Pediatr Radiol (2013) 43 (Suppl 3):S459–S656
DOI 10.1007/s00247-013-2675-4

ABSTRACTS

Founded in 1963
The European Society of Paediatric Radiology
50th Annual Meeting and 36th Postgraduate Course of the European Society of Paediatric Radiology

June 3–7 2013

Hotel Marriott Budapest

Budapest, Hungary

Table of contents

This supplement was not sponsored by outside commercial interests; it was funded entirely by the publisher.

Programme At A Glance

ESPR Budapest 2013, Programme at a Glance

Day	Location	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00
Monday 3 June			Chest		Coffee Break / Heart	Trauma	Lunch	Musculoskeletal		Coffee Break	Urogenital			
Tuesday 4 June			Gastrointestinal / Abdominal		Coffee Break / Neuroimaging I.		Lunch	Neuroimaging II.	Oncology	Coffee Break	Miscellaneous	Jesper Lecture	Jesper dinner	
Wednesday 5 June	Room A		ESPR Officers Meeting		Pediatric Radiology Journal Meeting	Opening Ceremony / Past into the future - 50 years of ESPR		Scientific Session 1. – Neuroradiology	Coffee Break	Scientific Session 2. – Chest / Cardiac			Welcome reception	
	Room B									Guerbet Symposium	Task Force 1: Neuroimaging			
Thursday 6 June	Room A		Scientific Session 3. – Interventional radiology	Scientific Session 4. – Oncology / Coffee Break	Scientific Session 5. – Genitourinary		Lunch	Gold Medalist, Honorary Member	Jacques Lefèbvre lecture	Coffee Break	Scientific Session 6. – Radiation Safety			Concert
	Room B				Task Force 2. Oncology						Task Force 3. Uroradiology			
Friday 7 June	Room A		Scientific Session 7. – Gastrointestinal	Coffee Break	Scientific Session 8. – Foetal/Neonatal		Lunch	Scientific Session 9. – Musculoskeletal		Coffee Break	Scientific Session 10. – Education / Miscellaneous	Close the Meeting and Call for Amsterdam		Annual Dinner
	Room B		Task Force 4. CT/Dose	Task Force 5. Child Abuse	Task Force 6. Research			Covidien Symposium			Task Force 7. Musculoskeletal			

General Information—European Society of Paediatric Radiology

Officers 2012–2013

President	Eva Kis (Budapest, Hungary)
Past President	Maria I. Argyropoulou (Ioannina, Greece)
1st Vice President	Rutger A.J. Nievelstein (Utrecht, Netherlands)
2nd Vice President	Michael Riccabona (Graz, Austria)
3rd Vice President	Karen Rosendahl (Bergen, Norway)
General Secretary	Catherine M. Owens (London, United Kingdom)
Treasurer	Catherine Adamsbaum (Paris, France)
Counsellor for Northern Europe	Karen Rosendahl (Bergen, Norway)
Counsellor for Southern Europe	Maria A. Argyropoulou (Ioannina, Greece)
Pediatric Radiology Managing Editor	Guy Sebag (Paris, France)
JESPeR delegate	Samuel Stafrace (Aberdeen, UK)
Webmaster	Rick Van Rijn (Amsterdam, Netherlands)
Head of Education Committee	Jean-François Chateil (Bordeaux, France)
Secretariat	Catherine M. Owens Department of Radiology Great Ormond Street Hospital for Sick Children Great Ormond Street, London, WC1N 3JH, UK
ESPR Executive Assistant	E mail: espr-office@espr.org

Honorary members of the Society

1964 John Caffey (USA)
1964 Lutz Schall (Germany)
1965 Sven R. Kjelberg (Sweden)
1965 Edward B. D. Neuhauser (USA)
1966 Jacques Lefebvre (France)
1973 Hardy M. Geffert (Hungary)
1973 Ksawery Rowinsky (Poland)
1974 Frederic Silverman (USA)
1975 Ulf G. Rudhe (Sweden)
1979 John Kirkpatrick (USA)
1979 Arnold Lassrich (Germany)
1979 Jacques Sauvegrain (France)
1982 Clement Fauré (France)
1982 Andes Giedion (Switzerland)
1983 Eberhard Willich (Germany)
1984 Roy Astley (England)
1987 Jean Bennet (France)
1987 Ole Eklof (Sweden)
1987 Charles A. Gooding (USA)
1987 John Holt (USA)
1987 Andrew Poznanski (USA)
1987 D.C. Harwood-Nash (USA)
1987 Hooshang Taybi (USA)
1988 Herbert Kaufmann (Germany)
1989 Bryan Cremin (South Africa)
1989 Klaus D. Ebel (Germany)
1989 Helmut Fendel (Germany)
1989 Elizabeth Sweet (Scotland)
1990 Donald Kirks (USA)
1991 Alan Chrispin (England)
1991 Edmund Franken (USA)
1991 Daniel Nussle (Switzerland)
1991 Beverly Wood (USA)
1992 Walter Berdon (USA)
1993 Javier Lucaya (Spain)
1993 Wilhelm Holthusen (Germany)
1994 Noemie Perlmutter (Belgium)
1994 Hans Ringertz (Sweden)
1994 Donald Shaw (England)
1996 Robert Lebowitz (USA)
1996 Bela Lombay (Hungary)
1997 Yan Briand (France)
1997 Philip Small (England)
1997 N. Thorne Griscom (USA)
1998 Alan Daneman (Canada)
1998 Gabriel Kalifa (France)
1999 Michael Grunebaum (Israel)
2000 Paul Thomas (Ireland)
2000 Noel Blake (Ireland)
2000 Peter Kramer (Netherlands)
2000 Gunnar Stake (Norway)
2001 Janet Strife (USA)

2001 Robert Brasch (USA)
2001 Max Hassan (France)
2001 Yacob Bar-Ziv (Israel)
2002 Sven Laurin (Sweden)
2003 Aldo Pelizza (Italy)
2003 Giampiero Beluffi (Italy)
2003 Helen Carty (England)
2003 Bruce Parker (USA)
2004 Christine Hall (England)
2004 Andrzej Marcinski (Poland)
2005 Ulrich Willi (Switerland)
2005 Jean-Philippe Montagne (France)
2005 Giuseppe Farielo (Italy)
2006 Francis Brunelle (France)
2006 Laurent Garel (Canada)
2006 Morteza Meradji (Netherlands)
2006 Alan E. Oestreich (USA)
2007 Marianne Spehl (Belgium)
2007 Gabriel Benz-Bohm (Germany)
2007 Pedro Daltro (Brazil)
2007 Richard Fotter (Austria)
2008 Jose Fonseca-Santos (Portugal)
2008 Ingmar Gassner (Austria)
2008 Tom Slovis (USA)
2008 Rita Teele (New Zealand)
2009 Reinhart Schumacher (Germany)
2009 Nicholas Gourtsoyiannis (Greece)
2009 Ines Boechat (USA)
2009 Steve Chapman (United Kingdom)
2009 Jochen Troeger (Germany)
2010 Ernst Richter (Germany)
2010 Veronica Donoghue (Ireland)
2010 Freddy Avni (Belgium)
2010 François Diard (France)
2010 Paola Toma (Italy)
2011 Rose de Bruyn (United Kingdom)
2011 Goya Enriquez (Spain)
2011 Cristian Garcia (Chile)
2011 Paul Kleinman (USA)
2011 George Tayor (USA)
2012 Corinne Veyrac (France)

Gold Medalists

2007 Javier Lucaya
2008 Gabriel Kalifa
2010 Ulrich Willi
2011 Richard Fotter
2012 Francis Brunelle

Jacques Lefebvre Awards

1977 Ringertz H. (Sweden)	The width of cranial sutures in neonates: an objective method of assessment
1978 Garel L. (France)	Xanthogranulomatous pyelonephritis in children: 19 cases
1979 Brauner M. (France)	Metrizamide myelography in infants with brain injury to the brachial plexus
1980 Spehl-Robberech M. (Belgium)	Ultrasonic study of the pancreas in cystic fibrosis
1981 Garel L. (France)	The renal sinus: an important anatomical landmark in children
1982 Couture A. (France)	Ultrasonographic exploration of cerebral malformations
1983 Brunelle F. (France)	Percutaneous cholecystography in children
1984 Veyrac C. (France)	Ultrasound of normal and pathologic choroid plexus
1985 Avni F. (Belgium)	Ultrasonic demonstration of abnormal and atypical gallbladder content in newborns
1986 Pariente D. (France)	Biliary tract involvement in children with Langerhans cell Histiocytosis
1987 Sellier N. (France)	Focal cortical dysplasia: a rare cause of epilepsy
1988 Deeg K. H. (Germany)	Pulsed Doppler sonographic measurement of normal values for the flow velocities in cerebral arteries of healthy infants
1989 Winkler P. (Germany)	Major pitfalls in the Doppler examination of cerebral vascular system
1990 Garel C. (France)	Laryngeal ultrasonographic study in infants and children. Pathological findings
1991 Pracros J. P. (France)	Systemic study of superior mesenteric vessels in abdominal ultrasound
1992 Hollman A. (UK)	Colour Doppler imaging of the acute paediatric scrotum
1993 Chami M. (France)	Ultrasound contribution in the analysis of the newborn infant normal foot and club foot: preliminary study
1994 Adamsbaum C. (France)	Vermian agenesis without posterior fossa cyst
1995 Sebag G. (France)	Magnetic resonance angiography of paediatric renal transplants with quantification of allograft blood flow
1996 Rohrschneider W. (Germany)	US, CT and MR imaging. Characteristics in nephroblastomatosis: evaluation of 23 Patients

1997 Hertz-Pannier L. (France)	Non-invasive preoperative motor mapping in children with brain functional MRI
1998 Nicaise N. (Belgium)	Dynamic Gd-DTPA-enhanced T1W turbo field echo imaging: Interest in paediatric renal evaluation
1999 Rypens F. (Belgium)	Fetal lung volume estimation by MRI: normal values and potential use
2000 Ziereisen F. (Belgium)	Doppler assessment of pulsatility index (PI) of the uterine artery in girls around puberty
2001 Lidegran M.K (Sweden)	MRI and echocardiography in assessment of ventricular function in atrially corrected transposition of the great arteries
2002 Cassart M. (Belgium)	The assessment of fetal uronephropathies by MR imaging
2003 Boddaert N. (France)	18F-Fluoro-L-Dopa PET scan of focal forms of hyerinsulinism of infancy
2004 Jourdan C. (Germany)	US evaluation of intima-media thickness (IMT) and elastic properties distensibility, stiffness and incremental modulus of elasticity of the common carotid artery as a marker of early vascular damage in children with chronic renal failure and reference values
2005 Kellenberger C.J. (Switzerland)	Cardiovascular MRI for investigating Newborns and Infants with Congenital Heart Disease
2006 Phalla O. (France)	Detection of coronary complications after arterial switch operation for transposition of the great arteries: first experience with 65-slice CT in children
2007 Sporcq C. (Belgium)	Reappraisal of the sonographic characteristics of the fetal and newborn kidney: introducing the cortico-medullary ratio
2008 Damasio M. B. (Italy)	Which is the best imaging modality to capture bone erosions in juvenile idiopathic arthritis?
2009 McDonald K. (UK)	DWI to assess chemotherapy response in solid tumors
2010 Ording-Müller L.S. (Norway)	Development of the wrist. Normal standards based on MRI for 6–15 year old
2011 Duran C. (Spain)	Voiding urosonography: normal and abnormal appearance of the urethra
2012 Vazquez J. (Spain)	External manual reduction with US assistance: a new procedure for pediatric idiopathic ileocolic intussuseption

Poster Awards

1994 Gomes H. (France)	Neonatal hip sonography from anatomy to sonography
1995 Schmit P. (France)	Imaging of cystic mesenchymal hamartomas of the liver. Review of 13 patients
1997 Schmit P. (France)	Congenital hepatic vascular malformations in children
1998 Brisse H. (France)	In utero MRI. Normal gyral development of the human brain
2000 Valle M. (Italy)	High-frequency ultrasound detection of the brachial plexus in newborns and infants
2001 Rohrschneider W. K (Germany)	Static dynamic MR-urography—simultaneous morphological and functional evaluation of the urinary tract
2002 Owens C.M (UK)	The utility of MRI in the assessment of symptomatic adenoidal hypertrophy and rhinosinusitis in children. pre and post medical therapy
2003 Schumacher R. (Germany)	Sonographical anatomy of the anal sphincter complex (ASC) and levator ani muscle in neonates and infants
2004 Mentzel H.-J. (Germany)	Comparison of whole body STIR MRI and ^{99m}Tc-methylene diphosphonate scintigraphy in the examination of children with suspected multifocal bone lesions

2005 Enriquez G (Spain)	Prenatal assessment of lung hypoplasia in congenital diaphragmatic hernia: correlation between volumetric MRI and biometric ultrasound measurements
2006 de Maupeou F. (France)	Whole body imaging in malignant bone tumours in children: preliminary results
2007 Punwani S. (UK)	Effects of reducing radiation dose on lung nodule detection
2008 Chateil J.-F. (France)	Imaging of acquired spinal cord lesions and spinal canal pathology in children
2009 Barez MG. (Spain)	Spectrum of imaging findings in the brachial apparatus anomalies
2010 Brun M. (France)	Diffusion tension imaging in attention deficit disorders in children treated for posterior fossa tumours: preliminary results
2011 Fonda C. (Italy)	3T arterial spin labelling (ASL) in pediatric patients
2012 Arthurs O. (UK)	Diffusion weighted MRI of the fetal brain in intrauterine growth restriction

Young Researcher Awards

2003 Brun M. (France)	Phonological Decoding in Dyslexic Children: Activation Pattern of FMRI
2004 Barnacle A.B (UK)	Image-guided percutaneous biopsy of soft tissue masses in children
2005 Raissiki M. (Greece)	Eye-lens Bismuth Shielding in Pediatric Head CT Examinations
2006 Sorge I. (Germany)	Reduction of radiotherapy in children with early stages of Hodgkin's lymphoma, influenced by a new imaging and FDG-PET based strategy
2007 Alison M. (France)	In vivo targeting of macrophagic activity with MRI contrast agent (USPIO) in an experimental model of neonatal brain lesions
2008 Herrmann J (Germany)	Capsular arterial collateralisation after paediatric liver transplantation
2010 Arthurs O. (UK)	MR Voiding cystourethrography for vesico-ureteric reflux in unsedated infants
2011 Gupta N (UK)	Predictors of vesicoureteric reflux in infants with UTI using NICE criteria
2012 Laborie L. B. (Norway)	Associations between femoroacetabular impingement and hip dysplasia as demonstrated radiographically. Preliminary results

President's Awards

2004 Kilian A.K. (Germany)	Prenatal magnetic resonance (MR) lung volumetry of congenital diaphragmatic hernia (CDH): comparison with the clinical outcome and the necessity of extracorporeal membrane oxygenation (ECMO)
2005 Larke A. (Ireland)	MRI findings as an indication of underlying genetic lesions in congenital malformations of the brain
2007 Duran C. (Spain)	Voiding cystosonography for the study of the urethra
2008 Calder A. (UK)	Computed tomography compared with ultrasound and chest radiography in children with pleural empyema
2009 Senocak E. (Turkey)	MRI and DWI findings in children with hemophagocytic lymphohistiocytosis: tendency for symmetricity
2010 Franchi-Abella S. (France)	Congenital portosystemic shunt: complications and outcome after closure: about 19 pediatric cases
2011 Punwani S. (UK)	MRI vs. PET/CT for detection of focal splenic lesions in paediatric and adolescent lymphoma at initial staging
2012 Xenophontos P. (Greece)	Detection of primary sclerosing cholangitis (PSC)-type lesions in children with inflammatory bowel disease via MRCP: a relative risk measures analysis

Past Presidents and Meeting Sites

1964 Jacques Lefebvre, Paris, France
1965 Ulf Rudhe, Stockholm. Sweden
1966 John Sutcliffe, London, England
1967 Herbert Kaufmann, Basel, Switzerland
1968 Arnold Lassrich, Hamburg, Germany
1969 Ksawery Rowinsky, Warsaw, Poland
1970 Guido Lannacone, Rome, Italy
1971 Gregers Rhomsen, Copenhagen, Denmark
1972 Jacques Sauvegrain, Paris, France
1973 Roy Astley, Birmingham, UK
1974 Per-Erik Heikel, Helsinki, Finland
1975 Klaus Knapp, Madrid, Spain
1976 Ole Eklof, Stockholm, Sweden
1977 Andreas Geidion, Lucerne, Switzerland
1978 Noemi Perlemutter-Cremer, Brussels, Belgium
1979 Klaus Dieter Ebel, Koln, Germany
1980 The Dutch Group of Paediatric Radiologists, The Hague, Netherlands
1981 Gunnar Stake, Oslo, Norway
1982 Antonin Rubin, Prague, Czechoslovakia
1983 Clement Fauré, Paris, France
1984 Gianfranco Vichi, Florence, Italy
1985 Elizabeth Sweet, Glasgow, Scotland
1986 Javier Lucaya, Barcelona, Spain
1987 Denis Lallemand (ESPR) and Derek Harwood-Nash (SPR), Toronto, Canada
1988 Daniel Nussle, Montreux, Switzerland
1989 Noel Blake, Dublin, Ireland
1990 Hlemut Fendel, Munich, Germany
1991 Hans Ringertz (ESPR) and Donald Kirks (SPR), Stockholm, Sweden
1992 Bela Lombay, Budapest, Hungary
1993 Donald Shaw, London, UK
1994 Fred Avni, Brussels, Belgium
1995 Peter Kramer, Utrecht, Netherlands
1996 Paul Thomas (ESPR) and Kenneth Fellows (SPR), Boston, USA
1997 Ulrich Willi, Lugano, Switzerland
1998 Basilos Theodoropoulos, Rhodes, Greece
1999 Jacob Bar-Ziv and Gabriel Kalifa, Jerusalem, Israel
2000 Jose Fonseca Santos, Lisbon, Portugal
2001 Francis Brunelle (ESPR) and Janet Strife (SPR), Paris, France
2002 Tore Nordhus, Bergen, Norway
2003 Paolo Tomà, Genoa, Italy
2004 Jochen Troeger, Heidelberg, Germany
2005 Veronica Donoghue, Dublin, Ireland
2006 Richard Fotter (ESPR) and George Taylor (SPR), Montreal, Canada
2007 Goya Enriquez, Barcelona, Spain
2008 Stephen Chapman, Edinburgh, UK
2009 Mithat Haliloglu, Istanbul, Turkey
2010 Jean-François Chateil, Bordeaux, France
2011 Catherine M. Owens (ESPR) and Dorothy Bulas (SPR), London, United Kingdom
2012 Maria I. Argyropoulou, Ioannina, Greece

Future ESPR Meeting

2014 Amsterdam, The Netherlands, June 2–6

Future SPR Meetings

2013 San Antonio, Texas, May 14–18
2014 Washington, DC, May 13–17
2015 Seattle, Washington, April 27–May 1

European Courses of Paediatric Radiology (ECPR)

1992 F. Brunelle, Biarritz, France
1993 P. Tomà, Genoa, Italy
1994 G. Enriquez, Barcelona, Spain
1995 C. Raybaud, Marseille, France
1996 G. Benz-Bohm, Koln, Germany
1997 H. Carty, Liverpool, UK
1998 C. Adamsbaum, G. Sebag, Montpellier, France
1999 P. Tortori-Donati, Genoa, Italy
2000 R. Fotter, Graz, Austria
2001 S. Laurin, Lund, Sweden
2002 B. Lombay, Budapest, Hungary
2003 E. Martin-Fiori, T Huisman, Zurich, Switzerland
2004 T. Berrocal, Madrid, Spain
2005 M. Spehl, C. Christophe, Brussels, Belgium
2006 J.-N. Dacher, Rouen, France
2007 R. Schumacher, Mainz, Germany
2008 K. Chong, London, UK
2009 R. R. van Rijn, A. Smets & E. Deurloo, Netherlands
2010 C. Fonda, Firenze, Italy
2011 I. Barber, Spain
2012 H-J. Mentzel, Jena, Germany

European Courses of Paediatric Neuroradiology (ECPNR)

Course run jointly by the ESPR, the ESNR and the ESMNR

2011 M. Argyropolou (ESPR), Andréa Rossi (ESNR), Nadine Girard (ESMRN)
2013 Andrea Rossi (ESNR), Maria I Argyropoulou (ESPR) Nadine Girard (ESMRN)

Curricula vitae of Gold Medal award recipient, Honorary Member and Jacques Lefebvre lecturer

ESPR 2013 Gold Medal Award

Professor Ephraim (Freddy) Avni

It is with great pleasure and pride that we celebrate the career of Professor Ephraim (Freddy) Avni, awarding him the Gold Medal of the ESPR, 2013.

Prof Avni was born in 1951 in Israël and moved to Belgium in 1959.

He studied for and was awarded his medical degree (MD) at the "Université Libre de Bruxelles (ULB)" in 1976.

He began his training in Radiology in Brussels, but also ventured to train in Paediatric Radiology in Paris at "Enfants Malades" with Prof J Sauvegrain, then to Boston Children' Hospital, Harvard Medical School as a fellow in 1980, under the supervision of Dr John Kirkpatrick.

Prof Avni returned home to become Chief and Professor of Radiology at the Department of Medical Imaging, Erasme Hospital, ULB, Brussels, Belgium.

Prof Avni's intellectual curiosity and prowess led him to study further and he was awarded his PhD in 1992, again at ULB: entitled 'The contribution of obstetrical US for the evaluation, understanding and treatment of selected fetal diseases'

He went on to become very actively involved within the society from his first ESPR meeting in Brussels in 1978 becoming Treasurer General Secretary and President of ESPR (and annual meeting organizer) in1994.

Official responsibilities within the Radiological Societies

Treasurer ESPR 1995–1999

General secretary ESPR 1999–2008

General Secretary RBSR 2004–2012

Chairman Subspecialty Committee (ESR) 2009–2011

Awards, accolades and memberships

J Lefebvre award 1985

Pioneer Award SPR 2001.

Honorary member French Radiological Society 2009.

Honorary member ESPR 2010

General Secretary (French Speaking) of the Royal Belgian Society of Radiology.

Member of the Executive Council of the European Society of Radiology.

Member of ESUR, ESR, RSNA, SFR, ESGAR.

Corresponding member SPR, SUR.

He is currently working in positions in Brussels (Erasme University hospital, Queen Fabiola Childrens' Hospital) and Lille (Senior Consultant, Department of Pediatric Radiology Jeanne de Flandre Mother and Child Hospital, University of Lille)

Prof Avni's contribution to visionary leadership, teaching and education is legendary. His particular area of interest is within foetal imaging and paediatric urinary tract imaging, where he is an internationally renowned and iconic leader in his field.

He has published over 150 peer-reviewed publications, 2 books and 25 book chapters. He is a reviewer for 8 international journals.

However those who are lucky enough to know 'Freddy' will understand that the written word alone cannot encapsulate the essence of his persona.

His sharp, incisive brain, his unfathomable wisdom, wit and his perspicacity are invaluable and unique. When combined with his energy and focus the mélange is unique and "c'est Freddy".

His love and dedication to his family is tangible i.e. his wife Jacqueline (Lussan) of 23 years, and his 3 children: Sarah (23), Fanny (22) and Nathan (20) who all share his passion for travelling, photography, friends, movies, skiing, and each other.

We are all richer for having had the skill, knowledge and brilliance of Prof Ephraim (Freddy) Avni as a leader, teacher, friend and mentor. We (his extended family) applaud and congratulate him for his tireless dedication to paediatric radiology.

Dr C M Owens

ESPR 2013 Honorary Member

Danièle Pariente (France)

Danièle PARIENTE fell in love with paediatric radiology when she was a young medical student working with Professor Jacques Sauvegrain in Paris.

In 1981 she spent a year as visiting Professor in Sacramento University California within Pediatric Radiology and then became a full time staff radiologist in 1982 at Bicêtre Hospital Paris, under the expert tuition and mentorship of Dr Pierre CHAUMONT. They had a wonderful working relationship and still are in contact professionally and socially to date.

Daniele became Head of department of pediatric radiology in 1990 after Pierre Chaumont retired and was one of the first female heads of department in the Paris Assistance Publique.

Daniele is well known and highly respected all over the world as an expert in Interventional paediatric radiology, particularly for hepatobiliary diseases, including diagnostic and interventional radiological management of the complications of liver transplantation.

She is a member of

- French Society of Radiology (SFR)
- ESPR
- French Sty of Pediatric and prenatal imaging (SFIPP)
- Associated member for SPR
- French abdominal imaging sty (SIAD)
- College of Medicine
- College of French radiologic teachers (CERF)
- She is on the Editorial board of Pediatric Radiology
- Expert panel for reading liver tumors (International Childhood Liver Tumor Strategy, SIOPEL)
- She has numerous publications in French and in English (pedagogic and scientific)

Bicêtre is the French national reference centre for biliary atresia and the premiere centre within France for liver transplantation, with a vast international referral base.

Daniele has a passionate involvement in teaching, and is much beloved by all of her students, fellows and colleagues. Her modesty belies a deep and brilliant understanding and command of her chosen area of expertise and she is a generous and talented teacher, with kindness and patience in abundance.

In 1999, with Daniele at the helm, Bicetre paediatric radiology department was awarded a special medal for “Quality in Assistance Publique de Paris”.

In 2010 Danièle coordinated the very happy merger of the Saint Vincent de Paul radiology team to join Bicetre, when governmental closures rationalized radiology service in Paris. Thanks to Daniele’s diplomacy and tact the ‘marriage’ is a great success and the department has increased in size with harmony.

Danièle has recently decided to step down as head of department to spend more time with her much beloved family, her husband Jean-Philippe and 2 teenagers, Guillaume (19 years old) and Louise (15).

She is a devoted mother and wife and her energy and passion extend outside medicine with her love of culture and knowledge of classical music and opera. This is shared with her family.

Moreover she is also very dexterous and can repair almost everything in the radiology department from computers to the coffee machines!

Daniele has outstanding integrity, is renown for her talent, kindness, simplicity and modesty. One of her close co-workers describes her as ‘a delicious colleague, indeed’.

She loves life and loves it to the full including: cooking, piano, tennis, ski, travels, museum and the arts.

In 2012 Danièle Pariente received the “Légion d’Honneur” (one of the highest accolades in France) in recognition of her lifetime of devotion to children.

We join her family, her radiology team and hospital to acknowledge and celebrate her lifetime of clinical commitment and excellence by awarding her honorary membership of the ESPR.

Dr C M Owens

2013 Jacques Lefebvre Lecturer

Istvan Seri MD, PHD, HOND

Dr. Seri obtained his MD (1976) and PhD (1985) in Budapest, Hungary at Semmelweis University School of Medicine and the Hungarian Academy of Sciences, respectively. He completed his clinical training in pediatrics and neonatology at Semmelweis University and his basic and clinical research training in developmental physiology, and renal cellular physiology and neonatology at the Karolinska Institute in Stockholm, Sweden (1984–86) and at Harvard Medical School, Boston, MA (1986–91), respectively. In 1991, Dr. Seri joined the faculty of the Joint Program in Neonatology at Harvard Medical School. In 1994, he was recruited to the Children's Hospital of Philadelphia (CHOP) and the University of Pennsylvania where he served as the Clinical Director of Newborn Services and, in 2001, as the Associate Division Chief. Later in 2001, he moved to the Children's Hospital Los Angeles (CHLA) and the University of Southern California (USC) as Professor of Pediatrics and the Chief of the USC Division of Neonatal Medicine at Children's Hospital Los Angeles and LAC+USC Medical Center.

Since his arrival at CHLA and USC, Dr. Seri has overseen the expansion of the USC Division of Neonatal Medicine and the establishment of the Institute of Maternal-Fetal Health (IMFH). In 2006, Dr. Seri became the Director of the newly formed "Center of Fetal and Neonatal Medicine" at CHLA incorporating the Division of Neonatology with its academic neonatal network and the IMFH into one multidisciplinary center.

