformity of the thoracic spine. The diagnosis of SD was confirmed by magnetic resonance imaging (MRI) and the response to antibiotic therapy were monitored with follow up MRI. Both patients responded well to the antibiotic therapy and were discharged home with thoracolumbar brace.

**Unique Teaching Points:** Diagnosis of spondylodiscitis in children can be delayed because of the scarcity in incidence and lack of awareness. Moreover, children with SD often present with unclear clinical picture leading to late diagnosis. Clinical suspicion, thorough physical examination and the early use of MRI in the investigation of children with bacteraemia may avoid unnecessary delay in diagnosis and starting treatment which may possibly prevent long-term complications.
Cytotoxic Lesion of the Corpus Callosum Secondary to Methicillin-resistant Staphylococcus Aureus (MRSA) Sepsis in Children: A Case Report

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Objectives: Cytotoxic lesions involving the entire corpus callosum are rare and are usually associated with seizure, drug therapy, metabolic abnormalities, malignancy, infections, subarachnoid hemorrhage and trauma. We discuss a case of Methicillin-resistant Staphylococcus aureus (MRSA) sepsicaemia causing transient corpus callosum lesion.

Case Presentation: We reported a rare case of an 11 year-old Malay boy with Methicillin-resistant Staphylococcus aureus(MRSA) infection complicated with septicemia, bilateral renal abscesses and sterile pyuria demonstrating a transient cytotoxic corpus callosum lesion on magnetic resonance imaging (MRI). He presented with a sudden onset of fever for three days duration associated with behavioral changes, fluctuating conscious level, incontinence, unsteady gait and non-purposeful movements of his hands. Laboratory results revealed an elevated white cell count, raised C-Reactive protein with acute kidney injury associated with metabolic acidosis. Blood cultures grew Methicillin-resistant Staphylococcus aureus (MRSA). Cerebrospinal fluid (CSF) biochemical parameters were not suggestive of infection and the CSF culture and sensitivity was negative. MRI on the third day of illness showed diffuse symmetrical hyperintense signal involving the entire corpus callosum on diffusion-weighted sequences with corresponding diffusion restriction on apparent diffusion coefficient (ADC) mapping suggestive of cytotoxic edema. This lesion showed faint hypertensive signal on T2-weighted and fluid-attenuated inversion recovery. He was treated with antibiotics and supportive treatment; subsequent follow-up MRI (which was done 2 months after the onset of illness) showed the corpus callosum lesion had completely disappeared and the patient made a full recovery. Keywords: Reversible, cytotoxic corpus callosum lesion, Methicillin-resistant Staphylococcus aureus (MRSA), magnetic resonance imaging (MRI), bilateral renal abscesses.

Unique Teaching Points: The lesion is seen in the entire corpus callosum, which is uncommon as most transient corpus callosum lesions are seen in the splenium. Cytotoxic lesion of the corpus callosum with underlying MRSA septicemia.

Parry Romberg Syndrome: Peculiar Enhancement Pattern Masquerading As Granulomatous Disease!

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Objectives: A rarity in the gamut of phenotypic manifestations and scarce literature supporting its etiology, Parry Romberg syndrome is but an amusing entity. Skeletal, dental and soft tissue atrophy on the affected hemiface with/without neurological symptoms form the bonework of this entity. This article reports the case of a 13-year-old girl who presented for evaluation of seizure disorder.

Case Presentation: A 13-year-old girl, with normal birth and developmental history presented with complaints of simple partial seizures for a duration of 5 years with onset at 8 years of age. The seizure frequency was 2-3 episodes per week, despite being on two antiepileptic drugs. Previously, she has received antitubercular therapy for 18 months based on MRI findings, however seizure frequency remained same. Clinical examination revealed an asymmetric face, left eye enophthalmos and left hemifacial atrophy. MRI revealed left cerebral hemiatrophy. Abnormal T2/FLAIR hyperintensities demonstrated involving the subcortical and lobar white matter of left temporoparietal and frontal lobes with areas of cystic changes /white matter rarefaction at the left temporal lobes and left basal ganglia. Areas of calcification were noted at left peri-atrial white matter and left basal ganglia. Cortical thickening was evident at left parietal lobe. Contrast scan showed nodular enhancement at the left basal ganglia and temporal white matter. Sequential imaging available (Jan & May 2016 & March 2019) showed reduction in white matter edema in present images with unchanged nodular enhancement pattern. Considering the static clinical course, non-responsiveness to antitubercular therapy and steroids with features of hemifacial atrophy and MRI changes, diagnosis of Parry Romberg Syndrome is considered.

Unique Teaching Points: Classically, the syndrome encompasses Jacksonian epilepsy, trigeminal neuralgia and changes in eyes. Onset in the first two decades with a progressive phase spanning 2 decades and culminating in resolution is dictum. Multiple theories have postulated association with linear scleroderma on account of similar facial features. Cerebral lesions are thought to trigger the atrophic cascade. Clinicoradiological assessment with ancillary support of histopathological studies form the diagnosis. The disease runs an incurable although a self remitting course. Orthodontic treatment coupled with immunosuppressive therapy is the forefront management. Imaging appearance of cerebral hemiatrophy, presence of parenchymal calcification and white matter signal changes in the
background of hemifacial atrophy forms the diagnostic framework of Parry Romberg syndrome. Presence of nodular enhancement is rare but known feature of this disease.

Case Presentation: 4-year old conjoined twin girls were sent to our center for pre-separation screening. One twin was seen to have a cleft lip and palate. Both of their cranial vaults were longitudinally attached in one continuous at the vertex. Inter-twin axial rotation of 40-50° was observed, reflective of O’Connell type III VT CPT. MRI and CT-scan revealed a CSF cleft separating the apposing brain cortices, however with few shared fronds of brain tissue were observed. Areas of agryria-pachygyria complexes were observed in both twins. Interventricular communication with partial agenesis of the corpus callosum were noted in both individuals as well. One large dominant lateral hemispheric dural sinus draining to the right transverse and sigmoid sinuses on each twin was demonstrated, although their respective arterial systems remain separate. Both twins had subsequent follow-up imaging studies, but at the time of writing, no operative management has yet been done.

Unique Teaching Points: This case highlights the increasing use of advanced imaging techniques to screen craniopagus twins. However, this also shows the difficulty in assessing for outcomes and viability of surgical separation based on the degree of conjoining in such patients.

Hypernatraemic Dehydration: Neuroimaging Findings in an Infant with Diarrhoea

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Objectives: Hypernatraemic dehydration(HD) is a potentially lethal condition in infants especially in early neonatal period which adversely affect central nervous system. Only few cases are reported from India. We present case of a 6 months old infant with acute gastroenteritis referred to our hospital in a state of severe dehydration and encephalopathy who had severe hypernatremia on investigation. Neuro-imaging revealed cerebral sinus thrombosis, subarachnoid haemorrhage, subdural effusion, bilateral infarcts with features of subfalcine and descending transtentorial herniation. These profound neuroimaging findings in a patient with hypernatremia are reported for the first time to the best of our knowledge.

Case Presentation: A six month old female referred to pediatric emergency from outside hospital with complaints of loose stools for 5 days, vomiting for 3-4 days, fever for 3 days and lethargy, decreased intake and scanty urination for 3 days, loss of sensorium and seizures for one day. There was history of giving concentrated oral rehydrated solution to the child at outside hospital. At admission, patient was sick, with tachycardia, tachypnea and
features of severe dehydration. Glasgow coma scale (GCS) was E3V3 M5, tone was increased in all the limbs, pupils were mid-dilated and had sluggish reaction. Rest of the systemic examination was unremarkable. Serum sodium at admission was 176 mEq/L, potassium 4mEq/L, blood urea 175mg/dL and serum creatinine 0.9 mg/dL. Repeat serum sodium after 6 hours was 175 mEq/L. Coagulation profile was within normal limits. Provisional diagnosis of Acute gastroenteritis with severe dehydration with shock with encephalopathy? HD was kept (in view of doughy skin). At 12 hours of admission, her GCS worsened to E1V1 M4 and anterior fontanel bulged. Possibility of raised intracranial pressure due to intracranial complications was thought of and neuroimaging was planned. NCCT was done which showed bilateral frontal infarcts showing subtle areas of bleed with associated subarachnoid haemorrhage (R>>L), right temporo-frontal subdural effusion, contra lateral subfalcine herniation, right uncal herniation with CSVT. Although MRI is more sensitive imaging modality, due to poor GCS MRI was not carried out. Patient was managed as per protocol. At 40 hours post-admission, patient had cardiac arrest and could not be revived.

Unique Teaching Points: Hypernatremia should be included in the differential of intracranial hemorrhage in an infant without history of accidental/nonaccidental trauma or coagulopathy. Awareness of the same can prompt timely diagnosis and appropriate management thus improving the outcome.

Attach Files 1: Coronal MPR Cranial CT scan shows right temporal subdural effusion, hyperdensity in region of superior sagittal sinus, right frontal hemorrhagic infarct, right SAH and contralateral midline shift.

Attach Files 2: NCCT Head Axial section and Coronal MPR show Bilateral infarcts, bilateral (Right>>Left) SAH, right subdural effusion with right descending transtentorial herniation and contralateral subfalcine herniation. Thrombus in region of superior sagittal sinus can be appreciated.

Congenital Infiltrating Facial Lipomatosis

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Objectives: Congenital infiltrating lipomatosis of the face (CILF) is a rare and underrecognized entity. It is a subgroup of lipomatosis tumour with diffuse infiltration of unencapsulated mature adipose cells over facial soft tissue. We present a case of a girl with unilateral facial swelling since birth and cutaneous manifestation in the ipsilateral neck.

Case Presentation: A two-year-old girl presented with progressively enlarging left facial swelling since birth. Physical examination revealed a soft, non-tender, left sided facial swelling extending from cheek to chin with associated intraoral buccal swelling. A café au lait patch was seen at the ipsilateral neck. Child was feeding well and had normal developmental milestones. Computed tomography (CT) showed a large well lobulated, non-enhancing, fat attenuation lesion extending from the left infratemporal region to the left mandible with bony hypertrophy. The visualised brain parenchyma was preserved. Magnetic resonance imaging (MRI) showed a diffuse non-encapsulated fat density lesion with some septations at the left face extending superiorly form the lateral aspect of the left orbit and left temporal region till the level of submental region inferiorly, with extension into the left parapharyngeal and retropharyngeal spaces. Fatty infiltration was seen at the left parotid gland and left side of the tongue causing hypertrophy of these structures. Subjacent bony hypertrophy was also appreciated with enlargement of the left zygoma, greater wing of left sphenoid, left temporal bone, left frontal bone, lateral wall of left maxilla and left side of the mandible. No vessel compromise noted. The treatment plan is for debulking surgery at the age of three to four years old.

Unique Teaching Points: Although CILF occur rarely, clinical suspicion is imperative in guiding the proper diagnosis. Although, histopathological diagnosis is confirmatory, CT and MRI enable detection of fat density lesion with relative ease and sparing the patient from invasive procedure. Imaging is also important for pre-operative evaluation. It is important that surgical intervention is only undertaken once the facial development has attained acceptable maturity with proper information imparted to the parents, as cosmesis and high rate of recurrence will be an on-going concern.
Huge Right Internal Jugular Vein Phlebectasia in Children: A Rare Occurrence and Its Imaging Challenges

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Objectives: Jugular vein phlebectasia is a rare, mostly benign condition present commonly in the paediatric age group. There were only 50 cases reported in English literature since 1928 and the reported phlebectasia size in most literature ranging from 3 to 6cm (measurement by imaging). Large size phlebectasia is an even rare entity. To our knowledge, none of the cases on literature review was as huge as our case.

Case Presentation: We report a case of a 2-year-old boy who presented with intermittent huge right neck swelling, more prominent on Valsalva maneuver since 7-months-old. Initial ultrasound examination showed a huge cystic mass in the right side of the neck with internal echoes extending from base of neck to mandibular region. It was difficult to delineate its origin due to its large size. Intermittent Doppler flow within the mass was mistaken as flash artifact from patient’s vigorous motion. Subsequent MRI showed huge right neck cystic mass measuring 6.4 cm x 7.2 cm x 6.7 cm with T2/STIR predominantly hyperintense signal and T1 iso-to hypointense signal. On post-Gadolinium study, it demonstrated avid enhancement to the same degree as the adjacent right IJV. As there was enhancement noted on MRI and difficulty in locating its origin, contrast enhanced CT neck was performed with reconstructed images showed communication between the mass and right internal jugular vein (IJV). The right carotid artery (CCA) was displaced posteromedially and thyroid gland to the left by the mass, which further support its origin from IJV. Repeated ultrasound done when patient was more co-operative showed turbulent flow with presence of venous waveform on Doppler study. This patient was followed up by Otorhinolaryngology team with no plan of surgical intervention as recommended by most literature.

Unique Teaching Points: This case report highlights the importance of recognition of this condition, especially in a peripheral district hospital setting which lack of familiarity in dealing with it. We will also discuss on imaging challenges encountered due to its huge size, rarity and pitfalls in paediatric imaging. Collaboration with a tertiary paediatric centre was needed to confirm the diagnosis. This case report will also deliberate on other differential diagnoses that need to be considered in paediatric neck mass triggered by Valsalva maneuver which include external laryngocele and cystic hygroma.
An Infant with Supratentorial Atypical Teratoma/Rhabdoid Tumor Resembling Choroid Plexus Carcinoma with Communicating Hydrocephalus

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Objectives: Atypical Teratoma/Rhabdoid Tumor (AT/RT) is a rare and highly malignant CNS tumor, comprising approximately 3% of pediatric brain tumors. Though the reporting numbers are variable, approximately half is infratentorial. The other half of AT/RT located at supratentorial, such as intraventricle, cerebral hemisphere, suprasellar region, and pineal region. Some patients show non-communicating hydrocephalus due to obstruction of the cerebrospinal fluid circulation by tumors. However, to our knowledge, there is no report of a case of AT/RT with communicating hydrocephalus.

Case Presentation: Here, we are going to present a 3-month-old girl with supratentorial AT/RT located in the posterior horn of the left lateral ventricle and pineal region with no dissemination. They are mainly composed of solid component, with hemorrhage and no calcification. The solid parts showed significant diffusion restriction and contrast enhancement on MRI. And communicating hydrocephalus coexisted, which gave us hard time to differentiate the tumor from choroid plexus carcinoma. She underwent a tumorectomy and it was proven that the pathological feature was compatible with AT/RT.