As for his teaching activities, Dr. Seri has been involved in graduate and postgraduate medical education and received numerous awards including the "Semmelweis Award' from Semmelweis Medical School (1998), the "Faculty Teacher of the Year Award' from CHOP (2000), the "Blockley-Osler Award for Excellence in Teaching Modern Clinical Medicine' from the University of Pennsylvania School of Medicine (2000), the "Neonatal Faculty Teaching Award' from the University of Pennsylvania School of Medicine and CHOP (2001), the "Philip E. Rothman Memorial Award for Excellence in Pediatric Resident Education, Guidance and Inspiration' from CHLA (2004), the R.H. Paul Award for Contribution to OB/MFM Resident, Fellow and Staff Education from the USC Division of MFM (2007), and the "3rd Annual Sophie Womack Lectureship Award' for contribution to the lectureship series at Wayne State University School of Medicine; Detroit, MI (2011). In 2001, upon Dr. Seri's departure from CHOP and the University of Pennsylvania, the "Istvan Seri Faculty Teaching Award in Neonatology' for the Department of Pediatrics and Division of Neonatology at CHOP and the University of Pennsylvania was established. Dr. Seri also received an Honorary Doctorate Degree ("Doctor Honoris Causa') from Semmelweis University, Budapest, Hungary in 2004, the Robert M. McAllister Faculty Mentoring Award for Excellence in Mentoring Junior Faculty from the Department of Pediatrics at CHLA and the Keck School of Medicine, USC, Los Angeles, CA in 2007, and the "Virginia Apgar Award' for contribution to advances in the field of Perinatology and OB-Anesthesiology in Hungary from the Hungarian Perinatal and OB-Anesthesiology Society, Budapest, Hungary in 2010. In collaboration with the Viterbi School of Engineering of USC and the Department of Radiology at CHLA, Dr. Seri also established a PhD training program with 3 positions in bioengineering in the Center of Fetal and Neonatal Medicine in 2008.

Dr. Seri's basic and clinical research activities have focused on the developmental regulation of cardiovascular and renal function and sodium-potassium ATPase, the pathophysiology and treatment of neonatal shock and, more recently, the use of functional echocardiography and novel non-invasive bedside hemodynamic monitoring approaches such as electrical impedance cardiometry, near infrared spectroscopy and Laser Doppler technology in research and neonatal critical care. He has received several awards to support his research activities from the NIH and other funding agencies. Dr. Seri has published over 130 peer-reviewed scientific

publications, editorials, and chapters and is the co-editor of the "Neonatal Hemodynamics and Cardiology' book published in 2008 with the second edition to be published in 2012. He has been a member or chair of boards of several national and international committees and scientific organizing committees and has served on different NIH study sections. He is a fellow of the American Academy of Pediatrics and a member of the Society of Pediatric Research, the Pediatric Academic Society, and the Subsection on Perinatal Pediatrics of the American Academy of Pediatrics. Dr. Seri has been an invited speaker at over 200 national and international meetings and postgraduate courses in the US and abroad. He has been a member of the organizing committee of the "Evidence vs. Experience in Neonatology' annual international conference from 2004 to 2008. Dr. Seri also established the Neonatal Hemodynamics Club at the PAS/SPR in 2004 and has been the chair of the club since its inception. He is the director for the Developmental Hemodynamics Course of the IPOKRaTES international organization of postgraduate medical education and has been serving on editorial boards and as invited reviewer of a number of peer-review specialty journals. As for his status in the research community, Dr. Seri is considered an expert in the field of developmental cardiovascular physiology in general and neonatal hemodynamics and neonatal shock in particular.

Congress Organisation

President
Éva Kis

Secretary
Ildikó Várkonyi

Scientific Committee
György Balázs
Péter Barsi
Katalin Bártfai
Attila Doros
Tamás Györke
Zoltán Harkányi
Zoltán Karádi
Béla Lombay
Gabriella Mohay
András Palkó
Gábor Rudas
István Szikora
Attila Tóth

Organising Committee
Éva Kis
Ildikó Várkonyi
Zsombor Papp – Convention Budapest Ltd.

Conference Secretariat
Convention Budapest Ltd.
H-1461 Budapest, P.O. Box 11.
Phone: + 36 1 299 01 84, -85, -86
Fax: + 36 1 299 01 87
E-mail: zspapp@convention.hu

The organizers acknowledge the support of the following organisations
Covidien
Guerbet
Bayer HealthCare
Toshiba Medical Systems
Philips
AGFA
Hitachi Medical Sytems Europe/Hitachi Aloka
Esaote
Siemens
GE Healthcare
Hungarian Radiologist Society
LMT Lammers Medical Technology GmbH
Euromedic Diagnosztika
GE Healthcare - Radizone Diagnost - X Kft.
Silver Wood -IT Ltd.
Carestream
BioMarin Europe Ltd.

This supplement was not sponsored by outside commercial interests; it was funded entirely by the publisher.

Dear Colleagues, dear Friends,

We are honoured and pleased to have you all in Budapest, Hungary to the 50th Anniversary Congress and 36th Postgraduate Course of the European Society of Pediatric Radiology in June 3–7, 2013. The meeting venue is the 5-star Marriott Hotel, which stands in the centre of Budapest metropolitan life, and is the sole hotel in the area offering spectacular views of the Danube river.

It has already been a tradition that ESPR congresses represent high standard of knowledge transfer with a very friendly atmosphere. The postgraduate course will take place on June 3–4. We are very grateful to the international speakers who accepted our invitation to give these lectures. As they are all experts in pediatric radiology and especially in the topics they are going to present we are expecting very instructive lectures.

Up-to-date lectures on chest and heart, gastrointestinal, urogenital, musculoskeletal, oncology, neuroimaging, trauma and ongoing development of imaging methods will be presented.

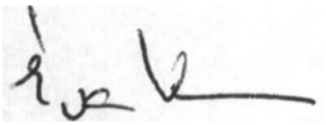
The 2-day course will be followed by the 3-day 50th Annual ESPR Meeting with lectures and posters on all field of pediatric radiology. Concurrent task forces on uroradiology, child abuse, oncology, neuro, radiation dose and hip ensure that there is something on the programme for everyone.

To encourage participation of young pediatric radiologist at the meeting ESPR provides grants for them.

Budapest is a one of the most beautiful cities of Europe with banks of the Danube, the Buda Castle Quarter, Andrássy Avenue, Heroes' Square and the Millennium Underground Railway, the second oldest in the world and the world's largest thermal water cave system.

The weather in June is pleasant, the temperature is about 20 C, but higher is not uncommon at this time of the year, rain of course is possible.

A marvelous social programme is planned, including a welcome reception at the Marriott Hotel, a concert at the Downtown Parish Church and a gala dinner : boat cruise along the majestic Danube.
On behalf of the organizing committee of the meeting welcome and enjoy the beautiful historic town of Budapest!



Eva Kis
President ESPR 2013

ESPR 2013, Budapest 36th POSTGRADUATE COURSE June 3th–June 4th

Monday 3 June
09:00–11:00 CHEST
Chaired by: *Veronica Donoghue*

09:00–09:30 Imaging of neonatal chest emergencies (non-surgical)
Veronica Donoghue
09:30–10:00 MRI of lungs in children
Wolfgang Hirsch
10:00–10:30 Thoracic developmental anomalies of the newborn and infant
György Balázs
10:30–11:00 Imaging the small airways in children how why and when?
Catherine Owens

11:00–11:30 Coffee Break
11:30–12:00 HEART
Chaired by: *Catherine Owens*

11:30–12:00 Neonatal heart diseases - MRI or CT?
Christian Kellenberger

12:00–13:00 TRAUMA
Chaired by: *Paul Kleinman*

12:00–12:30 Rib injuries: mechanisms and imaging challenges
Paul Kleinman
12:30–13:00 Imaging of sport injuries
Miguel Rasero Ponferrada

13:00–14:30 Lunch
14:30–16:00 MUSCULOSKELETAL
Chaired by: *Guy Sebag*

14:30–15:00 MRI of bone marrow
Lil-Sofie Ording-Müller
15:00–15:30 Soft tissue tumors and tumorlike lesions
Philippe Petit
15:30–16:00 Whole body imaging and DWI in pediatric skeletal disorders
Guy Sebag, Marianne Alison

16:00–16:30 Coffee Break
16:30–18:00 UROGENITAL
Chaired by: *Fred Avni*

16:30–17:00 Congenital nephrotic syndromes—an update
Fred Avni
17:00–17:30 Imaging of the neonatal female pelvis
Michael Riccabona
17:30–18:00 Imaging of fetal uropathies
Marie Cassart

Tuesday 4 June
08:30–10:30 GASTROINTESTINAL/ABDOMINAL
Chaired by: *Alan Daneman*

08:30–09:00 The relationship of US and contrast exams of the GIT in evaluation of the vomiting infant.
Alan Daneman

09:00–09:30 Sonography of hepatic vascular disorders: diagnosis and long term follow up
Zoltán Harkányi
09:30–10:00 MRI of the GI tract/MRCP
Gábor Rudas
10:00–10:30 Anorectal malformations—a systematic approach
Simon Robben

10:30–11:00 Coffee Break
11:00–12:30 NEUROIMAGING I.
Chaired by: *Jean-François Chateil*

11:00–11.30 The different faces of epilepsy in childhood
Péter Barsi
11:30–12:00 Phakomatosis
Jaques Schneider
12:00–12:30 Pericerebral spaces, acute and chronic subdural collections
Jean-François Chateil

12:30–14:00 Lunch
14:00–15:00 NEUROIMAGING II.
Chaired by: *Andrea Rossi*

14:00–14:30 Systematic approach to inherited white matter diseases in children
Andrea Rossi
14:30–15:00 Imaging of Inflammation, Infection and Tumours from the Intradural Spaces to the Spinal Cord
Maria Argyropoulou

15:00–16:00 ONCOLOGY
Chaired by: *George Taylor*

15:00–15:30 Posttransplantation Lymphoproliferative Disease (PTLD)
Oystein Olsen
15:30–16:00 Complications in oncology
George Taylor

16:00–16:30 Coffee Break
16:30–17:30 MISCELLANEOUS
Chaired by: *Karen Rosendahl*

16:30–17:00 Paediatric MRI-safety revisited
Karen Rosendahl
17:00–17:30 Contrast-enhanced ultrasound in children: where do we stand and where should we go?
Kassa Darge

17:35–18:10 JESPER LECTURE
Chaired by: *Sam Stafrace*

17:35–18:10 Pediatric multiple sclerosis, ADEM, and other demyelinating diseases: where do we stand?
Andrea Rossi

36th Postgraduate Course Presentations

Imaging of Neonatal Medical Chest Emergencies

Veronica Donoghue
Radiology Department, Temple St. Children's University Hospital, Dublin 1, Ireland

The medical conditions which cause newborn respiratory distress largely relate to the gestational age of the infant. The chest radiograph remains the most common and most useful imaging tool in the diagnosis of conditions which contribute to respiratory distress in the newborn period, in particular those which cause lung parenchymal disease. A detailed clinical history should be obtained prior to interpretation. Ultrasonography and occasionally CT may also be necessary for further evaluation.

In the premature infant the commonest abnormality is **hyaline membrane disease**, a deficiency of the lipoprotein surfactant superimposed on structural immaturity of the lungs. Prenatal steroid administration to mothers during the 2 days prior to delivery significantly reduces the incidence of the disease in premature infants. The clinical use of artificial surfactant is also a very important recent therapeutic advance. The lungs in smaller infants, although becoming clear with surfactant therapy are very immature with fewer alveoli than normal, leading to inadequate gas exchange and the need for prolonged ventilation.

Although the initial radiographic findings may be noted shortly after birth, occasionally the maximum findings are not present until 6–24 h of life. Prior to commencement of assisted ventilation, typically the radiographic findings are those of underaeration of the lungs with fine granular opacification and air bronchograms which are diffuse and symmetrical. This is due to collapsed alveoli with distended terminal bronchioles and alveolar ducts. When distension is very poor there is more generalised opacification and a frank whiteout of the lungs. Very small infants less than 26 weeks gestation may have clear lungs initially or mild perihilar haziness. Their lungs are biochemically and structurally immature and require prolonged ventilatory support.

Despite the therapeutic advances and improvements in ventilation complications of therapy arise, particularly in the very premature infants.

A patent ductus arteriosus is common in premature infants and is thought to contribute to the lung disease.

Positive pressure ventilation in these premature infants is the most common cause of complications such as pneumothorax, pneumomediastinum, pnuemopericardium, and pulmonary interstitial emphysema. These air leaks are less common since the more routine use of artificial surfactant and high frequency ventilation.

Focal atelectasis, due to tube malposition of the endotracheal tube, poor clearance of secretions or mucous plugging is also a common complication of surfactant deficiency.

Pulmonary haemorrhage may also develop in infants with hyaline membrane disease secondary to severe hypoxia and capillary damage.

Bronchopulmonary dysplasia (BPD) or chronic lung disease, described by Northway in 1967, is a long-term consequence of neonatal lung disease. It occurs most commonly after treatment for hyaline membrane disease with mechanical ventilation but may occur following any lung condition which leads to prolonged oxygen therapy and mechanical ventilation. The incidence of BPD has not changed significantly despite the many advances in ventilatory support and the introduction of artificial surfactant. This is largely due to the survival nowadays of very low birth weight premature infants. However, its severity has decreased, particularly in infants greater than 28 weeks gestation.

During fetal life the lungs are expanded with fluid, an ultrafiltrate of fetal serum which contributes to amniotic fluid volume. During and after birth the fluid is removed by the pulmonary lymphatics and capillaries. When there is slow or incomplete removal of the lung fluid the infant may suffer from **transient tachypnoea of the newborn** and the condition most commonly occurs in term infants. The incidence is increased in infants delivered by caesarian section. It is postulated that the absence of squeezing of the thorax during passage through the vaginal canal results in retention of lung fluid. The condition is also reported in infants with hypoproteinaemia, hyponatraemia, maternal fluid overload, small hypotonic or sedated infants and infants who have experienced a precipitous delivery. The most common radiographic appearance is mild overaeration of the lungs, perihilar interstitial shadowing, prominent blood vessels and the presence of fluid in the horizontal fissure. Occasionally there is a small pleural effusion and mild cardiomegaly.

Meconium Aspiration Syndrome, which occurs in term infants, may be secondary to aspiration of meconium in utero or at birth, and may be related to alterations in the pulmonary vascular system which occurs as a result of asphyxia or indeed the presence of meconium itself. It

appears that the degree of symptomatology is directly related to the viscosity of the meconium and large amounts of thick meconium can completely obstruct the airways. The radiographic picture is that of chemical pneumonitis which leads to pulmonary vasoconstriction and in turn persistent pulmonary hypertension in the newborn. One third of infants with meconium aspiration syndrome require assisted ventilation. High frequency ventilation, and inhaled nitric oxide are also used and if these fail extracorporeal membrane oxygenation (ECMO) can also be useful. The chest radiographic picture includes any combination of diffuse patchy coarse infiltrates which maybe asymmetric or symmetric and focal or general, overinflation, air leaks, pleural effusions and cardiomegaly.

Although the fetal environment is considered relatively protected **congenital neonatal pneumonia** can occur even in the presence of intact amniotic membranes. Congenital infections can occur through transplacental spread of organisms most commonly the "TORCH" group (cytomegalovirus, herpes, rubella, toxoplasmosis) and are rare. Perinatal infections can be acquired via ascending infection from the vaginal tract which also causes chorioamnionitis, transvaginally during the birth process and nasocomially in the neonatal period. It is postulated that most organisms causing neonatal pneumonia gain entry during the birth process as the fetus takes the first gasping efforts at breathing. The radiographic changes in neonatal pneumonia are non-specific to the extent that it is not possible to determine a causative organism from the appearances. In addition many neonates do not suffer from pneumonia in isolation but it may complicate other conditions. The radiographic pattern may mimic hyaline membrane disease or transient tachypnoea of the newborn. The presence of pleural effusions with opacification is more suggestive of pneumonia especially group B streptococcus pneumonia. A diffuse, bilateral alveolar pattern which develops in the first 4–6 h of life is characteristic though not specific.

Spontaneous Pneumothorax/Pneumomediastinum may be the result of the infants own forceful initial respiratory effort or may result from rescuscitation. Pneumothorax causes varying degrees of respiratory distress. They are usually transient and do not need intervention. Pneumomediastinum is for the most part asymptomatic.

The aetiology of **chylothorax**, which causes respiratory distress is not known. Late maturation of the thoracic duct has been proposed and may explain the resolution of the abnormality following repeated episodes of aspiration. The condition resolves following aspiration and frequently repeated aspiration is necessary.

Disorders of surfactant deficiency due to a genetic abnormality in the surfactant protein B(SpB) and C(SpC) and the ATP-binding cassette transporter protein A3 (ABCA3) can lead to interstitial lung disease. Inherited mutations in the SpB and ABCA3 are autosomal recessive and may present immediately after birth with respiratory symptoms. Mutations in the SpC are autosomal dominant and may present later in infancy. Pulmonary interstitial glycogenosis (PIG) may present in the preterm or term infant very soon after birth. It has been reported in isolation but is frequently associated with conditions that affect lung growth and the diagnosis is made by the pathological examination of lung tissue. The imaging features may be similar to those seen in the other disorders of surfactant deficiency.

MRI of Lungs in Children

Franz Wolfgang Hirsch, Ina Sorge
Department of Paediatric Radiology, University Hospital Leipzig, Germany

Compared with a conventional chest radiograph MRI of a child's lung offers additional information relevant for diagnosis. In addition using an adequate examination technique, MRI of the lung may replace many of the CT scans that expose children to radiation. The lack of radiation exposure makes MRI of the lung particularly attractive for paediatric radiology.

Depending on experience with the technology and the availability of scanner time, MRI has become the first-line cross-sectional imaging technique for pulmonary disease in many departments. Characteristic features of the paediatric setting influence the choice of protocols. Depending on the size of the patients and their ability to comply with the procedure and breathing instructions, it appears useful to prepare a separate protocol tree not only with motion compensated protocols but also with adjusted fields of view, slice thickness and in-plane resolution with optimised signal-to-noise ratios for smaller patients.

Two basic strategies have been pursued for motion compensation: fast single shot imaging with very short acquisition time and respiratory gating/triggering of fast spin echo techniques. In our department the lung MR is performed exclusively during free breathing with respiratory triggering. Typically, these fast and robust sequences would be used for an speeding up the acquisition. In most cases, the difference to non-gated acquisitions is much less than in adult subjects with low respiration rates. T2-weighted fast spin echo sequences can be applied with repetition times of 2000 ms or less, usually triggered to the expiratory phase, which is around 2 s, depending on the individual respiration frequency. This time frame allows for excellent T2-weighted images without relevant motion artefacts. Depending on the available hardware and specific experience of the team, both mechanical (respiratory belt) or image-based (e.g. navigator) devices for the detection of respiratory motion can be

applied with good results. A radial read-out scheme of the k-space further improves the robustness against motion artefacts but prolongs the examination. The application of additional cardiac triggering may be helpful only in specific cases, but paid for with a significant increase of acquisition time and is unnecessary in the most cases. The other approach, steady state (SSFP) or partial Fourier single shot sequences (e.g. HASTE) have been successfully implemented in other sites. SSFP sequences allow for a rapid acquisition of ten slices with breath-hold times below 10 s.

A second characteristic feature of the paediatric setting is the need for sedation or general anaesthesia in many cases. Sedation will normally be avoided as much as possible, but may be indispensable. For propofol sedation, an incidence of up to 42% of dorsal atelectasis has been described. It is important to know this condition, since it may mask relevant pathology. In case of doubt, additional scans in the prone position may be warranted. In case exact correlation with CT is needed, e.g. when switching follow-up examinations from CT to MRI, it may be useful to acquire the MRI examination with elevated arms. However, this position is usually not tolerated by children for more than 15–20 min and can not be generally recommended.

Pulmonary processes with alveolar exudation and infiltration as pneumonia, mycosis with alveolar infiltration, later stages of pulmonary oedema or alveolar proteinosis are reliably and consistently detected using MRI.

There are still limitations to imaging early stages of interstitial processes as fibrosis and pulmonary metastases. Lung metastases are diagnosed reliably from 5 mm in diameter Therefore for identification of lung metastases, CT is still used as the initial diagnostic measure however subsequent therapy monitoring may be carried out with the help of MRI. These limitations also apply to identifying emphysema and bullae.

Typical paediatric diseases such as mucoviscidosis, aspergillosis, aspergilloma, and malformations of the lung may be reliably diagnosed by MRI. MRI is used today for all follow-up examinations in inflammatory diseases especially for imaging of complications as abscesses. Diffusion imaging is an additional tool to differentiate between abscess and simple fluid retention.

The increased use of lung MRI as an alternative to CT contributes immensely to reducing radiation exposure in chest imaging in children.

Further readings

Biederer J, Beer M, Hirsch W et al. (2012) MRI of the lung. Why ..when how? Insights Imaging Aug;3(4):355–71

Eichinger M, Optazaite DE, Kopp-et al. (2012) Morphologic and functional scoring of cystic fibrosis lung disease using MRI. Eur J Radiol. Jun;81(6):1321–1329

Hirsch W, Sorge I, Krohmer S et al. (2008) MRI of the lungs in children. Eur J Radiol 68:278–288

Montella S, Maglione M, Bruzzese D, et al. (2012) Magnetic resonance imaging is an accurate and reliable method to evaluate non-cystic fibrosis paediatric lung disease Respirology Jan;17(1):87–91

Ley-Zaporozhan J, Ley S, Sommerburg et al. (2009) Clinical application of MRI in children for the assessment of pulmonary diseases. Rofo 181:419–432

Thoracic developmental anomalies in newborns and infants

György Balázs
Cardiovascular Center, Semmelweis University, Budapest, Hungary

Congenital developmental anomalies of the chest may manifest in early cardiorespiratory failure with potentially lethal outcome or in less severe cases the anomalies can later give rise to complications such as recurring bronchopulmonary infections. Early recognition of these anomalies in newborns and infants is of primary importance since rapid deterioration of cardiovascular and/or respiratory functions can develop even in cases when the vital signs are seemingly normal in the postnatal period. Prenatal ultrasound screening detects a large part of developmental intrathoracic anomalies, these patients can be closely followed up both pre- and postnatally allowing for a better chance of early diagnosis and treatment. Lately the introduction of prenatal MRI improved further the accurate anatomical mapping and characterization of inborn anomalies thus providing essential prognostic information for the selection of best pre- and/or postnatal treatment. After birth conventional radiography and ultrasound are the primary imaging modalities either in symptomatic babies or those with prenatally diagnosed lesions. If these examinations are negative or reveal minor change in a stable baby further imaging is not needed, close follow-up is sufficient to see whether therapeutic measure is to be considered. In the presence of thoracic lesion which may imply progressive disease or the patient is already in unstable cardio-respiratory condition advanced cross-sectional imaging is indicated by CT or MRI. While MRI as a radiation-free modality is always preferred for children and its tissue specificity is superior to CT, performing a detailed MRI examination even on a state-of-the-art scanner is at the order of 15–30 min. Advanced multidetector CT technology permits the aquisition of chest CT of an infant in one second which may be feasible without anesthesia. Furthermore for the visualization of lung and airway anatomy CT offers the best resolution. New CT protocols integrating iterative image reconstruction provide high definition imaging at low radiation dose thus making CT the currently available best

modality for the imaging of chest anomalies in newborns and infants.

Intrathoracic developmental anomalies can be ordered into four groups according to the organ system primarily involved: broncho-pulmonary anomalies, foregut malformations cardiovascular anomalies and diaphragmatic anomalies. It has been suggested that the use of broncho-pulmonary foregut malformation is a „common denomination" of different anomalies, which on one hand are often seen in combination and on the other hand are thought to have common mechanisms in their evolution.

The main entities belonging to bronchopulmonary anomalies are bronchopulmonary sequestration (BPS), congenital bronchopulmonary airway malformation (CPAM), bronchogenic cyst, congenital lobar hyperinflation (CLH), congenital bronchial atresia (CBA), pulmonary hypo- aplasia with or without associated vascular anomaly. In most of the cases adequate prenatal US screening is able to diagnose the presence of these abnormalities at 18–20th gestational week if they are large enough. The extent of the lesion can be assessed and followed up and the development of serious mass effect and possible hydrops can also be detected. MRI if available can further clarify the size and nature of the pathology. This may warrant intrauterine therapeutic measures. If intrauterine imaging studies demonstrate signs of high risk criteria postnatal physical symptoms and chest radiography will detemine whether CT or MRI examination is to be performed immediately after birth. Treatment of expansile lesions is surgical removal. In asymptomatic cases close clinicaI follow-up is justifiable and cross-sectional imaging is performed in a delayed manner only 3–6 months after birth. Planned surgery is usually performed between the age of 6–12 months in order to balance the decreasing operative risk, increasing chance of complications and decreasing regeneration potential of the lung.

Bronchopulmonary sequestration (BPS) is defined as pathologic lung tissue with systemic arterial supply, missing normal bronchial communication. Two main types are extralobar and intralobar BPS. Extralobar BPS which is more frequently seen in infants is sharply demarcated from surrounding lung tissue with own pleural encasement and systemic venous drainage. Intralobar BPS is more often diagnosed in older kids and adults, does not have sharp demarcation and venous drainage is towards normal pulmonary veins. Both types are predominantly located on the lung base, and receive systemic arterial supply from aberrant branches of the descending thoracic or upper abdominal aorta. Ectopic subdiaphragmatic location is occasionally seen Postnatal ultrasound with color Doppler is usually able to establish the diagnosis based on the presence of solid or partly cystic lesion replacing normal air-containing lung and direct visualization of feeding artery arising from the aorta. If detected on prenatal ultrasound, BPS is hyperechogenic, appearing on MRI with high T2 signal. In infancy radiographic signs of BPS are not specific, extralobar lesions typically manifest as persistent paravertebral opacities on the lung base. For the detection of systemic arterial supply conventional catheter studies are now replaced by CT- or MR-angiography. When the lesion is to be resected accurate mapping of the feeding systemic arteries and draining veins is essential. Currently multidetector CT-angiography can provide the finest anatomical detail at lowest patient strain.

Congenital pulmonary airway malformation (CPAM) or as formerly called, congenital cystic adenomatoid malformation (CCAM) is a heterogenous group of pathologies with subclassification to different types according to its composition. Type I. is a macrocystic lesion with at least one dominant cyst with a diameter >2 cm; Type II. is multilocular with multiple cysts measuring less than 2 cm diameter; and Type III. is a solid or microcystic lesion. The cystic spaces are fluid filled during fetal life and at birth. Later fluid is usually replaced by air. Pre- and postnatal US appearance may be cystic or solid as well, depending on the actual type. Radiography typically demonstates single or multiple air-containing thin walled cysts in the lung with varying degrees of displacement of normal anatomic structures. Both pre- and postnatal MRI are sensitive in the detection of cystic structures and solid chest masses. After the clearance of intracystic fluid CT is superior in the assessment of air-containing cystic lesions, together with the airways and normal lung tissue.

Bronchogenic cysts arise from aberrant branching of the tracheo-bronchial tree and are usually located in the neibourhood of the airways, most typical location is near the tracheal bifurcation. On pre- or postnatal ultrasound their cystic, usually unilocular appearance and location may be sufficient clue for the diagnosis. On contrast-enhanced CT non-enhancing homogenous demarcated lesion is seen in peri-tracheobronchial location. Both pre- and postnatally T2 weighted MRI images can best demonstrate the cystic nature of the lesion.

Congenital lobar hyperinflation, or known formerly as congenital lobar emphysema is an abnormal progressive overinflation of one or more lobes or occasionally one or more segments of the lung. The underlying pathology is focal maldevelopment of cartilagineous bronchial wall resulting in hypoplastic bronchi. Typical location of CLO is the left upper lobe, and with decreasing frequency right middle and upper lobes. Related to its progressive expansile nature CLO causes compression of normal lung and displacement of mediastinal vessels clinically manifesting in respiratory distress. Symptomatic patients require surgery. Conventional radiography is diagnostic in most of the cases, surgical planning, however, benefits from further imaging by CT which can provide more accurate evaluation of which

are the involved lobes or segments and which are the compressed but otherwise intact lung segments. Lately, a growing number of CLOs are diagnosed prenatally by ultrasound and MRI. This subgroup is thought to be often associated with congenital bronchial atresia (CBA), which is an entity sharing common features with CLO. CBA in its pure form is rarely seen in infants, rather diagnosed in adolescents and young adults.

Pulmonary hypo- aplasia is often secondary, but primary hypo- aplasia and even unilateral total agenesis can occur as an isolated intrathoracic anomaly, often in association with extrathoracic anomalies. Unilateral hypo- aplasia causes marked asymmetry, with mediastinal shift towards the affected side. Some form of vascular anomaly is often present, too. The chest side may be partially opaque, however, in the presence of pulmonary artery hypo-aplasia the small lung is hyperlucent. In congenital venolobar syndrome hypogenetic lung typically on the right side is associated with partially anomalous venous return. From the radiographic appearance of the typical course of anomalous pulmonary vein originates the name: scimitar syndrome.

Among foregut malformations esophageal atresia is seen most commonly and in about half of the cases it is associated with anomalies of other organ systems, in 10–20% part of VACTERL syndrome. Prenatal ultrasound and MRI may detect polyhydramnios, missing stomach bubble and occasionally prominent proximal pouch. In postnatal diagnosis conventional radiography of the chest and abdomen is most useful to visualise the gas content of the proximal dilated esophagus, optionally with air injection through NG tube. Bowel gas pattern is informative about the presence of tracheo-esophageal fistula. Contrast esophagram is rarely indicated pre-surgically, however, regularly performed post-surgically to detect possible complications. Esophageal duplication cysts are most often located in the caudal portion of the posterior mediastinum. In the presence of associated vertebral anomalies they are considered neurenteric cysts. Bronchopulmonary anomalies can rarely communicate with the upper GI tract usually through an esophageal bronchus extending into a BPS or CPAM.

From the wide spectrum of cardio-vascular anomalies, mediastinal large vessel anomalies are discussed here. Aortic coarctation is congenital stenosis of the thoracic aorta at the level of the isthmus, frequently associated with congenital heart defects. Clinical presentation in infancy is characteristic of cases where the stenosis affects longer segment of the aortic arch with more serious hemodynamic disturbance. This type was formerly called infantile or preductal coarctation. Symptoms are dominated by left ventricular failure. Urgent surgical reconstruction or in selected cases balloon angioplasty is the therapy of choice. Diagnostic imaging in newborns and infants is still performed via catheterisation in most of the centers worldwide although the diagnostic accuracy of ECG-gated multidetector CT-angiography is already evident. MRI allows for more comprehensive morphological and hemodynamic analysis in a single session, but is more feasible in older children.

Developmental anomalies of the aortic arch are often called vascular rings which describes the circular or at least partially circular nature of the constellation of normal and anomalous vessel trunks surrounding the trachea and the esophagus. Varying degrees of compression occur which manifest in clinical symptoms of dysphagia, cough, wheezing, stridor and in severe forms airway obstruction. Immediate surgical repair is indicated if airway compression is critical. The diagnosis of vascular ring can be established by Barium swallow study with high confidence: characteristic esophageal impressions are seen in the presence of anomalous vessels. For surgical planning, however, further imaging analysis is necessary. CT-angiography or MR-angiography is now the mainstay of imaging of vascular rings. Both modalities provide real 3D interpretation of vascular anatomy. CT's added value is the simultaneous high resolution visualisation of the airways and lung parenchyma. The best known classical vascular ring, double aortic arch results from the complete lack of normal regression of primitive fourth aortic arch segments. It usually causes prominent airway and esophageal compression necessitating surgery in the early postnatal life. An unique vessel anomaly is aberrant left pulmonary artery or, as commonly called, pulmonary sling. This typically implies serious distal tracheal compression extending on the right main stem bronchus with displacement to the left caused by the traction effect of the „sling". This is the only anomaly where there is an anterior impression on the Barium filled esophagus when a lateral projection is obtained at swallow study. Confirmation is easiest by CT-angiography given that simultaneos vascular and tracheobronchial assessment is required.

Congenital diaphragmatic hernia (CDH) is one of the best known malformations requiring surgical repair in newborns and young infants. Two main types are posterolateral, Bochdalek hernia accounting for the majority (90%) and about 80% being left sided, and anterior Morgagni hernia which is more common on the right side. Depending on the location and size of the hernia abdominal organs move into the chest cavity compressing and displacing normal structures. Since this compression is already present in fetal life normal genesis of both ipsi- and contralateral lung is altered. The degree of consequent lung hypoplasia is the major determinant of postnatal prognosis. Clinical signs of severe respiratory distress are present from birth in severe cases, while mild cases may manifest later. Prenatal ultrasound has variable performance, it can detect about 60% of the cases by the 24th gestational week. Prenatal MRI enables better

differentiation of abdominal structures herniated in the chest. The severity of pulmonary hypoplasia is most reliably assessed by lung volume measurement which is currently most accurately measured on MRI images. After birth conventional radiography of the chest and abdomen shows partial opacification of a hemithorax with contralateral shift of the mediastinum with displaced NG tube. Later when the GI tract is air-filled bowel loops or stomach are identified in the chest instead of the normal intraabdominal location. CT or postnatal MRI is seldom performed in CDH, mainly in cases where differential diagnostic information is needed.

Imaging the small Airways in Children: why, when and how?

Catherine M. Owens
GOSH and University College, London UK

Why and When?

Diseases affecting the small airways in children can be difficult to detect when using traditional diagnostic tests. Indeed widespread airway involvement is usually present before we are able to demonstrate either clinical symptomatology, abnormalities on basic pulmonary function testing, or abnormal plain chest radiographs. Bronchiolar obstruction may be detected indirectly, by computed tomography (CT), manifest as regional under-ventilation and air trapping. This in turn will result in the body's homeostatic mechanisms then causing reduced pulmonary arterial perfusion to these nonfunctional (area of obstructive over inflated) airways. On CT this is manifest as oligaemia and more hyper lucent lung contributing to the 'mosaic attenuation' within the lung parenchyma.

When there is inflammation of the bronchioles with associated exudate, the airways may become directly visible on CT, for example in cases of **exudative (diffuse pan-) bronchiolitis**.

Quantification of the various morphological features of small airways disease is possible from CT images and this increased precision has aided investigations of structural and functional relationships in affected patients.

Understanding the pathology and anatomical distribution of diseases that affect the small airways allows some prediction of the likely computed tomography appearances in this wide spectrum of conditions, and thus helps to refine the differential diagnosis.

CT in constrictive obliterative bronchiolitis and small airways disease

The detection of various forms of small airways disease has been made simpler as a result of increased understanding of the high-resolution computed tomography (HRCT) appearances of the different pathological subtypes of small airways disease. Investigation of small airways dysfunction in isolation, that is, without considering the status of the more proximal or distal airways, was a feature of much of the early pathophysiological work on small airways disease. Despite this being conceptually convenient, in reality there is anatomical continuity between the small and large airways, and the presence of coexisting parenchymal abnormalities in many diseases, is easily manifest in the excellent quality images provided with HRCT.

The known spatial resolution limits of HRCT would suggest that attempts to image 'normal' small airways (by convention in adults, those with internal diameters $\leq$2 mm) would appear to be futile, however the presence of disease enables HRCT to reveal the anatomical detail present in the diseased state. Abnormalities on HRCT that reflect small airways disease are broadly categorized into **indirect** and **direct** signs:

That is widespread scarring thence obliteration of the bronchioles results in the **indirect** sign of patchy density differences of the lung parenchyma, representing areas of under-ventilated and under-perfused lung (the mosaic attenuation pattern). By contrast, the thickening of the bronchiolar walls caused by inflammatory infiltrate and/or luminal exudate will result in the affected small airways becoming directly visible.

1. Pathological background and classification

The specific and classical term 'constrictive obliterative bronchiolitis' (also known as bronchiolitis obliterans) renders many confused, indeed bemused, primarily because of its use in the context of bronchiolitis obliterans organizing pneumonia (BOOP). The clinico-pathological entity of BOOP, more usefully termed (cryptogenic) organizing pneumonia or (C)OP, should be regarded as quite distinct from obliterative bronchiolitis. Indeed it is the authors opinion that the 'BO i.e. bronchiolitis obliterans' part of BOOP be discarded altogether and the term (cryptogenic) organizing pneumonia always used in preference.

An empirical and simple approach to classification and understanding of SAD relies on the fundamental difference between the **indirect** HRCT signs of constrictive bronchiolitis and the **direct** visualization of small airways on HRCT in **exudative bronchiolitis**. In fact these two basic HRCT patterns of small airways disease account for the majority of small airway related disorders, which we encounter clinically.

HOW?

High-resolution computed tomographic technique

Standard HRCT technique is adequate to demonstrate the features of obstructive lung diseases but some modifications are needed (especially in children) to enhance the early/subtle signs of small airways disease.

The two fundamental forms of small airways disease, namely constrictive (obliterative) bronchiolitis and, at the other end of the pathological/imaging spectrum, diffuse exudative

(pan) bronchiolitis, make differing demands on CT technique; for the optimal imaging of patients with constrictive bronchiolitis, appropriate contrast resolution is needed to demonstrate regional density differences (mosaic attenuation pattern), whereas the imaging of patients with diffuse pan bronchiolitis necessitates adequate spatial resolution in order to depict the characteristic small branching structures (tree-in-bud pattern).

Window settings have an important effect on the apparent size of important structures. Whence addressing airways disease, the predominant effect of inappropriate window settings is on bronchial wall thickness i.e. narrow window settings increase apparent bronchial wall thickness and simultaneously reduce apparent internal bronchial diameter.

It is difficult to recommend absolute window settings because of variation between CT machines and individual preferences, however for diagnostic purposes consistent window settings are advisable and a window level of −400–−950 Hounsfield Units (HU) and a width of 1,000–1,600 HU are popular. Many thoracic radiologists evaluate lung parenchyma at a window level of −600 HU and a window width of 1,500 HU.

A typical HRCT protocol used in clinical practice would simply be thin (1–2 mm) collimation sections at 10 mm interval from lung apices to the cost phrenic angles at full inspiration, in a supine position. Normal lung parenchyma increases in attenuation on expiration Areas of air trapping caused by small airways disease are seen as regional inhomogeneity, i.e. areas that remain relatively lucent (black) interspersed with areas of normal higher density lung. This important sign of exacerbation of the pre existing mosaic attenuation pattern on CT sections obtained at end-expiration (usually limited to approximately 3 sections taken between the aortic arch and right hemi diaphragm) has led some workers to suggest that they should be acquired routinely. Whether expiratory CT sections need to be obtained in all cases of suspected small airways disease is questionable.

Obtaining end-expiratory CT images is not always straightforward and few small children are able to comply, despite coaching by an experienced technologist, with the request to "breathe out and hold it." Hence for children and patients who are unable to reliably suspend respiration at end-expiration, scanning in the decubitus position is useful where the dependent lung is relatively restricted so mimics the state of the lungs at end-expiration.

Density differences that characterize mosaic attenuation on HRCT, on either inspiratory or expiratory images, may be subtle and close to the limit of visual detection. Altering window settings may increase the conspicuity of a mosaic pattern

Another possibility to demonstrate regional heterogeneity of lung parenchyma is simple image processing of CT data, which then improve detection and decrease observer variation. When volumetrically acquired (spiral) CT is used to obtain a "slab" of anatomically contiguous thin-sections (for example, a 6 mm slab consisting of 6 adjacent 1 mm sections); an image processing algorithm applied where only the lowest attenuation value of the 6 adjacent slices is projected on the final image, producing a "minimum intensity projection (MinIP) image". This technique improves the detection of subtle areas of low attenuation, encountered in small airways disease and emphysema. MinIP post processing of thin section CT images enhances the conspicuity of the regional inhomogeneity of lung parenchyma caused by small airways diseases This technique is very useful in the investigation of structure/function relationships and should be used in routinely clinical practice.

Conclusion: HRCT is essential in the characterization and detection of a group of diseases, which until relatively recently had been regarded as being beyond the scope of radiological imaging. It is useful to have a logical categorization of small airways diseases into those conditions showing indirect signs on HRCT (the mosaic attenuation pattern of constrictive bronchiolitis) and those in which the affected airways are directly visualized (the tree-in-bud sign of exudative bronchiolitis). This in turn is supported strongly by the robust correlation between the various HRCT signs of bronchiolar diseases and physiological measures of small airways dysfunction.

High-resolution computed tomography is an invaluable diagnostic tool for children with unexplained obstructive lung disease and as a research tool for characterizing and quantifying morphological features of small airways disease.

Further readings

Abbott, GF, Rosado-de-Christenson, ML. Rossi, S E, Suster, S (2009) Imaging of Small Airways Disease Journal of Thoracic Imaging November,Volume 24 - Issue 4, 285–298

Hansell DM. Small airways disease detection and insights with computed tomography ERJ June 1 Vol 17, 6,1294–1313

Thurlbeck WM. Chronic airflow obstruction (1995). In: Thurlbeck WM, Churg AM, editors.

Pathology of the Lung (1982) 2nd edn. New York, Thieme Medical Publishers Inc., pp. 739–825 Worthy SA, Müller NL Small airway diseases. RadiolClin North Am;36:163–173

Myers JL, Colby TV (1993) Pathologic manifestations of bronchiolitis, constrictive bronchiolitis, cryptogenic organizing pneumonia, and diffuse panbronchiolitis. Clin Chest Med 14:611–622

Neonatal heart disease – MRI or CT?

Christian J. Kellenberger
University Children's Hospital Zürich, Switzerland

Introduction: Neonatal heart disease mainly consists of congenital heart disease (CHD) defined as a gross structural

abnormality of the heart or intrathoracic great vessels of potentially functional significance, besides congenital arrhythmias, cardiomyopathies and tumours. Excluding functionless variations of systemic thoracic veins or branches of the aortic arch, patent ductus arteriosus or foramen ovale, isolated ventricular septal defects and other trivial lesions, the incidence of moderate to severe CHD, which is clinically evident and requires expert cardiac care in the neonatal period, is estimated at about 6/1000 live births.

Major cyanotic and acyanotic CHD is increasingly diagnosed prenatally by expert foetal echocardiography, allowing optimal perinatal and neonatal management, including delivery in a specialised tertiary centre, immediate administration of prostaglandins in CHD with duct-dependent pulmonary or systemic circulation, or early minimal invasive intervention when necessary, and so improving outcome of affected neonates by reducing hypoxemic complications and stabilizing their clinical condition before surgery.

For postnatal assessment of CHD, echocardiography and abdominal ultrasound including Doppler techniques are the primary and most important modalities for defining the visceral situs, intracardiac anatomy, ventricular and valvular function, as well as haemodynamics. The vast majority of neonates with CHD are managed just with echocardiography and chest radiography for assessing the pulmonary vasculature. Only when echocardiography cannot provide sufficient information on cardiac morphology and extracardiac vascular anatomy for a comprehensive diagnosis and planning the initial treatment, further imaging is needed which traditionally involve catheterisation and conventional angiocardiography. With the advent of the less invasive angiographic techniques utilising computed tomography (CT) and magnetic resonance (MR) imaging, cardiac catheterisation in neonates can now be restricted to measurements of chamber pressure and oxygen saturation, and to catheter-guided interventions including atrial septostomy or ductal stenting.

Indications for complementary imaging

The most frequent reason for advanced imaging following echocardiography in neonates is better visualisation of the ventricular outflow tracts, the pulmonary blood supply and the aortic arch with its arterial branches in conotruncal anomalies. Truncus arteriosus communis (TAC) is classified based on the origin of the pulmonary arteries from the large single vessel (truncus). The presence of a main stem pulmonary artery and the arrangement of the branch pulmonary arteries will determine the surgical technique for inserting a valved conduit between the right ventricle and pulmonary arteries. Aortic arch anomalies may be associated with TAC; the presence and extent of a coarctation or interruption of the aortic arch, the exact calibre of the ascending and descending aorta as well as the origin of the carotid and subclavian arteries need to be defined for planning the reconstruction of the aortic arch. In severe forms of tetralogy of Fallot (TOF), with extremely diminutive pulmonary arteries, or in pulmonary atresia, the type of pulmonary blood supply will determine the choice of initial palliation for increasing blood flow and thus growth of the native pulmonary arteries. For deciding on whether to perform a surgical modified Blalock-Taussig or central aorto-pulmonary shunt, catheter-guided stenting of a ductus arteriosus or right ventricular outflow tract, or coiling of selective aortopulmonary collateral arteries in cases with a dual blood supply, all vessels supplying the lungs need to be precisely delineated. A comprehensive assessment of the pulmonary blood supply includes the presence and size of the main stem pulmonary artery; presence, size, stenosis, and confluence of the native branch pulmonary arteries; presence, position, and patency of a ductus arteriosus; and presence, size and course of aortopulmonary collateral arteries. In neonates with double-outlet right ventricle (DORV) and transposition of the great arteries (TGA), echocardiography is usually sufficient for characterising associated intracardiac lesions and showing the spatial relationship of the aorta, pulmonary trunk and respective ventricles. Only when there are associated anomalies of the aortic arch or echocardiography fails to precisely delineate the coronary artery anatomy, further imaging may be necessary preoperatively.

Neonates with total anomalous pulmonary vein connection (TAPVC) may present with severe cyanosis, pulmonary hypertension or congestion requiring emergent surgical correction. For preoperative planning, the connection of the individual pulmonary veins to a retrocardial venous confluence, the site of drainage into the heart or coronary sinus, systemic or portal venous systems as well as potential stenoses need to be identified. A rare indication for assessing partial anomalous venous connection (PAPVC) in a newborn is the hypogenetic lung complex, or scimitar syndrome, presenting with congestive heart failure. Pulmonary venous anomalies may be part of more complex CHD frequently associated with visceral heterotaxy. In neonates with complex congenital heart disease, CT or MR allows evaluation of the visceral situs (e.g. asplenia, polysplenia, bronchial anatomy), systemic and pulmonary venous anatomy and connections, atrio-ventricular and ventriculo-arterial connections, ventricular anatomy and size, anomalies of the aorta and pulmonary arteries with a single examination, complementing the information on intracardiac morphology (e.g. atrial, atrio-ventricular, ventricular septal defects) provided by echocardiography. Such a comprehensive evaluation of cardiovascular anatomy provides the basis for deciding on and planning further treatment steps including catheter-based interventions, palliative and corrective surgery. In the presence of borderline hypoplastic ventricles or unbalanced atrioventricular septal defect, exact measurements of the ventricular volumes may aid

in the clinical decision to perform a biventricular repair or univentricular palliation (Fontan procedure). Assessment of cardiac tumours includes definition of their location, extension into the myocardium and relation to the ventricular inflow and outflow tracts. Tissue characterisation by MR may help to avoid a biopsy in cases of fibromas or haemangiomas.

CT or MR imaging?

Both CT and MR are excellent means for a comprehensive three-dimensional (3D) evaluation of the extracardiac vasculature in neonates with CHD by imaging the chest during the first pass of an intravenously applied contrast-material bolus. Individual vessels and their anatomical relationship can be assessed in any desired plane by multiplanar reconstructions (MPR) and thin maximum intensity projections (MIP), or shown three-dimensionally by volume rendering (VR) techniques, which may be helpful to the surgeon for planning the surgical approach and technique.

With the advent of multi-detector CT (MDCT) technology, it has become possible to image neonates with high spatial (0.5–0.6 mm^3) and improved temporal resolution during spontaneous quiet breathing. The short duration of a CT examination, with the possibility to image critically ill neonates (e.g. with obstructed TAPVC) with no or minimal sedation, are its advantages over MR. In addition, airways and lungs are more easily assessed (e.g. in scimitar syndrome). The major disadvantage of CT is the exposure to ionising radiation, which should be kept as low as possible in children and particularly in neonates with CHD, as they are most vulnerable to radiation induced carcinogenesis and will potentially undergo several more imaging studies during their lifetime. For evaluation of the extracardiac thoracic vasculature alone, a non-gated helical acquisition is usually sufficient and can be performed with about 1 mSv effective dose, by using 80 kV and weight-adjusted effective mAs settings. For functional evaluation of the ventricles or reliable assessment of the coronary arteries, high temporal resolution imaging covering the entire cardiac cycle is required. This can be achieved on most MDCT scanners with retrospective ECG-gating, a low pitch and multi-segment image reconstruction, but results in an up to five-fold increase of radiation dose. Newer MDCT scanners with dual-source technology or wider detectors covering the entire neonatal chest allow prospective ECG-triggered sequential acquisitions limited to a predefined temporal window in the cardiac cycle (end-systole), thus reducing the radiation dose to the level or even below that of a non-gated helical study. However, with a prospectively ECG-triggered sequential acquisition no functional information can be obtained and the neonate may have to be examined in general anaesthesia with intubation enabling image acquisition in a prolonged breath-hold for avoiding potential step artefacts due to respiratory or gross motion.

Neonatal cardiovascular MR may be technically more challenging as all imaging parameters need to be adapted to the small size of the structures of interest and rapid heart and respiration rates. Since a comprehensive MR study including morphological and functional assessment of the heart and thoracic vasculature can be lengthy (30–45 min), it commonly requires sedation or general anaesthesia with intubation for avoiding respiratory artefacts and providing the best image quality possible. However, in most cases the MR study can be limited to gadolinium-enhanced angiography and ECG-gated gradient echo cine imaging in axial and short-axis planes providing all pertinent information in less than 10 min scanning time. When a small multi-channel phased-array coil (FOV ~20 cm, covering the entire chest) is available, dynamic contrast-enhanced MR angiography utilising parallel imaging and temporal *k*-space undersampling techniques (key-hole, TRICKS) can be obtained yielding a good temporal resolution (1–2 s) and sufficient spatial resolution (~.1 mm^3) for assessing the larger mediastinal vessels. Accurate delineation of small aortopulmonary collateral arteries requires a higher spatial resolution (~ 0.5 mm^3), which can be accomplished by using a more conventional 3D gradient echo sequence with elliptic-centric *k*-space sampling, bolus tracking and longer acquisition times (~ 20 s per dynamic). The application of gadolinium chelates is generally considered off-label use for MR angiography in children. Some regulatory agencies have cautioned the use of gadolinium-based contrast agents because of the theoretical risk for developing nephrogenic systemic fibrosis (NSF) due to immature renal function in neonates. In order to minimise the risk for NSF, it seems prudent to use the more stable macrocyclic contrast agents (Dotarem®, Gadovist®), although they might not be explicitly approved for neonates. Alternatively, the thoracic vasculature including the coronary arteries may be investigated without contrast-material with an ECG-gated 3D steady-state free precession (SSFP) sequence employing respiratory navigator gating. However, this technique may not be available on all MR scanners and may not yield sufficient results with high heart rates. The anatomy or narrowing of the central airways can usually be sufficiently delineated with minimum intensity projections obtained from the 3D contrast-enhanced MR angiography dataset or with additional ECG-gated black-blood images aligned to the trachea and main stem bronchi. Cardiac tumours can be assessed with ECG-gated cine images aligned to the axes of the heart and ECG-gated black-blood images with different image contrasts (T1-weighted, T2-weighed) for tissue characterisation.

The choice of CT or MR for imaging neonatal heart disease needs consideration of the advantages and disadvantages of each modality, and it will depend on the available equipment, anaesthesiology support and clinical situation. At our institution, we prefer MR posing a

potential risk (gadolinium toxicity) over CT with a known risk (radiation exposure) for all indications except unstable patients.

Further readings

Kellenberger CJ, Yoo SJ, Büchel ER (2007) Cardiovascular MR imaging in neonates and infants with congenital heart disease. Radiographics 27:5–18
Krishnamurthy R (2010) Neonatal cardiac imaging. Pediatr Radiol 40:518–27
Krishnamurthy R, Lee EY (2011) Congenital cardiovascular malformations: noninvasive imaging by MRI in neonates. Magn Reson Imaging Clin N Am 19:813–22
Young C, Taylor AM, Owens CM (2011) Paediatric cardiac computed tomography: a review of imaging techniques and radiation dose consideration. Eur Radiol 21:518–29
Valsangiacomo Buechel ER, Fogel MA (2011) Congenital cardiac defects and MR-guided planning of surgery. Magn Reson Imaging Clin N Am 19:823–40

Rib Injuries: mechanisms and imaging challenges

Paul K. Kleinman
Children's Hospital Boston, USA

Rib fractures are highly associated with abuse in young children. A 2008 systematic review of the world literature found that, after exclusion of motor vehicle crashes, documented accidental violent trauma and post-surgical cases, the pooled probability of abuse given a rib fracture was 0.71. The review found that all but one study showed that children who had rib fractures from abuse had more fractures than those who had not been abused. Rib fractures are usually occult, identified incidentally on a chest radiographs or on skeletal survey. Bruising overlying rib fracture is very uncommon.

Fractures can occur at any point along the rib arc, from the costovertebral articulations to the costochondral junctions. Between 33% and 65% of rib fractures in young abused children occur near the costovertebral articulations. Conventional chest radiographs tend to underestimate the number rib fractures subsequently found on chest CT. When rib resection, specimen radiography and histopathology are employed in fatal cases, the distribution of fractures heavily favors the regions of the costovertebral articulations.

Fractures of the posterior rib arcs are frequently multiple and bilateral. Most involve the rib head at the costovertebral articulation, or the rib neck near the costotransverse process articulation. The basic morphologic features, biomechanical analyses and clinical studies provide compelling support for the concept of anteroposterior thoracic compression of the chest as the causative mechanism of posteromedial rib fractures. In most instances the fractures appear to result from manual thoracic compression as the child is gripped and sometimes shaken.

Beyond the level of the transverse processes, the rib arcs are exposed and may fracture from direct blows. The tendency for the fractures to occur at multiple levels at similar points along the arcs of adjacent ribs, however, supports thoracic compression as the usual mechanism of injury.

The unique patterns of fractures near the costochondral junctions are closely linked to the regional anatomy. In infants and children, a growth plate is present between the osseous anterior rib end and the costal cartilage. The histologic features are similar to those of growth plates elsewhere, and thus the bony rib end can be viewed as a metaphyseal equivalent. The depression of the sternum and/or costal cartilages during manual thoracic compression appears to explain costochondral junction fractures.

Acute rib fractures are often invisible radiographically, even with high-detail imaging systems. In the absence of callus formation, detectability of the fracture depends on the plane of the fracture line and the position and alignment of the fracture fragments. The subtlety of acute rib fracture provides an argument for the supplementary use of skeletal scintigraphy and CT in the initial evaluation of suspected abuse. Osseous injury may be associated with substantial hemorrhage, and an extrapleural soft tissue density may be visible. This may provide the first clue to underlying rib injury, which can be confirmed by high-detail skeletal imaging.

Most posterior rib fractures manifest a substantial callus formation. In the phase of soft callus the margins are indistinct without clear trabecular architecture. With further healing, a sharply marginated zone of callus, often with a nodular appearance, becomes evident. More laterally and anteriorly situated fractures are difficult to identify acutely unless displacement or separation of the fracture fragments is present. Oblique views are useful, as they may bring the fracture line into tangent or accentuate any modest displacement.

Injuries near the costochondral junction are exceedingly difficult to identify acutely, but in some cases an appearance similar to the bucket handle pattern of abusive metaphyseal injuries may be apparent. Even with oblique views, and with healing, there may be little bone production. Occasionally, substantial fracture callus may produce a rounded opacity at the costochondral junction, first noticed on an abdominal radiograph.

CT has superior accuracy over radiography for rib fracture. Since the ribs generally course in non-orthogonal planes, the ability to reformate the axial data into oblique axial sections that visualize a greater length of the rib arc is a particularly attractive feature of CT. It is clear that the advantages of CT must be weighed against the radiation risks, but in some instances, the need for clarification of indeterminate radiographic findings will require this technique. Failure to recognize lower rib fractures on an abdominal CT in a young

child with unexplained abdominal findings may have catastrophic consequences.

Two reports comparing 99 m technetium medronate and 18F-NaF PET bone scans with high quality standardized skeletal surveys affirm the superior sensitivity of scintigraphy for the detection of rib fractures. PET imaging affords the advantages of a volumetric acquisition and 3D display with mutiplanar CT image fusion in selected cases. Perez-Rossello and others studied 21 infants (0–12 months) with suspected abuse with whole body MRI and high-detail skeletal surveys. Radiography showed superior identification of rib fractures when compared with WB-MRI. Rib injuries are most likely to be identified by MR when recent, with associated surrounding fluid signal, and this may be evident before radiographs become positive.

A variety of mimics enter the differential diagnosis of inflicted rib fractures, including developmental variants, birth injuries, iatrogenic and accidental injuries, metabolic disorders and spurious imaging appearances. Most are readily distinguished on clinical, laboratory and imaging grounds.

Skeletal surveys performed for suspected abuse should conform to the standards of the American College of Radiology and the British Society of Paediatric Radiology, including oblique as well as frontal and lateral views of the thorax. When further early documentation of rib fractures is required, radiography may be supplemented with scintigraphy and/or CT. Follow-up skeletal survey should be performed whenever there are rib fractures demonstrated on the initial survey or other imaging, and also when initial imaging is normal, but abuse is strongly suspected on other grounds.

Although the evidence is clear that rib fractures in infants occur with rib compression, quantitative data are lacking. Preliminary studies with finite element modeling show promise in defining the precise types and magnitude of applied forces entailed in the production of these familiar and strong predictors of abusive injury.

Further readings

Kemp AM, Dunstan F, Harrison S, Morris S, Mann M, Rolfe K, et al. (2008) Patterns of skeletal fractures in child abuse: systematic review. BMJ, 337:a1518

Kleinman P (1998) Diagnostic Imaging of Child Abuse, 2nd ed. St. Louis, MO: Mosby-Year Book Inc..