Unique Teaching Points: When we see an intraventricular tumor with communicating hydrocephalus, we need to add AT/RT as a differential diagnosis.

A Surprise Discovered at Birth: A Rare Case of Congenital Oral Immature Teratoma in a Newborn

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Objectives: Congenital oropharyngeal teratoma is a rare malformation. Immature teratoma is an even rarer condition in neonates, especially in the oral cavity. This tumour can be a real clinical surprise at birth if not detected earlier because it can be remarkably large in the oral cavity, which results in a constellation of symptoms due to upper airway obstruction. Respiratory compromise is the most serious complication of oropharyngeal teratoma, leading to death in most neonates. This case reveals the challenges to diagnose and manage this condition as an unexpected finding in an uneventful delivery.

Case Presentation: Background: We report a case of a prematurely born baby girl at 31 weeks with an uneventful antenatal history. She was born flat at birth with a huge intraoral mass compromising her respiration, was resuscitated and eventually needed an emergency tracheostomy. Prompt imaging was done after stabilizing the baby with subsequent complete excision of the intramural mass in a tertiary centre at day 11 of life. The mass was proven to be an immature teratoma histologically. Unfortunately, she developed a recurrent intraorwalsal mass with a new right neck mass at 2 months of life, indicating a recurrent immature teratoma. Surgically, the mass was not operable due to its extensive local involvement. The child did not improved after completion of third cycle chemotherapy and her parents opted for palliative care.

Findings and procedure details: At birth, the baby had a huge exteriorized lobulated intraoral mass, occupying almost the entire oral cavity. Pre-operative contrasted Computed Tomography (CT) of neck demonstrated that the mass was arising from the hard palate with local infiltration and extension into the right nasal cavity, complicated with near complete obstruction of the oral cavity. Mixed cystic, fat and solid soft tissue components were observed in the mass. Serum alpha-fetoprotein (AFP) was significantly high. Intraoperatively, the mass was completely excised but the hard palate was found to be extremely abnormal and defective. The subsequent post-operative contrasted CT study when the baby developed a recurrent immature teratoma revealed a new right intraoral mass with almost similar density arising from right lateral oropharyngeal wall extending to right deep neck spaces. Serial serum AFP also showed an increasing trend.

Unique Teaching Points: Congenital oral immature teratoma is rare in a newborn, which can be a major problem leading to
mechanical airway obstruction. Complete surgical resection is considered the definitive treatment, although recurrences occur with immature teratomas.

**EP_ABD_01**

**Postoperative Doppler Ultrasound in Pediatric Liver Transplants: Predictor of Acute Complications**

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**Objectives:** To determine Doppler parameters of acute complications in postoperative pediatric liver transplants and to review the incidence of acute liver transplant complications

**Methods & Materials:** A retrospective case review of 20 pediatric liver transplants at Siriraj hospital was performed from October 2011 to February 2018. Gray-scale and Doppler ultrasound (US) were evaluated within first 10 days after liver transplantation. Clinical, Doppler US, and histopathologic findings were reviewed. All cases in surgical or histopathologic proven of acute liver transplant complications were collected and reviewed Doppler US findings.

**Results:** 19 children (7 boys and 12 girls) in 20 procedures of liver transplants (twice transplants in 1 boy) were identified. Increased resistive index (RI) of hepatic artery (HA) (>0.8) showed statistically significant associated with acute HA complications (p = 0.019) and acute graft failure (p = 0.004). There was no correlation between HA velocity and HA complications (p=0.37) and between HA velocity and acute graft failure (p = 0.64). Total acute liver transplant complications were observed in 9 procedures (45%). HA artery complications and acute graft failure were detected in 6 and 7 procedures (30% and 35%), respectively. 4 procedures (20%) had portal vein (PV) or hepatic vein (HV)/ inferior vena cava (IVC) thrombosis.

**Conclusions:** High hepatic arterial RI (>0.8) with deteriorate clinical status in immediate post-operative pediatric liver transplants should be concerned for acute complications, providing early diagnosis and prompt management.

**Attach Files 1:** A 3-month-old male infant, known case of biliary atresia with liver cirrhosis at S/P Kasai’s operation Doppler US was performed at 2nd day after liver transplantation. Figure a showed hepatic artery proper velocity about 64.2 cm/s. Figure b showed RI at distal intrahepatic artery about 0.56. Follow-up study revealed normal graft outcome.

**Attach Files 2:** A 1 year-old girl, known case of biliary atresia S/P liver transplant (1st day post-operation). Doppler US was performed at 1st day after liver transplantation. Figure a showed hepatic artery proper velocity about 124.5 cm/s. Figure b showed RI at distal intrahepatic artery about 0.82. Follow-up study revealed graft rejection.

**EP_ABD_02**

**Spectrum of Adrenal Pathologies in Children: A Multimodality Imaging Review**

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**Objectives:** 1. To study the spectrum of adrenal pathologies in paediatric population with their relevant imaging findings 2. To determine the appropriate modality of imaging according to age

**Contents:** 1. Congenital adrenal hyperplasia 2. Adrenal haemorrhage- Unilateral and Bilateral 3. Infections -Adrenal tuberculosis 4. Neuroblastoma: a. small typical mass b. predominantly necrotic mass c. Large mass extending into retroperitoneum and encasing major vessels d. Large mass extending into perinephric space, surrounding and compressing the kidney 5. Adreno-cortical carcinoma (with metastasis at presentation)

**Teaching Messages:** 1. In neonates, ultrasound should be the initial modality of choice because of its easy accessibility, availability of appropriate acoustic window for visualising the suprarenal space and lack of ionising radiation. It is the problem solving tool
to differentiate cystic from solid lesions and is helpful in guiding biopsy for definitive diagnosis. In older children with adrenal neoplasms, ultrasound will not suffice and cross-sectional imaging will be required for appropriate characterisation, extent and staging. In cases of tumors, it is necessary to distinguish benign from malignant lesions by taking into account size, enhancement pattern, adjacent organ involvement, presence of a feeding artery etc. Neuroblastoma is the most common paediatric adrenal tumor. However, rare entities like adrenocortical carcinoma may be encountered. Many times adrenocortical tumors are a part of a syndrome, like Li-Fraumeni and Beckwith-Wiedemann syndromes. Thus this has to be kept in mind whenever such cases are encountered and relevant organ involvement has to be looked for accordingly, which will result in a revised management and timely follow up.

Relevant literature: Involvement of the adrenal glands in children is not an uncommon event. They can present with a variety of clinical features from being asymptomatic to abdominal pain to a myriad of endocrinological manifestations posing a lifetime of morbidities. Adrenal tumors may present with paraneoplastic syndrome as the presenting complaint. Thus early and accurate diagnosis is necessary to start appropriate medical or surgical management. Apart from biochemical tests, imaging plays a very important role in the diagnosis, management as well as follow up of these cases. Characterisation of various adrenal lesions, as well as differentiation of benign from malignant lesions, have been described in literature and it is important for a radiologist to have knowledge about this in order to make an accurate diagnosis. Appropriate imaging modality has to be chosen taking into consideration radiation exposure to the child but at the same time not to compromise on characterisation and localisation of the lesion.

Attach Files 1: A four year old child presented with lump in abdomen (a) Non Contrast Enhanced Computed Tomography shows a large, ill defined heterogenous mass lesion, with multiple foci of stippled calcification seen in the left suprarenal region (Red asterisk) causing inferior displacement of left kidney and superior displacement of the spleen (b), (c), (d) Contrast Enhanced Computed Tomography shows a heterogenously enhancing mass lesion, with large necrotic component, in the left suprarenal region. Retroperitoneal lymphadenopathy was noted forming a conglomerate mass encasing the aorta, inferior vena cava and bilateral renal vessels (blue and yellow arrows). It was causing anterior displacement of the bowel loops and extending posteriorly to the left paraspinal region. (e) enlarged heterogenously enhancing lymph nodes were noted along left jugular chain in the neck (yellow asterisk) and subcarinal region (blue asterisk) in mediastinum s/o nodal metastasis. A small nodule was also noted in the middle lobe of right lung (red arrow) suggestive of pulmonary metastasis. A diagnosis of left suprarenal neuroblastoma was suspected, based on tumor location, morphology, fine calcific foci, vascular encasement and heterogeneous enhancement characteristics. Distant metastasis to cervical and mediastinal nodes and lung parenchyma at the time of presentation were atypical for neuroblastoma. Histopathology slide shows adrenal tumor cells with necrosis.
Renal Cysts in Children: Unveiling the Mystery

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Objectives: Renal cysts in children are of diverse etiology. Cystic kidney diseases have a protean manifestation. ascertaining the cause of cysts in kidney in children on imaging has significant prognostic implications. It is a very challenging task to ascertain the actual nature of the cystic kidney disease on USG and requires adaptation of a specific diagnostic algorithm.

Contents: This exhibit will discuss - The causes of cystic kidney diseases in children (syndromic and non-syndromic) - Techniques and pitfalls of pediatric renal sonography - Sonographic differentiation of different causes of cystic kidney disease in children

Teaching Messages: A meticulous high resolution USG is very crucial in making a diagnosis of cystic kidney disease. Cysts can be differentiated on imaging into broad categories such as glomerular cyst, tubular cyst etc. Depending on the location, number and appearance of the cysts as well as renal size, it is possible to arrive at a reasonable set of differential diagnoses.


Pediatric Adrenal Lesions – A Pictorial Review

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Objectives: The purpose of this review is to demonstrate appropriate imaging approach of adrenal lesions and describe the imaging features of the wide spectrum of adrenal lesions.

Contents: Adrenal glands are a common site of disease. To detect adrenal lesions has increased with the expanding use of imaging modalities. The purpose of this review is to demonstrate appropriate imaging approach of adrenal lesions and describe the imaging features of the wide spectrum of adrenal lesions. 1. Normal adrenal gland. 2. Adrenal hemorrhage. 3. Adrenal hyperplasia. 4. Adrenal cyst. 5. Adrenal mass

Teaching Messages: This review will demonstrate a range of pediatric adrenal lesions with a brief review of mode of presentation and typical characteristics on imaging.

Relevant literature:

Congenital Fibrocystic Liver Diseases: Making It Easy For The Pediatric Radiologist!!

Binit Sureka, Pawan Kumar Garg

Dept of Radiology, Taruna Yadav, Assistant Professor; Dept of Radiology, Pushpinder Singh Khera, Additional Professor; Dept of Radiology, Poonam Elhence, Professor; Dept of Pathology & Lab Medicine, Vaibhav Varshney, Assistant Professor; Dept of Surgical Gastroenterology

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Objectives: • To review the normal embryogenesis of the biliary ductal system in a diagramatic and simplified manner. • To enumerate different hepatobiliary disorders associated with ductal plate malformations. • To describe the characteristic imaging findings of different ductal plate malformations at computed tomography (CT) and magnetic resonance (MR) imaging. • In addition the characteristic pathologic features of each are discussed.

Contents: Ductal plate malformations, also known as fibrocystic liver diseases, are a group of congenital disorders resulting
from abnormal embryogenesis of the *biliary ductal system*. The abnormalities include: Choledochal cyst, Congenital hepatic fibrosis, Caroli’s disease, Caroli’s syndrome, Adult autosomal dominant, polycystic liver disease Biiliary hamartoma.

**Teaching Messages:** Key Imaging Features:
- **Biliary Hamartoma:** Incidental, <1.5-cm; US: Hypo/hyperechoic; Comet Tail artefacts; MR: No communication with biliary tree
- **Congenital hepatic fibrosis:** Right lobar atrophy & Hypertrophied left lateral segments; Associated with renal tubular ectasia
- **Polycystic liver disease:** Autosomal Dominant; Cysts of varying sizes throughout the liver; Associated polycystic kidney disease (50%) • Caroli’s disease/syndrome: Non-obstructive ectasia of bile ducts; Central dot sign; Caroli’s syndrome: Caroli’s Disease + CHF • Choledochal cyst: Intra-or extrahaepatic biliary tree dilatation; Associated APBJ; Todani types: I – V

**Relevant literature:** The normal development of intrahepatic bile ducts apparently requires finely timed and precisely tuned epithelial–mesenchymal interactions, which proceed from the hilum of the liver toward its periphery along the branches of the developing portal vein. Lack of remodelling of the ductal plate at various stages of embryogenesis results in the persistence of an excess of embryonic bile duct structures remaining in their primitive ductal plate configuration. This abnormality has been termed the ductal plate malformation. Exact incidence and prevalence of ductal plate malformation is not known as literature reveals existence of this entity in the form of case reports and pictorial reviews.

**Attach Files 1:** Pictorial Diagram of embryogenesis of abnormal ductal plate malformation

**Attach Files 2:** Pictorial Diagram of spectrum of ductal plate malformation

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**Bowel Sonography in Neonates**

**Hwa-Young Kim**

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**Objectives:** To learn the bowel sonography in neonates.

**Contents:** We reviewed sonographic finding with pathological correlation in necrotizing enterocolitis, viral enterocolitis and hypoxic ischemic injury.

**Teaching Messages:** The sonographic finding of bowel diseases in neonates was bowel wall thickening, increased bowel wall echogenicity and ascites. The bowel wall revealed strong echogenic dots in necrotizing enterocolitis and severe viral enterocolitis. Diffusely increased bowel wall echogenicity and mucosal slough were identified in hypoxic ischemic injury. Echogenic spots in bowel was correlated with pneumatosis intestinalis in experimental study which was seen on abdominal radiograph in advanced necrotizing enterocolitis. The distribution of abnormal sonographic finding was different. RLQ was mainly involved in necrotizing enterocolitis. Viral enterocolitis and hypoxic ischemic injury involved randomly or whole abdomen.

**Relevant literature:** raschel@daum.net

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**Neonatal Pneumoperitoneum - A Review of the Challenges in Diagnosis.**

**Prasanna Karpaga Kumaravel**, **Harish Jayaram**, **Abirami Krithiga**, **Nithin Ashok**

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**Objectives:** Gastrointestinal perforation in neonates is a grave event which should be diagnosed not only as soon as possible but with a fair degree of accuracy. The management depends on the detection of free air in imaging which could be very obvious or extremely subtle requiring a trained eye for detection. Since the survival after a bowel perforation depends on early recognition and appropriate management, it is important to know all the imaging signs of pneumoperitoneum.