Hansen KK, Prince JS, Nixon GW (2008) Oblique chest views as a routine part of skeletal surveys performed for possible physical abuse–is this practice worthwhile? Child Abuse Negl 32(1):155–9

American College of Radiology (2011) ACR–SPR Practice Guideline for Skeletal Surveys in Children Revised (Resolution 54)*. Reston, VA: American College of Radiology 2011:1–6

Standard for skeletal surveys in suspected non-accidental injury (NAI) in children: The British Society of Paediatric Radiology, (2008)

Imaging of sport injuries

Miguel Rasero Ponferrada

Pediatric Radiology Department. Hospital U. Doce de Octubre. Madrid, Spain

The International Consensus Conference on Physical Activity Guidelines for Adolescents recommends that "all adolescents…be physically active daily, or nearly every day, as part of play, games, sports, work, transportation, recreation, physical education, or planned exercise, in the context of family, school, and community activities" and that "adolescents engage in three or more sessions per week of activities that last 20 min or more at a time and that require moderate to vigorous levels of exertion"

Children's participation in sports is a fundamental part of their education as a person and in health promotion.

There is an international concern about data that show upward shifts in paediatric body mass index (BMI), especially in countries undergoing economic transitions favouring industrialized, western urban lifestyles. The childhood obesity epidemic brings associated health problems of cardiovascular disease and diabetes mellitus. In this cohort of children and adolescent sports participation can promote energy balance and healthy body weight.

On the other hand there are a growing number of children participating in sports competitions systematically. There is also a trend towards specific and systematic training in each of the disciplines. The higher demand placed on these children involves a high intensity training that produces an increase in the number of overuse injuries. Many of these children also participate in various sports in succession throughout the season, without sufficient rest periods.

The large number of participants in sports competitions also raises the number of acute injuries related to the different disciplines.

Sport injuries can be found in relation to both organized and non-organized play.

The most common acute injuries are sprains, bruises and fractures.

Fortunately, most acute injuries are mild and can be managed on an outpatient basis by sports physicians or primary care physicians.

There are a growing number of patients who are seen in emergency departments of hospitals in relation to the increase in sports participation. The highest percentage of queries is made in case of boys aged between 5 and 14 years of age.

The sports that are more often associated with acute injuries are basketball, ice hockey, rugby and soccer and, for girls, gymnastic also. The anatomical areas where injuries are more frequent are the lower extremities.

Generally acute injuries are related to accidents. We must try to prevent and avoid them. Risk factors should be identified to implement the necessary strategies for prevention.

Chronic lesions are related to micro trauma. The most common are bone and tendon stress injuries. In general, they occur when training demands exceed the body's physiologic ability to compensate. Without adequate time to recover, injuries manifest in many ways: fatigue fractures, apophysitis, injuries to the physis and muscle and tendon injuries.

The immature skeleton of children presents a number of differences from adults, among them are: weak chondro-osseous unions, less muscle mass, hormonal changes in adolescence, thinner bones and less calcium. These differences make some sports injuries, acute and chronic, different from those of adults.

Imaging methods used in the study of skeletal sports injuries:

Plain radiography is often the first and only form required for diagnosis. Sometimes it is necessary to perform comparative contra lateral projections to identify subtle findings.

MRI is the most useful tool of second choice for the diagnosis and management of acute sports injuries, and especially of overuse injuries. It is very useful to evaluate the occult fractures, ligament and tendon injuries, alterations in the bone marrow and cartilage damage, especially of the physis.

High-resolution ultrasound also allows an accurate assessment of the musculoskeletal system in children, it is very useful in the study of muscles, joints, tendons and ligaments.

CT is reserved for the study of complex fractures.

Upper extremity:

More frequent in children engaged in baseball, judo, gymnastic, and snowboarding.

Shoulder: Most of the lesions are related to repetitive motions in sports requiring overhead activity (football, swimming, tennis, baseball, etc.)

The proximal humeral physis is the affected part of the shoulder in little league shoulder.

Elbow: Little league elbow was described in pitchers, but is also seen in tennis or football players or javelin throwers. It is related to tension on the medial elbow and compression in the lateral elbow.

Panner disease and osteochondral disease of the capitellum are also seen.

Wrist: Chronic pain is frequently found in skeletally immature gymnasts. The distal radial growth plate is affected. MRI is very useful because the findings are subtle.

Lower extremity:

Hip:

Overuse injuries are usually due to traction apophysitis around the pelvis. The different types are related to the attachment sites of the abdominal oblique muscles, the rectus femoris, the Sartorius or the hamstring tendons.

Acute injuries are frequently soft tissue injuries. Acute osseous avulsions are very common in adolescent athletes.

Knee:

Anterior knee pain is a very common complaint in pediatric athletes. The main causes are related to the extensor mechanism. Osgood-Schlatter disease is a traction apophysitis at the insertion of the patellar tendon on the tibial tuberosity. Sinding-Larsen-Johannson disease is another traction apophysitis that affects the origin of the patellar tendon at the inferior pole of the patella. Patellofemoral stress syndrome is a vague group of abnormalities that usually cause chronic anterior knee pain. Osteochondritis dissecans is also a very common cause of knee pain.

Acute injuries are usually related to anterior cruciate ligament and meniscal tears due to the increasing participation of children in organized sports. Another common acute injury is the transient dislocation of the patella.

Ankle and foot:

Overuse injuries: Ostechondral lesion of the talus. Tarsal coalitions that become symptomatic when adolescents increase the sport involvement. Similar traumatic irritation can occur in accessory bones. Traction apophysitis and osteochondrosis also occur in the foot (Sever, Köhler and Freiberg diseases are among them).

Acute injuries to the foot and ankle are very common. Sprains, osseous contusions, and fractures can occur. Attention must be paid to Salter-Harris type I or II fractures in patient with open physes.

Summary:

With the growing number of youths worldwide participating in sports and the high level of training intensity there is an increase in the risk of chronic and acute injuries. Repetitive training without sufficient rest predisposes children and adolescents to a wide spectrum of disorders. Early diagnosis can often prevent serious sequelae. Imaging plays a key role in the assessment, understanding, and management of these entities. MR imaging is very helpful to diagnose stress injuries. Pediatric radiologists must be familiar with the findings related to acute and chronic injuries.

Further readings

Kerssemakers SP, Fotiadou AN, De Jonge MC (2009) Sport injuries in the paediatric and adolescent patient: a growing problem. Pediatric Radiology May;39(5):471

Soprano JV (2005) Musculoskeletal injuries in the pediatric and adolescent athlete. Current Sports Medicine Reports 4:329–334

Jaimes C, Jimenez M, Shabshin N, Laor T, Jaramillo D (2012) Taking the stress out of evaluating stress injuries in children. Radiographics 32:537–555

Kirkland W, Davis (2010) Imaging pediatric sports injuries: Upper extremity. Radiol Clin N Am 48 1199–1211

Kirkland W, Davis (2010) Imaging pediatric sports injuries: Lower extremity. Radiol Clin N Am 48 1213–1235

MRI of bone marrow

Lil-Sofie Ording Müller
Section for Paediatric Radiology, Department of Radiology and Nuclear Medicine
Oslo University Hospital, Ullevål, Norway

Introduction: Radiological evaluation of pathology in the skeletal system in children is complicated by the process of skeletal growth and maturation due to the changes caused by conversion of cartilage into bone, and to marrow conversion. In the enchondral ossification process, the epiphyseal cartilage becomes gradually ossified, replacing this highly vascular cartilage with bony tissue. The paediatric bone marrow is different from adults in two main ways; the cellular *composition* of the red bone marrow in children changes with age and simultaneously the high cellular red marrow is gradually replaced by fatty white marrow in the normal bone-*marrow conversion*. Therefore the imaging techniques and their interpretation must be specific to the developmental stage of the child.

At birth red marrow, which is the highly cellular haematopoietic marrow, is present throughout the entire ossified skeleton. Ossification of the phalanges and of the tarsus begins in fetal life whereas the carpus begins to ossify at approximately 3 months after birth. The transition from red to fatty marrow begins shortly after birth and occurs in parallel in the long bones within the first decade of life. The conversion starts at the diaphyses and progresses toward the metaphyses in the distal phalanges of the upper and lower limbs and progresses proximally into the axial skeleton, i.e. from the periphery to the centre. Presence of red marrow in the diaphyses after the first year of life is abnormal. The cartilaginous epiphyses and apophyses lack marrow until they ossify and once ossified they contain red marrow. Epiphyseal marrow conversion occurs within 6 months of the radiological appearance of the ossification centre.

Marrow reconversion occurs at times of physiological stress and involves fatty marrow transforming into red marrow. This process can be patchy and asymmetrical but generally begins in the axial skeleton and later involves the peripheral skeleton in an opposite fashion to the physiological marrow conversion.

MRI of bone marrow

The exquisite soft tissue contrast of MRI and in particular its ability to define fat and water enables detection of bone marrow abnormalities. Conventional T1- and T2 weighted images have the highest specificity for detection of bone marrow abnormalities. T1weighted imaging provide excellent anatomical detail and can be acquired using spin echo, fast spin echo or gradient echo. Conventional T1weighted spin echo sequences demonstrate fat better than gradient echo imaging hence is the preferred technique for marrow imaging.

STIR and fat-suppressed T2 weighted imaging are the most frequently employed sequences in combination with T1weighted sequence. STIR produces uniform fat suppression and is ideal when a large field of view is required. Fat suppressed T2 weighted imaging typically results in less homogenous fat suppression but normally gives more signal and is ideal when a smaller field of view is required. Chemical shift imaging and contrast enhanced MRI with dynamic contrast series, may be used to differentiate red marrow from pathological marrow infiltrates. However normal red marrow also shows some degree of contrast enhancement, particularly in the spine in young children. Diffusion weighted imaging (DWI) is not yet part of the standard imaging protocol in paediatric musculo skeletal imaging. However, DWI is thought to have a high sensitivity for bone marrow pathology and is particularly used in oncology imaging. It has also been shown to have a role in detection of active inflammatory changes. Tissues with high cellularity like tumours or inflammatory infiltrates will often have restricted water diffusion. This gives a high signal on DWI. Diffusion weighted imaging with body-background suppression (DWIBS) is a novel diffusion weighted sequence particularly suitable for whole-body imaging designed for tumour staging and screening for metastases.

Red marrow is composed of approximately 40–60% lipid. The fatty component in red marrow accounts for the fact that its signal is higher on T1weighted sequences than that returned by muscle and intervertebral discs. Conversely the signal is lower than muscle on fat-suppressed T2 weighted imaging. An exception is in very young children where the fat content can be lower hence the MRI-signal from the red marrow differs from that in older children. Yellow marrow is almost entirely composed of fat with an almost 95% adipocyte content and therefore has a similar signal to subcutaneous fat.

Pathological bone marrow due to infiltration or inflammation usually returns lower signal than red marrow on T1 weighted images. Marrow lesions usually have a high content of free water and return higher signal on T2 weighted sequences than red marrow. As a rule of thumb red marrow has diffuse borders whereas marrow infiltration have sharp margins. Red marrow returns relatively homogenous signal and the bone marrow changes in inflammation, particularly osteomyelitis is often more heterogenous. Still this is not always the case and misdiagnosis can occur for a number of reasons. Firstly it is important to recognise normal variants.

Common pitfalls

Several studies describe the presence of focal altered marrow signal at different sites in healthy children that can be misinterpreted as pathology. The best documented bone marrow oedema (BMO)- like lesion in children is from residual red marrow in the proximal metaphyses of the

femora and humeri. These pseudo-lesions are characterised by high signal on fat saturated T2 weighted sequences and low T1 signal, which should not return lower signal than adjacent muscle and typically have a flame shape with a base adjacent to the physis and have straight vertical margins with no mass effect on the adjacent yellow marrow. The background trabeculation is not distorted. This contrasts with contusions and tumour in which well-defined lesions and distortion of the trabecular pattern are typical. Occasionally this can be difficult to differentiate from pathological marrow signal, e.g. in early phases of inflammation, like in osteomyelitis. However, signal from residual marrow is bilateral and relatively symmetrical hence images of both extremities could be obtained when in doubt.

Studies in asymptomatic and healthy children have demonstrated the presence of foci, which are hypointense on T1 weighted sequences and hyperintense on fluid sensitive sequences in the ankle and foot as well as in the carpus. In one study 50% of children aged 5 to 15 exhibited these marrow signal changes in at least one of the carpal bones. It is uncertain what causes this signal but one theory is that it represents bone marrow oedema from 'microtrauma' occurring after normal activity, due to the relative plasticity of the growing knuckles. It has also been postulated that small patchy areas of high signal on water sensitive sequences could represent 'islands' of residual red marrow. Bone marrow oedema (BMO) is a non-specific expression on MRI and only refers to a finding with defined signal characteristics regardless of the histological characteristics of the tissue. It is not unlikely that the 'BMO' seen in healthy children represents a different entity to the 'BMO' caused by inflammation. The problem is that the BMO-signal caused by physiological processes is indistinguishable from BMO-signal caused by inflammation on standard fat suppressed T2 weighted sequences. This makes it difficult to differentiate normal findings from pathology based on the MRI alone. Marrow can appear diffusely hyperintense on STIR sequences and this can simulate tumour infiltration particularly in children under 5 years. This occurs as both fat and fluid can contribute to increased signal and correlation with T1weighted imaging is essential. Positive STIR can be difficult to interpret, however with negative findings on the STIR sequence bone marrow infiltration is highly unlikely. Restricted diffusion is also shown to be a normal finding in healthy children, even in an asymmetrical pattern. It is likely that cellular red marrow within the axial skeleton and proximal femur accounts for some of the high signal seen on the DWI but also growth zones with high cellularity showed restricted diffusion in the cohort of healthy children. To date methods for accurately distinguishing physiological causes from pathological causes of restricted diffusion in children are lacking hence using DWI as a screening tool for marrow involvement may lead to over-diagnosing of disease.

Conclusion: Knowledge of the age dependent appearance of bone marrow, normal variants and the characteristics features of true pathology is crucial in the interpretation of MRI in children. Pathology may be difficult to differentiate from normal variants. Further research is needed to find MR-techniques that increase the specificity of alterations in bone marrow on MRI in children. Clinical correlation is crucial to establish the diagnosis, particularly in infectious and inflammatory disorders. Histopathology remains the gold standard for malignant lesions within the skeleton.

Further readings

Foster K, Chapman S, Johnson K (2004) MRI of the marrow in the paediatric skeleton. Clin Radiol 59:651–673

Burdiles A, Babyn PS (2009) Pediatric bone marrow MR imaging. Magn Reson Imaging Clin N Am 17:391–409

Shabshin N, Schweitzer ME, Morrison WB, et al. (2006) High-signal T2 changes of the bone marrow of the foot and ankle in children: red marrow or traumatic changes? Pediatr Radiol 36:670–676

Muller LS, Avenarius D, Damasio B, et al. (2011) The paediatric wrist revisited: redefining MR findings in healthy children. Ann Rheum Dis 70:605–610

Ording Muller LS, Avenarius D, Olsen OE (2011) High signal in bone marrow at diffusion-weighted imaging with body background suppression (DWIBS) in healthy children. Pediatr Radiol 41:221–226

Soft tissue tumors and tumorlike lesion
Or
How to obviate missing the essential

P. Petit – A. Aschero – B. Bourliere-Najean- C. Desvignes – G. Gorincour – C. Sorensen – N. Colavolpe – P. Devred
Service d'Imagerie Pédiatrique et Prénatale – Hôpital de la Timone Enfants – Marseille - France

There is definitely an increasing demand from the pediatricians and from the plastic surgeons to the pediatric radiologists for exploration of soft tissue lesions. At least two main factors explain this situation:

- The parents who insist for imaging confirmation of a clinical diagnosis. The role of Internet in this comportment is undeniable.
- The ability on an easy access exploration (i.e., Ultrasound Doppler) to resolve with a high specificity some inconclusive clinical situations.

The responsibility of the radiologist is then considerable. He needs to rely on corner stones clinical informations (patient's age, site of the lesion, clinical history and especially chronicity of the lesion) and to a perfect knowledge of all typical lesions.

USD is the first imaging examination to perform. Not only the use of linear high frequency probes is essential but also the *use of low frequency probes in order to always rule out an iceberg lesion*.

Most of soft tissue lesions are benign and some of them present an USD signatures.

- *Pilomatricomas* are mummification of sudoral glands. Clinicians generally do not ask for an imaging exploration but when their diagnosis is doubtful USD will be needed. The lesion is well limited with an hypoechoic rim, its contain is partially cystic, containing some calcified focis with posterior shadowing. Vascularization when present is peripheral.
- *Hemangiomas*, which represent benign tumoral endothelial cells proliferation, may need an imaging exploration especially when they are deeply located or when they present without typical cutaneous stigmatas. They are well-limited lesions with rich arterial supply. Presence of calcifications and rich venous components are two USD findings in favor of congenital hemangiomas. Ill-defined contours may lead to suspicion of Kaposiform hemangioma. Since 50% of the latter lesion may be associated with Kasabach Merritt phenomenon, a close follow up of the D-dimers and platelets is warranted. Up to 10% of death are reported when this coagulopathy occures.
- *Congenital vascular malformations* are the most frequent soft tissue lesions. Most of them can be perfectly identified by USD. However, differential diagnoses include malignant tumors and a careful thorough exploration is always mandatory. Microcystic lymphatic malformations and complicated venous or lymphatic malformations (hemorrhage, infection) may be misleading. Well-limited arteriovenous malformations are uncommon and must be considered very suspicious and biopsied. Differential diagnoses include alveolar soft part sarcoma and angiosarcoma.
- These malignant tumors are rare, accounting for around 1% of all soft tissue tumors in pediatrics. *Rhabdomyosarcoma* represents 50% of all soft tissue sarcomas. They may happen at any age and the principal differential diagnosis is the intramuscular venous malformation (VM). Some US findings can be confusing. The presence of fluid-fluid level in the lesion is not sufficient to ensure the diagnosis of VM. On the other hand the presence of some poor arterial flow (<15 cm/s) within the lesion will not exclude the diagnosis of VM. Looking for a round shaped phlebolith with or without posterior shadowing becomes then essential to ensure the diagnosis of VM. Rhabdomyosarcoma is a well limited lesion principally composed of tissues of different echogenicity with usually a rich arterial flow. One must take into account that even with the high sensitivity of Doppler, an absence of flow does not mean that the lesion is not vascularized. However, this finding is in favor of the benign nature of the lesion. Contrast-US would be of interest in this setting. However, the use of this product has not been yet approved in pediatric patients.
- *X-rays* need frequently to be added to USD either to look for additional information in the soft tissues, to help to characterize the lesion (calcified phlebolith in venous malformation, fat in lipoma and lipoblastoma) or to look for associated bony involvement (all vascular malformations, lipoma). All calcified structure in the soft tissue must no be considered phlebolith and care must be taken that calcification may also be present in malignant lesion (synovial sarcoma). Furthermore, in case of atypical superficial vascular lesion the rule is *always to consider tumor especially of bony origin with soft tissue extension.*
- *MR imaging* has two definite roles: first of all to assess the full extension of the malformation and to accurately localize the lesion compare to vital anatomical structures. Its second role will be potentially to add useful informations to the USD findings in order to definitely identify the lesion. *From the results of the USD exam will depend the type of MR-sequences to realize and the need for Gadolinium administration.* If the lesion is definitely identified by clinical and US finding as a venous or a lymphatic malformation there is for us no interest for gadolinium administration. If an arteriovenous malformation is identified on USD then a dynamic MR angiography is required. MR exploration must includes sequences that allow to search for fluid-fluid level that can be missed on USD. This sign is not specific and can be found either in benign (venous and complicated lymphatic malformation, myofibromatosis) or in malignant lesions (angiomatoid fibrous histiocytoma, synovial sarcoma). Anyhow, it will restrain the differential diagnoses. At least axial SpinEcho T2 and sagittal T1 sequences are required. The use of only T2 Fat saturation sequence may lead to wrong diagnosis of benign liquid containing lesion; necrotic malignant lesions and myxoid lesions may have a pseudocystic appearance. Except the previous mentioned non-indications, Gadolinium injection is systematically required. MR diffusion sequences has not proved at that time to be determinant either to separate benign from malignant processes or to accurately evaluate post therapeutic changes. Criterias in favour of malignancy remain: size (more than 5 cm), absence of low signal intensity on T2, signal heterogeneity on T1, peripheral and centripetal contrast enhancement, contiguous invasion of bone and/or neurovascular structures However, all these MR criterias are not 100% specific.

– *CT* exploration is exceptionally indicated. Suspicion of myositis ossificans with its centripetal calcifications is the most frequent relevant indication.
– *Angiography* is only dedicated for exploration of arteriovenous malformation. Due to its aggressiveness especially in pediatrics, it is almost only performed as the first step before embolization. In some rare cases where the feeding vessels are not well enough demonstrated by angio-MRI, the angiography will be done to accurately define the therapeutic strategy. In this situation, the risk of an increase activity of the lesion by the stimulation due to the catheter is always to be considered.

All soft tissue masses, which remain of uncertain origin must, benefited from a multidisciplinary consultation in order to decide what kind of biopsy (fine-needle aspiration, core biopsy, surgical open biopsy) will be necessary. Multiple samples need to be realized through a dedicated approach and send to specifics labs, including histopathology, immunohistochemistery and cytogenetic.

Whole body imaging and DWI in pediatric skeletal disorders

M. Alison, A. Tanase, A. Rega, B. Tilea, *G. Sebag*
Hôpital Robert Debré, Université Paris Diderot Paris VII, Assistance Publique-Hôpitaux de Paris France

Recent technological advances of MRI (multi-channel coil, parallel acquisition, automatic free table motion, moving table/rolling table platform, pulse sequence design) have enabled to cover the whole body in a reasonable time frame. At the same time, diffusion weighted imaging (DWI) has been developed for whole body imaging and for musculoskeletal disorders, providing functional information.
Therefore MRI has become the imaging of choice for pediatric musculoskeletal disorders as a radiation free technique, associating both anatomical and functional informations. MRI tends to have an important role competing with radiating techniques such as whole body skeletal survey, scintigraphy or TEP-CT.

Whole body MRI

The role of whole body MRI (WB-MRI) is to detect and localize all the lesions in a single examination, including asymptomatic lesions. A targeted imaging with more sequences can then be performed, as a complement, to characterize a lesion.
Most lesions have different signal intensity than normal tissue on STIR sequence. This technique is therefore highly sensitive but non specific as signal abnormalities can reveal tumoral lesions (benign or malignant) as well as infection, inflammation or traumatic injuries.
WB-MRI is the imaging of choice to analyse the bone marrow and to determine if a bone lesion is isolated or multifocal. Thanks to a high contrast resolution, whole body MRI is also highly sensitive in order to assess multiple soft tissue lesions.

Technical considerations

There is no current consensus about which sequences to perform. The total acquisition time depends on the size of the child, the number of sequences used and can vary from 30 to 60 min.
The coronal plane is commonly used as the faster plane to cover the whole body. Sequential stations are performed with an overlap of a few centimetres in order to merge the images during post processing. The STIR sequence is the most commonly used, being highly sensitive enough to detect oedema and most lesions. For thoracic and abdominal acquisitions, respiratory gating can improve diagnosis accuracy at the cost of increased acquisition time.
T1-weighted sequences without fat saturation can be useful in children to analyse the bone marrow. Contrast enhanced T1-weighed sequences are used by some authors for the staging of tumoral diseases. Three-dimensional gradient echo sequence can be performed in a single breath hold for each station. This sequence can also be used for vascular analysis.
Diffusion weighted sequences with fat saturation (DWIBS) can be performed with high b value (b=500 to 1000 s/mm^2), in the axial plane, with coronal reconstructions.

Clinical applications

Oncology/hematology

WB-MRI is the imaging of choice to analyse the bone marrow. Normal bone marrow conversion from haematopoietic to fatty bone marrow has inter-individual variations but always follows the same temporal sequence. Comparison to the controlateral side can be useful in children.
Diffuse abnormal signal of the bone marrow can be related to bone marrow infiltration (leukemia, neuroblastoma), storage disorders (Gaucher disease) or regenerative bone marrow (sickle cell disease, chemotherapy, bone marrow graft…).
The use of WB-MRI for the **staging of malignant disease is increasing**. Most indications in paediatrics patients are lymphomas, neuroblastomas and sarcomas.
Whole body MRI is more sensitive than bone scintigraphy to detect **bone metastases**. The sensitivity of WB-MRI to detect skeletal lesions in children ranges from 82% to 99%, whereas the sensitivity of bone scintigraphy ranges from 26% to 71%. Goo et al. have also demonstrated on 26 children that MRI with coronal ± sagittal STIR sequences and coronal enhanced T1-weighted sequence was more specific (94% vs 76%) than bone scintigraphy.
For **neuroblastomas,** the role of WB-MRI has to be established in comparison to MIBG scintigraphy. Goo et al. have demonstrated in 13 patients that WB-MRI

was highly sensitive (100% versus 25%), but with a low specificity for both bone (8% versus 100%) and visceral lesions (57% vs 100%). However, MIBG scintigraphy has also several limits: a low sensitivity to detect bone marrow lesions and 6% to 10% of false negative representing (neuroblastomas without fixation).

Sensitivity of whole body MRI has recently improved in comparison to PET-CT. Krohmer et al. have demonstrated on 24 children with **sarcoma or lymphoma** that WB-MRI had a high sensitivity for bone lesions (100%) and for extra skeletal lesions (93.7%) compared to PET-CT used as the gold standard. Punwani et al. have studied 31 children with lymphoma. WB-MRI was compared to PET-CT as the reference, with a good agreement: sensitivity/specificity of 98/99% for nodal disease and 91/99% for extra nodal disease. A recent multicentric study of the American College of Radiology, on 66 children with lymphomas and solid tumours (neuroblastomas, sarcomas) has failed to establish non inferior accuracy of WB-MRI (STIR sequences) for the diagnosis of distant metastasis compared with conventional methods, including CT, bone or MIBG scintigraphy or FDG PET. This low performance was mainly due to the low sensitivity of WB-MRI to detect extra skeletal metastases, in particular small metastases ≤1 cm located in the lung or liver. However, the main limit of this study was that other sequences with respiratory gating and diffusion weighted imaging were not used. These complementary sequences could improve diagnosis accuracy.

Other skeletal disorders

For **Langerhans histiocytosis** WB-MRI is the imaging of choice for the staging and the follow-up: MRI is more sensitive than bone scintigraphy or plain film with more than 25 to 50% of additional lesions depicted on MRI. WB-MRI can also assess visceral involvement (liver and spleen).

WB-MRI is also useful for the diagnosis and the follow-up of **chronic recurrent multifocal osteomyelitis, fibrous dysplasia or multifocal osteonecrosis** (post chemotherapy or graft).

WB-MRI could have a role in **musculoskeletal infection**, for patients at high risk of multifocal infections (sickle cell, immunocompromised, newborn) or for severe infection due to virulent germ such as necrotizing fasciitis or septic shock. WB-MRI achieves accurate extension of the lesions in order to perform surgical procedures in a single step (joint lavage, subperiostal abcess drainage). WB-MRI can also detect associated extra skeletal infectious lesions (lung septic emboli, splenic abcess, intra muscular collection…).

For non accidental trauma, WB-MRI is not recommended yet and the gold standard remains the skeletal survey. Indeed, Perez-Rossello et al. have demonstrated on 21 children that WB-MRI (coronal and sagittal STIR sequences) was specific (95%) but not sensitive (40%) compared to plain films in this context, especially for highly specific fractures such as classic metaphyseal (Se: 31%) and rib fractures (Se: 57%).

Soft tissue lesions

WB-MRI is also the examination of choice for the diagnosis and the follow-up of diffuse muscular lesions like **myositis**. STIR sequence can detect active lesions, their distribution pattern and can help to determine the biopsy site. T1-weighted sequence without fat suppression can demonstrate muscular fatty infiltration in more advanced states.

Diffuse vascular malformations like hemangiomatosis and cystic lymphangiomatosis can involve both the bone and the soft tissue (liver, spleen, lung). At diagnosis, enhanced sequences will be performed to differentiate enhancing hemangiomatosis from non enhancing lymphangiomatosis.

Several studies have also demonstrated the role of WB-MRI to follow-up **neurofibromatosi**s, for volumic assessment of plexiform neurofibromas.

Limits and perspectives

The main limits of WB-MRI are its **low specificity for staging in oncology**, with the risk to overestimate secondary lesions and over-treat the patients. Conventional sequences do not differentiate benign from malignant lymphadenopathy as PET-CT does. Adding diffusion sequence may help to overcome this limitation.