**Contents:** Though CT abdomen is more sensitive in detecting free intraperitoneal air, plain radiography is a simple bedside, quick and
cheap imaging modality. Free air under diaphragm, the common sign of pneumoperitoneum in adults, is less commonly appreciated in neonates. This article reviews all the x-ray imaging signs of bowel perforation in neonates.


**Applying the Updated PRETEXT System in Staging of Hepatoblastoma in Children: Key Images to Remember them**

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**Objectives:** 1. To review the definitions of PRETEXT groups and annotation factors (V, P, E, F, C, N, M) in 2017 PRETEXT system. 2. To review typical CT, MRI images of various PRETEXT groups and annotation factors (V, P, E, F, C, N, M) 3. To summarize confusing scenarios for staging by sample cases

**Contents:** 1. Introduction - Clinical importance of PRETEXT system - The background of updates to the PRETEXT system 2. PRETEXT groups (I, II, III, IV) - Sample cases (abdomen CT, liver MRI) 3. Annotation factors : sample cases with positive finding - V(hepatic vein, inferior vena cava) - P(portal vein) - E(extrahepatic disease contiguous with the main liver tumor) - F(multifocality) - R(upture) - C(caudate) - N(lymph node) - M(distant metastases) 4. Special concern : confusing scenarios

**Teaching Messages:** Over the past two decades, major multicenter study groups have adopted different staging systems and treatment strategies for this rare tumor, making it incapable to directly compare its outcome. Fortunately, the PRETEXT system has become the most widely used staging system for risk stratification of hepatoblastoma across the world. The latest update was made in 2017 with aimed to clarify definitions for its uses in future collaborative trials. Radiologists should become familiar with recent changes in annotation factors of PRETEXT system through key images.

**Imaging of Hybrid Congenital Lung Abnormalities**

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**Objectives:** An imaging approach to making a diagnosis of hybrid congenital lung abnormalities is presented.

**Contents:** A case series demonstrating a spectrum of co-existing congenital lung anomalies identified on ultrasound, chest radiograph and computed tomography scan is presented. While type 2 congenital pulmonary airway malformation and bronchopulmonary sequestration hybrids are relatively common, examples of these hybrid lesions co-existing with an additional anomaly such as a congenital diaphragmatic hernia and a bronchogenic cyst is presented. A case of bronchial atresia co-existing with a bronchogenic cyst is also presented.

**Teaching Messages:** An awareness of this entity is essential when evaluating a congenital lung anomaly to ensure that appropriate imaging techniques are performed and correctly interpreted so that co-existing lesions visible on imaging are not missed.

**Relevant literature:** Congenital lung abnormalities have been broadly categorized into bronchopulmonary anomalies, vascular anomalies and combined lung and vascular anomalies with each category demonstrating distinct imaging and histological features. However histological evaluation of these congenital lung lesions have revealed that these entities often co-exist as hybrid lesions, possibly due to a common embryological etiopathogenesis.

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**Opaque Hemithorax in Children: A Systematic Imaging Approach**

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**Objectives:** 1. To enlist the causes of unilateral opaque hemithorax in children and discuss their imaging features 2. To determine a systematic approach to opaque hemithorax and highlight the differentiating features of the various causes 3. To discuss the role of ultrasound as a non radiating modality in diagnosis


**Teaching Messages:** 1. A methodical approach based on thoracic volume, mediastinal shift and internal heterogenicity can aid in early and accurate diagnosis of paediatric opaque hemithorax 2. Ultrasound, as a non radiating modality, is a valuable tool in differentiating the various causes

**Relevant literature:** Unilateral opaque hemithorax is a frequently encountered condition in paediatric emergency as well as routine clinics. Sometimes the opaque appearing hemithorax may not actually be so and is rather a contralateral hyperlucent lung where imaging can help in differentiation. Although few of the conditions do not need urgent medical attention, certain conditions could be life threatening and hence accurate diagnosis is important. A chest radiograph and ultrasound can often suffice, thus evading the need for a cross-sectional imaging and hence the risk of radiation exposure in children. However, at times diagnosis is difficult and further imaging needs to be done

**Attach Files 1:**  
- (a) Chest radiograph shows left opaque hemithorax with air lucencies noted in left lower zone with slight mediastinal shift to the left (b) Ultrasound chest shows an echogenic area in the left upper chest suggestive of collapsed lung; lower chest shows normal aeration in the lung (c) Contrast enhanced computed tomography shows total collapse of the left lung with lower lobe bronchiectatic changes; coronal reformatted image showed a nodular hyperdense lesion (Red arrow) in the left main bronchus suggestive of foreign body; At bronchoscopy foreign body was extracted
Multidetector Computed Tomographic (MDCT) Imaging of Congenital Anomalies of the Pulmonary Artery: A Pictorial Review

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Objectives: This is a pictorial review that shall illustrate the MDCT imaging findings of the common and rare pulmonary artery congenital anomalies namely anomalous origin of left pulmonary artery, interruption/agenesis, stenosis, dilatation, and hypoplasia.

Methods & Materials: MDCT imaging of 12 pediatric patients with pulmonary artery anomalies will be reviewed, analyzed and set in this pictorial review.

Results: MDCT allows comprehensive noninvasive evaluation of pulmonary artery anomalies in neonates and children. It is effective in demonstrating the anatomy and delineating abnormalities of the pulmonary arteries, as those affecting the vessel wall, intraluminal and extraluminal abnormalities.

Conclusions: MDCT has proved to be effective in demonstrating anatomy and delineating congenital abnormalities of the pulmonary arteries namely anomalous origin of left pulmonary artery, interruption/agenesis, stenosis, dilatation, and hypoplasia. This modality also provides an advantage of examining the lung parenchyma and osseous thoracic structures.

Spectrum of Coronary Arterial Anomalies Associated with Tetralogy of Fallot and their Surgical Implications

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Objectives: To evaluate the patterns of coronary arterial anomalies in patients with tetralogy of Fallot (TOF) on multidetector CT angiography and their implications pertaining to corrective cardiac surgeries in this subset of patients.

Contents: Prevalence of coronary arterial anomalies increases significantly in the presence of Tetralogy of Fallot, as compared to the general population. With advancements in corrective cardiac surgeries, the presence of these coronary arterial anomalies assumes greater significance making preoperative identification of these anomalies imperative before planning any kind of surgical intervention. Multidetector CT angiography, with its multiplanar reformattting & volume rendering techniques, offers precise information about the 3D anatomy and spatial relationships of various cardiovascular structures. The various coronary arterial anomalies which may be associated with TOF include: a. Left anterior descending (LAD) artery from right coronary artery (RCA) or right coronary sinus (RCS) [LAD artery from RCA, Accessory LAD artery from RCA, LAD artery from LCS] b. RCA from LAD artery or left coronary sinus (LCS) [RCA from LAD artery, RCA from LCS] c. Single coronary artery (SCA) [SCA from RCS, SCA from LCS, SCA from non-coronary sinus (NCS)] d. Hypertrophied conal artery e. Other anomalies [High take off, Left circumflex (LCX) artery from RCS, LAD artery to pulmonary artery fistula, Separate origin of conal artery from RCS]

Teaching Messages: Isolated coronary anomalies may be of little functional importance and can be considered as anatomical variants. However in patients with TOF requiring surgery, it may contribute significantly to morbidity and mortality rates during complete cardiac repair. Knowledge of coronary artery abnormalities. Any coronary artery crossing the right ventricular outflow tract anteriorly influences timing, surgical technique and outcome of surgery. Coronary vessels that would interfere with right ventriculotomy or resection of outflow obstruction must be identified pre-operatively.

Relevant literature: TOF is the most common cyanotic congenital heart disease (3.5% of infants born with congenital heart disease) and consists of right ventricular outflow obstruction, right ventricular hypertrophy, ventricular septal defect and aortic override. In addition, there may be other associated abnormalities, often including coronary anomalies, which have a reported
incidence of 4-36%. Since the coronaries normally form by connection of coronary buds from the aorta with an already established myocardial vascular network, it has been suggested that the anterior position of the aorta may predispose to anomalous coronary anatomy.

**EP_MSK_01**

**Progressive Pseudorheumatoid Arthropathy of Childhood: A Mimicker of Jia**

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**Objectives:** Progressive Pseudorheumatoid arthropathy of childhood (PPAC) (OMIM #208230) is a rare skeletal dysplasia which mimics juvenile idiopathic arthritis; and presents with an early development of contractures in small joints of hand and foot. It is very important to correctly diagnose this entity as the treatment is different.

**Contents:** This exhibit will discuss - Clinical features of PPAC - Imaging features of PPAC - Diagnostic pearls and differentiation from rheumatologic conditions

**Teaching Messages:** Early onset of painless contractures of small joints of hand is a clinical hallmark of this entity. Typical imaging findings include metaphyseal expansion of the phalanges, anterosuperior endplate defects of the vertebral bodies, and generalized epiphyseal irregularity. Recognizing this entity on imaging is very important as unnecessary use of DMARDs can be avoided.


**Attach Files 1:**
- A. Accessory left anterior descending (LAD) artery arising from the right coronary artery (RCA)
- B. Accessory left anterior descending (LAD) artery from the right coronary sinus (RCS) crossing anterior to the right ventricular outflow tract (RVOT)
- C. Right coronary artery (RCA) arising from the left coronary sinus (LCS)
- D. Single coronary artery (dotted circle) branching into all three major coronary arteries.

**Attach Files 2:**
- A. Origin of right coronary artery (RCA) from the ascending aorta >1 cm above the sinotubular junction (dotted line)
- B. Origin of left main coronary artery (LMCA) from the ascending aorta >1 cm above the sinotubular junction (dotted line)
- C. Conal artery arising directly from the right coronary sinus (RCS) separate from the right coronary artery (RCA)
- D. Left circumflex artery (LCx) artery from the right coronary sinus (RCS) crossing anterior to the right ventricular outflow tract (RVOT) with a retroaortic course
Imaging Atlas of Soft Tissue Masses in the Backs of Neonates and Young Children

Gayoung Choi, Young Hun Choi, Seul Bi Lee, Yeon Jin Cho, Seunghyun Lee, Jung-Eun Cheon, Woo Sun Kim, In-One Kim

Objectives: 1) To summarize the list of soft tissue masses that can develop in the backs of neonates and young children 2) To present key imaging findings of soft tissue masses in the backs of neonates and young children

Contents: Various soft tissue masses can develop in the backs of neonates and young children. Even though most of them have nonspecific imaging findings, some have imaging clues that can help narrow the differential diagnosis. This exhibition summarizes the list of soft tissue masses that can develop in the backs of neonates and young children, and presents imaging findings of representative masses. The list includes dermoid/epidermoid cyst, pilomatricoma, neurofibroma, fibrous hamartoma, lipoma, lipoblastoma, hemangioma, and lymphatic/vascular malformation.

Teaching Messages: Imaging plays an important role in the evaluation of soft tissue masses in children. Ultrasound is the first choice of imaging modality due to its inexpensive, readily accessible, and repetitive natures. MRI is also useful for larger and deeper lesions with high tissue contrast and multiplanar capability. In most cases, correlation with clinical findings enriches imaging interpretation. Histopathologic tissue confirm is still needed in many cases for a final diagnosis.


Interpretation of Infantography: Normal Development and Related Diseases of Bony Skeleton

Yun Young Lee

Objectives: To be familiar with normal developmental findings of bony skeletal system and associated pathologies on interpreting infantography.


Teaching Messages: Radiologists who are not familiar with neonatal radiographs, sometimes miss specific diseases or misinterpret normal findings as abnormalities. When if they become friendly with normal bony development of neonates and associated specific pathologies, they become more confident in interpreting infantography.

Imaging Spectrum of Intracranial Cavernous Malformations in Children

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Objectives: Intracranial cavernous malformations (CMs) have an incidence of 0.1-0.5% in the general population, and represent 10-20% of all vascular lesions within the brain1. The classical pathological findings are a ‘blackberry-like’ aggregation of grossly enlarged capillary cavities, consisting of a single layer of endothelium, filled with blood at various stages of thrombosis1. There is a wealth of information about CMs in the adult population, however, there is little described in the literature regarding imaging of Paediatric CMs. Paediatric CMs have characteristics that differ from adults in terms of their clinical presentation with higher rates of haemorrhage as well as larger lesions1. We aim to describe the spectrum of radiological presentations in Paediatric CMs and their evolution.

Contents: 1. Describe the range of clinical and imaging presentations in Paediatric CMs. 2. Describe the imaging findings in uncomplicated CMs (presenting acutely with haemorrhage). Uncomplicated lesions a. Rounded or ovoid macrocytic lesions with haemosiderin b. Transmantle cystic lesions extending from ventricular outline to cortical surface c. Mixed features d. Small focal SWI lesion without any discernible internal cysts (adult pattern). Complicated lesions presenting acutely with intracranial haemorrhage a. Large contained/rounded space with mass effect and oedema b. Peripheral or eccentric areas – small cystic spaces c. Haemosiderin rim d. No enhancement. 3. Describe the imaging findings of the evolution of uncomplicated CMs into more complex CMs (may demonstrate mixed radiological features).

Teaching Messages: As the first case series focussed on the imaging findings in Paediatric CMs it is our aim to improve both radiologists and clinicians knowledge and awareness of the spectrum of imaging presentations in this condition so that they can consider this as a primary diagnosis in patient’s presenting with acute intracranial haemorrhage with an underlying CM.

Brain MRI Features in Children with Congenital Cranial Dysinnervation Disorders

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Objectives: To investigate the brain MRI feature and to explore the neural mechanism of congenital cranial dysinnervation disorders (CCDDs).

Methods & Materials: Thirteen children with CCDDs (5 males and 8 females, 7 month–7 years old) received conventional brain MRI, 3D-CISS sequence and 3D T2-SPACE scanning (SIEMENS Magnetom Verio 3.0T). Among these patients, six patients underwent MRA scanning and two patients underwent spinal plain film.