Small lesions in the lung or small lymph nodes can also be overlooked with WB-MRI. Indeed, Brennan et al. have demonstrated that sensitivity of WB-MRI using coronal and axial sequences was 100% for lymph nodes larger than 12 mm, but was only 11% for lymph nodes smaller than 6 mm. For tumoral staging, it is therefore recommended to add axial sequences on the trunk with respiratory gating if possible. DWI could also improve the sensitivity of WB-MRI to diagnose small lesions.

Technological advances could decrease movement artefacts, using respiration gating, but with a slight increase of the acquisition time.

Dynamic enhanced sequences can be performed with some manufacturers with a reasonable temporal resolution.

3T MRI can improve signal to noise ratio, but can also increase susceptibility artifacts in particular for DWI. Fat suppression is also challenging at higher-field MRI.

Diffusion-weighted imaging

Diffusion-weighted imaging (DWI) can help to characterise lesions, adding functional information.

DWI sequence for whole body examination is now available on most devices, however acquisition time remains high and this sequence is not performed routinely. Single shot echo planar (SS-EPI) sequence is commonly used. DWIBS (Diffusion-weighted Whole Body Imaging with Body background Signal Suppression) is performed with fat saturation,

free breathing, and a high b value (b=1000 s/mm^2) in order to suppress background noise and to enhance lesion signal. Inversion of grey scale is used to obtain TEP like images. DWIBS sequence only provides qualitative analysis.

Some authors have demonstrated that DWIBS improves the staging of lymphoma allowing a better visualisation of the lymph nodes and liver lesions. However, measurement of the lymph node should be performed on conventional sequences (STIR or T1-weighted).

The pediatric bone marrow is also heterogeneous on DWI. Ording-Müller et al. have demonstrated on normal children that haematopoietic bone marrow, physes and apophyses have asymmetric high signal intensity on diffusion particularly on the pelvis and on the spine, with important inter individual variability.

DWI could help to characterize bone lesions and to differentiate malignant highly cellular tumors with lower ADC from benign lesions with higher ADC, but with overlapping values.

More interestingly, DWI can evaluate the effect of chemotherapy on cellularity by detecting tumor necrosis with increased diffusion. ADC value seems to be a better indicator of tumor response than tumor volume, signal or enhancement pattern.

For bone infection, DWI could help to differentiate oedema from tumor, acute from chronic infection and to assess the response to antibiotic therapy.

Conclusion: As a non ionizing modality, WB-MRI has increasing indications for multifocal lesions in pediatrics. However, acquisition time remains long and recommendations and detailed protocols have to be worked out. The physiological heterogeneity and cellularity of pediatric bone marrow make this examination more challenging in children. The role of WB-MRI for tumoral staging has to be further determined and included in protocols. The high sensitivity of this technique with its low specificity could result in an increase of complementary examination and the risk of overtreating the patients.

DWI has been developed for bone analysis and may provide complementary functional information for the diagnosis and the monitoring of several musculoskeletal injuries.

Congenital nephrotic syndromes: a review on the clinical, genetic and sonographic evaluation

E. Fred Avni
Department of Pediatric Imaging, Jeanne de Flandres Hospital, CHRU-Lille,France

Introduction: A nephrotic syndrome (NS) is a disease consisting of massive leakage of proteins in urine, potentially lifethreatening due to hypovolemia, hypercoagulability and infections. It is defined by the association of edema, urinary protein >20 g/L and serum albumin level <10 g/L. The annual incidence of NS in the USA and Europe is estimated at about 1–7/100.000 births. Most NS result from a dysfunction of the podocytes at the level of glomerular filtration barrier. Treatment ought to be installed as early as possible in order to reduce hypoproteinemia and its secondary effects. Several NS are corticoid-sensitive but many are corticoid-resistant especially among congenital NS.

There are three types of NS, idiopathic (the most common), secondary and congenital. Congenital NS (CNS) is a NS diagnosed in utero or during the first 3 months after birth. Infantile NS cases are discovered later during the first year and childhood NS after the first year. This clinical classification is however arbitrary, since the majority of early onset NS have a genetic origin and have a widespread age of diagnosis (from fetal life to several years). Among CNS, some occur as an isolated finding but some are part of more complex syndromes. Their diagnosis has been greatly facilitated thanks to genetic progresses. On the contrary, surprisingly enough, the role of US in the diagnosis of CNS has been rarely highlighted.

The aims of the present review are to illustrate the knowledge accumulated on CNS in terms of genetic classification, findings at histology and ultrasound.

2. Forms of CNS

As more and more genetic defects are detected in CNS, their classification is presently based upon the genetic mutations and less on the clinical characterisation.

2.1. Genetic forms of CNS

- *Nephrin gene (NPHS1) mutations:*
  Mutations in NPHS1 gene (coding for nephrin) cause a severe form of CNS also known as CNS of the Finnish type (Both terms are used).
  The incidence is one in 8000 live births in Finland. Close to 100 mutations of the *NPHS1* gene have been described (Fin Major and Fin Minor are the commonest in Finland).
- *Podocin gene (NPHS2) mutations:*
  Mutations in the *NPHS2* are common causes of CNS and of childhood corticoid resistant NS.
  The severity of proteinuria and the spectrum of clinical findings are more variable than with *NPHS1 mutations*.
- Wilms' tumor suppressor gene (*WT1*) encodes for a transcription factor WT1 which plays a significant role in the embryonic development of the kidney and genitalia. Mutations in *WT1* may cause several types of syndromes manifesting in childhood or at birth (e.g. Denys-Drash, Frasier, WAGR (Wilms' Aniridia

Genito-urinary malformation and mental retardation syndrome). *WT1* mutation may exist as an isolated kidney disease. Renal biopsy reveals diffuse mesangial sclerosis (DMS) of the glomeruli (as in Denys-Drash syndrome that associates CNS + disorders of sexual differentiation + risk for Wilms' tumors) or Focal and segmental Glomerulosclerosis (FSGS) (as in Frasier syndrome that associates male pseudohermaphrodism and CNS).

– Other mutations include the Lamin-ß2-gene mutations (*LAMB2*) as in the Pierson Syndrome (CNS + ocular anomalies) and more recently *PLCE1* mutation has been described.
– In some syndromes such as the Galloway-Mowat Syndrome (NS + central nervous system anomalies), the mutation has not yet been determined. The NS appears at the age of a few months and kidney biopsy may show only minor changes (minimal change, FSGS or DMS).

2.2. Non-genetic forms of CNS

CNS may be secondary to various infectious agents (CMV, syphilis, rubella, toxoplasmosis…). On histology, lesions of membranous nephropathy are described. It may also develop secondary to maternal lupus and allo-immunization against maternal neutral endopeptidase (NEP). Allo-immunization against maternal NEP has been shown to cause (transient) still severe forms of fetal and neonatal renal disease as a result of the transplacental passage of anti-NEP antibodies. This results in an acute glomerulonephritis with features of CNS that resolves spontaneously after birth with the reduction of circulating antibody levels. On histology, distended Bowman's spaces and thickening of the capillary walls are described during the acute stage.

As mentioned, secondary CNS is more likely to resolve spontaneously.

3. Clinical diagnosis of CNS

The diagnosis of CNS is based on clinical findings associated to proteinuria (edema, urinary protein/creatinine ratio >2 and severe hypoalbuminemia <10 g/l). Renal failure may or may not develop within the first months. Small accounts of red blood cells and leucocytes are present in the urine.

Renal biopsy does not easily reveal the etiology of CNS as the histological findings may overlap or be segmented and scarce. Some authors stress that the knowledge of the severity of glomerular sclerosis and interstitial fibrosis may help in the assessment of treatment. Furthermore, for others, the histological finding and electronic microscopy may orient the diagnosis more rapidly.

Genetic analysis is the method of choice in order to obtain precise CNS diagnosis. Yet, not all mutations have been identified at this stage. Furthermore, it may take time to obtain the diagnosis.

4. Contribution of Ultrasound (US)

4.1. Antenatal diagnosis

Hyperechoic kidneys are a classical finding on obstetrical US that prompt a complete fetal and maternal work-up in order to differentiate between the potential diagnoses. This finding is not by itself specific of CNS; still, the detection of hyperechoic kidneys in association with a *thick placenta, intra-uterine growth retardation and polyhydramnios* should suggest the diagnosis. An amniotic fluid analysis should then be performed to look for increased proteins and αFP levels as well as maternal blood sampling to look for increased serum αFP. As CNS can develop secondary to maternal diseases and various infections, the disease should be suspected whenever renal parenchymal abnormalities are detected in association with any of such conditions. Furthermore, it is usually accepted that in case of a familial history of a renal disease, the finding of abnormal kidneys in a subsequent pregnancy signifies a recurrence of the disease (as for instance in maternal neutral endopeptidase deficiency—see below).

4.2. Post-natal diagnosis

There are several US patterns suggestive of sub-types of CNS. First, in patients with *diffuse mesangial sclerosis (DMS),* a sonographic pattern as described by Salame et al. seems specific: normal sized kidneys displaying *inhomogeneous (patchwork-like) parenchymal hyperechogenicity that includes areas of both the cortex and the medullar,* and *partial loss of cortico-medullary differentiation (CMD)*. This correlates well with the pathological changes that are observed in patients with DMS. In the same kidney, various stages of glomerular lesions can co-exist with a cortico-medullary gradient. The most specific lesions are found in the mid-cortical layer and consist of glomeruli with a solidified flocculus and enlarged Bowman's capsule, which is responsible for compression and disappearance of the capillaries. Glomeruli situated in the superficial layer are atrophic. The coexistence of various degrees of glomerular involvement is possibly responsible for the patchwork appearance on US, and might also be responsible for diagnostic difficulties in specimens obtained by renal biopsies.

Second, in patients affected by *CNS of the Finnish type*, a typical evolutive US pattern can be observed: *enlarged kidneys (around +2SD) with hyperechoic cortex and variable size and shape of the pyramids*. During follow-up, the size of the kidneys reduces and *the pyramids "shrink" resulting in a progressive disappearance of the CMD*. In CNS of the Finnish type, the changes observed on US can be related to the pathological findings as well. For instance, the renal cortex hyperechogenicity could be related to the microcystic dilatation of the tubules and interstitial inflammation typical of the disease. These changes progress during the following months. Interstitial fibrosis and glomerular sclerosis develop progressively as well.

The US pattern (and evolution) in CNS secondary to *maternal deficiency in Neutral endopeptidase allo-immunization (NEP)* may also be a suggestive pattern. NEP allo-immunization has been determined to cause severe forms of fetal and neonatal disease as a result of the transplacental passage of anti-NEP antibodies. This results in acute membranous glomerulonephritis with subsequent NS that will resolve spontaneously and progressively after birth with the reduction of the circulating antibody levels. As the disease starts in utero, the fetal kidneys present *an increased cortical thickness and echogenicity.* The US pattern can be related to the histological findings: distended Bowman's spaces, and thickening of the capillary walls during the acute stage. Recurrence of the disease should be suspected in subsequent pregnancies whenever the kidneys display any abnormal feature on obstetrical US. After birth, the kidneys may still appear moderately enlarged and hyperechoic with preserved CMD. In most cases, the US pattern evolves toward slow post-natal normalization.

To date, no other specific US patterns have been observed in patients with CNS.

Due to hypercoagulability, patients with CNS are at risk for developing renal vein thrombosis; this diagnosis as well as its follow-up can be monitored by US.

Noteworthy is that US has another potential contribution by allowing the monitoring of patients with WT1 mutation who are at risk for developing Wilms tumor.

5. Management of CNS

As most cases of CNS are steroïd-resistant, the goal of therapy is to control edema and uremia as well as to control other related complications as thrombosis, infections, rickets, hypothyroidism, anemia, etc. Massive albumine infusions will be necessary to counterbalance the severe hypoproteinemia. Angiotensin converting enzyme inhibitors may also be used to reduce protein excretion. High energy diet is mandatory. Supportive therapy will be sufficient in cases with resolving secondary CNS.

Kidney transplantation is the only curative treatment in steroid resistant CNS.

Further readings

Davin JC Ruties NW (2011) Nephrotic syndromes in children : From bench to treatment Int J Nephrol 2011:372304. doi: 10.4061/2011/372304. Epub 2011 Aug 28

Salame H, Damry N, Vandehoudt K, Hall M, Avni F (2003) The contribution of US for the differential diagnosis of congenital and infantile nephrotic syndromes. Eur Radiol 13 : 2674–2679

Avni EF Vandenhoute K Devriendt A Ismaili K & al (2011) Update on congenital nephrotic syndromes and the contribution of US Pediatr Radiol 41: 76–81

Jolly M, Goodburn S, Cox P, Loughna P (2003) Congenital nephropathy and ventriculomegaly: a report of 4 cases Prenat Diagn 23 : 48–51

Nortier JL, Debiec H, Tournay Y et al. (2006) Neonatal disease in neutral endopeptidase allo-immunisation : lessons for immunological monitoring. Pediatr Nephrol 21 : 1399–1405

Imaging of the neonatal female pelvis

Michael Riccabona
Department of Radiology, Division of Pediatric Radiology, University Hospital LKH Graz, Austria

Introduction: This presentation focuses on imaging of the neonatal female pelvis. It is based on the work and the recommendations of the ESPR Uroradiology Task Force and ESUR Paediatric Working Group Part VI, recently published in Paediatric Radiology, after presentation a discussion al last years meetings . These aim at providing standard recommendations for important paediatric uroradiology procedures in order to homogenize imaging, increase patient safety, reduce burden from imaging and invasiveness, as well as to provide comparable data for future meta-analysis to improve the potential for meta-analysis and increased evidence based knowledge. A large variety exists in the approach of the work-up of these conditions between the various centers. Practically all imaging modalities are used in a varying order.

The recommendation for an imaging algorithm in assessment of the neonatal female genital tract focuses on the potential of a detailed and through initial ultrasound (US) examination (including perineal US and US-genitography) - this intrinsically reduces the need for more invasive or radiating imaging adhering to the ALARA principle. The most common query is the assessment of congenital malformations or ambiguous genitalia, other conditions are much rarer in the neonatal female pelvis and not addressed in detail. Based on the US findings and clinical data as well as laboratory information, additional steps such as fluoroscopy or MRI should be indicated in selected cases only. Hopefully adherence to these recommendations will in future allow generating comparable data that hopefully will provide more evidence for adaptation of imaging strategies. After thorough review of existing literature and assessment of different approaches in various centers the group has distilled a proposal for common proceedings as a consensus statements due to lack of sufficient evidence based data.

The following will briefly summarize the imaging algorithm, will present the procedural aspects of US, US- and fluoroscopic genitography, and MRI, and shall illustrate typical images of normal findings as well as common pathology. Other conditions in the neonatal female

pelvis such as urinary tract pathology or typical conditions of older girls (particularly torsion and infection) will not be addressed.

What to consider

Basic requisite of all imaging is familiarity with normal appearances of inner genitalia in neonates and infants. Additionally, knowledge and awareness of typical imaging appearance of malformations and other genital pathologies is essential. Finally technical details on how to properly image the various conditions applying the relevant imaging techniques must be known.

The female genital tract develops together with the genital tract from the Gartner, Wolffian and Muellerian duct. Knowledge of this development is indispensable for understanding and properly classifying respective disorders, and also explains why there is a higher prevalence of genital malformations in girls with urinary tract anomalies.

The often quite complex disorders of sexual differentiation (or intersex) cover a wide and complex group of abnormalities resulting from non-accordance between chromosomal, gonadal and genital gender. They are now called "disorders of sexual development" and replace the term intersex. Due to their complexity and the need for a multidisciplinary team approach, these patients should be referred to a dedicated pediatric centre. Some basic facts can be found in the consensus statement on management of intersex disorders issued by the Lawson Wilkins Pediatric Endocrine Society and European Society for Pediatric Endocrinology, introducing a new terminology and thus also defining the question imaging needs to answer (Table 1). The major task of imaging is to define the presence or absence of crucial structures of the inner genitalia (uterus? ovaries? testis?). These will allow - together with laboratory and clinical, genetic and endocrinological findings—the proper classification.

What to look for

The ovaries and uterus are typically prominent in female neonates (by maternal hormonal stimulation). This allows for a unique opportunity to detect and characterize particularly uterine congenital anomalies, which is helpful for planning therapy and to prevent later complications at onset of puberty. As genital anomalies or often associated with urinary tract malformations, early and accurate imaging assessment of the inner genitalia is advisable in neonates and infants with such conditions. Likewise, neonates and infants with genital tract malformations should undergo a complete evaluation of the urinary tract to search for associated and/or combined urinary tract anomalies.

The most common entities to be considered are in the urinary tract a multicystic dysplastic kidney, an unilateral dysplastic kidney, or a single kidney, potentially also with an ectopic drainage of an ureter or an ureterocele. In genital tract the most common findings are uterine variations with associated vaginal changes (e.g., arcuate or duplex ueterus, uterus didelphis with duplex vagina and/or vaginal atresia leading to hydro-/methrocolpos). Malformations of the outer genitalia or ovarian pathology is not commonly associated with urinary tract anomalies. The other big groups that indicate imaging on the female pelvis are clinically obvious ambiguous/altered outer genitalia including congenital adrenal hyperplasia or cloacal malformations—commonly presenting with an ambiguous genitalia or clitoral hypertrophy and a urogenital sinus tract. Ovarian pathology in neonates usually is associated to hormonal overstimulation causing sometimes huge cysts potentially with secondary haemorrhage or even intrauterine torsion. Ovarian or pelvic tumours are very rare in neonates, except for the more common (sacrococcygeal) teratoma. These as well as other findings affecting the sacrum/coccyges (e.g., Curarino triad, sacral agenesis, tethered cord …), the pelvis or the pelvic cavity, as well as the bladder and the bowel/rectum/pelvic floor will not be addressed.

How to image

Ultrasound is the primary imaging modality to evaluate the neonatal female genitalia. A dedicated and sophisticated US technique is essential to obtain maximum diagnostic information. High frequency linear transducers must be applied. A systematic transabdominal examination of the entire pelvic cavity via a full bladder and a complementing perineal approach are fundamental. Filling of the bladder after catherisation by a saline drip infusion as for voiding urosonography (VUS) may be extremely helpful, the same catheter can then be used to complete the investigation by instillation of an US-contrast agent (commonly SonoVue®, Bracco, Italy) to look for associated vesico-ureteric reflux (VUR) by contrast-enhanced VUS (ce-VUS). The contrast agent instillation (1% of filling volume) can also be helpful to detect and document fistula tract or irregular connections between cavities such as a urogenital sinus tract. Note that these US contrast agents are presently not licensed for paediatric use. Additional CDS has little importance; 3DUS may be very helpful to conspicuously demonstrate uterine anatomy as known from adult imaging, as the crucial coronal plane can be reconstructed for unequivocal differentiation of the various forms of uterine anomalies.

Fluid (usually sterile pre-warmed saline as in VUS) instillation into the vagina via a small flexible feeding tube may considerably improve visualization particularly of the vagina and cervix. This procedure is called US-genitography and should be performed whenever genital US is insufficient for adequate characterization of utero-vaginal anomalies, in suspicion of vaginal duplications, of if fistula tracts and urogenital sinus etc. are considered. Additional rectal saline filling via enema may be useful, such as in

Müllerian duct agenesis to assure the absence of uterus, or for fistula detection. In cloacal malformations, bowel/rectal filling may be achieved via colonostomy (if already in place) or via the stenotic anal canal/fistula tract after gentle catheterisation. In all these conditions a complementing perineal approach is mandatory.

Further imaging is only indicated if US cannot answer all treatment relevant questions or pre-operatively; it should not be performed as a routine baseline study. It commonly is achieved by fluoroscopic genitography and (ce-)MRI. Very rarely ce-CT is indicated or justified - mainly if no MRI is available for assessment of complex anatomy, potentially involving pelvic osseous structures, for pre-operative assessment of difficult cloacal malformations (also using a dedicated technique and filling of the various orifices as well as dedicated paediatric protocols with lowest possible radiation burden)—this technique, however, should be reserved for dedicated centers. Unlike in adults or children, MRI evaluation of the neonatal genital tract is often less useful due to resolution issues and sedation needs. If required, high resolution 3D sequences, potentially after saline instillation into the vagina. Additionally bladder as well as rectal filling with variably diluted contrast material may be useful. In these cases a "morphologic" (T2-) MR-urography should be added for evaluation of associated urinary tract malformations to complete the investigation.

Conclusion: Ultrasound is the mainstay of imaging the "neonatal female pelvis". Proper technique using high resolution transducers and a perineal access with complementary US-genitography are the corner stone of neonatal genital sonography. Provided sufficient knowledge of the embryology and of the various forms of genital anomalies as well as the crucial queries in evaluating disorders of sexual development US usually is sufficient. Complementary assessment of urinary tract for commonly associated malformations is advisable. Rarely additional imaging by fluoroscopic genitography and/or MRI will become necessary.

Table 1: Classification of disorders of sexual development (DSD), according to the Lawson Wilkins Pediatric Endocrine Society and European Society for Pediatric Endocrinology, adapted according to presentation of Orazi C, Silveri M, Cappa M, Bizarri C, Schingo PMS, Toma P. Disorders of sexual development: role of imaging. Oral presentation at the 49th meeting of the European Society of Pediatric Radiology, Athens, 2012 May)

Numerical sex chromosome anomalies	46,XY	46,XX
47,XXY Klinefelter Sy and variants	Disorders of gonadal (testicular) development	Disorders of gonadal (ovarian) development
	• Complete or partial gonadal dysgenesis	• Gonadal dysgenesis
	• Ovo-testiscular DSD (true hermaphrodisdism)	Ovo-testicular DSD (true hermaphrodisdism)
45,XO Turner Sy and variants	• Testis regression Sy	• Testicular DSD
	Disorders in androgen synthesis or action	Androgen excess
45,XO/46,XY MGD ovo-testicular DSD (true hermaphrodisdism)	• Leydig cell failure	
	• LH receptors mutations	
	• Androgen biosynthesis defects	
	• Defects in androgen metabolism	
	• Defects in androgen action	
	Androgen insensitivity Sy	
	Drugs and environmental modulators	
46,XX/46,XY Chimeric, ovo-testicular DSD	Disorders of AMH gene/Persistent Müllerian Duct Sy	
	Others	Others
	• Syndromic associations of male genital development Cloacal anomalies etc..	Syndromic associations (& cloacal anomalies)
	• "Vanishing" testes Sy	• Müllerian agenesis/hypoplasia
	• Maternal excessive exogenous oestroprogestins	• Uterine anomalies
	• Congenital hypogonadotropic hypogonadism	• Vaginal atresia
	• Isolated hypospadias	McKusick- Kaufman Sy
	• Cryptorchidism	Mayer-Rokitansky- Kuester-Hauser Sy
	• Environmental influences	• Labial adhesions

Further readings
Ahmed SF, Achermann JC, Arlt W, et al. (2011) UK guidance on the initial evaluation of an infant or an adolescent with a suspected disorder of sex development. Clin Endocrinol 75: 12–26
Chavhan GB, Parra DA, Oudjhane K, et al. (2008) Imaging of ambiguous genitalia: classification and diagnostic approach. RadioGraphics 28: 1891–1904
Gassner I, Geley TE. (2004) Ultrasound of female genital anomalies. Eur Radiol 14: L107–L122
Geley TE, Gassner I. (2008) Lower urinary tract anomalies of urogenital sinus and female genital anomalies. In: Fotter R, editor. Pediatric uroradiology, 2nd ed. Berlin/Heidelberg: Springer; p 137–163
Kiechl-Kohlendorfer U, Geley TE, Unsinn KM, Gassner I. (2001) Diagnosing neonatal female genital anomalies using saline-enhanced sonography. AJR 177: 1041–1042

Imaging of fetal uropathies

Marie Cassart
Hôpital d'Ixelles- Iris sud- Brussels - Belgium

Introduction: Ultrasound and MRI are complementary imaging techniques used in antenatal diagnosis of urinary tract anomalies. In the present course, we will shortly review the embryological development of the urinary tract and depict the most common anomalies encountered in fetuses when the normal development course is impaired.

Embryological development

The urinary system includes the kidneys, the ureters, the bladder and the urethra. The kidneys seen on US scans since the eleventh week originate from the metanephricblastema (a mass of intermediate mesoderm). It differentiates as it is penetrated by the metanephric diverticulum (ureteric bud). The metanephric diverticulum is the primordium of the ureter, renal pelvis, calices and collecting tubules. The ureteric bud and the metanephricblastema interact in a process of reciprocal induction. These metanephric kidneys lie in the fetal pelvis and will gradually reach their adult position thanks to the growth of the fetal body caudal to the kidneys. The development of the urinary bladder arises from the division of the cloaca by the urorectal septum into a dorsal rectum and ventral uro-genital sinus. This sinus is divided into three parts, the upper part which will form the bladder, the middle part that will become the entire urethra (in females) and the posterior urethra (in males) and the bladder neck (in both sexes), the caudal part will form the phallic portion of the urethra.

Congenital anomalies of the urinary tract

Fetal urinary tract malformations affect from 0.1 to 1% of all pregnancies, they encompass heterogeneous groups of diseases with variable degrees of severity. Uropathies correspond to 30 to 50% of all structural abnormalities found at birth. They are commonly detected by obstetrical sonography. The fetal kidneys should be seen on the routine US scans since the 12th week of gestation like small hyperechoic structures, which will then secondarily increase in size and differentiate. The bladder can be identified in the fetal pelvis from 10 to 12 weeks. The spectrum of malformations is wide and the prognosisis significantly poorer in fetuses with bilateral anomalies and decreased amount of amniotic fluid.

- Renal agenesis and renal ectopy

Absence of kidneys occurs when the metanephric diverticulum fails to penetrate the metanephricblastema. Bilateral renal agenesis is invariably lethal. It has an incidence of one upon 4000 births with a male to female ratio of 2.5. The intrauterine consequences are severe oligohydramnios, pulmonary hypoplasia, facial and limb hypoplasia and subsequent neonatal death. In these poor US conditions, the diagnosis may be complicated by the globoid reniform shape of the supra renal glands giving the appearance of a dysplastic kidney. MR imaging thanks to its good contrast resolution, allows a better visualisation than US and may help in these circumstances. It is important however to remember that if kidneys are not seen in anatomic locations, they can be ectopic (contralateral or intra pelvic location), however in such cases, the bladder is normal and there is no oligohydramnios.

- Multicystic kidney disease (MKD)

MKD results from dysmorphology during the development of the renal system secondary to a failure of the ureteric bud to encounter the metanephric mass, which therefore does not differentiate normally. The prognosis is good since 75% of cases are unilateral. The morphological criterion is the presence of multiple cysts of various sizes without normal parenchyma. There is most often a contralateral hypertrophic kidney. These dysplastic kidneys spontaneously shrink with time.

- Upper urinary tract dilatation

Upper urinary tract dilatation is the most common anomaly detected on prenatal US with a reported frequency of 2.5%. The upper urinary tract dilatation may be an indicator of obstruction (pelviureteric junction obstruction, vesicoureteral junction obstruction…). The pelvicaliceal cavities are considered dilated if they are superior to 4 mm in the second trimester and to 7 mm in the third trimester. The interest of the prenatal diagnosis of pelvicaliceal dilatation is to optimize the postnatal follow-up of the new born in order to prevent further alteration of the renal function. Often, in these conditions, antenatal US is sufficient to

establish the diagnosis and no antenatal complementary imaging is necessary.

- Complex upper urinary tract malformations

Upper urinary tract malformations include duplicated systems, which result from abnormal division of the metanephric diverticulum. This division can be either complete or incomplete resulting respectively in a duplicated or bifid ureter. The ureters draining the upper pole of the kidney may have an ectopic insertion and be obstructive with a resulting dilatation of the renal upper pole. The ureter draining the lower pole is most often refluxing. In complex cases with significant dilatations, MR imaging may clarify the diagnosis.

- Bladder anomalies

Cases of *enlarged bladder* in the first trimester are of poor prognosis. Mostly they are secondary to urethral atresia, some are included in syndromes (i.e. Prune Belly), or chromosomal anomalies. Later in pregnancy, megabladders are mainly due to outflow obstruction or to major bilateral reflux. The prenatal differentiation between both is often difficult because the two entities may be associated. The reflux will resolve after the treatment of the urethral obstruction. Megabladder is defined as a cephalo-caudal diameter superior to 3 cm in the second trimester and to 5 cm in the third trimester. The bladder wall may be irregular and thickened in cases of outflow obstruction. The pelvicaliceal cavities can be enlarged or thickened in cases of reflux. Megacystis-microcolon syndrome, which is one of the differential diagnoses of a fetal megabladder, carries a very poor prognosis. It can be excluded by MR thanks to the good visualisation of the colon in the third trimester. *Absent bladder* can be secondary to lack of urine production in cases of renal agenesis or dysplasia (see above) or to inability of the bladder to store urine like in *Bladder extrophy.* It is a very rare sporadic malformation in which the anterior wall of the bladder is absent. Its incidence is one upon 30000 cases with a male to female ratio of 2.3. The main postnatal problems include urinary incontinence, sexual and reproductive difficulties. The diagnosis can be suspected on US because the fetal bladder is not visualized between the umbilical arteries. Kidneys and amniotic fluid are normal. MR imaging may help to precise the pelvic anatomy of the fetus (position of pelvic bones…) and therefore confirm the diagnosis. The differential diagnosis has to be made with cloacal malformations.

Cloacal malformations occur in 1 upon 5000 newborn infants. Most of these malformations result from absence of anterior abdominal wall closure and abnormal development of the urorectal septum, resulting in incomplete separation of the cloaca into urogenital and anorectal portions. It is a spectrum of malformations from vesico-intestinal fissure to OEIS complex (Omphalocele, Exstrophy of the bladder, Imperforate anus, Spinal defect). The diagnosis of cloacal malformation can be made in the fetus relying on the non-visualization of the bladder, a large anterior wall defect and a huge cystic pelvic structure corresponding to the uro-genital sinus. Ano-rectal malformations associated or not with uro-genital fistulas are more frequent but are still difficult to diagnose. MR imaging is useful in this context to precise the position of the rectal pouch.

Conclusions: Obstetrical ultrasound plays a key role in the detection of fetaluropathies. In conclusive cases, MR is an interesting complementary imaging modality. The better antenatal depiction of urinary tract malformations leads to an optimization of the antenatal management of the pregnancy and a more adequate post natal work up.

Further readings

Avni EF. Maygey-LaulomB, Cassart M et al. (2007) Fetal urinary tract. Echographie obstétricale et gynécologique II, 3–43

Cassart M, Massez A, Metens T et al. (2004) Complementary role of MRI after sonography in assessing bilateral urinary tract anomalies in the fetus. AJR 182:689–695

Graziolo S, Parvex P, Merlini L et al. (2010) Antenatal and postnatal ultrasound in the evaluation of the risk of vesicoureteral reflux. Pediatr Nephrol 25:1687–1692

Pinette M, Blackstone J, Wax J et al. (2003) Enlarged fetal bladder: differential diagnosis and outcomes. J Clin Ultrasound 31:328–334

Wilcox DT and Chitty LS (2001) Non-visualisations of the fetal bladder: aetiology and management Prenat Diagn 21:977–983

The relative roles of sonography and contrast examinations of the gastrointestinal tract in the vomiting infant

Alan Daneman

Department of Diagnostic Imaging,Hospital for Sick Children and University of Toronto, Toronto/Canada.

Vomiting is a very common symptom of disease in neonates and infants. In this age group the causes of vomiting may be due to a wide variety of congenital anomalies or acquired diseases of the gastrointestinal tract. However, vomiting may also be unrelated to primary gastrointestinal disease and may reflect abnormalities of other organ systems such as renal, adrenal and central nervous system disease.

When faced with a vomiting neonate or infant the clinician has therefore, tro initially try to determine whether the symptoms is due to primary gastrointestinal or extra-gastrointestinal disease. Furthermore, the clinician has to decide which infants will require an imaging procedure in order to further elucidate the cause for the vomiting and then

to determine which imaging modality to request as the modality of choice.

Over the past three decades utilization of the various imaging modalities has undergone a continuous evolution in pediatric imaging, particularly in neonates and infants. The benefits of sonography are well documented: safe, does not utilize ionizing radiation, relatively cheap, easily available, bedside utilization. Furthermore, sonography is ideally suited for use in small patients and thus is extremely valuable when examining neonates and infants. However, the unique role of sonography in the evaluation of the stomach and intestines in neonates and infants was only fully realized after its use in the evaluation of other intra-abdominal structures had already been established. Recent technical advances with the introduction of the newer linear array transducers functioning at a higher megahertz have facilitated evaluation of the stomach and intestines in much greater detail than was previously possible. Not only can the detailed grey scale sonographic anatomy of the layers of the wall of the stomach and intestines be defined but real-time imaging enables evaluation of peristalsis and Doppler interrogation enables evaluation of blood flow. From a practical point of view it is important to remember that the wider field of view of the vector and curved array transducers are essential to evaluate the abdomen as a whole and to delineate the overall relationship of the gastrointestinal tract to other viscera and free fluid and focal fluid collections. However, the detailed images of the gastrointestinal tract are usually optimally obtained by magnifying the linear array high megahertz images so as to depict only one or at most only a few loops of intestine in any one image and to ensure the focal zone is directed at the level of maximum interest in the gastrointestinal tract.

Furthermore, an added advantage of sonography is that it enables evaluation of other intra-abdominal viscera and vessels which may be the site of the disease causing the vomiting. The ability to define the stomach and intestines clearly has led to changes in management protocols and in many situations sonography may be the only imaging modality required. The presence of gastric and bowel gas does not necessarily impede the sonographic examination in infants as the gas may be gently pushed aside by applying gentle graded abdominal pressure with the transducer.

In recent years fluoroscopic examinations using contrast material to outline the upper or lower gastrointestinal tract have been used less frequently as the full value of sonography in gastrointestinal imaging has become better understood and more widely used. The main disadvantage of fluoroscopic examinations is the use of ionizing radiation and this should be kept in mind at all times when using this modality, particularly in neonates and infants. A further disadvantage of fluoroscopic contrast examinations of the gastrointestinal tract is that the other viscera and vessels of the abdomen are not delineated as they are with sonography.

An essential reminder is that whichever modality is used (whether it be sonography or a contrast examination under fluoroscopy), meticulous attention to technique is necessary in order to optimize the images in order to obtain the most information from the examination.

In infants with non-bilious vomiting, sonography is the modality of choice as it can easily differentiate a normal pylorus from hypertrophic pyloric stenosis, antral webs, gastric duplications, gastric foveolar hyperplasia and other rarer causes of gastric outlet obstruction. Those infants who continue to vomit even though the initial sonogram reveals a pylorus that is considered normal should be evaluated with follow-up sonograms as hypertrophic pyloric stenosis may sometimes be encountered as an evolving process and its typical features may only be seen on follow-up examination.

In infants with bilious vomiting, sonography is also the modality of choice for the diagnosis of midgut volvulus. Occasionally these infants may have non-bilious vomiting. In those vomiting infants without volvulus, sonographic evaluation of the entire duodenal anatomy, particularly the position of the third part of the duodenum which is normally between the aorta and superior mesenteric artery, might elucidate the presence or absence of midgut malrotation. Visualization of the position of the duodenum may be facilitated by the presence of fluid in the lumen and may occasionally require placement of a nasogastric tube to fill the duodenum with fluid. Sonographic delineation of the position of the cecum and the relation-ship of the superior mesenteric vessels may provide useful additional information regarding diagnosis of midgut malrotation.

In most of the above-mentioned conditions sonography that is meticulously performed will obviate the necessity for an upper gastrointestinal series with contrast material under fluoroscopic guidance. However, it must be remembered that midgut malrotation is a complex anomaly and controversy still persists regarding the value and accuracy of making the diagnosis based solely on the position of the third part of the duodenum.

Sonography is also extremely helpful in the diagnosis of the cause of congenital bowel obstructions that present with vomiting. An examination of the large bowel with contrast material under fluoroscopic guidance is required in many of those with low congenital bowel obstructions, particularly those with meconium ileus or meconium plugs, who require therapeutic relief of the obstruction using water soluble contrast material mixed with acetylcysteine.

Sonography is the modality of choice in those infants who are suspected of having an intussusception as it is highly accurate in depicting intussusceptions. Furthermore, sonography may also depict the presence of pathologic lead points as the cause of intussusceptions. In infants, duplication cysts of the intestine are easily depicted whether they are a lead

point of an intussusception or whether they are a separate finding. The commonest pathologic lead point is, however, a Meckel's diverticulum. Although this has some characteristic findings as a lead point on sonography there are some instances where the appearances are more nonspecific and a definitive diagnosis of Meckel's diverticulum as a lead point cannot be made. Sonography may also depict complicated Meckel's diverticula (without intussusception) that may be the cause of vomiting rather than painless rectal bleeding. In these, the diverticulum often has a thickened wall and may appear similar to, but more irregular than, a duplication cyst. Imaging of a vomiting infant may often be simple and require only one or two modalities to reach a definite diagnosis. Sonography has certainly revolutionized the way in which the gastrointestinal tract is imaged in these patients. Pediatric radiologists must interact with our clinical colleagues closely in order to optimize the choice of modalities in any particular patient. The use of imaging modalities should always be considered in relation to other modes of investigation such as pH monitoring (in infants with suspected gastro-esophageal reflux), endoscopy, nuclear medicine examinations and magnetic resonance imaging.

The Sonography of Hepatic Vascular Disorders: Diagnosis and Long Term Follow Up

Zoltán Harkanyi
Department of Radiology, Heim Pal Hospital, Ulloi ut 86, 1089 Budapest, Hungary

Most of the vascular anomalies of the liver are incidentally detected during abdominal US studies in the pediatric population. A smaller percentage of the vascular anomalies are associated with liver masses. B-mode and color Doppler are still the leading imaging methods for both detection and characterisation of the lesions. The hepatic vascular disorders can be congenital or acquired by etiology. Regarding the clinical significance, the hepatic lesions can be divided into vascular variants, vascular malformations and vascular tumors. Most of these disorders are harmless, no treatment is suggested however in a small percentage of the cases, careful treatment planning is required based on multidisplinary consultation.

The clinical importance of pediatric vascular anomalies

- Development of congestive heart failure due to shunting
- Before guided biopsy of liver masses
- Before surgical liver resection
- Before interventional procedures (local tumor ablation, TIPS etc.)
- Before liver transplantation
- Interpretation of contrast enhanced imaging studies (perfusion changes can occur in case of shunts depicted by CE-MR, CE-CT, CE-US)
- Systemic chemotherapy affecting liver perfusion

After the detection of various hepatic vascular lesions, several questions should be answered by the radiologist and the gastroenterologist:

- Is it necessary to perform other imaging studies after US and in which order (MRA/CTA/angiography)?
- Is it necessary to follow up the lesions, if yes, how often should US/color Doppler studies be repeated?

Is there any need for treatment with special regard for long term consequences of the lesions? (drugs, embolization, surgical intervention).

Classifications of hepatic vascular anomalies

The new classifications of vascular anomalies have recently become widely accepted. Abnormal communication can occur between all the three hepatic vascular systems and some other very rare hepatic anomalies can also be detected by US:

- **Arterio-portal shunt**
- **Porto-hepatic (intra and extrahepatic) shunt**
- **Arterio-hepatic shunt**
- **Porto-portal shunt**
- **Veno-venosus shunt**
- **Portal vein aneurysm**
- **Hepatic web (IVC)**
- **Vascular hepatic masses**

Infantile hepatic hemangioma (IHH) is the most frequent anomaly representing a spectrum of hepatic vascular tumors. The recent classification should be used because of the prognostic and therapeutic consequences of the findings. Three categories are suggested: focal, multifocal and diffuse lesions . The association of IHH with superficial hemangiomas in various locations can occur and its prevalence is debatable (approximately 10–47%). Differentiation of IHH from hepatoblastoma can usually be made based on clinical and imaging/US findings and by elevated AFP in hepatoblastoma (in 90% of the cases).

In addition, several hepatic **vascular variants** can be detected incidentally without abnormal communications of the vessels. Some of these lesions can be appreciated by B-mode US (portal and hepatic veins), hepatic artery variations mainly depicted by CTA/MRA or angiography.

The **acquired vascular hepatic lesions** can be detected less frequently in the pediatric age, often associated to surgical or interventional procedures (e.g. surgical shunts, arterio-portal shunts after biopsy, portal or hepatic vein thrombosis, hepatic veno-occlusive disease, etc.).

The imaging of pediatric vascular anomalies

US and MR are the basic imaging methods in the work up of hepatic vascular disorders. Most of the hepatic lesions

can be detected and characterized by **US methods**: B-mode US, color Doppler, duplex Doppler should be used. The extent of the lesions, types of vessels, and often the communication of the vascular structures can be analysed by Doppler. Spectrum Doppler evaluation, especially in small babies, is difficult or sometimes impossible. However, using proper methodology in experienced hands the diagnosis can be established by US. In the future, contrast enhanced US (CE-US) may also play role in the diagnosis and differential diagnosis of pediatric hepatic anomalies, and CEUS can also depict perfusion changes non-invasively.

MR and MRA are the problem-solving modalities in almost all hepatic vascular anomalies, without ionizing radiation. The drawback is the long examination time of the studies, sedation usually cannot be avoided, and the availability of MR is a major problem in many countries.

CT and CTA are also accurate means in both detection and characterisation. The major advantage of CT is the very short exam time (seconds), however the radiation exposure of the patient is significant, which is nowadays a major consideration indicating CT studies.

Angiography is extremely rarely indicated for diagnostic purposes, if vascular intervention can be planned, the procedure could be performed in special centers.

Follow up studies for hepatic vascular malformations

The decision about the follow up of different vascular hepatic lesions must always be made on an individual basis. Multiple factors can influence the plan of follow up studies: the size and multiplicity of the lesions, estimation of shunt volume, signs of CHF, the age of presentation, other associated anomalies, liver function, the presence of coagulopathy.

We followed up 22 pediatric patients with various hepatic disorders in our institution. The longest follow up period of the patients was 20 years. In the vast majority of the cases US/color Doppler was used during the years, CT or MR were mainly applied in the initial work up. Vascular lesions with shunts: Arterio-portalis shunt (n=1), porto-hepatic shunt (n=3), porto-caval shunt (n=1), persistent ductus venosus (n=1), vascular hepatic tumors (n=5), Others: portal vein aneurysm (n=1), hepatic web (VCI) (n=1), portal cavernoma with various etiology ((n=9).

A close cooperation between medical specialists (pediatric gastroenterologist/hepatologist, angiologist, pediatric radiologist) is of utmost importance in the management of these patients. The comparison of the findings of the different imaging studies is sometimes difficult, color Doppler is able to demonstrate the functional (circulatory) changes in experienced hands. Follow up imaging is an obvious need in the case of drug treatments (steroids, beta blockers), which are mainly used for superficial hemangiomas. The indication of drug treatment in the case of congenital hepatic lesions can be carefully planned and US follow up is recommended.

Further readings

Gallego C, Miralles M, Carlos Marin C, et a (2004) Congenital hepatic shunts. RadioGraphics 24:755–772

Burrows PE, Dubois J, Kassarjian A (2001)Pediatric hepatic vascular anomalies. Pediatr Radiol31:533–545

Mulliken JB, Glowacki J (1982)Hemangiomas and vascular malformations in infants and children: a classification based on endothelial characteristics. Plast Reconstr Surg 69(3):412–422

Christison-Lagay ER, Burrows PE, Alomari A, et al. (2007) Hepatic hemangiomas: subtype classification and development of a clinical practice algorithm and registry. J Pediatr Surg 42(1):62–67; discussion 67–68

Chung E. M. et al. (2010)Pediatric Liver Masses: Radiologic-Pathologic Correlation. Part 1. Benign Tumors. RadioGraphics 30:801–826

MRI of the Gastrointestinal tract/MRCP

Gabor Rudas

MR Research Centre, Semmelweis University, Budapest, Hungary

Introduction: The purpose of this article was to evaluate the role of MR examination in case of pediatric gastrointestinal diseases. The most important illnesses are the inflammatory bowel diseases, the pancreatitis (acute and chronic) and the biliary tract diseases.

Inflammatory Bowel Diseases, MR enterography

Until the last 10–15 years, in case of the suspicion of Inflammatory Bowel Disease (IBD) the imaging methods were small bowel follow-through and enteroclysis. Unfortunately both methods have low sensitivity and specificity.

The ultrasound—first of all the so called Hydrocolon sonography or the Sonoenterography—has a very important role in the examination of the colon and the terminal ileum, but it has a lot of limitations in case of the small bowels—first of all the jejunum - and the pelvis.

The disadvantages of CT Enterography are the poor—native - soft tissue contrast (contrast medium is required), the CTE is only a “snapshot” and the high ionizing radiation.

Nowadays, the two most important investigations are the Ileocolonoscopy (IC) and the Magnetic Resonance enterography (MRE). With IC we have information about the mucosa of the colon and the terminal ileum and in addition we can carry out the biopsy. Still, the MRE is extremely important, because sometimes the IC cannot reach the terminal ileum or quite often the result of the histology is questionable. In addition, with IC only we have no information about the intramural, the extramural pathologies (e.g. fistula, abscess, inflammation of the fat tissue surrounding the terminal ileum, lymph nodes) or about the other parts of the small bowels (e.g. involved other parts of the small bowel, stenoses, etc.). Another very important indication for

MRE is the follow up of the treatment: to exam the signs of the activity of the disease.

The advantages of MRE are the perfect soft tissue contrast with different sequences (T2, T2 fat sat., DWIBS, T1 with or without contrast medium), the multiplanar capabilities, that it is without radiation, and that with the so called cine steady state free procession (SSFP) scan we can exam the peristaltic and strictures, the "functional" informations (by DWIBS). In addition, MRE requires no specific preparation before the examination.

During the last 9 years we have had more than 1000 MRE examinations (children and adults as well). Our technique was changed several times and we believed that we could find an optimal protocol.

Formerly we used naso-jejunal enteric tube for the administration of the oral contrast agent (PolyEthylenGlicol, Methilcellulose or VoLumen) and for the optimal distension of the small bowel. The naso- jejunal enteric tube was taken under fluoroscopy control, but it is less well tolerated by patients and with ionizing radiation. Nowadays the patient should drink 20 ml/kg oral contrast medium in right lateral decubitus position over 30 min. Addition of flavor crystals to the oral contrast material can improve patient compliance with contrast intake.

During the MR examination, in the scanner, the patient is in prone position, but the small bowel distension is not always optimal.

At first, to evaluate the oral contrast medium position, coronal T2 weighted single-shot turbo spine echo (SSTSE) sequence is require. Just before the diagnostic scanning and again before contrast administration—when required—slow intravenous Glucagon (0,3 mg) is taken. The MRE is divided into two parts: the abdomen and the pelvis.

The suggested standard protocol in the abdomen: axial and coronal T2-weighted turbo spin echo (TSE), axial T2 TSE with fat saturation, axial 3D DWIBS. The T1 is not always part of the examination, because the T2 TSE has a better anatomically resolution and generally the diffusion weighted measurement and the T2 TSE with fat-saturation give us much more reliable information about the inflammation or the lymph nodes, than the T1 with contrast. In this way we can shave the contrast administration and the examination time is only ca. 15–20 min (despite the respiratory triggering). When the question is the fistula or abscess axial 3D T1 spoiled gradient recalled echo (SPGR) – native and with fat-saturation after contrast—is required. Because of the different sequences we can distinguish the small bowel spasm - first of all in the jejunum—from the real pathologic bowel wall thickness. Our experience shows that with respiratory triggering the quality of the examination is better than with breath-holding. Sometimes when the patient is restless—it is our observation that in general the IBD patient is very cooperative—we should use the T2 SSTSE sequence, despite the fact that it has a poor resolution.

Our protocol in the pelvis: axial 3D T1 WAVE, 3D T2 VISTA, axial T2 TSE with fat-saturation and axial 3D DWIBS. Here again: the contrast administration and the 3D T1 WAVE with fat-saturation is necessary only when the question is the fistula or abscess. The DWIBS axial T2 TSE with fat-saturation helps us to find the inflammation (e.g. sacroileitis, abscess, fistula, etc.). The problem with the DWIBS is that it has a false positivity at the spastic jejunum.

At the image interpretation the most important findings are: bowel wall thickening (small bowel and colon), reduced diffusion, mucosal contrast enhancement, stenosis, mural stratification, inflammation of the mesenteric fat (reduced diffusion and/or enhancement), mesenteric lymph nodes, loss of haustration of the colon wall, fistula, abscess, sacroileitis, ascites.

In case of the perianal Crohn's disease the superiority of MR versus other modalities is doubtless . MRI has sensitivity for detecting parianal fistulas of over 80% with an accuracy of over 90% . The diffusion weighted MRI has recently been applied to perianal fistula and may be an adjunct to T2 especially in patients with risk factors for contrast material.

In the literature the sensitivity and specificity of MRE range between 60% and 100%. According to our experience both are around 90%. The three most important difficulties are the jejunum, the mucosal contrast enhancement as a sign of the active inflammation and the ileo-ileal fistula. In the jejunum it is sometimes difficult to distinguish the spastic but normal bowel wall from the real pathological wall thickening and in this case the cine SSFP can be of help . The contrast enhancement of the normal mucosa is quite close to the moderately active inflammation. During the last 5 years we have used the diffusion and it has seemed to increase the sensitivity and specificity. The ileo-ileal fistula is a very difficult question, because when this question arises generally we have an inflammatory small bowel conglomerate and sometimes it is extremely difficult to find or exclude the fistula.

In case of ulcerative colitis the MRE has a very good sensitivity (86%) and specificity (88%) as well. The most typical findings are the colon wall thickening, the loss of haustration and the reduced diffusion.

The MRE is a reliable modality to make the diagnosis of the IBD, but it requires good experience and a very careful interpretation to rule out overdiagnosis.

Magnetic resonance cholangiopancreatography, MRCP

In case of the diseases of the biliary tract the US, the CT, ERCP and the magnetic resonance cholangiopancreatography (MRCP) are valuable in showing dilatation of the bile duct

and complications in pediatric pancreatobiliary tract. MRCP is noninvasive, provides high-resolution 3D images of the bile tree and pancreatic duct. The MRCP could reveal the intra- and extrahepatic bile ducts, gallbladder, protein plugs and bile duct stenosis and it is helpful in differentiating pancreaticobiliary maljunction from choledochal cyst. It should be the first choice for the diagnosis of this kind of disease.
Biliary indications for MRCP:

1. biliary atresia
2. intrahepatic bile duct dilatation (cholestasis, sclerotic cholangitis)
3. choledocholithiasis
4. choledochal cyst and anomalous pancreatobiliary junction
5. bile leakage.

Pancreatic indications:

1. Acute, recurrent and chronic pancreatitis
2. Pancreas divisum
3. Pancreatic trauma

Method: MRCP axial and coronal T2 TSE, Axial T2 TSE with fat sat, axial 3D DWIBS and the MRCP: a heavily T2 weighted high resolution 3D scan. We can improve the sensitivity and specificity of the MRCP with Secretin, when the question is the pancreatic ducts. Secretin is administrated intravenously slowly—over 1 min—at a dose of 0.2 ug/kg (max 16 ug).

Pancreatitis

1. Acute pancreatitis

The most common etiologies are idiopathic (23%), trauma (22%), structural anomalies (15%), multisystem diseases (14%), drugs and toxins (12%) and virus infections (10%). The mortality is almost 10%. Acute pancreatitis is not really a radiological diagnosis: despite the obvious clinical picture—sudden onset of pain, vomiting and increased pancreatic enzyme levels—the US, CT and MR could be quite normal in the first few days. The enlargement or changes of the structure have a low diagnostic value and the most sensitive is the diameter of the pancreatic duct . The sensitivity of the non-contrast-enhanced US is only 62–67% . The CT has a poor sensitivity to find the ductal pathologies. MR is indicated first of all in case of trauma or during the follow up, when the result of the US is not clear. In this situation—e.g. cystic lesion, pancreaticobiliary junction lesion, etc. – the MR and MRCP are the first choice examinations.

2. Chronic pancreatitis

In childhood chronic pancreatitis is a rare and challenging disease. This is a progressive disease and the result is poor quality of life. The etiology of chronic pancreatitis includes cystic fibrosis, trauma, biliary obstruction (choledocholitiasis), anatomical, hereditary, idiopathic, inborn errors of metabolism or hyperlipidaemia.
The complications of pancreatitis include pseudocyst, fistula, splenic vein thrombosis, ductus choledochus and duodenal obstruction.

Further readings

Zimmermann E, Al-Hawary M (2011) Magnetic resonance imaging of the small bowel in patients with Crohn's disease. Curr Opin Gastroenterol 27(2): 132–138
Ashah I, Bruining D, et al. (2012) MR Enterography in pediatric inflammatory bowel disease: retrospective assessment of patient tolerance, image quality and initial performance estimates. AJR 199:W367–375
Dillman J et al. (2011) Comparison of MR and CT enterography and histopathology in the evaluation of pediatric Crohn disease; Pediatr Radiol 41:1552–1558
Hori M, Oto A et al. (2009) Diffusion-weighted MRI: a new tool for the diagnosis of fistula in ano. J Magn Reson Imaging 30(5):1021–1026
Tom K Lin, Bradly A Barth(2012 Endoscopic retrograde cholangiopancreaticography in pediatrics. Techniques in Gastriontestinal Endoscopy (on line, article in press)

Anorectal Malformations: a systematic approach

S.G.F. Robben
Maastricht University Medical Center, Maastricht, The Netherlands

Introduction: Anorectal malformations (ARM) include a wide spectrum of diseases and involve the distal rectum and anus lying in an abnormal position. At one end of the spectrum there is anterior anus and at the other end are sirenomelia and cloacal extrophy.
The most used classification system is the Wingspread classification that distinguishes between high, intermediate and low anomalies. High anomalies are anorectal agenesis with rectovaginal and rectopostatic-urethral fistula and rectal atresia; intermediate malformations are rectovestibular, rectovaginal and rectobulbar-urethral fistula; low-type malformations are classified as anovestibular and anocutaneous fistula as well as anal stenosis. Cloaca and rare malformations are considered separate entities. Pena modified this classification based on the type of fistula because this was more useful in the choice of a surgical approach.
The latest modification of these classifications systems is the Krickenbeck classification. This system comprises a classification system for anatomy (cutaneous fistula, rectourethral fistula, rectovesical fistula, vestibular fistula, cloaca, no fistula, anal

stenosis and rare or regional variants), a classification system for operative procedures (perineal operation, anterior sagittal approach, PSARP, etc.) and a classification system for follow up (voluntary bowel movements, soiling and constipation).

Anorectal Malformations

The prevalence of imperforate anus in newborns is 1:4000–5000, most frequently with a rectourethral fistula in boys and a rectovestibular fistula in girls.

The incidence of imperforate anus without fistula is reported at 5%. Approximately half of these patients suffer from Down's syndrome and around 38% have associated genitourinary defects.

Rectoperineal fistula represents the simplest of all defects. The rectum opens in a small and stenotic orifice, located anterior to the centre of the sphincter. Most of these patients have an excellent sphincter mechanism, with the rectum and vagina usually well separated.

Rectovestibular fistula is the most common female defect, clinically evident as a normal external urethral opening and vagina, with a third hole in the vestibule represented by the rectum. Approximately 10% of cases have two hemivaginas.

Rectovaginal fistula is quite rare, occurring in <1% of cases, often misdiagnosed as vestibular fistula or cloaca.

Rectal atresia or stenosis occurs in approximately 1% of all cases, and is the only entity in this spectrum with normal anal canal and sphincter mechanisms.

High urological malformations can also be associated with ARM.

Persistent cloaca is the most severe type of ARM and seen exclusively in girls. It is a rare malformation with an incidence of 1:50000 and accounts for 10% of all ARMs. The rectum, urethra and vagina fail to separate and drain via a single common channel onto the perineum. The length of the common channel is 1–7 cm. A long common channel (>3 cm) is associated with complex defects.

In approximately 50% of these patients, the vagina is abnormally distended by secretion (hydrocolpos). Approximately 50% of cloaca patients have a significant incidence of Müllerian anomalies and 90% of cloaca patients have associated urological abnormalities. Awareness and identification of such anomalies are an important task for the pediatric radiologist.

Sacral deformity is frequently associated with ARM. High-type malformations generally show more severe sacral deformity than low-type malformations. Often, one or more sacral vertebrae are missing, with negative implications for bowel function. In particular, the presence of tethered cord is associated with a poor prognosis in terms of urofaecal continence. High urological malformations can also be associated with ARM.

Rare combinations of ARM and the caudal regression syndrome are the Currarino triad and sirenomelia.

The Currarino syndrome (also known as autosomal dominant sacral agenesis; OMIM no. 176450) consists of (1) partial sacral defects consisting of (partial) sacral agenesis with an intact first sacral vertebra (hemisacrum or "sickle-shaped" sacrum), (2) a pre-sacral mass, including an anterior meningocele, an enteric cyst and/or a pre-sacral teratoma, and (3) congenital anal stenosis or other anorectal malformations (such as imperforate anus with/without anal fistula to the spinal cord or to the urogenital system).