Results: According to clinical feature, ten cases were classified as Duane syndrome (7 cases), congenital fibrosis of the extraocular muscles (CFEOM) (3 cases), horizontal gaze palsy and progressive scoliosis (HGPPS) (2 cases) and Möbius syndrome (1 case). All cases with Duane syndrome showed absence of the ipsilateral abducens nerve and one case showed absence of bilateral abducens nerves and brainstem dysplasia. Among 3 cases with CFEOM, we found ipsilateral oculomotor nerve dysplasia and bilateral internal carotid artery malformation (one case), ipsilateral oculomotor nerve absence with brainstem dysplasia (one case), and brainstem and corpus callosum dysplasia (one case). Two patients with HGPPS showed brainstem dysplasia and thoracolumbar scoliosis. Absence of bilateral abducens nerves and facial nerve was found in the patient with Möbius syndrome.

Conclusions: High resolution MRI can reveal characteristic findings of the cisternal segment of the ophthalmic motion nerves and brainstem, which perhaps lead to congenital strabismus of the patients with CCDDs.

Clinical and Imaging Features of Cerebral Venous Sinus Thrombosis Associated with ALL in Children

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Objectives: To investigate the clinical and imaging features of 4 cases of pediatric patients with cerebral venous sinus thrombosis (CVST) associated with acute lymphocytic leukemia.

Methods & Materials: Four patients with CVST associated with ALL, consecutively admitted to the Department of Hematology, Children's Hospital of Suzhou University from January 2017 to December 2018, Their clinical presentations and neuroimaging features were retrospectively analyzed.

Results: Four patients (age range 5-11 years) with CVST associated with acute lymphocytic leukemia were collected, of which 3 cases were male and 1 case was female. The results of clinical features showed as follows: 3 cases were received chemotherapy with the scheme of VDLD, the other one was received chemotherapy with the scheme of VDLP. The CVST mostly occurred in intermediate risk ALL, all 4 cases had sudden convulsions. CT and MRI revealed 3 case of hemorrhagic in head. CT revealed ”strip or triangle sample” with high-density sign in 3 cases. Magnetic resonance imaging (MRI) revealed a lack of flow in the affected cerebral veins in all 4 cases. MR venography revealed that all 4 cases were cerebral venous thrombosis. The sites of thrombus were superior sagittal sinus in 4 cases, straight sinus in 2 cases, transverse sinus in 2 cases, and sigmoid sinus in 1 case.

Conclusions: CVST in children with acute leukemia is associated with chemotherapy drugs. Sudden convulsions are an important clinical manifestation of CVST. Recognizing the characteristics of CVST on plain CT and plain MRI and combining with MRV examination are helpful for accurate diagnosis in time.

Moya Moya Like Vasculopathy: Etiology and MR Imaging Spectrum

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Objectives: 1. To study the etiological factors of moya moya like vasculopathy 2. To illustrate the imaging findings of moya moya like vasculopathy


Teaching Messages: Moya moya like vasculopathy is quite uncommon but can still lead to development of stroke and neurological deficits. Failure to identify this pattern in time may lead to hemiparesis or neurological deficits. Hence it is important
for a radiologist to be aware of these findings in order to properly
and accurately recognise this pattern and thus help in timely
management.

**Relevant literature:** Moya moya disease/Syndrome is progressive
arteriopathy characterised by stenosis of distal supraclinoid internal
carotid arteries. If it is idiopathic, it is considered Moya moya
disease otherwise if an etiology can be ascertained then it is called
Moya moya Syndrome Ethnic predilection for Asian population is
seen. Various etiologies include infections, Rheumatic heart disease,
vasculitis and some uncommon ones like Neurofibromatosis 1,
radiation therapy, Down's Syndrome. Peculiar radiological findings
are seen in this vasculopathy like multiple flow voids in the basal
ganglia region, "swimming worms in bare cistern", "ivy sign" and
"puff of smoke" appearance.

**Attach Files 1:** Figure(A-D): Axial T2w MR image showing multiple flow
voids in basal cisterns [Red arrow](A). Axial T1w MR image showing
multiple flow voids in basal ganglia region (B). MR Angiography image
showing obliteration of bilateral supraclinoid ICA with multiple collaterals
giving puff of smoke appearance (C and D).

**Attach Files 2:** Figure (A and B): Axial Gadolinium enhanced T1 weighted
image shows a conglomerate ring enhancing lesion in suprasellar
cistern(A). MR Angiography image shows attenuated calibre of bilateral
 supraclinoid ICA (B).

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**Cortical Maldevelopment: MR Imaging Spectrum**

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Delhi, India

**Objectives:**
1. To illustrate the spectrum of MRI findings in
malformations of cortical development
2. To demonstrate
additional findings in such cases.

**Contents:**
1. Introduction
2. Brief embryology and classification
3. Clinical features
4. Imaging features of various malformations
5. Conclusion

**Teaching Messages:** Malformations of cortical development can
occur due to disruptions occurring at different stages of cortical
development. All these disorders have pathognomonic imaging
features and it is important for radiologists to be cognizant of these
entities as they have a pivotal role in their accurate diagnosis.

**Relevant literature:** Malformations of cortical development(MCD)
consist of a diverse range of disorders that commonly cause
neurodevelopmental delay and seizures. MCD can be divided into
three groups based on the stage of development: 

1. Secondary
to neuronal/glial proliferation abnormalities–Microcephaly,
Megalencephaly, Cortical dysgenesis with abnormal cell proliferation
(Focal cortical dysplasia, cortical tubers, hemimegalencephaly)
b.
2. Secondary to neuronal migration abnormalities–Periventricular
grey matter heterotopia, Lissencephaly, Subcortical heterotopia
c.
3. Postmigrational developmental abnormalities—Schizencephaly,
Polymicrogyria, Focal cortical dysplasia

**Attach Files 1:** Figure(A-D): Smooth cortical surface with inward cortical
thickness in bilateral cerebral hemispheres with shallow and open
bilateral Sylvian fissures[A][A-D].T1 Hypointense[A–blue arrow] and
T2 hyper intense[B–orange arrow] linear cell sparse zone is seen with
overlying thin cortex and thick inner band of grey matter and reduced
volume of underlying periventricular white matter. Axial FLAIR image
shows prominence of occipital horn of lateral ventricles compared to
frontal horn[C–Green arrow].Coronal T2w MRI image shows few broad and
flat gyri in bilateral temporal lobes s/o Pachygyria (D–Yellow arrow)
Ultrasound and MRI Spectrum of Hypoxic-Ischaemic Encephalopathy

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Objectives:
1. Identify and describe the ultrasound (US) and MR appearances of neonatal hypoxic-ischemic encephalopathy (HIE).
2. Classifying these imaging findings into conventional HIE grades.

Contents:
1. Introduction
2. Pathophysiology of HIE
3. Clinical presentation
4. US and MR imaging features of HIE in preterm and term patients.
5. Conclusion

Teaching Messages:
1. To identify the various patterns, severity, and grades of HIE and their clinical spectrum.
2. A methodical approach based on gestational age, maternal-fetal predisposing conditions, predominantly affected area and imaging appearances can aid in timely and accurate diagnosis of HIE.

Relevant literature:
HIE results from inadequate blood flow or oxygen to the fetal brain causing a cascade of deleterious events. HIE is the most grievous of paediatric brain insults and may require immediate medical intervention. Severe neurological deficits, cognitive dysfunction, developmental delays and death may follow. US and MR are the two key imaging modalities used in the diagnosis of HIE and can help identify various patterns in preterm and term infants, and further delineate grades and severity of HIE. Early diagnosis of neonatal HIE is vital for appropriate timely management and prevention of long term neurological deficits.

All about the Temporal Bone: From Embryology to Congenital Pathology

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Objectives: Temporal bone is one of the most elaborate structure in human body. Development of the temporal bone includes highly complicated, including inner ear, middle and external ear. Knowledge of the embryology of temporal bone assists understanding various congenital anomalies of the temporal bone.

Contents:
1- Embryology and development of the temporal bone
2- Normal anatomy of the temporal bone including external, middle and inner ears
3- Radiologic findings and key clinical features of the diagnosis
   3.1) Congenital anomaly: Inner ear anomalies and external / middle ear anomalies
   3.2) Benign infectious etiologies: necrotizing external otitis, acute/chronic otomastoiditis and labyrinthitis
   3.3) Neoplastic etiologies: Exostosis, cholesteatoma, EAC malignancy, glomus tympanicum, labyrinthine / facial schwannoma and endolymphatic sac tumor
4- Re-arrangement by location of the lesions: Where we should find what?
5- Take home notes
Teaching Messages: The temporal bone is one of the most elaborate and complicated structure in our body. The purpose of this exhibit is to: 1) Understand embryology and normal appearance of the temporal bone and 2) Review typical radiological findings for diagnosis of temporal abnormality in the inner, middle, and external ear. After reviewing this exhibit, the learner will be able to identify common pathologic image findings with subtle differences in the temporal bone.


Attach Files 1 : M/34mo, Bilateral Mondini dysplasia and a large vestibule, The axial (A) and coronal (B) CT scans of the right ear show shortening of the cochlea [arrows] along its modiolar axis and the intercalar septum is not visualized.

Unusual Neck Lesions of Children with Ultrasound Findings

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Objectives: To review unusual neck lesions of children with ultrasound findings.

Contents: It is very common for pediatric patients to come to the complaint of their palpable neck lesions. In these cases, the first imaging test is ultrasound, and various congenital and acquired diseases show relatively characteristic imaging findings, which help to diagnose them. However, some unusual diseases can be difficult to differentiate with other diseases. In this case series, we will look at the unusual neck lesions of children with ultrasound findings.

Teaching Messages: Palpable masses of the neck are common in the pediatric population, with the vast majority of these lesions are benign including reactive lymph nodes and congenital cystic neck lesions. However, there could be other unusual lesions such as chondroma or papillary thyroid carcinoma. Ultrasound is the first-line modality of choice for the evaluation of pediatric neck lesions. US provides size, location, shape, characteristics, vascularity, and adjacent architecture. It is necessary to understand typical diagnostic findings of ultrasound and, if other findings are seen, we need to carefully evaluate them to suggest other specific diagnosis or propose additional imaging tests.


Attach Files 2 : M/11mo, CHARGE syndrome. The axial (A) and coronal (B) scans present aplasia of the entire SCC [Black arrows]. This boy had a congenital ossicular deformity as well. Left stapes is not seen and the facial nerve canal is inferomedially directed and atretic bilateral oval window [White arrow].
Imaging Features of Common Pathologies of Middle and Inner Ear in Children

Joonsuk Park, Yung Suk Lee, Jisun Hwang

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Objectives: To review the features of common pathologies of middle and inner ear in children

Contents: Understand anatomy, normal findings, and imaging techniques of ear and temporal bone Discuss clinical importance and background updates on common pathologies of middle and inner ear in children. Review radiologic findings on infection, inflammation and various pathologies of ear such as otomastoiditis, cochlear nerve agenesis, vestibular aqueduct ectasia, cholesteatoma, Mondini's dysplasia and others.

Teaching Messages: In ENT practice, middle and inner ear diseases in children are of high incidence. Extensive research and studies have been given for reviewing features of common pathologies of middle and inner ear in children. This study, we present a selection of important childhood middle and inner ear diseases and discuss the common radiologic findings of such disease entities.


Attach Files 1 : cholesteotoma12

Spinal Dysraphism: Myriad of Imaging Features on MRI

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Objectives: 1. Describe the embryology and normal development of spine. 2. Illustrate the MR imaging spectrum of various forms of spinal dysraphism.

Contents: 1. Introduction 2. Brief embryology and development 3. Classification of spinal dysraphism 4. MR imaging features 5. Conclusion

Teaching Messages: Accurate depiction of the abnormal anatomy in cases of spinal dysraphism is of utmost importance for surgical management in these patients. MRI makes this possible due to excellent soft tissue contrast resolution and multiplanar capability, allowing the radiologist to evaluate the intricate details in small pediatric spinal structures.

Relevant literature: Spinal dysraphism is an umbrella term describing the herniation of meninges or neural elements through defective neural arch. MRI is the investigation of choice to study and assess the severity of neural abnormalities. Imaging helps the surgeons to know the status of spinal cord and other associated abnormalities.

Attach Files 1 : Sagittal T1W (a) and STIR (b) as well as axial T1W (c) and T2W (d) MR images show subcutaneous fatty mass with placed-lipoma interface within spinal canal - suggestive of lipomyelocele.
Caudal Regression Syndrome: A Multimodality Review of Imaging Features

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Objectives: This multimodality imaging review of cases aims to present the characteristic imaging features that depict and aid in the diagnosis of Caudal Regression Syndrome.

Contents: Background: Caudal Regression Syndrome is a rare spectrum of congenital anomalies which affects 0.005%–0.01% of the population [1]. It is characterized chiefly by the abnormal development of the caudal spine and is often accompanied by anorectal and genitourinary disorders, as well as musculoskeletal deformities [2]. Currently, patients with this condition can be broadly classified into two types based on the termination of the spinal cord: Type 1 for high or abrupt termination of the conus medullaris, or Type 2 for a low-lying tethered cord [3]. While magnetic resonance imaging is the ideal modality for the detailed evaluation of the vertebrae and spinal cord [4], multimodality imaging may help assess concomitant anomalies that may guide further evaluation and management.

Materials and Methods: Radiographic (XR), fluoroscopic (RF), computed tomography (CT) and magnetic resonance (MR) images were obtained from children identified with caudal regression syndrome in our pediatric radiology database. Multimodality imaging features were reviewed, analyzed and included in this series of 4 patients. Concomitant spectrum of clinical abnormalities were also discussed.

Results: The age at MR imaging ranges from 4 months to 5 years. MR findings show a spectrum of sacral dysgenesis, with all but one case demonstrating high/abrupt cord termination. Associated genitourinary and musculoskeletal abnormalities are common, and features suggestive of urinary tract dysfunction are increasingly seen with chronicity (75%).

Teaching Messages: Conclusion: The characteristic imaging features of caudal regression syndrome has been demonstrated with the use of multiple imaging modalities. Early MR imaging is central to the diagnosis of this condition. Prompt multimodality imaging and follow-up is also important for the evaluation of other associated abnormalities, to gear management towards prevention and mitigation of chronic complications.


Dual Energy CT for the Pediatric Radiologist: Tools to Incorporate Into Daily Practice

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Objectives: This educational poster will discuss practical concepts of DECT and applications that may be incorporated into daily pediatric radiology practice.