Sirenomelia, or the mermaid syndrome, is the most extreme example of the caudal regression syndrome. It presents with lower limb fusion, sacral and pelvic bony anomalies, absent external genitalia, imperforate anus and renal agenesis or dysgenesis. Prognosis is very poor.

Finally, imperforate anus is also part of the spectrum cloacal extrophy/OEIS complex.

Cloacal exstrophy is an extremely rare congenital malformation resulting in an exstrophy of the hemibladders with hindgut extrusion and imperforate anus.

The OEIS complex (Omphalocele, Extrophy of the bladder, Imperforate anus, Spine anomalies) may represent the most severe manifestation of a spectrum of birth defects, the exstrophy-epispadias sequence. The OEIS complex affects 1 in 200.000 to 400.000 pregnancies and is of unknown cause.

Imaging techniques

Conventional radiographs have limited value but are not completely obsolete. Particularly in the newborn bowel dilatation and osseous abnormalities can be diagnosed while the child is still in the incubator. These findings determine short term therapy and guide additional imaging techniques.

However, in a stable patient additional imaging techniques are necessary to evaluate the local anatomical and functional abnormalities. Moreover, screening of the spinal cord and genitourinary tract is mandatory (see introduction). For this purpose fluoroscopy, ultrasonography (US) and magnetic resonance imaging (MRI) should be used.

Conventional radiographs

Immediately after birth the digestive tract progressively fills with air until the rectum is reached within 24 h. Abdominal radiographs can monitor abnormal passage of air by showing dilatation, air fluid levels and often the site of obstruction (complete or incomplete) can be roughly estimated. Massive dilatation may be prone to blow out or volvulus and warrants early surgical intervention.

Although obstruction can be demonstrated, its cause and exact localization is difficult to determine in children with anorecal malformations.

Historically, the pubococcygeal line is drawn on a lateral film from the middle of the pubic bone to the sacrococcygeal junction. When the air-filled hindgut ends above that line it is a high obstruction (above the puborectal muscle), below the line it is a low obstruction (below the puborectal muscle). However, the modified "M" line seems

to be a more reliable estimation of the puborectal muscle. This line is drawn, parallel to the pubococcygeal line, more caudally through the junction of the lower and upper two-thirds of the ischial bones.

These lines are indirect indicators of high or low atresias, therefore, at present the evaluation of the rectum in children with anorectal malformation is assessed with fluoroscopy, US or MRI.

Fluoroscopy

Initial treatment of some patients with anal atresia is a colostomy. Direct contrast injection (iodinated contrast medium) into the colonostomy prior to definitive second-stage reconstruction demonstrates the level of the obstruction and also the ectopic anus connecting to the vagina, urethra or bladder.

In patients with cloacal malformations contrast injection in all accessible orifices shows the relation of urethra, vagina and rectum to a better advantage than MRI or US. Major disadvantage is the lack of visualization of surrounding soft tissue structures that are of concern of to the surgeon, such as the pelvic floor musculature.

Ultrasonography

The overall incidence of associated anomalies in other organ systems in children with ARM is more than 60%. Routine abdominal US is mandatory to evaluate the genitourinary system because of the high incidence of abnormalities in patients with anorectal malformations. The overall incidence of urological anomalies is 52%.

Also spinal dysraphism is common in children with ARM and it seems higher in patients with complex ARM. Reported incidence varies widely between 9% and 50%. Abnormalities included low conus medullaris, fibrolipoma of filum, intradural lipoma, hydrosyringomyelia, dermal sinus tract and meningocele. US is a good screening modality in the first week of life because at this age the relative lack of ossification facilitates the visualization of the spinal cord.

Transperineal US is used as a noninvasive imaging technique for identification of a fistula and for determining the distance between the rectal pouch and the perineum.

Magnetic resonance imaging

MRI has the potential to combine all advantages of the above mentioned imaging techniques and is probably the best technique to evaluate the pelvic floor including the sphincter complex. MRI is able to determine the level of ARM and the degree of maldevelopment of the sphincter muscle complex and to visualize associated anomalies of the spinal cord, spine and urogenital system. Sequences include T1- and T2-weighted images of the pelvic region with the coronal plane perpendicular and the transverse plane parallel to the pelvic floor. T2-weighted fatsat images may improve visualisation of fistula. The choice of an appropriate FOV and dedicated coil is important.

MRI is feasible without the need for sedation in children up to 3 months of age when performed immediately after feeding. Usually these newborn infants fall into a deep sleep after a meal and this effect can be enhanced by some sleep- and food deprivation prior to the meal. Unfortunately this protocol fails after the age of 3–6 months. Older infants and preschool children usually need sedation for dedicated MRI examinations.

Conclusion: Anorectal malformations are frequently associated with lifelong debilitating sequelae such as fecal and urinary incontinence and sexual dysfunction. During the last decades significant advances have occurred in the surgical management of anorectal malformations. It is the task of the pediatric radiologist to supply the surgeon with optimal anatomical and functional information for planning surgery according to the Krickenbeck criteria.

Further readings

Holschneider A, Hutson J, Pena A, et al. (2005) Preliminary report on the International Conference for the Development of Standards for the Treatment of Anorectal Malformations. J Pediatr Surg 40:1521–6

Pena A and Hong A (2000) Advances in the management of anorectal malformations. Am J Surg 180:370–6

Teo AT, Gan BK, Tung JS, et al. (2012) Low-lying spinal cord and tethered cord syndrome in children with anorectal malformations. Singapore Med J 53:570–6

Haber HP, Seitz G, Warmann SW, et al. (2007) Transperineal sonography for determination of the type of imperforate anus. AJR Am J Roentgenol 189:1525–9

Nievelstein RA, Vos A, Valk J, et al. (2002) Magnetic resonance imaging in children with anorectal malformations: embryologic implications. J Pediatr Surg 37:1138–45

The different faces of epilepsy in childhood

Péter Barsi

Semmelweis University MR Research Centre, Budapest

Chair of Neuroradiology, Department of Neurosurgery, University of Pécs, Hungary

Introduction: 10.5 million children are estimated to have active epilepsy worldwide. The annual incidence rate of childhood-onset epilepsy is 41–50/100,000 in developed countries, falling from 150/100,000 in the first year of life to 45–50/100,000 after 9 years of age. Under the age of 15 years, 1.0–1.7% of children have at least one unprovoked seizure (not equivalent with epilepsy) and 0.7–0.8% have repeated seizures.

About 75% of all epilepsy patients reach remission on antiepileptic drugs (AEDs). There are 4 prognostic groups: 1. Benign epilepsies (20–30% of patients): remission occurs after several years and treatment can be avoided in most cases; 2. Pharmacosensitive epilepsies (30%): seizures are easily controlled by medication and remission occurs after

several years; 3. Pharmacodependent epilepsies (20%): drug treatment control seizures but must be lifelong; 4. Pharmacoresistant epilepsies (20–25%): seizures cannot be adequately controlled by AEDs.

The goal of epileptology and neuroimaging

Repeated seizures mean a high risk as they may result in severe cognitive impairment, trauma, neurological deficit, social isolation/dysfunction and even death (SUDEP—sudden unexplained death in epilepsy). Therefore, seizure control is the most important medical task. The selection of the adequate AEDs depends on the classification of the epilepsy syndrome where neuroimaging plays an important role together with age, the definition of seizure type, clinical context, neurophysiology and neuropsychology. The role of neuroimaging is even more important in pharmacoresistant epilepsies where neurosurgery is the only effective tool in cases where a focal brain lesion can be detected. It is important to realize that a completely seizure-free state is not the exclusive goal of neurosurgery: significantly decreased seizure frequency or partial pharmacosensitivity, decreasing the hazards of severe trauma and encephalopathy and increasing the chance of normal cognitive development may be good results in cases of severe childhood epilepsy.

The basic concept of neuroimaging in childhood epilepsy: the MRI protocol

Many pathological processes and brain lesions can cause symptomatic epilepsy in children but the most common lesions causing severe epilepsy are perinatal and postinfective encephalopathy, malformations of cortical development (MCD), phacomatoses and hippocampal sclerosis (HS). HS may coexist with other lesions (tumours, MCDs, ischaemic or postinfectious brain damage, etc.) – the important entity of double pathology.

Computed tomography (CT) should be avoided due to the hazard of the ionising radiation (even more dangerous in children than in adults) and its lack of sensitivity and specificity in these cases, and reserved to the very rare cases where the detection of calcification is important for differential diagnostics (DDG) and not shown by MRI.

The unique neuroimaging tool is magnetic resonance imaging (MRI). The proper depiction of the common abnormalities described above and the exclusion of other lesions define the special epilepsy MRI protocol. It depends on the child's age as well: the FLAIR sequence is very useful after 2 years when the cerebral white matter has achieved the adult state of myelination but is rather inaccurate earlier. The 3D gradient echo (GRE) T1 weighted sequence is an important tool, but a T2 weighted sequence with thin slices and high resolution may better delineate small MCDs before the myelination has been completed.

Protocol under 2 years: 1. Axial turbo spin echo or fast spin echo T2 weighted sequence with high resolution (HR) and thin slices—*for an overview of the brain*; 2. HR 3D GRE T1 weighted sequence—*a primary tool to find MCDs*; 3. Diffusion weighted sequence and apparent diffusion coefficient map (DWI/ADC) or better diffusion tensor imaging with different parametric maps (DTI) – *obligatory in all brain MRIs, a great help in DDG and DTI with tractography important in surgical planning*; 4. GRE T2* weighted sequence or susceptibility weighted imaging (SWI) – *obligatory in all brain MRIs to detect haemosiderin or calcifications as explained by Prof. Anne G. Osborn*; 5. Coronal T2 weighted sequence with thin slices and high resolution, perpendicular to the long axis of the hippocampi and covering the whole brain—*for a detailed evaluation of the hippocampi and the whole brain*. The administration of a contrast medium and/or perfusion weighted imaging (PWI) and MR spectroscopy are reserved for phacomatoses, tumours and metabolic disorders. MR angiography is used in cases of possible vascular disease.

Protocol over 2 years: It is similar, but an additional coronal FLAIR sequence with possibly thin slices and high resolution in the same plane perpendicular to the long axis of the hippocampi is mandatory—*for a detailed evaluation of the hippocampi and the whole brain*.

The same protocol is used in postoperative cases to provide precise comparison.

The MRI protocol may be considered too meticulous and time-consuming and indeed, most children below 6 years as well as mentally retarded children need anaesthesia for the examination. Several notes on the problem: 1. The general MRI protocol is inadequate for epileptic patients as it does not allow the reliable evaluation of the hippocampi that should be scrutinised in each case for a possible double pathology; 2. The general protocol will not show reliably small lesions like MCDs that may have a crucial role; 3. In severe epilepsies, time means brain as the sooner the seizures are controlled the smaller the chance of encephalopathy. It makes no sense to waste time with an inadequate MRI and perform a proper one later—with a second hazard of anaesthesia in some cases. 4. An MRI of good quality can be re-evaluated and any new clinical-neurophysiological data would suggest the possible localisation of the epileptic lesion (though a follow-up MRI may be indicated if the clinical picture is progressive or changing significantly). 5. There are lesions that are best seen on FLAIR and T2 weighted images while others are easily missed on FLAIR/T2 even in older children, but conspicuous on HR T1 as it will be demonstrated. 6. The protocol can successfully show the important lesions at lower field strength as well.

Malformations of cortical development (MCDs):

These lesions are obviously present from the intrauterine life, but occasionally give the principal symptom of epilepsy relatively late—in adolescence or young adulthood. They are diverse in size (from a single subependymal heterotopic—

SEHT - nodule to lissencephaly involving both cerebral hemispheres) and in imaging appearance. The large lesions are easily noticed, but are sometimes hard to describe and it may be difficult to give the proper diagnosis. Those caused by ischaemic or other damage to the developing brain in the second trimester (polymicrogyria - PMG, schizencephaly - SCH) usually contain gliosis shown as hyperintensity on FLAIR. The best way to find these lesions is to 1. look at the mid-sagittal plain (corpus callosum, sella region, posterior fossa, craniocervical junction) as common non-epileptic developmental disorders can be found and frequently accompanied by cortical malformations; 2. scrutinise the ependymal contour of the lateral ventricles (several of the most common MCDs like SEHT, SCH, and the subependymal nodules of tuberous sclerosis will be present there), 3. search gliosis or other causes of signal increase on FLAIR and calcification on GRE T2*/SWI; 4. follow the cortical ribbon in both hemispheres and look for thickening of the cortex, blurring of the cortex-white matter interface, abnormally small and numerous or large and flat gyri.

Phacomatoses:

These diseases (tuberous sclerosis and Sturge-Weber syndrome being the most important from epileptological point of view) may be easy to diagnose as they are represented by skin lesions and abnormalities of other organs, raising a strong suspicion in most cases. It is to be noted however, that e.g. in rare cases of Sturge-Weber syndrome no facial angioma is indicative of the diagnosis. Contrast administration is crucial in such cases to detect the leptomeningial angioma. The MRI protocol is otherwise the same, as hippocampal sclerosis is a possible complication.

Hippocampal sclerosis (HS) or better mesial temporal sclerosis (MTS):

The hippocampus is a part of the paleocortex and limbic system, together with the amygdala, the parahippocampal cortex, the fornix and the mammillary body. Its unique anatomy explains why specially designed sequences are required for its proper depiction. During the development of the brain, the hippocampus rotates around its long axis and finally reaches a spiral inner architecture of grey and white matter layers on its cross-section. During the rotation, the hippocampal sulcus may not completely close, leaving a pouch that can cause a DDG problem. The spiralling grey matter layers are divided into four sectors (cornu Ammonis – CA1-CA4). HS is based on the selective vulnerability of the neurons predominantly in the CA1 and CA4 sectors. The pathological consequences are atrophy, gliosis, disruption of the inner architecture, dilatation of the temporal horn, atrophy of the fornix (the bundle of white matter fibres collecting at the surface of the hippocampus, the fimbria) and of the mammillary body. The other limbic structures listed above may be involved too. The pathological changes are reflected on the images of an adequate MRI examination as hippocampal atrophy, increased signal intensity (SI) on FLAIR/T2 and decreased SI on T1 weighted images, blurring/disruption of the inner architecture, dilatation of the temporal horn, atrophy of the ipsilateral fornix and mammillary body. There are also increased diffusivity (differentiating the abnormality from post-ictal cytotoxic oedema with restricted diffusion) and MRS changes (predominantly decreased N-acetyl-aspartate). The diagnosis of HS is very important since 1. It is one of the most common causes of pharmacoresistant epilepsy; 2. Surgical removal of the abnormal hippocampus provides a great chance of a seizure-free state; 3. As part of the double pathology complex, it may continue to cause seizures after the excision of a tumour or MCD, resulting in surgical failure.

Finally, the importance of the clinical information cannot be stressed enough. The MRI protocol is almost the same in most cases, though e.g. contrast administration in phacomatoses makes a difference. However, the large number of images and parametric maps cannot be properly and successfully evaluated and diagnosed without the knowledge of the patient's medical history, the epilepsy syndrome, the suspected localisation of the epileptic focus and the current seizure state among others. As described above, a proper MRI may be re-evaluated if new clinical or neurophysiological evidences occur. A final, very useful and thus inevitable step in cases possibly requiring neurosurgical intervention is a clinical session where neurologists, neuropsychologists, neurosurgeons and neuroradiologists discuss the gathered data to make a decision on the necessity and the procedure of invasive EEG monitoring after implantation of intracranial electrodes and/or the operation to resect the epileptogenic lesion or for palliative purposes like callosotomy, multiple subpial transections and vagus nerve stimulation.

Conclusion, take-home message

Epilepsy is a common problem in paediatric neurology. It can be related to many cerebral abnormalities and has a variety of clinical presentations. Neuroradiology, and primarily MRI, has crucial role in the diagnostic work-up. Its role is even more important in pharmacoresistant cases where neurosurgery may be the only tool of seizure control. The most frequent pathologies requiring special imaging are malformations of cortical development and mesial temporal/hippocampal sclerosis. The routine brain MRI makes no sense. The most important components of the special MRI protocol are the 3D GRE T1 weighted sequence and coronal T2 and FLAIR sequences with thin slices and high resolution, perpendicular to the long axis of the hippocampus. Systematic processing of the examination based on knowledge of the clinical and neurophysiological data and consultation are necessary to provide complete recovery or at least relieved symptoms

and a chance of the normal somatomental development of our patients.

Phakomatoses

Jacques F. Schneider
University Children's Hospital Basel, Schwitzerland

Phakomatoses, from the greek "phakos" meaning "spot, lens", is a group of different congenital entities sharing developmental hamartomatous malformations and sometimes tumorous growths involving primarily the skin, the eye and the nervous system, the combination of which is alternatively called neurocutaneous syndrome. These syndromes are classically diagnosed or suspected based on a number of clinical features which may vary within a broad spectrum of manifestations and on thorough assessment of familial history. The variability of the hallmarks in each of these entities makes the clinical diagnosis sometimes difficult. In most of these syndromes, the genetic background has been identified, leading not only to a better insight into the underlying pathophysiology but also to a more consistent diagnosis, which may be sought after even in the prenatal period.

Neuroimaging plays a pivotal role in all neurocutaneous syndromes, as it helps not only to establish the diagnosis, but also to demonstrate the extent of the disease and to monitor disease progression or even regression in time. We will review common and rare imaging characteristics of the following most frequent neurocutaneous syndromes: neurofibromatosis (predominantly Type I), tuberous sclerosis complex (TSC), Sturge-Weber syndrome (SWS), von Hippel-Lindau syndrome (VHL).

Neurofibromatosis Type I (NF1)

NF1 is the most common phakomatosis (also called von Recklinghausen's disease) and is transmitted in an autosomal dominant mode occurring in up to 1 in 3000 births. The genetic defect underlying the disease is located on chromosome 17, at a tumour suppressor gene locus encoding for neurofibromin, a protein controlling cellular signal transduction. Spontaneous mutations occur in 50% of affected individuals.

Cutaneous manifestations present as "café-au-lait"spots and skin frecklings.

Ocular manifestations include iris hamartomas (Lisch's nodules).

Peripheral nervous system manifestations of NF1 mainly consist of neurofibromas which are benign tumours from the nerve sheath. These neurofibromas may be localized (most often), sometimes diffuse (mainly solitary), but may also show severe infiltrative characteristics (pathognomonic) and occur in subcutaneous (especially head and neck) or deep locations. Neurofibromas are usually T1-hypointense, T2-hyperintense and show variable contrast-enhancement. More rarely, NF1 may be associated with malignant peripheral nerve sheath tumours, which mostly arise from the plexiform sort of neurofibromas.

Central nervous system (CNS) manifestations consist of either benign T2-hyperintensities called "unknown bright objects"(UBOs) or low-grade tumours (gliomas and astrocytomas). UBOs have been demonstrated to represent myelin vacuolization on histology and are typically found bilaterally in the dentate nuclei, cerebellum, brainstem, basal ganglia, thalamus, and amygdalo-hippocampal complex. UBOs usually show little mass-effect, are T1-hypointense, T2-hyperintense and do not enhance. CNS tumours are most frequently gliomas principally involving the visual pathway (optic glioma) or astrocytomas in other brain regions. Optic gliomas may produce severe dilatation of the optic nerve and/or optic chiasm, are T1-hypointens, T2-hyperintense and may show intense contrast enhancement. They only rarely produce visual disturbances and usually regress over time.

Skeletal manifestations of NF1 may affect the spine and characteristically cause severe kyphosis and rapidly progressive scoliosis, vertebral scalloping, neuroforaminal widening, based either on dural insufficiency (and resulting into dural ectasia), mesodermal dysplasia or a combination of both. The effects of mesodermal dysplasia and extrinsic pressure (from infiltrative/plexiform neurofibromas) may result in deficient bone formation of the thorax, abdomen or extremities. In this context, distal and anterolateral tibial bowing and pseudarthrosis are typically present during the first years of life, before other signs of NF1 become evident.

Vascular manifestations consist of intracranial aneurysms or stenosis, which are directly related to mesodermal insufficiency.

Tuberous sclerosis complex (TSC)

TSC is the second most common phakomatosis (also called Bourneville-Pringle disease) and is transmitted in an autosomal dominant mode in up to 1 in 6000 births. The genetic defects underlying this disease are located at a tumour suppressor gene locus either on Chromosome 9 (encoding for hamartin) or on Chromosome 16 (encoding for tuberin), both proteins affecting the regulation of cellular growth, adhesion and migration. It is characterized by the formation of benign hamartomas and low-grade tumours in the following systems: skin, CNS, kidneys, heart, lungs, bones and vessels. As the diagnosis of TSC can be difficult and the clinical signs rare, a set of criteria has been established and updated, distinguishing major from minor features, allowing patients to be categorized into definite, probable or suspected TSC categories. Medical imaging is heavily relied upon for most of the non-cutaneous criteria.

Cutaneous manifestations of TSC consist of hypomelanotic macules (ashleaf spots) which may only be detected under Wood's lamp, facial angiofibroma, forehead plaques, shagreen patches, periungueal fibroma, dental pits.

CNS manifestations of TSC consist of subependymal nodules (which may be calcified), subependymal giant cell astrocytomas (which may obstruct the foramen of Monro and cause hydrocephalus), white matter abnormalities (wedge-shaped or linear signal alterations from the ependymal lining up to the cortex) and cortico-subcortical tubers (hamartomas with an slight expansive character). All these manifestations are the consequence of disorders in histogenesis, proliferation and migration of neuronal and glial cells which can be found anywhere from the ependymal surface up to the cortical plate. The amount of tissue burden is related to the degree of behavioural problems, mental retardation (in up to 50%), autism (in up to 25–50%) and severity of epilepsy (in up to 90%). MR appearance of these lesions is age-dependant and varies according to the water content and myelination state.

Abdominal manifestations of TSC include angiomyolipomas (AML) and the formation of renal cysts. AMLs are hamartomas composed of muscle, fat and abnormal blood vessels, which are at increased risk of bleeding if larger than 4 cm, or in the presence of intrahamartomatous aneurysms larger than 5 mm. AMLs can also be found in other intraabdominal organs. The presence of benign renal epithelial cysts in TSC is related to the vicinity of the TSC2 gene and the autosomal dominant polycystic kidney disease gene (PKD1). Furthermore, there is some evidence that TSC patients are at risk to develop renal cell cancer and malignant AMLs.

Cardiopulmonary manifestations of TSC consist of cardiac rhabdomyomas (the most common cardiac tumour in children) and lymphangioleiomyomatosis (LAM, unusual interstitial lung disease in women). 80% of children with cardiac rhabdomyomas are found to have TSC. These tumours are usually asymptomatic (sometimes causing outflow obstruction if large) and regress during the first year of life. LAM is a proliferation of atypical smooth muscle cells in the lymphatics of the lungs of women, probably a result of hormonal interaction as oestrogen promotes abnormal smooth muscle cell migration. Lymphatic obstruction leads to interstitial lung disease, cystic lung destruction, chylous effusions as seen by CT imaging.

Skeletal manifestations of TSC consist of localized areas of sclerosis on vertebral bodies and along sacroiliac joints, as well as phalangeal cysts.

Vascular manifestations of TSC are the result of a generalized vascular dysplasia, occurring not only in AMLs but possibly also involving large intracranial vessels and even producing aneurysms of the aorta. Vessel aneurysms are probably the result of a disruption of the arterial wall, weakened by either the infiltration of hamartomas or intrinsic dysplasia of the elastic fibers.

von Hippel-Lindau syndrome (VHL)

VHL is a relatively rare phakomatosis (also called retinocerebellar angiomatosis) which is inherited as an autosomal dominant trait with an incidence about 1 in 36000 births. The genetic defects underlying this disease are located at a tumour suppressor gene locus on Chromosome 3 which acts as a regulator of hypoxia-inducible genes. In contrast to NF1, TSC and SWS, 80% of affected individuals inherit the mutation which will become manifest only in the second to third decade of life. It is characterized by lesions in following systems: CNS, kidneys, pancreas, extra-adrenal pheochromocytomas, epididymis and inner ear.

CNS and ocular manifestations consist of retinal angiomas and mainly infratentorial, cerebellar hemispheric hemangioblastomas, which share the same histology and are de facto the same disease in a different location. Hemangioblastomas are cystic in 75% of cases with a mural contrast enhancing nodular structure (mimicking cystic astrocytomas). They are essentially benign tumours with slow growth but may bear life-threatening complications.

Renal manifestations of VHL consist of renal cysts, renal angiomas and renal clear cell carcinomas (most common cause of death with a cumulative life-time risk of 70%).

Pancreatic manifestations of VHL occur in 50% of patients and consist of simple cysts, cystadenomas, islet tumours (non-functional, slow growing hypervascular and intensive contrast enhancing lesion) and very rarely adenocarcinomas.

Pheochromocytomas occur in 20% of VHL patients mostly in extra-adrenal locations. They are T1-isointense to the liver, strongly T2-hyperintense and demonstrate marked enhancement following gadolinium administration.

Epididymal simple cysts occur in up to 60% of VHL patients.

Sturge-Weber syndrome (SWS)

SWS is a relatively rare phakomatosis (also called trigeminal encephalo-angiomatosis), which has not yet been linked to a specific genetic defect and occurs in about 1 in 40000 births. It is characterized by a port-wine stain in the ophthalmic division of the trigeminal nerve (strictly abutting the midline if unilateral) and ipsilateral intracranial leptomeningeal angiomatosis.

Ocular manifestations include congenital glaucoma and choroidal angioma.

CNS manifestations consist of typically thickened contrast-enhancing arachnoid membrane (on CT and MRI) with histological evidence of abnormal tortuous vascular structure and molecular evidence that the regulation of blood vessel structure and function, vascular innervation and vasoactive molecules are altered in SWS. Chronic diminished regional cerebral blood flow with impaired vasomotor reactivity leads to brain atrophy with a variable amount of astrogliosis, neuronal loss, dysgenic cortex and calcifications. These brain alterations may lead to cognitive problems (in up to 80%)

and to seizures in 75% of patients (often the presenting symptom), while progressive cortical hemiatrophy leads to contralateral spastic hemiparesis.

Pericerebral spaces, subarachnoid space enlargements, acute and chronic subdural collections

Jean-François Chateil[1, 2], Sophie Missonnier[2]
[1] Univ. Bordeaux, RMSB, UMR 5536, F-33000 Bordeaux, France
[2] CHU de Bordeaux, Service d'imagerie anténatale, de l'enfant et de la femme, F–33000 Bordeaux, France

Normal variations and pathologies of meningeal spaces are frequent in infants. The clinical circumstances are variable: isolated macrocephaly or associated with other neurological signs, acute traumatic context or infectious syndrome. The demonstration of a pathological process at this level raises several questions:

- What is the exact location of the anomaly and its relation to the brain?
- What is the pathophysiological mechanism?
- What is the impact on the brain parenchyma?
- What will the outcome be with or without treatment?

The question of a non-accidental head injury (NAHI) is the most difficult to rule out when a subdural collection is found.

Anatomy and CSF outflow

From outside to inside, the pericerebral spaces are divided into:

- The extra-dural space which lies between the inner table of the skull and the dura; it is more rarely affected in infants because the dura adheres firmly to the bone.
- The subdural space which lies between the dura mater and the arachnoid. This is normally a virtual space: the accumulation of fluid at this level corresponds to a cleavage between the dura mater and the outer surface of the arachnoid, which becomes thicker.
- Subarachnoid spaces which are located between the arachnoid membrane that passes over the sulci and the pia mater in contact with the brain. These areas are normally not dilated, almost virtual at the convexity, larger at the level of cisterns. The cerebrospinal fluid (CSF) circulates within the subarachnoid spaces. The cortical veins and arteries circulate within the subarachnoid spaces; cortical veins cross the arachnoid to drain into the superior sagittal sinus.
- Virtual space between the pia mater and surface of the cortex, which is exceptionally involved in children.

The CSF is secreted at the intra-ventricular level by the choroid plexus. It is reabsorbed at the arachnoid villi, which are arachnoid expansions of dural sinuses, in particular along the superior sagittal sinus. These villi, when larger, constitute the Pacchioni granulations. They are found from the age of 18 months and correspond to intra-dural venous lakes communicating with the neighboring sinus. Arachnoid villi maturation is poorly understood and it is possible that in some patients it may be delayed, which could explain a transient accumulation of CSF in subarachnoid spaces. In addition, any disease of the meninges can cause a disorder of CSF resorption. Finally, if there is an obstruction to venous return, this can also lead to an upstream repercussion.