Contents: - DECT Practical Concepts - DECT techniques and applications - Bone subtraction - Renal stone detection and composition analysis - Iodine material specific images - Iodine mapping - Virtual non-contrast images - Virtual mono-energetic imaging Pearls and Pitfalls of DECT specific to the pediatric population

Teaching Messages: Dual Energy CT (DECT) can distinguish clinically relevant materials in the body (calcium, iodine, water, fat) on the basis of K-edge characteristics and differences in attenuation at different kV. Bone subtraction imaging can improve conspicuity of intracranial hemorrhage in pediatric head trauma. Renal stone composition analysis can differentiate hydroxyapatite from oxalate, cysteine, and uric acid stones to guide treatment. Iodine material specific images can be used in daily pediatric practice to increase conspicuity of solid organ injury in blunt trauma, improve lesion detection and characterization in oncologic imagim, and demonstrate pulmonary perfusion patterns in pulmonary embolus. Virtual monochromatic imaging can be use to successfully reduce beam hardening artifact from metal stents and orthopedic hardware in pediatric patients.


Attach Files 1 : Dual Energy CT : Bone Subtraction

Attach Files 2 : Dual Energy CT: Monoenergetic Imaging

Free-Breathing Upper Abdominal MRI in Children Using 3D Gradient Echo T1-Weighted Images with Golden Angle Stack-of-Stars Acquisition Technique: Comparison Between Spectral Fat Suppression and Fat Suppression Using Modified Dixon

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Objectives: To compare the image quality of contrast-enhanced 3D gradient echo T1-weighted images (GRE T1WI) using Cartesian acquisition (Cartesian eTHRIVE), golden angle stack-of-stars acquisition with spectral fat suppression (3D VANE eTHRIVE) and golden angle stack-of-stars acquisition with fat suppression using modified Dixon (3D VANE mDixon) of upper abdomen in children with free-breathing state.

Methods & Materials: Pediatric patients who underwent whole-body MRI with free-breathing contrast-enhanced GRE T1WI axial scans of upper abdomen using Cartesian eTHRIVE, 3D VANE eTHRIVE and 3D VANE mDixon were enrolled in this study. Qualitative analysis of image quality was performed for overall image quality, hepatic edge sharpness, hepatic vessel clarity, respiratory artifact, radial artifact, lesion conspicuity, and lesion edge sharpness on each sequence. Quantitative analysis using coefficient of variation of signal intensity of liver, spleen and air was performed.

Results: In 41 pediatric patients, 3D VANE eTHRIVE showed the highest scores, followed by 3D VANE mDixon and Cartesian eTHRIVE (P ≤ 0.001) for all image quality parameters. 3D VANE eTHRIVE (2.42 ± 0.63) also showed significantly higher score in radial artefact than 3D VANE mDixon (2.28 ± 0.81, P = 0.001). The scores for lesion conspicuity and lesion edge sharpness of 3D VANE eTHRIVE and 3D VANE mDixon were higher than those of Cartesian eTHRIVE and 3D VANE mDixon, however, there were no statistical significance. 3D VANE eTHRIVE and 3D VANE mDixon showed less variation of signal intensity compared with Cartesian eTHRIVE within liver (P ≤ 0.001) and spleen(P ≤ 0.011), but the difference between 3D VANE eTHRIVE and 3D VANE mDixon was not significant. Acquisition time of 3D VANE eTHRIVE (81.26 ± 16 seconds) was higher than those of Cartesian eTHRIVE(7.87 ± 0.95 seconds) and 3D VANE mDixon (76.66 ± 12.44 seconds, P < 0.001).
**Conclusions:** Golden angle stack-of-stars acquisition technique applied in 3D fat-suppressed T1WI of abdominal MRI has better image quality and decrease respiratory artifact than Cartesian acquisition technique in children with free-breathing state. In the golden angle stack-of-stars acquisition, fat suppression by spectral fat suppression has better image quality and fewer respiratory and radial artifacts than mDixon.

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**SP_ABD_03**

**The Association between Intestinal-Vertebral Ratio by Supine Abdominal Radiography and Pediatric Intestinal Obstruction Surgical Findings in Harapan Kita Women and Children’s Hospital**

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**Objectives:** The vast anatomical variation in pediatric’s intestines, suggest the need of a standard reference to measure quantitatively the bowel dilatation in pediatric intestinal obstruction cases. With the standard reference for each individual measurement, in the form of intestinal-vertebral ratio, we can get quantitative and absolute measurement result.

**Methods & Materials:** A cross-sectional observational study was conducted in 31 patients underwent supine abdominal radiograph in radiology department and laparotomy procedure in pediatric surgery department Harapan Kita Women and Children’s Hospital. The patients were divided into 2 main groups based on the surgical findings (the obstructive intestinal group and non-obstructive intestinal group).

**Results:** McNemar comparative test and Kappa analysis revealed significant homogeneity with moderate association between the intestinal-vertebral-ratio and the surgical findings, in both pediatric group (R Kappa= 0,54; p= 0,003). The ROC analysis revealed 1,024 for the optimal intestinal-vertebral ratio cut-off point, which gives 83,3% sensitivity and 84,6% specificity to differentiate between pediatric obstructive and non-obstructive intestinal group.

**Conclusions:** There is a moderate association between the intestinal-vertebral ratio and the surgical findings, in pediatric obstructive and non-obstructive intestinal group. The intestinal-vertebral ratio in obstructive intestinal group is greater than the non-obstructive intestinal group. This ratio can be used as an additional quantitative finding to differentiate between obstructive and non-obstructive intestinal cases in the basis of abdominal radiography.
Imaging Study of the Liver and Spleen in Gaucher Disease

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Objectives: Using new magnetic resonance imaging (MRI) technology to explore the liver and spleen imaging manifestations and assessment of functional status of patients with Gaucher disease (GD), to provide an objective theoretical basis for the treatment.

Methods & Materials: Adopting iterative decomposition of water and fat with echo asymmetry and least-squaresestimation quantitation (IDEAL-IQ) technique and intravoxel incoherent motion imaging (IVIM) technique to analyze the differences of the fat content, iron content, perfusion parameters and diffusion parameters of the liver and spleen in 40 GD patients undergoing enzyme replacement therapy (ERT) and 30 healthy volunteers according to the fat ratio imaging, R2* relaxation rate imaging, quantitative standard apparent dispersion coefficient (sADC), slow apparent diffusion coefficient (D*), and perfusion fraction (f) respectively. The difference of parameters between the two groups was analyzed by t-test. P < 0.05 was statistically significant.

Results: The contents of the liver and spleen fat in GD patients were (3.07±3.06)% and (2.01±0.77)%, in normal control group were (2.87±1.37)% and (1.79±0.34)%. There was no significant difference between the two groups (P > 0.05). The iron content in the liver and spleen of GD patients were (54.18±24.13)Hz and (39.17±26.32)Hz, respectively. In the normal control group were (49.45±7.96)Hz and (42.32±19.84)Hz, respectively. There was no significant difference between the two groups (P > 0.05). The values of sADC, D, D* and f in the liver of GD patients were (1.42±0.35)×10-3mm²/s, (1.02±0.53)×10-3mm²/s, (0.94±0.45)×10-3mm²/s, (0.32±0.11), respectively. In the normal control group were (1.50±0.21)×10-3mm²/s, (0.99±0.29)×10-3mm²/s, (1.02±0.49)×10-3mm²/s, (0.31±0.08). There was no significant difference between the two groups (P > 0.05). The sADC, D, D* and f values of spleen in GD patients group were (0.83±0.13)×10-3mm²/s, (0.66±0.15)×10-3mm²/s, (0.66±0.15)×10-3mm²/s, (0.57±0.42). There was no significant difference between the two groups (P > 0.05).

Conclusions: GD is a disorder of lipid metabolism. Multiple sets of images can be obtained by one scan of IDEAL-IQ and IVIM sequence. It can quantitatively analyze the functional status of organs and tissues in GD patients, and provide important clinical value for the diagnosis and evaluation of curative effect.

Images:

Attach Files 1: Image 1. Measurement of dilated intestinal and L1-2 vertebra

Attach Files 2: ROC curve for intestinal-vertebral ratio value

Image 1. Measurement of the dilated intestinal and L1-2 vertebra

Image 2. ROC curve for intestinal-vertebral ratio value

Attach Files 1: Figure 1. [A-B] A 24-year-old male patient, the fat fraction image (A) and R2* relaxation rate image (B) of the liver and spleen showed slight increase in signal. The liver fat content and iron content were 17.66% and 135.42Hz, respectively. The spleen fat content and iron content were 2.04% and 123.70Hz, respectively. [C-D] A 18-year-old healthy female, the fat fraction image (C) and R2* relaxation rate image (D) of the liver and spleen showed the signal was normal. The liver fat content and iron content were 1.82% and 44.28Hz, respectively. The spleen fat content and iron content were 2.20% and 21.80Hz, respectively.

Attach Files 2: Figure 2. [A-E] A 10-year-old male patient had IVIM-DWI, sADC, D, D* and f maps of the liver and spleen, respectively. The values of sADC, D, D* and f of the liver were 0.00147mm²/s, 0.00116mm²/s, 0.055mm²/s, 0.23; The values of the spleen were 0.00081mm²/s, 0.00078mm²/s, 0.156mm²/s, 0.04. [F-J] A 27-year-old healthy man had IVIM-DWI, sADC, D, D* and f maps of the liver and spleen, respectively. The values of sADC, D, D* and f of the liver were 0.00155mm²/s, 0.00089mm²/s, 0.191mm²/s, 0.41; The values of the spleen were 0.00073mm²/s, 0.00068mm²/s, 0.122mm²/s, 0.06.
Objectives: Hirschsprung’s disease (HD) is a result of failure of the cephalocaudal migration of ganglion cells through the neural crest causing a lack of ganglion cell in the colon. Three diagnostic tests are used for evaluation of HD. The gold standard is rectal biopsy but has it an iatrogenic complication. The physicians seek non-invasive techniques for the diagnosis of Hirschsprung’s disease, such as contrast enema which is less invasive, readily available and provides prompt diagnosis. Question arises, if the transition point of HD is identified in the recto sigmoid on the initial enema examination, and whether we really need 24-hour delayed film which is a routine practice ,for further confirmation of our initial findings since this additional imaging increases the radiation exposure to pediatric patients. The main aims of this study was to evaluate the usefulness of a 24-hour delayed film in the diagnosis of Hirschsprung’s disease and to evaluate other imaging features of contrast enema for diagnosis in our tertiary care center in Pakistan.

Methods & Materials: This retrospective study was conducted after approval from the ethical review committee. Records of pediatric patients referred for radiological evaluation of symptoms and signs suspicious of HD Examinations were performed under fluoroscopy with either diluted barium or water-soluble contrast media. Findings evaluated in every study were as follows: transitional zone (TZ), rectosigmoid index (RI), mucosal irregularity and irregular contractions, filling defect due to fecal material and delay in contrast evacuation after 24 h . Full thickness biopsy was obtained by an experienced pediatric surgeon. A consultant pathologist reviewed final specimen.

Results: The overall sensitivity, specificity and positive predictive value of barium enema was 80.36%( CI: 67.57% to 89.77%), 73.08 % (CI: 52.21% to 88.43%) and 86.54% (CI: 77.11% to 92.46%) respectively. Transition zone was identified in 51 cases being the most commonly seen barium enema examination finding in patients diagnosed with HD. The most sensitive radiologic finding was also the transition zone with a sensitivity of 91.07 %. 59% patients had positive delayed 24 hours film and HD on biopsy. The sensitivity, specificity and positive predictive value of delay in barium evacuation after 24 hours was (81.25% CI: 67.37% to 91.05), (90.91 % CI: 58.72% to 99.77%) and (97.50% CI: 85.69% to 99.61%) respectively.

Conclusions: The contrast enema examinations along with the 24-hour delayed film with mid transverse colon cutoff are optimal for investigating Hirschsprung’s disease and our results show that it correlates well with biopsy.
Application of ASIR-V Combined with Double-Low Scan Technique in The Diagnosis of Congenital Heart Disease in Children

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Objectives: discuss the value of Asir-V combined with low dose scanning technique in children with congenital heart disease (CHD);

Methods & Materials: 34 cases of children with CHD, randomly divided into two groups, Group A: 17 cases, Asir-V:50%, B group: 17 cases, Asir-V:80%, the scanning conditions of the two groups were voltage 70 Kv, automatic milliampere, noise index (NI): 24, rotation time of spherical tube 0.28 s/r, slice thickness 0.625 mm, detector width 100-160 mm, contrast agent ioxanol 270 mg I/mL, dosage 1 mL/kg, flow rate 0.1 mL/s per kg body weight, injection of saline 25 ml at the same rate after contrast agent injection. Contrast tracer triggered automatic scanning mode was used. The region of interest was located in the descending aorta with a threshold of 160 Hu. The shortest time after reaching the threshold (default machine 1.3 s) was scanned. The exposure time was 0.28 s. record the CT value of the ascending aorta, descending aorta, pulmonary artery and left ventricle and record the CT value and SD of soft tissue at the same level according to the SD calculation of the area of interest signal-to-noise ratio (SNR) and the contrast ratio of the signal to noise ratio (CNR), record the dose length product (product dose-length, DLP) of each case and convert the effective dose (doses effective, ED) according to the formula, make medical diagnosis and image quality score independently by two doctors who work more than ten years;

Results: the CNR and SNR of group A were less than B group. The difference was statistically significant (P<0.01), the difference of DLP and ED of two groups was not statistically significant (P>0.05). Two doctors read the film shows that the image quality of each case is good, the consistency is good (κ=0.621,0.683).

Conclusions: CTA is an important diagnostic method for congenital heart disease in children. Under the same scanning conditions, using Asir-V:80% can obtain higher image signal-to-noise ratio and lower radiation dose. It is recommended for clinical use.

Exogenous Lipoid Pneumonia: A Case Series and Review of Radiologic Findings in Infants

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Objectives: Lipoid pneumonia is an uncommon condition resulting from pulmonary accumulation of endogenous or exogenous lipids. The aim of this study is to present cases of lipid pneumonia of the exogenous form in children who were given supplemental virgin coconut oil and to describe the imaging presentation in each case.

Methods & Materials: In this series, we present three cases of infants, 3 to 6 months of age, with history of virgin coconut oil supplementation for poor weight gain. Chest radiographs and computed tomography (CT) studies showed areas of consolidation in the lower and posterior lung segments. On CT, low areas of attenuation (negative Hounsfield values) are demonstrated within the areas of lung consolidation.

Results: Radiologic presentation of lipoid pneumonia include ground glass or consolidative opacities, predominantly involving the middle and lower lobes, nodules, and the less common pneumatoceles, pneumothorax and pneumomediastinum. Diagnostic finding is demonstration of areas of negative attenuation values within the consolidative opacities and nodules. Therapy is primarily supportive and conservative. Bronchoalveolar lavage is both diagnostic and therapeutic. The key measure to treatment is identifying and discontinuing exposure to the offending agent.

Conclusions: Recognizing the clinical history and radiological manifestations of lipid pneumonia are important for prompt and accurate diagnosis, thereby decreasing morbidity and mortality rates.

Assessment of Ventricular Volume And Myocardial Strain Using Cardiac Magnetic Resonance in Pediatric Patient with Repaired Tetralogy of Fallot

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Objectives: This study is to assess early change of ventricular function and analyze the relationship among right ventricular function, pulmonary regurgitation, age, and surgery duration in pediatric patients with repaired Tetralogy of Fallot using cardiac magnetic resonance imaging (CMR).

Methods & Materials: Forty-six patients with repaired TOF underwent CMR from January 2017 to December 2018 and 55 volunteers without any disease or medical history served as controls were enrolled in this study. In the 46 patients group, patients with right ventricular ejection fraction (RVEF) preserved (RVEF≥55%) and the same sample size controls with age and gender matched were chosen and divided into two groups, the ventricular volume and strain parameters were designed to compare between these two groups. Correlation analysis performed on patients with RV end-diastolic volume index (RVEDVi) dilation among pulmonary valve regurgitation, right ventricular function parameter, years after repair (yar) and age.

Results: In twenty r-TOF patients with RVEF preserved, RVEDVi, RV end-systolic volume index (RVESVi) and RV stroke volume index (RVSVi) were found significantly higher compared to controls, also, RV segment and global strain except RV global longitudinal strain were found to be higher compared to controls. RVEDVi dilation was found in forty patients, pulmonary regurgitation fraction was found to be positively correlated with RVEDVi, RVESVi, RV apical radial strain and apical circumferential strain; EF was found to be correlated with global longitudinal strain.

Conclusions: Myocardial strain as derived from CMR feature tracking contributes detection of early myocardial abnormalities; among PVR, age and year after repair, PVR was the main risk factor of RVEDVi dilation. In young patients with r-TOF within short surgery duration, GLS is the major contributor to the overall RV performance.

Objectives: Congenital heart disease is the first birth defect in China, and MRI plays an important role in the postoperative evaluation of cardiac function. Long acquisition time makes CMR not be tolerated for children. 4-dimensional flow (4D flow), a new technique of CMR, can obtain both flow and anatomical information in just one acquisition. In this study, our aim was to compare the results of right and left ventricular volume between 2D phase contrast cine and 4D flow in volunteers and patients with congenital heart disease, and was to assess the accuracy of 4D flow. The purpose of this study is to validate CMR based 4D flow ventricular volume quantification between children with congenital heart disease and those volunteers.

Methods & Materials: Sixteen volunteers (6 females, mean age 10 years) and sixteen pediatric patients (3 females, mean age 7 years) with repaired Tetralogy of Fallot (rTOF) were referred for cardiac MRI. The 2D b-SSFP cine and 4D flow sequences were performed on a 3.0T MRI scanner with an eight-channel phased-array cardiac coil (Discovery 750, GE Healthcare). The 4D flow data sets were uploaded to Arterys MICA’s online service, which was accessed via the Internet. The end-diastolic, end-systolic and stroke volume of the left ventricle and right ventricle between volunteers and patients with congenital heart disease were measured by 4D flow and were compared with 2D b-SSFP cine.

Results: In all 32 cases, the differences between volunteers and patients with rTOF in both 4D flow and 2D b-SSFP have shown no meaning. The Pearson’s correlations between CMR 4D flow and 2D b-SSFP cine sequences of volunteers were 0.98, 0.92, 0.95, 0.97, 0.88 and 0.89 for left and right ventricular end-diastolic, end-systolic and stroke volumes respectively, and the correlations between these two CMR sequences of the patients with rTOF were 0.99, 0.98, 0.96, 0.99, 0.99 and 0.84 for left and right ventricular end-diastolic, end-systolic and stroke volumes respectively. The end-diastolic, end-systolic and stroke volumes of both left and right ventricle from 4D flow and 2D b-SSFP were well correlated, while the correlations of right ventricular volumes of these two sequences were weaker than those of left ventricle.

Conclusions: Left and right ventricular end-diastolic, end-systolic
and stroke volumes in both volunteers and patients with congenital heart disease can be measured accurately by 4D flow CMR, which were compared with 2D b-SSFP cine. 4D flow CMR not only provide cardiac flow information also can assess cardiac function.

Comparison of Non-ECG-Gated 64-slices Multi-detector CT Angiography with Echocardiography in Diagnosis of Congenital Heart Diseases

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Objectives: Congenital heart diseases (CHD) are relatively common disorders, with a reported prevalence of 4 – 10 per 1,000 births. Timely and accurate preoperative diagnosis and evaluation are important to improve the survival rate. Echocardiography is the primary non-invasive imaging modality for the evaluation of CHD. Computed tomography Angiography (CTA) has also showed potential to examine the anatomy of complex heart anomalies as well as the extra-cardiac vascular involvement. We hypothesized that CTA provides additional information which is of clinical value and may differ from the primary findings with echocardiography. The aim of this study was to evaluate the diagnostic accuracy of Non-ECG-Gated 64-slices Multi-detector CT Angiography (CTA) in CHD and comparing the results with echocardiography.

Methods & Materials: A sample of 110 consecutive infants and children (Females/Males: 1), aged 23.25±2.90 months with CHD who were candidate for cardiac surgery were included in this prospective study. The patients had a provisional diagnosis of CHD provided by clinical examination and primary echocardiography as well as CTA were already ordered for further delineation of diagnosis. Echocardiography was performed by two Pediatric Cardiologists, with at least 3 years of experience in cardiology ultrasound diagnosis. The interpretation of the CTA results was performed separately by two specialists in cardiology and radiology, who were blinded to the primary echocardiography diagnosis. Using the surgical findings as the standard value, diagnostic accuracy, sensitivity and specificity of both modalities were measured.

Results: A total number of 322 cardiovascular malformations in 110 patients were detected by operation. The most common findings were Ventricular septal defect (VSD) (16.1%), Atrial septal defect (ASD) (16.1%) and Patent ductus arteriosus (PDA) (15.7%). Diagnostic accuracy of echocardiography and CTA were 85.40% and 83.23%, respectively. The findings were divided in two categories: cardiac and extra-cardiac vascular malformations. Out of 322 anomalies, 175 (54.3%) were cardiac and 147 (45.6%) were extra-cardiac vascular anomalies. In diagnosing cardiac anomalies, the sensitivity and specificity of CTA were 89.57% and 78.57%, respectively compared to the similar values of echocardiography which were 98.90% and 78.57%, respectively. In detecting extra-cardiac vascular anomalies, CTA had a sensitivity of 94% and a specificity of 100%, as opposed to the sensitivity of 90.53% and specificity of 100% for echocardiography.

Conclusions: Echocardiography and CTA had a relatively overall similar diagnostic accuracy in CHDs. Echocardiography was the modality of choice for diagnosing the wide range of CHDs, especially the intracardiac abnormalities. CTA had additional value in detecting extra-cardiac vascular anomalies.

Attach Files 1 : Note: Abbreviations, Complete atrioventricular canal defect (CAVCD), Atrial septal defect (ASD), Ventricular septal defect (VSD), Tetralogy of Fallot (TOF), Total anomalous pulmonary venous connection (TAPVCA), persistent left superior vena cava (LSVC), Aortic stenosis (AS), Aberrant right subclavian artery (RSA), Patent ductus arteriosus (PDA), Truncus arteriosus communis (TAC), Transposition of the great arteries (TGA), Tricuspid atresia (TAI), Pulmonary valve stenosis (PS), Patent foramen ovale (PFO), Double outlet right ventricle (DORV), Double SVC (Superior Vena cava), Major aortopulmonary collateral arteries (MAPCAs), Pulmonary atresia (PA), Aortopulmonary window (AP window), Hypoplastic right ventricle (HRV), Pulmonary artery stenosis (PAS)
Prenatal MRI Diagnosis of Abnormal Cardiothoracic Ratio in Fetuses without Congenital Heart Disease

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Objectives: To explore the value of MRI in the diagnosis of fetal abnormal cardiothoracic ratio (CTR) without congenital heart disease.

Methods & Materials: A total of 143 fetuses diagnosed with suspected non-congenital heart malformation by prenatal ultrasound who underwent MRI examination within 24 hours in the Second Hospital of Hebei Medical University from March 2016 to December 2017 were retrospectively analyzed. There were 107 cases in the normal group, 19 cases in CTR-increased group, and 17 in CTR-reduced group. The MRI features of fetuses with abnormal CTR were analyzed, and the differences between normal and abnormal fetuses were compared.

Results: Among the 17 CTR-reduced fetuses, there were 12 cases of congenital pulmonary adenomatoid cystic malformation, 4 cases of congenital diaphragmatic hernia and 1 case of congenital airway high obstruction syndrome, with CTR of 0.39 (0.37, 0.40). Among the 19 CTR-increased fetuses, there were 3 cases of Glean venous aneurysm-like malformation, 4 cases of infantile hepatic angioendothelioma, 5 cases of meconium peritonitis, 3 cases of intestinal obstruction and 4 cases of simple amniotic fluid increase, with CTR of 0.51 (0.50, 0.53). The CTR of 107 normal fetuses was 0.45±0.02, and the difference between normal and abnormal fetuses was statistically significant (P<0.05).

Conclusions: MRI is of great value in the diagnosis of CTR abnormalities in fetuses without congenital heart disease, which contributes to find the cause, confirm the diagnosis and provide more comprehensive diagnostic information in clinic.

Disease Concordance in Multifetal Pregnancies

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Objectives: An upsurge in multifetal pregnancies has been observed in developed and developing countries, this could partly be due to the increased utility of the expanded fertility treatments worldwide. Accompanying risks and complications in newborns of multiple births have been widely studied, and while the presence of disease concordance in multifetal pregnancies is frequently encountered, this is yet to be established.

Methods & Materials: This was a retrospective search of the radiographic records of neonates born of multifetal pregnancies from January 2017 to December 2018 in St. Luke’s Medical Center - Global City who underwent cranial ultrasound on the same day showing concordant findings. The procedures were performed and interpreted by experienced and trained pediatric radiologists. Infants with prenatally known or suspected congenital/ chromosomal anomalies were excluded. Demographic and clinical data of the patients were retrieved from the hospital’s digital database.

Results: Among the patients born of multifetal pregnancies, there is significant concordance of findings in the cranial ultrasound of one compared to the others. Data and specific findings will be discussed.

Conclusions: Findings in one of the multifetal pregnancies can be expected to be present in the other siblings since all of them were exposed to the same environment and circumstances. It is however recommended that further studies be done to take into consideration the specific type of multiple pregnancies including fraternal or dichorionic twinning.

Assessment of Irreducible Aspects in Developmental Hip Dysplasia by Magnetic Resonance Imaging

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Objectives: The present study aimed to access the diagnostic capability of MRI for precisely detecting the irreducible mechanisms of preventing concentric hip reduction in DDH before surgery, and its applicability in helping pediatric orthopedic surgeons to choose appropriate treatment strategies.

Methods & Materials: Acetabular magnetic resonance imaging (MRI) (3.0 T) was performed in 39 children with DDH among which 4 had bilateral DDH and 35 had unilateral involvement. The diagnostic capability of 3.0T MRI for irreducible aspects
were assessed by studying the influential factors in embole of DDH including labrum, ligamentum teres, iliopectos, intraarticular fat hyperplasia and joint effusion.

Results: Results of sensitivity and specificity of MRI were 90.3% and 83.3% for the affected labrum, 92% and 83.3% for thickening of the round ligament, 90.0% and 91.3% for atrophy of the iliopectos muscle, and 100% for fibrofatty pulvinar tissue and joint effusion, respectively.

Conclusions: 3.0T MRI can provide useful informations on the reducibility of the femoral head and help to determine the appropriate treatment.

Attach Files 1: Female, 19 months, type II dislocation of left hip. A) Coronal T1WI showed glenoid lip valgus (long arrow), intra-articular adipose hyperplasia (*),and round ligament coarsening (short arrow); B) Grey-white specimens showed the thick, twisted circular ligaments. C) The round ligament was shown under fiberoptic microscopy, leading to dense fibrous tissue hyperplasia, accompanied by focal hyaline degeneration (HE,*200).

Attach Files 2: Female, 2 years old, type III dislocation of left hip. A) Coronal T1WI showed glenoid lip hyperplasia, inversion (arrow A), and intra-articular adipose hyperplasia (arrow B); B) Gross specimens showed slight yellowish fat; C) Microscopically, adipose tissue hyperplasia was seen(HE,*400).

Comparative Study between The Typical and Oblique Scans of the Traumatic Child Knee Joint

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Objectives: To assess the acute traumatic knee joint injury patients referred to MRI at 1.5T scanner between November 2018 and April 2019.

Methods & Materials: MRI at Siemens Magnetom Essenza 1.5T (in Korea) was performed in patients who suffered acute traumatic knee joint injury. MR protocols included Pd_tse_fs axiol, Pd_tse_f sagittal, Pd_tse_fs coronal, T2_tse coronal, Pd_tse_coronal, T2_pd_coronal and Optional scans ACL and PCL tears of the traumatic knee joint patients partial tear of ACL optional scans Oblique Pd_tse-Fs Coronal and Sagittal, Oblique T2_tse_coronal and Sagittal, partial tear of PCL optional scans Oblique Pd_tse-Fs Coronal and Sagittal, Oblique T2_tse_coronal and Sagittal sequences for patients who suffered acute traumatic knee joint injury. The images were retrospectively revised and data were analyzed using SPSS 21.0.

Results: From 76 Knee joint MRI cases, images of 69 child patients had been retrieved from the imaging database. The average age was 12.1±4.3 years. The F:M ratio was 37:32. Partial tear of the ACL 21/69, Partial tear of the PCL 13/69, Partial tear of the ACL and PCL 9/69, Complete tear of ACL 5/69, Complete tear of PCL 2/69, only effusion and edema 19/69.

Conclusions: Always sports knee injuries occur among young children in Mongolia. We have done From 69 Knee joint MRI cases, images of 57 child patient’s optional scans oblique Pd_tse_fs_sagittal and coronal-2mm, oblique T2_tse_sagittal and coronal-2mm sequences for patients who suffered acute traumatic knee joint injury. Revelation of the ACL and PCL partial and complete tears was greater than typical scans.

Attach Files 1: Partial tear of the ACL Oblique_Pd_tse_fs_Cor_2mm sequence.

Attach Files 2: Partial tear of the PCL Oblique_Pd_tse_fs_Cor_2mm sequence.
Osteomyelitis and Septic Arthritis in Angola, a Retrospective Study

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Objectives: Osteomyelitis (OM) and joint infections are common among children in non-industrialized countries. Diagnosis is often delayed and outcome is poor. We undertook a retrospective study on OM in the Pediatric University Hospital of Luanda, Angola.

Methods & Materials: All images and data of the children who suffered from bone and joint infections in the department of surgery during year 2014 were reviewed. Data is presented in medians and percentages, as appropriate.

Results: From a total of 45 symptomatic children (26 boys), 40 had OM and 5 septic arthritis. Median age was 6 years. Before arrival the median duration of illness was 14 days. Some treatment was executed to 98% of children, but only 76% were given antibiotics. 23 children presented with chronic, 3 acute and 19 subacute OM. Tibia was affected in 14 and femur in 11 cases. Due to multifocal cases a maximum of 61 foci were involved. 14 children presented with a pathological fracture, 7 with sequestrum, 5 with draining sinus, and 2 with bone abscess. 29 patients were operated on, whereas 4 had traction for hip luxation. 23 children suffered from sickle cell disease and required several blood transfusions; 6 children had severe malnutrition. Antibiotic therapy (mostly cloxacillin +/- gentamycin) were given in median of 28 days and the hospital care was needed 31 days. Median blood hemoglobin was 5.7 mg/L, erythrocyte sedimentation rate 115 mm/h, and white blood cell count 15.4 x 109/L. Staphylococcus aureus, Klebsiella, Enterobacter and Citrobacter spp were the bacteria found. 71% of patients had fever which lasted longer than one week in 54%.

Conclusions: In Angola, and probably elsewhere in sub-Saharan Africa, OM is often diagnosed with a delay and many cases become chronic. Traditional x-ray is the routine imaging modality; whereas MRI is rarely available. Prospective studies are urgently needed to struggle against devastating OM in many countries of the developing world.

TW3-Based Fully Automated Bone Age Assessment System Using Deep Neural Networks

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Objectives: In this paper, we propose a complete end-to-end BAA (bone age assessment) system to automate the entire process of the Tanner–Whitehouse 3 method, starting from localization of the epiphysis–metaphysis growth regions within 13 different bones and ending with estimation of the corresponding BA (bone age).

Methods & Materials: An annotated database of 3300 X-ray images of Korean children under the age of 18 is built to train and evaluate the system. The annotation file contains the coordinates of the 13 actual ROIs within the corresponding bROIs, the skeletal maturity levels of individual ROIs, and the estimated BA. The skeletal maturity levels of individual ROIs were agreed upon by two professional radiology doctors to ensure the BAA accuracy.

Results: The experimental results show that the average top-1 and top-2 prediction accuracies for skeletal bone maturity levels for 13 regions of interest are 79.6% and 97.2%, respectively. The mean absolute error and root mean squared error in age prediction are 0.46 years and 0.62 years, respectively, and accuracy within one year of the ground truth of 97.6% is achieved.

Conclusions: In this paper, we presented a TW3-based fully automated BAA system using deep neural networks. The core
functions of the proposed system are the extraction of 13 ROIs and classification of the skeletal maturity levels of the ROIs. The proposed system is shown to outperform a commercially available Greulich–Pyle-based system, demonstrating the potential for practical clinical use.

The Incidence of Spondylolysis and Spondylolisthesis in Pediatric Patients at a Single Hospital in Korea

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Objectives: The aim of the study is to assess the incidence of spondylolysis and isthmic spondylolisthesis in children under age 11 using abdominal and pelvic CT (A-P CT) performed for unrelated lumbar condition.

Methods & Materials: Total 809 APCTs of 809 children under age 11 (479 boys and 330 girls, mean age = 6.5± 2.7 years) performed between March 2014 and December 2018 were reviewed retrospectively. We evaluated the CT scans for the presence, level, and site (unilateral or bilateral) of spondylolysis. In addition, we evaluated the presence of spondylolisthesis. For statistical analysis, we separated the patients into two groups according to the presence or absence of spondylolysis (S group and non-S group).

Results: Among the 809 APCT scans, 21 spondylolysis were detected in 20 children. The incidence of the spondylolysis was 2.4% (20/809, 15 boys and 5 girls). There was no statistically significant difference in sex and age between the S and non-S groups (p = 0.146). According to age distribution, the incidence of spondylolysis was 0.5 % in under age 5 (1/182) and 3.0% in under age 11 (19/627). There were 10 bilateral and 11 unilateral spondylolysis, one patient had 2 spondylolysis in different lumbar levels (unilateral L3 and bilateral L5). The most common sites for lumbar spondylolysis was L5 (16/21, 76.2%). The other levels were noted: L1 (n = 2), L3 (n = 2), and L4 (n = 1). Only 1 patient had spondylolisthesis, among 20 children.

Conclusions: We evaluated the incidence of incidentally detected spondylolysis and isthmic spondylolisthesis on A-P CT of the children under 11 years. The results of our study would be helpful data for screening of Korean children.

Imaging Study of Skeletal System In Gaucher Disease

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Objectives: By using new magnetic resonance imaging technology to study the imaging changes of the skeletal system in Gaucher disease that could provide more valuable quantitative indicators for the clinical study.

Methods & Materials: MRI of the spine and femur was performed in 40 GD patients and 34 healthy volunteers. The techniques included iterative decomposition of water and fat with echo asymmetry and least-squaresestimation quantitation (IDEAL-IQ) and intravoxel incoherent motion imaging (IVIM). The difference of fat content, iron content, standard apparent diffusion coefficient (sADC), slow apparent diffusion coefficient (D), perfusion-related diffusion coefficient (D*) and perfusion fraction (f) between the control group and the case group was analyzed by t-test. P < 0.05 showed significant difference.

Results: The fat content of spine, left femur and right femur in GD patients was (28.35±9.46)%, (48.52±14.95)%, (48.13±16.63)%. The fat content of spine, left femur and right femur in normal control group was (33.84±8.46)%, (82.31±6.39)%, (81.36±6.05)%. There were significant differences in the fat content of spine and left femur between the two groups (P<0.05). The iron content of spine, left femur and right femur in GD patients was (182.86±36.20) Hz, (132.97±28.45) Hz and (132.73±31.64) Hz, respectively. The iron content of spine, left femur and right femur in normal control group was (151.01±25.52) Hz, (90.16±36.33) Hz, (94.03±36.66) Hz. There were statistical differences between the two groups (P<0.05). sADC, D, D* and f values of spine in GD patients were (0.47±0.10)×10-3mm2/s, (0.38±0.07)×10-3mm2/s, (0.65±0.13)×10-1mm2/s, (0.38±0.05). sADC, D, D* and f values of spine in normal control group were (0.45±0.10)×10-3mm2/s, (0.34±0.06)×10-3mm2/s, (0.70±0.14)×10-1mm2/s, (0.37±0.04), only D value had statistical difference between the two groups (P < 0.05). sADC, D, D* and f values of left femur in patients with GD group were (0.82±0.21)×10-3mm2/s, (0.52±0.18)×10-3mm2/s, (0.61±0.19)×10-1mm2/s, (0.29±0.06). sADC, D, D* and f values of left femur in normal control group were (0.93±0.15)×10-3mm2/s, (0.45±0.18)×10-3mm2/s, (0.65±0.19)×10-1mm2/s, (0.33±0.06), only sADC and f values between the two groups were statistically significant (P < 0.05). sADC, D, D* and f values of right femur in GD patients were (0.59±0.25)×10-3mm2/s, (0.43±0.21)×10-3mm2/s, (0.37±0.19)×10-1 mm2 /s, (0.46±0.13). sADC, D, D* and f values of right femur in normal control group were (0.80±0.30)×10-3mm2/s, (0.45±0.10)×10-3mm2/s, (0.33±0.15)×10-1mm2/s,
(0.48±0.10), only sADC values between the two groups were statistically significant (P < 0.05).

**Conclusions:** IDEAL-IQ and IVIM-DWI can detect the abnormalities in skeletal system, which provides important clinical value for the diagnosis and evaluation of curative effect.

**Attach Files 1:** Figure 1. (A-D) A 10-year-old male patient, the fat fraction image [A] and R2* relaxation rate image [B] of femur showed flask-like deformity, bone erosion or osteolysis, and decreased intraluminal medullary signal. The fat fraction image [C] and R2* relaxation rate image [D] of spine showed obtuse anterior margin of lumbar spine. The fat content and iron content of left femur were 29.57% and 185.83 Hz, respectively. The fat content and iron content of right femur were 27.67% and 193.43 Hz, respectively. The fat content and iron content of vertebral body were 17.76% and 206.32 Hz, respectively. (E-H) A 19-year-old healthy man, the fat fraction image [E,G] and R2* relaxation rate image [F,H] of femur and spine showed the signal was normal. The fat content and iron content of left femur were 81.53% and 84.57 Hz, respectively. The fat content and iron content of right femur were 79.17% and 90.47 Hz, respectively. The fat content and iron content of vertebral body were 27.46% and 152.76 Hz, respectively.

**Attach Files 2:** Figure 2. (A-J) A 10-year-old male patient with IVIM-DWI [A,F], sADC [B,G], D [C,H], D* [D,J] and f [E,J] maps of the spine and femur, respectively. The values of sADC, D, D* and f of the spine were 0.00036mm²/s, 0.00034mm²/s, 0.078mm²/s, 0.36 respectively. While, the values of sADC, D, D* and f of the left femur were 0.00021mm²/s, 0.00017mm²/s, 0.075mm²/s, 0.34 and the right femur were 0.00017mm²/s, 0.00025mm²/s, 0.013mm²/s, 0.47 respectively. (K-T) A 27-year-old healthy man with IVIM-DWI [K,P], sADC [L,Q], D [M,R], D* [N,S] and f maps [O,T] of the spine and femur, respectively. The values of sADC, D, D* and f of the spine were 0.00040mm²/s, 0.00031mm²/s, 0.055mm²/s, 0.42 respectively. While, the values of sADC, D, D* and f of the left femur were 0.00090mm²/s, 0.00048mm²/s, 0.030mm²/s, 0.38 and the right femur were 0.00058mm²/s, 0.00048mm²/s, 0.040mm²/s, 0.45 respectively.

**SP_MSK_07**

**Systematic Imaging Approach using Magnetic Resonance Imaging (MRI) for Musculoskeletal Soft Tissue Tumor Diagnosis and Its Correlation to Pathological Findings**

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**Objectives:** This study aimed to investigate the ability of systematic imaging approach using magnetic resonance imaging (MRI) in soft tissue tumor (STT) diagnosis and its correlation to pathological findings.

**Methods & Materials:** This is a cross-sectional study to evaluate patients with suspect of STT. Patients underwent MRI and pathologic examination in Fatmawati General Hospital during 2018. Systematic approach include 9 characteristics: size, shape and lobulation, border, T2 signal intensity, peritumoral edema, necrosis, bone involvement, contrast enhancement, and neurovascular involvement. MRI-based results and pathologic findings were analyzed to calculate sensitivity, specificity, predictive value, and its correlation. A prediction model then developed if necessary.

**Results:** A total of 34 patients included in this study. Median age was 17 years old with 61.7% were below 18 years old. The most common STT location were femur (13 cases), cruris (5 cases), and humerus (4 cases). The majority of pathological findings are Giant Cell Tumor (6 cases) and hemangioma (6 cases). In bivariate analysis, all MRI-based characteristics have good correlation to pathological findings with neurovascular involvement as the most statistically significant (p < 0.001). Irregular-lobulated shape, T2 signal hyperintensity, and contrast enhancement have the highest sensitivity and negative predictive value (100%, 90.9%, and 90.9%, respectively). The best specificity were found in neurovascular involvement (100%, positive predictive value 100%) followed by irregular border, necrosis, and bone involvement (73.9%, positive predictive value 85-89.5%). Based on ROC curve analysis, we decide a screening cut-off point is 3 characteristics (90% sensitivity and 37.5% specificity), while diagnostic cut-off point is 7 characteristics (70% sensitivity and 87.5% specificity). This model has a good discrimination performance (area under curve = 0.817).

**Conclusions:** Systematic imaging approach using MRI with 9 main characteristics showed a promising simple and easy to use diagnostic tools specific for STT diagnosis. A further study with larger sample is needed to test its external validation performance.
Brachial Plexus MR Technique: Experience in Hospital

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Objectives: To assess the acute traumatic C-spine and Brachial plexus injury patients referred to MRI at 1.5T scanner between July 2018 and April 2019.

Methods & Materials: MRI at Siemens Magnetom Essenza 1.5T (in Korea) was performed in patients who suffered acute traumatic C-spine and Brachial plexus injury. Coil using Head_Neck and Body coil with combined connect. MR protocols included T2_tse_cor and T2_tirm_coronal, typical_T2_sag and Oblique_T1, T2 and stir sagittal, Oblique_T2_and T2_fs_axial sequences for patients who suffered traumatic C-spine and Brachial plexus injury. The images were retrospectively revised and data were analyzed using SPSS 21.0.

Results: From 242 C-spine cases, images of 227 patients had been retrieved from the imaging database. The average age was 26.1±15.3 years. The F:M ratio was 78:116 (43 children from 6 to 16 years old participated in the survey). No age predilection for C-spine injury obstruction level was determined. The main cause of brachial plexus injury is accident from riding and motorcycles. Children who ride horses are mostly injured in their brachial plexus in Naadam festival in Mongolia.

Conclusions: We have done From 227 C-spine MRI cases, images of 31 patient’s Brachial plexus MRI scans. Case of 14 patients were 6-16 years of age Brachial plexus MRI scans. Optional protocols Oblique_T1, T2_tse and T2_fs Axial, sagittal and coronal sequences for patients who suffered acute traumatic brachial plexus injury. Coil using Head_Neck and Body coil with combined connect.

Cerebral Metabolic Changes Caused by Pediatric Mild TBI

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Objectives: Majority of the Proton magnetic resonance spectroscopy (1H MRS) studies report reduced total NAA and NAAG (tNAA) white matter (WM) concentrations in the acute phase of mild Traumatic brain injury (mTBI), and injury as well as reduction of tNAA only in the patient group with post-concussion symptoms (PCS) as compared to non-PCS patients. In about 25-30% of WM tNAA signal is determined by NAAG contamination. Therefore, reduced WM tNAA signal intensity might be associated both with NAA and NAAG drop and even opposite changes of these two neurometabolites. Currently the most promising method for the NAAG and NAA separation is a J-editing with the MEGA-PRESS pulse sequence. Main aim of this study was to determine WM NAA and NAAG concentrations in acute mTBI.

Methods & Materials: Two groups of participants were included in the study: patients (n=12, mean age–15.3±0.8 years) with acute mTBI (mean time between trauma and MRI examination 41±16 hours; Coma Glasgow score – 15; 5 with loss of consciousness, 7 w/o); 8 healthy children (mean age-15.7±1.6 years) without history of any TBIs. All investigations were performed on the 3.0T MRI scanner. The research protocol contained following spectra: NAA_MEGA-PRESS, NAAG_MEGA-PRESS, PRESS and Unsuppressed water spectra. All voxels in size of 50×19×27mm were located in the left centrum semiovale (Fig.1. WM-dominant region). NAAG/tCr and NAA/tCr ratios were quantified from MEGA-PRESS spectra. [tCr], [tCho], [tNAA], [Ins] and [GLX] concentrations were quantified with LCmodel with normalization on tissue contamination, T2 and T1 relaxation.

Results: The significant effect on the NAAG was found, with the patients having lower [NAAG] (Fig.2) as compared to the control group on 19%. [tNAA], [tCho], [tCr], [GLX], [Ins] were unchanged (Fig.2).
Conclusions: This study for the first time revealed decreased cerebral WM NAAG concentration without NAA changes in the pediatric acute mTBI. Previous findings of [tNAA] reduction in WM might not be associated with a decrease in [NAA] but just with a decrease in [NAAG], which certainly changes current vision on the following problem. Since NAAG via the action of its peptidase was suggested as an important mediary of neuronal-glial communication, it might be that NAAG is spent on protection and repair of nervous tissue after damage. Finally, the extensive modulatory role for NAAG on both glutamatergic and GABAergic systems implicates NAAG in the regulation of the balance between excitatory and inhibitory neurotransmission that has been shown to be shifted in acute mTBI. The work is supported by the RFBR 17-04-01149

Attach Files 1: Fig. 1. Location of the voxel for 1H mrs

Attach Files 2: Fig.2. Measured with 1H MRS concentrations of neurometabolites

Normative Values for Tonsils in Pediatric Populations Based on Ultrasonography

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Objectives: Peritonsillar infection is common in pediatric populations, particularly in adolescents. Inaccurate diagnosis for peritonsillar infection causes delayed management and potentially life-threatening complications such as extra-tonsillar extension into deep neck space and mediastinum, aspiration pneumonia, sepsis. Ultrasonography (US) has high sensitivity and specificity for diagnosing peritonsillar abscesses and can diagnose tonsillitis by enlargement of the gland. In this study, we established normal tonsillar measurements and volumes according to age in pediatric populations. Also, to determine whether any measurement could serve as valid predictor of tonsillar volume.

Methods & Materials: Transcervical US of the peritonsillar region to measure tonsillar size and volume was performed in patients who had undergone neck US without throat symptoms. In total, 322 normal tonsils were examined from 161 patients who underwent neck US between October 2016 and May 2017. Transverse and anteroposterior diameters, length, and volume were measured. The volume of each tonsil was calculated by the formula: transverse diameter x AP diameter x length x 0.523

Results: In total, 161 patients (age range, 1 month–18 years) were enrolled in the study. The mean tonsillar volumes ± SD were 1.58±1.26 (total), 0.30±0.14 (10 years) cm3. Mean measurements for the sums of both tonsils for the transverse diameter, anteroposterior diameter, and length were 1.98±0.61, 2.17±0.66, and 2.28±0.69 cm, respectively. Tonsillar size and volume increased according to age. Simplified models for volume estimation showed that anteroposterior diameters had the highest coefficients of determination (R2=0.71 and 0.74). Regression models for the tonsillar volume of 6 measurements in the multiple linear regression models showed an R2 of 0.89. Regression models for log(volume) showed an improved coefficient of determination (R2=0.96).

Conclusions: In conclusion, tonsillar US is feasible technique for diagnosing tonsillar infection in pediatric populations without radiation exposure. Normal tonsillar values can allow the radiologist to correctly diagnose tonsillar infections.
Intracranial Hemorrhage in Term Neonates

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Objectives: To evaluate the clinical characteristics and neuroimaging data of neonatal intracranial hemorrhage (ICH) and how these findings relate to outcomes.

Methods & Materials: We reviewed MRI data from July 2004 to June 2015 for 42 term neonates with ICH who were less than 1 month old. We recorded clinical data and manifestations, mode of delivery, Apgar score at 1 and 5 min, associated hypoxic insult, birth trauma, neurological symptoms, EEG results, extent and site of hemorrhage, neurosurgical intervention, and developmental outcomes. Risk factors were assessed in relation to ICH.

Results: 42 neonates with ICH underwent MR imaging postnatally (mean age: 9.3 days). The majority of clinical symptoms were present in patients within the first 24 h of life (n=31). Seizure-like activity was the most common presenting symptom (17/42, 40.5%), with apnea seen in another seven infants (7/42, 16.7%). Ten had infratentorial hemorrhage, and 2 had supratentorial hemorrhage. A total of 30 infants had a combined hemorrhage. Subdural hemorrhage (SDH) was the most common type (40/42, 95.2%), followed by nine cases of parenchymal hemorrhage, seven of subarachnoid hemorrhage, three of germinal matrix hemorrhage (GMH), and one of epidural hemorrhage (EDH). SDH was identified along the tentorium (n=38) as well as over the cerebellar hemispheres (n=39), along the interhemispheric fissure (n=10), and over the occipital (n=13) or parietooccipital (n=11) lobes. Traumatic delivery was suspected in 20 patients (47.6%), and perinatal asphyxia was present in 21 patients (50.0%). A low Apgar score at 5 min and a history of perinatal asphyxia were the factors that most predicted poor clinical outcomes (n=27). Logistic regression analysis revealed that a history of perinatal asphyxia resulted in the poor outcomes. No patients were died.

Conclusions: SDH was the most common type ICH in term infants. Combined supra- and infratentorial hemorrhage was more common than isolated infratentorial hemorrhage. 44.4% of patients had poor outcomes, with perinatal asphyxia the most common statistically significant cause.

Posterior Reversible Encephalopathy Syndrome in the Pediatric Age Group: an Experience from a Tertiary Care Hospital in Pakistan

Kiran Hilal, Kumail Khundwala, Waseem Akhter

Objectives: Posterior reversible encephalopathy syndrome (PRES) is a clinical entity with a distinctive radiological appearance. The features of this syndrome in pediatric patients remain obscure. This study was conducted to evaluate the radiological and clinical spectrum of PRES in pediatric population and determine its possible causation.

Methods & Materials: We performed a retrospective evaluation of the pediatric patients with PRES seen over the last 10 years in Aga Khan University Hospital, Karachi. The radiological findings were independently reviewed by two experienced pediatric radiologists along with the clinical profile, contributory factors, and outcome.

Results: Out of 29 patients, 19 were males and 10 females with a mean age of 9 years. The most common primary disease was hematological malignancy (72%). Seizures in 82%, headache in 76%, and altered mentation in 55% were frequent presenting symptoms. The most common contributory factor was uncontrolled hypertension (100%); with mean highest blood pressure of 155/102 mmHg. Imaging showed involvement of parietooccipital lobes (96%) and atypical findings were noted in 56% with predominantly frontal lobe involvement. All patients had complete clinical neurological recovery within an average of one week, however, on long-term (>1 year) follow-up 1% of the patients presented with recurrent PRES and seizures. Complete and partial restitution of imaging abnormalities was seen in 85% and 15% of cases, respectively.

Conclusions: It is imperative to be familiar with the clinical spectra and radiological findings in children with PRES to avoid misdiagnoses. Our results show that resolution of imaging findings is slower than clinical recovery.
Single Institute Experience: Work-load Achievement in Radiology Residency Training Program

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Objectives: Introduction: Every residency training program needs its self-evaluation to determine the weak and strong points. For sure, enhancing the strong points as well as recognize and looking for solutions to realign the weak points. Through this research mainly, aims to evaluate the progression or deflation of the work-load achievement by the residents. So, we can establish recognition of weak points that need to be corrected. Indeed, this research is helpful for other radiology residency programs world-wide.

Methods & Materials: This is a retrospective analysis study. Reviewing the records of radiology residents who trained in security forces hospital, Riyadh – Saudi Arabia. Targeting the work-load of R2 residents who was rotating in ultrasound, neuroradiology and musculoskeletal rotations due to well-coverage in the hospital. Considering the number of minimum requirements achieved (File 1). We excluded R1 residents because the limitation during their first year of residency program. In addition, we exclude R3 and R4 residents who had most of their rotations outside the hospital. In certain condition, we include the other residents’ level in the research if they were rotating in the above-mentioned rotations with R2 residents. We calculated the percentage of residents’ work-load per desired rotation and compare it to the percentage of the minimum requirements through the academic years from 2014-2019, starting from October to the next year September. We conducted the research upon neuroradiology, musculoskeletal and ultrasound.

Results: (File 2) detailing the average percentage of the work-load in targeted rotations over the academic years. Neuro-rotation shows right-shift chart that agrees direct-supervision, increased number of residents, emergency courses that provided has improved the work-load achievement. In MSK-rotation we can figure out there is a fluctuating of the average percentage of work-load starting from 2014-2015. Because almost one resident was covering the whole duty. Ultra-sound rotation shows degree of deflation in recent years. We find out when two residents rotating in the same rotation they split the work-load with varying number of cases. However, by calculating the overall work-load, it achieved the minimum requirements. Inadequacy of academic teaching plays major role in the way maintaining work-flow of each resident to achieve the minimum requirement, at least.

Conclusions: Conclusion: Comprehensive direct supervision by consultant, academic teaching, educational activates, enhancing self-learning skills of the resident as well as monthly work-load evaluation ends-up with excellent outcome of structured program.

A Prospective Experimental Study on the Extent in Size and Type of Lead Gown Damage and Associated Primary Radiation Dose Risk at St. Luke's Medical Center - Global City

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Objectives: To determine the maximum allowable size of damage of lead gowns that is adequate and safe for use during radiologic fluoroscopic procedures. To identify suboptimal lead gowns which are deemed inappropriate for use. To relate the type of lead gown damage with regards to the degree of radiation risk.

Methods & Materials: This is an experimental study using old lead gowns marked for disposal by the Institute of Radiology at St. Luke's Medical Center-Global City. Materials: 1. Calibrated dose meter with 2.2 cm detector length 2. Lead gown with 0.5...
mm thickness. X-ray machine with Automatic Exposure Control (AEC) system. Methodology: a. Place undamaged lead gown on top of x-ray on top of the x-ray detector with a fixed distance of 107 cm (distance from overhead x-ray machine to x-ray bed which holds the lead gown). b. Place the dose meter on top of the lead gown. Make sure that the dose is properly positioned. c. Make an x-ray exposure using the Automatic Exposure Control (AEC) d. Record the factors and the dose measured. e. Place the dose meter under the lead gown. Make sure that the dose meter is properly positioned. f. Make an exposure using the Automatic Exposure Control. g. Record the factor and dose measured. h. On the same lead gown, create a 1 cm crack. Repeat steps f. and g. i. Perform step h using different length of cracks: 1.5 cm and 2 cm. j. Record the measurements. k. Perform step h. using holes with different diameters: 1 cm, 1.5 cm and 2 cm. l. Repeat and perform a total of four (4) trials of measurements, to get the average value.

**Results:** The larger the length of the crack and the diameter of the hole, the higher radiation passes through the lead gown which in turn leads to more radiation exposure of the individual.

**Conclusions:** Lead gowns minimize radiation doses to individuals exposed to it, which in turn can prevent possible health complications that may arise. Over time, lead gowns develop damages such as cracks or holes which may increase the radiation risk to wearers, as supported by this study. This study aims to improve the current quality equipment control protocols of our hospitals, as to come up with a consensus to determine the threshold value of maximum allowable size of damage of lead gowns that is safe for use in radiologic procedures.

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**Sedation-related Atelectasis in Children:**

**Comparison between Propofol and Dexmedetomidine**

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**Objectives:** To compare propofol and dexmedetomidine as a sedative in regard to occurrence of atelectasis and to investigate factors associated with atelectasis development in children imaged whole-body MRI under sedation.

**Methods & Materials:** Patients who underwent whole-body MRI under sedation with either propofol or dexmedetomidine, had American Society of Anesthesiologist Physical Status Classification I or II, and had available medical records including their medical history were included in this study. Development of atelectasis was visually and quantitatively assessed on coronal short tau inversion recovery (STIR) images of thoracic level obtained initially and lastly. To identify independent factors associated development of atelectasis, univariate and multivariate logistic regression analysis were performed.

**Results:** Atelectasis was frequently developed in patients sedated with propofol (n=28/59, 47.5%) than dexmedetomidine (n=6/34, 17.6%) on either initial or last images (p=.004). Additional oxygen supply during sedation was more frequently required in patients sedated with propofol (n=38/59, 64.4%) than dexmedetomidine (n=1/34, 2.9%) (p<.001). Among variables including type of sedatives, requirement of additional oxygen supply, and induction time, requirement of additional oxygen supply was the only significant factor that affecting atelectasis occurrence.

**Conclusions:** Compared to dexmedetomidine, propofol induced atelectasis more frequently by increasing requirement of additional oxygen supply in pediatric patients who imaged under sedation.
Create a medical diagnostic platform

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