Clinical circumstances and imaging

Increased head circumference is often the first clinical sign observed. The macrocephaly is defined by a measurement above the 97th percentile. Other signs include infectious context, trauma or neurological signs (seizures, signs of increased intracranial pressure, impaired consciousness).

Plain films of the skull are only mandatory if non-accidental trauma is suspected. Head sonography allows demonstration of pericerebral effusion. A widening of the inter-hemispheric fissure greater than 6 mm is abnormal. Echogenicity of this abnormal space, visibility of the arachnoid membrane and vessels in the pericerebral effusion are important. Ultrasound can also assess the size of the ventricular system.

Head CT has to be performed in emergency when neurological signs or trauma are present. CT evaluates location and density of pericerebral spaces, but also brain parenchyma. MRI is indicated when CT is equivocal or discordant with clinical signs, or in order to give more details about pericerebral spaces or parenchymal lesions. The examination should include T1-weighted images (two orthogonal planes), T2-weighted or gradient-echo T2* to better detect degradation products of haemoglobin; susceptibility weighted imaging (SWI) is more sensitive for small haemorrhages and is considered as the best tool to depict a bleeding. FLAIR is useful for demonstrating extra axial, acute bleeding. Diffusion weighted imaging (DWI) is also mandatory to look for hypoxic-ischaemic changes and axonal injuries.

Diagnosis

Multiple aetiologies are associated with an abnormality of meningeal spaces. Elements that will allow more accurate diagnosis are:

- The clinical data: trauma, infection, curve of the head circumference, other neurological signs.
- The exact topography of the effusion and its nature: pure fluid, hematic, purulent.

Increased head circumference

Benign macrocephaly corresponds to an accumulation of cerebrospinal fluid in the subarachnoid spaces. The exact pathophysiology is poorly understood (transient immaturity of CSF resorption? Another anomaly?). Clinically, the main

sign is the increase in head circumference with a wide fontanel. This increase may be present at birth or appears secondarily. Psychomotor development is usually normal or only slightly disturbed, with axial hypotonicity. Imaging shows a bilateral subarachnoid effusion, which predominates in the frontal region. The evolution is usually favourable: head circumference may remain high; in some cases delayed psychomotor development will still be present. Rarely, complications can occur: clinical signs of poor tolerance may be in relation with the occurrence of acute bleeding; tensioning cortical bridging veins by the effusion may be a contributing factor, but this point is discussed. Parents should be warned of this risk of progression to avoid shaking. This requires clinical monitoring and new exploration to further understand the reasons for any changes in clinical status.

External hydrocephalus was first defined (Dandy) by the accumulation of cerebrospinal fluid in the subarachnoid spaces upstream of an obstacle, with increased intracranial pressure. A superior vena cava thrombosis represents the pathophysiological model, as the stenosis of jugular foramen encountered in achondroplasia. In fact, it is a heterogeneous group where primitive mechanical causes have to be distinguished from possibly transient reabsorption of CSF (post-meningitis, post-traumatic, post-haemorrhagic, post thrombotic…). The literature is sometimes quite confusing, the term "benign external hydrocephalus" has also been employed to describe true primitive benign macrocephaly.

Patent traumatic context versus NAHI and shaken baby syndrome

Acute extradural haemorrhage is rare, and can be found in both abusive and accidental head injury. **Subarachnoid haemorrhage** is common in cases of head trauma and is usually asymptomatic if it is isolated; it is better seen at the initial phase with CT than with conventional T1 and T2 MRI, but FLAIR (hyperintensity) and SWI (hypointensity) are still sensitive. **Subdural hematoma (SDH)** is the most frequent haemorrhage encountered in NAHI. At time of presentation, SDHs can be acute, subacute or chronic and seen as hyper-, iso- or hypodense, respectively, on CT. MRI is more sensitive than CT for detecting small collections, and is also useful in the differentiation between CSF in the subarachnoidal space and chronic SDHs. Dating of haemorrhages is very difficult on both CT and MR: after the acute phase, several concentric compartments can be seen within the SDH; it appears very difficult to affirm that they correspond to repetitive trauma, because in case of SDH, new spontaneous bleedings can occur within the first one. Secondary thrombosis of a ruptured bridging vein may be associated, but is not responsible for subdural haemorrhage. CT and MR (DWI, SWI) help also to identify parenchymal lesions. Search for retinal haemorrhages and bone fractures (skeletal survey) is mandatory when NAHI is suspected.

Acute or sub-acute infectious context

Ultrasound in the acute phase may show a widening of pericerebral spaces, which may become echogenic. Subdural empyema corresponds to a collection developed within the subdural space. It can be peripheral or insinuate against the falx, the tentorium. Ultrasound shows a subdural collection that can be transonic or more echogenic and heterogeneous. Other arguments in favour of a true empyema rather than an inflammatory reactive collection are the presence of a boundary with a deep echogenic membrane, the existence of a mass effect, hyperechogenicity of the pia mater. CT demonstrates a contrast enhancement at the periphery of the collection. MRI is also useful with DWI, to look for a restricted water diffusion within the purulent collection.

Other conditions with enlargement of pericerebral spaces

An enlargement of the subarachnoid spaces can be observed in cases of dehydration, malnutrition, and treatment with corticosteroids or anti-mitotic chemotherapy. Other conditions that accompany subarachnoid collections also include metabolic diseases (such as glutaric aciduria type 1). Subdural collections may be observed in coagulopathies, Menkes disease.

Finally, the diagnosis of "**brain/cortical atrophy**" should be used with caution because the prognosis is pejorative: severe neurological history (neonatal distress, severe trauma, other) is normally found. Clinically, there is some psychomotor retardation; head circumference curve shows a growth defect. Imaging demonstrates circumferential pericerebral subarachnoid effusion. There is a widening of cortical sulci over all the convexity, which is best shown by CT and MRI. The ventricular system is enlarged, but with no sign of trans-ependymal absorption. Reduced total or regional brain volume can be assessed with volumetric MRI.

In conclusion, enlargement of pericerebral spaces may be in relation with a lot of aetiologies. Clinical circumstances are very important to consider. Any subdural collection is suspicious for NAHI. On the other hand, interactions between subarachnoid and subdural spaces may occur during the evolution, and the chronology of events and imaging findings must be clearly studied to avoid misinterpretation.

Systematic approach to inherited white matter diseases in children

Andrea Rossi
G. Gaslini Children's Hospital, Genoa, Italy

Introduction: The increased use of magnetic resonance imaging (MRI) in children with neurological impairment has expanded our knowledge about genetic disorders affecting white matter. By using a specific "MRI pattern recognition

study", some new genetic diseases, such as megancephalic leukoencephalopathy with subcortical cysts and vanishing white matter/childhood ataxia with central hypomyelination, have recently been identified. Furthermore, increased knowledge on the role of structural proteins of myelin, on astrocyte-oligodendrocyte interaction, and on oligodendrocyte-neuron interaction during myelin formation has widened the concept of hypomyelinating disorders. Recent advances in understanding the genetic basis of Alexander disease and glial fibrillary acidic protein have led to consider this disease the first example of a primary genetic disorder of astrocytes. Different classifications of myelin disorders are available (based on either pathological, biochemical, genetic data, or combined clinical and histological/biochemical criteria). By using an integrated MRI and pathophysiological approach, as recently proposed by van der Knaap, white matter disorders may be categorized into the following categories:

Classified leukoencephalopathies
- Leukoencephalopathies with known biochemical and/or molecular defect
- Hypomyelinating diseases
- Dysmyelinating diseases
- Leukoencephalopathies defined on the basis of clinical and neuroradiological criteria, but still without known defect

Unclassified leukoencephalopathies
- Cases without a specific diagnosis despite extensive investigations (about 40–50% of cases)

Hypomyelinating leukoencephalopathies

This group of disorders includes conditions due to a *primary* disturbance in the formation of myelin (such as Pelizaeus-Merzbacher disease that may be considered the prototype of hypomyelinating diseases), and other conditions leading to hypomyelination *secondary* to neurons or astrocytes dysfunction (such as Cockayne syndrome, Tay syndrome, Salla disease, GM1 and GM2 gangliosidoses, and infantile neuronal ceroid lipofuscinosis).

Pelizaeus –Merzbacher disease (PMD) (OMIM 312080)

Pelizaeus–Merzbacher disease (PMD) is an X-linked recessive disorder caused by mutations in the PLP gene. Different mutations in this gene cause a spectrum of phenotypes ranging from PMD to spastic paraplegia type 2 (SPG2), thus leading to the concept of PLP-related disorders. PMD shows a variable onset age ranging from birth (connatal PMD) to childhood (classic PMD) . The *connatal form* is characterized by horizontal, vertical or pendular nystagmus, hypotonia, and feeding difficulties. In the *classic form,* usually at onset in the first year of life, nystagmus, developmental delay, ataxia, limb spasticity and choreoathetosis are evident. Children with the severe form may not survive the first decade; the others with classic form may live into adult age. Evoked-potential studies are abnormal with loss of rostral waves on the brainstem-evoked potentials. EMG and peripheral nerve conduction velocities are usually normal, except for cases showing a PLP null mutation who present with peripheral neuropathy and without nystagmus.. The majority of classic PMD cases results from duplication of PLP gene; the other variants are due to mutations of PLP gene. Either an overexpression of proteolipid protein gene or a deficiency of proteolipid protein results in a disturbed formation of myelin. In addition, it has been suggested that accumulation of misfolded proteins in oligodendroglia may trigger oligodendrocytes apoptosis and consequent demyelination.

Dysmyelinating diseases

In this group of disorders, the composition of the myelin membrane becomes progressively abnormal, leading to myelin instability and finally to myelin loss.

X-linked adrenoleukodystrophy (ALD) (OMIM 300100)

It is due to mutations of the gene (ABCD1) encoding a peroxisomal membrane protein, the ALD protein (ALDP). The ABCD1 is a member of the ATP-binding cassette (ABC) transporter superfamily that translocate a wide variety of substrates across extra- and intracellular membranes. The ALDP is required for the peroxisomal localization of Very Long Chain Fatty Acids (VLCFA). The consequence of this defect is inability to metabolize VLCFA into shorter chain fatty acids. In normal individuals shorter chain fatty acids compose bilaminar membrane of myelin. In ALD patients, VLCFA are incorporated into bilaminar membrane of myelin instead of shorter chain fatty acids, resulting in destabilization of the membrane . An inflammatory response by dysfunctional microglia is characteristically present and is unique to ALD among the metabolic leukoencephalopathies. Although the cause of inflammation is not clear, both biochemical and immunological mechanisms have been postulated: the inflammation process seems to be a secondary phenomenon (in contrast to multiple sclerosis) and this is supported by the location of the inflammatory cells in the second zone of the lesion (see below). The clinical phenotype of ALD can be divided into the following types: childhood cerebral, adolescent cerebral, adult cerebral, adrenomyeloneuropathy and Addison only; heterozigote females may develop symptoms of adrenomeyloneuropathy. No genotype-phenotype correlation is known. Childhood onset is between 4 and 8 years with subtle cognitive decline. An acute onset with focal seizure may be observed. Spasticity, pseudobulbar signs, dementia, cortical disturbances of vision and hearing subsequently develop. Adrenocortical insufficiency is also present. Death results after a few months to several years.

Krabbe disease (Globoid cell leukodystrophy) (OMIM 245200)

Krabbe disease is an autosomal recessive disorder due to a deficiency of the lysosomal enzyme galactosylceramidase (galactocerebroside-β-galactosidase) that catalyzes the first step of cerebroside (galactosyl ceramide) degradation, splitting cerebroside into galactose and ceramide. Cerebroside is almost exclusively found in oligodendrocytes, Schwann cells and myelin sheaths and its metabolism is related to the metabolism of myelin. Accumulation of cerebroside into phagocytic cells is responsible for transformation of these cells into globoid cells. The deacylated form of cerebroside, called psychosine, is a cytotoxic substance that accumulates within oligodendrocytes causing their death and therefore myelin sheath loss. In the *classic early-onset infantile form*, symptoms begin before 6 months of age with irritability and crying followed by rigidity and tonic spasms; peripheral velocity nerve conduction is reduced and brainstem auditory-evoked are often disrupted. In the *late-infantile onset form*, symptoms appear between 6 months to 3 years of life with ataxia, weakness, spasticity and dysarthria. In the *juvenile onset form,* symptoms appear between 4 and 19 years with optic atrophy, progressive spastic tetraplegia, and peripheral neuropathy; approximately half of patients have preserved mental function. An *adult onset form* has also been described.

Metachromatic leukodystrophy (OMIM 250100)

Metachromatic leukodystrophy (MLD) is an autosomal recessive disorder that, in the majority of patients, is due to a deficiency of the enzyme arylsulfatase A that catalyzes degradation of sulfatides (the sulfate ester of cerebroside). Different mutations of the arylsulfatase A gene are associated with phenotypes of different severity. A deficiency in the sphingolipid activator protein, saposin B or SAP-1, is the cause of disease in a minority of patients whose clinical and neuroradiological picture is the same as MLD. Arylsulfatase A removes the galactose-3-sulphate group from glycolipids; its deficiency leads to an accumulation of sulphatide and to a reduction of cerebroside (both these substances are normally present in myelin sheaths). The resulting abnormal myelin composition leads to myelin instability and demyelination. Furthermore, oligodendrocytes dysfunction and death occur due to both storage of sulphatide and to releasing of highly toxic substances from lysosome degeneration. Three subtypes of MLD are known: the late infantile, the juvenile, and the adult type. The most common type is the *late infantile MLD* characterized by gait abnormalities, ataxia, hypotonia, and peripheral neuropathy at onset after the first year of life. Spasticity leading to spastic tetraplegia, bulbar and pseudobulbar symptoms, and mental regression subsequently develop.

Canavan disease (OMIM 271900)

Canavan disease is an autosomal recessive disorder due to aspartoacylase deficiency. Two mutations of the gene for human aspartoacylase account for about 98% of the alleles of Ashkenazi Jewish patients . Many non-Jewish mutations have been reported. In non-Jewish patients of European origin, the A305E mutation accounts for 50% of alleles.

Patients with Canavan disease show delayed psychomotor development by 3 months of age. In the first year of age macrocephaly appears. Seizures and optic atrophy become evident in the second year of age. Most patients die in the first decade of life. Clinical variant without macrocephaly or with late onset have been described. Diagnosis is based on demonstration of N-acetylaspartate in urine. Although the pathogenesis has not been completely elucidated, it has been suggested that the deficiency of aspartoacylase in the white matter causes accumulation of N-acetylaspartate and of its precursor, N-acetylaspartylglutamate that may be responsible for intramyelinic edema, extensive vacuolization, and oligodendrocyte failure .

Van der Knaap disease (Megalencephalic leukoencephalopathy with subcortical cysts (OMIM 604004)

Megalencephalic leukoencephalopathy with subcortical cysts (MLC) is a recently described autosomal recessive disorder due to mutations in the MLC1 gene encoding a putative membrane protein . The onset is during the first year of life with macrocephaly, and slowly progressive deterioration of motor functions with pyramidal signs and ataxia. Mental abilities are relatively spared. Seizures, easily controlled with antiepileptic drugs, occur in most patients.

Alexander Disease (OMIM 203450)

Alexander disease is a genetic disorder due to a defect in the gene encoding for the glial fibrillary acidic protein (GFAP). Heterozygous mutations of GFAP gene have been reported in the majority of patients. Mutations occur *de novo* and are predicted to act in a dominant way . GFAP is an astrocytic protein and Alexander disease represents the first example of a primary genetic disorder of astrocytes. The failure of myelin deposition due to the astrocyte dysfunction illustrates the role of astrocytes in the process of myelination. Clinically, the most common form of Alexander disease is the *infantile variant* at onset at around 6 months of age, with developmental delay, macrocephaly, seizures and progressive spasticity. Neonatal, juvenile and adult variants have also been described. In the *juvenile variant* the onset is between 6 and 15 years with bulbar dysfunction, slowly progressive gait disorders, ataxia, spasticity. Cognitive decline and behavioral changes occur only late in the disease. All the 3 subtypes of Alexander disease have been shown to be caused by mutations in the GFAP gene. The pathological hallmark of all forms of Alexander disease is the presence of

Rosenthal fibers which are astrocytic inclusions containing the intermediate filament protein GFAP in association with small heat-shock proteins.

Vanishing White Matter Disease (OMIM 603896)

Vanishing White Matter Disease, also called Childhood Ataxia with Central Hypomyelination (CACH), is a recently described autosomal recessive disease, due to mutations in all five gene subunits encoding the eukaryotic translation initiation factor eIF2B . This factor is a regulator of translation initiation (i.e. the final step of proteins production, in which mRNA is translated into proteins) under circumstances of mild stress. Clinically, after an initial normal or mildly delayed psychomotor development, patients show a neurological picture whose course is chronic progressive, with additional episodes of rapid deterioration following minor infection and minor head trauma that may lead to lethargy or coma. Cerebellar ataxia and spasticity are the main neurological signs. Optic atrophy and seizures may occur. Mental impairment is relatively mild, and usually less severe than motor dysfunction. Phenotypic variation is wide.

Pathological abnormalities primarily involve the axons. It has been suggested that an abnormal stress reaction (related to the dysfunction of eIF2B that plays a crucial role in regulating protein synthesis under mild stress conditions) may cause deposition of denaturated proteins within oligodendrocytes leading to hypomyelination, loss of myelin, and subsequent cystic degeneration.

Undefined leukoencephalopathies

About 50% of patients with white matter abnormalities remain without diagnosis. Therefore a specific protocol for studying and categorizing these patients is crucial. *Clinical information* concerning familiarity, onset of symptoms, neurological examination, presence of non-neurological symptoms, progression of disease should be integrated with *neurophysiological studies* as well as *neuroimaging evaluation* based on the systematic analysis proposed by van der Knaap and Valk in 1995. MR spectroscopy and new MR techniques will provide further information. The integrated description of the clinical, neuroimaging and pathophysiological features is crucial for categorizing myelin disorders and defining novel homogeneous subgroups of patients. This is the basis for better understanding the basic processes involving the white matter and the genetic basis in the case of an undefined leukoencephalopathy.

Further readings

Barkovich AJ (2000) Concepts of myelin ad myelination. AJNR 21:1099–1109

Di Rocco M, Biancheri R, Rossi A, Filocamo M, Tortori-Donati P (2004) Genetic disorders affecting white matter in the pediatric age. Am J Med Genet B Neuropsychiatr Genet Aug 15;129B(1):85–93

van der Knaap MS, Valk J (2005) Magnetic resonance of myelin, myelination, and myelin disorders. Berlin: Springer Ed. Third Edition

van der Knaap MS, Breiter SN, Naidu S, Hart AA, Valk J (1999) Defining and categorizing leukoencephalopathies of unknown origin: MR imaging approach. Radiology Oct;213 (1):121–33

van der Voorn JP, Pouwels PJ, Hart AA, Serrarens J, Willemsen MA, Kremer HP, Barkhof F, van der Knaap MS (2006) Childhood white matter disorders: quantitative MR imaging and spectroscopy. Radiology Nov;241(2):510–7

Imaging of inflammation, infection and tumours from the intradural spaces to the spinal cord

Maria I. Argyropoulou
Medical School, University of Ioannina, Greece

Inflammatory disorders

Multiple Sclerosis (MS), ***Acute Disseminated Encephalomyelitis*** (ADEM) ***Acute Transverse Myelitis*** (ATM) and ***Neuromyelits Optica*** (NMO) are inflammatory demyelinating disorders involving the spinal cord in children. The typical appearance of ***MS*** lesions is: predominance in the cervical spinal cord, preferential involvement of the dorsal and lateral columns and of the central spinal gray matter, longitudinal extent less than two vertebral body segments, and transverse extent less than half the cross-sectional area of the cord. Spinal cord lesions in ***ADEM*** extend over more than three vertebral segments in length and occupy more than two thirds of the cross-sectional area of the cord. Differences in brain and spinal cord imaging findings are useful in the differential diagnosis between MS and ADEM. Spinal cord involvement similar to that found in ADEM may be found in ***ATM*** and in ***NMO***. Lack of brain involvement in ATM and the presence of the NMO specific IgG autoantibody are useful in the differential diagnosis of ADEM.

Inflammatory demyelinating disorders may also affect the spinal nerve roots. ***Guillain-Barré Syndrome*** (GBS) is an autoimmune acute demyelinating poly-radiculo-neuropathy. The typical appearance of GBS is: history of viral or febrile illness, acute onset of weakness or sensory changes, depressed or absent muscle stretch reflexes, elevated levels of protein in the cerebrospinal fluid, nerve conduction blocks on electrophysiologic studies and either diffuse or ventral nerve root enhancement on MRI.

Infection

Meningeal infection may affect the spinal meninges. The condition is clinically recognizable and imaging may only play a role upon suspicion of complications. ***Intradural extramedullary*** or ***intramedullary abscesses*** are extremely rare in children and are often the result of contiguous spread through a dermal sinus.

Tuberculosis (TB) may affect the spinal cord and the intradural spaces. TB ***spinal arachnoiditis*** is rare in children and represents an inferior extension of intracranial meningeal TB involvement. Loss of spinal cord borders on T1WI due to high protein content in the CSF, increased signal intensity of the spinal cord on T2WI and extensive enhancement of the arachnoid, the nerve roots and the conus medullaris are the most prevalent imaging findings. ***Intramedullary tuberculomas*** are extremely rare. Hypointensity on T1WI, hypointensity with or without central hyperintensity on T2WI and ring enhancement after contrast administration represent the most common imaging findings.

Tumours

Spinal tumours in children are much less common than intracranial tumours. Depending on localization they are divided into intramedullary, intradural-extramedullary and extradural tumors. Only intramedullary and intradural-extramedullary tumours will be discussed in this article.

Intramedullary tumours are more prevalent between 1 and 5 years of age and they account for 25% of all spinal tumours. They are mainly represented by ***low grade pilocytic astrocytomas*** (75% of cases) and ***gangliogliomas*** (15% of cases). Localization at the cervical and cervicothoracic junction, spinal cord enlargement, heterogeneous appearance with solid and cystic components and heterogeneous enhancement pattern (intense with necrotic components, mild heterogeneous or even absent) represent the main characteristics of intramedularry tumours. Cystic components of the lesion may be: a) Neoplastic resulting from tumour necrosis, located inside the tumour and presenting enhancing borders, b) Non-neoplastic located at the top or the bottom of the mass resulting from obstruction of the ependymal canal and presenting non-enhancing borders. Abnormal appearance of the whole spinal cord suggesting "holocord" involvement may be seen, but in most cases represents tumour associated with extensive edema. Based on imaging appearance the differential diagnosis between pilocytic astrocytomas and gangliogliomas is difficult except for the cases with coarse calcifications where the diagnosis of ganglioglioma is more probable. Pediatric ***intramedullary ependymomas*** are almost never seen outside the context of neurofibromatosis type 2 (NF2). These lesions may appear as multiple small hypervascular intramedullary masses. A low signal intensity pseudocapsule may appear at the interface of the lesion with the spinal cord and it is due to frequent small bleedings. The hypervascularity of the lesion and a discrepancy in motion (craniocaudal displacement during the cardiac cycle) between the normal spinal cord and the tumour are thought to be responsible for the development of pseudocapsule.

Intradural extramedullary tumours: The most common intradural extramedullary tumour in the paediatric population is ***subarachnoid metastatic disease*** from primary brain tumours. Metastatic seeding of the subarachnoid spaces occurs with CSF flow transporting tumour cells and it is greatest at the dorsal surface of the spinal cord and the caudal part of the thecal sac. Primary neuroectodermal tumours (PNET) either supratentorial, but mostly infratentorial such as medulloblastomas represent the primary tumour responsible for subarachnoid metastatic disease. ***Primary intradural extramedullary tumours*** are rare and are mainly represented by multiple ***schwannomas*** and ***meningiomas*** occurring in the setting of NF2 and ***neurofibromas*** occurring mostly in the setting of neurofibromatosis type 1 (NF1). ***Myxopapillary ependymomas*** of the filum terminale are rare tumours but more frequent in childhood. Very rare intradural extramedullary tumours are PNETs and teratoid rhabdoid tumours. Dermoids and epidermoids are intradural extramedullary masses arising from ectodermal rests. The presence of a dermal sinus is often responsible for an early imaging revealing the presence of a spinal dermoid.

Post-transplantation lymphoproliferative disorder

Øystein E Olsen
Radiology Department, Great Ormond Street Hospital for Children NHS Trust, London, UK

Post-transplantation lymphoproliferative disorder (PTLD) is a group of diseases in which lymphocytes (usually B-cells) proliferate (on a scale from hyperplasia to neoplasia) in recipients of solid organ or stem-cell transplants (due to immunosuppression and graft-host interaction), a proliferation that is often driven by infection with the Epstein Barr-virus (EBV).

Epidemiology

PTLD represents about 20% of all cancers after organ transplantation.

PTLD occurs within 6 months following transplant in about half of cases, within 5 years in about 90%.

Lifetime risk by type of transplant

Intestinal	30%
Heart	2%–10%
Heart-lung	9%–35%
Liver	9%–14%
Kidney	1%–3%

Bone marrow 1% (higher in unrelated and/or non HLA-identical transplants)

Risk factors

Young age (four-fold incidence childhood relative to adults recipients)
EBV-naïve recipient
EBV in transplanted organ
Intensive immunosuppression

Larger amount of lymphoid tissue in the transplant
Cytomegalo-virus infection
Hepatitis C infection

Aetiology

The most common aetiology is EBV infection that drives B-lymphocyte proliferation. This proliferation is unchecked due to impaired T-cell (CD8+) immune surveillance, which again is a result of immunosuppression. There are however also cases of T-cell (NK-cell) PTLD and of EBV-negative PTLD.

Diagnosis

Clinical diagnosis is difficult because symptoms and signs are vague and nonspecific. So are imaging findings, but temporal information may be useful, e.g. lesions that persist (or increase) during anti-infective therapy. A final diagnosis and classification can only be achieved with biopsy. Therapy in a typical situation of EBV-driven PTLD is based on the viral load (EBV-DNA as measured by the polymerase chain reaction). Treatment (reduced immunosuppression and/or antiviral therapy) will start in an EBV seroconverted patient, or in a pre-transplant EBV positive patient with an increasing or high viral load. The decision to add chemotherapy depends on the histopathological class.

Classification

Five classes of PTLD are recognised by the Society for hemopathology (1997):

Early – within 3 months of transplantation, usually caused by primary EBV infection, expressed as lymphoid hyperplasia in tonsils and/or lymph nodes, the architecture being relatively preserved

Polymorphic – variable interval, solid organ-infiltration with architectural distortion

Monomorphic – may have a later presentation (3 months–12 years), sometimes no concurrent intensive immunosuppression, resembles classical B-cell lymphoma, poorer prognosis

Two further categories (*plasmacytoma-like* and *Hodgin disease-like*) are rare

Prognostic factors

Poorer prognosis is associated with a higher number of affected organs, monoclonal PTLD and EBV-negative PTLD. Whereas about one-quarter respond well to reduction of immunosuppression alone, among those requiring chemotherapy, mortality is >60%.

Pathology and imaging

Sites

Host organs affected in descending order of frequency: abdomen (>50%), chest, head/neck, brain (about 5%)

In half of patients PTLD is confined to lymph nodes.

Overall, the graft is affected in about 20% of PTLD cases, but graft involvement is more common in intestinal and lung transplantation (about 80%).

Findings

1. Solid organs, lymph nodes and tonsils may show a *nodular pattern* (low-attenuation at CT, intermediate signal intensity at T2-w MRI) or an *infiltrative pattern* with organomegaly and loss of function (most commonly seen in the liver). PTLD may also cause periportal infiltration and secondary biliary obstruction.
2. Hollow viscera usually show segmental circumferential mural thickening. There may be secondary obstruction, intussusception and/or ulceration.
3. Mesenteric/omental infiltration
4. Lung-involvement may be expressed as nodules (may have a halo and therefore be confused with fungal infection) or consolidation
5. Paranasal sinus-involvement is usually seen as mucosal thickening (sinusitis-like)
6. Brain PTLD is lymphoma-like (but more often with haemorrhage and necrosis), usually supratentorial

Differential diagnosis

Some common or important differentials to consider are: infection (lung nodules/consolidation, mucosal thickening of sinuses), rejection (graft lesions), metastases (lymph node enlargement, nodules), inflammatory bowel disease (mural thickening and ulceration), lymphocytic interstitial pneumonitis (nodules and septal thickening).

Imaging strategy

Early treatment is important for outcome. Symptoms and clinical findings are diffuse, so extended imaging may be necessary: abdomen/pelvis, chest, head/neck and brain. Imaging protocols need to ensure radiation protection: radiography/CT of the chest only, US and/or MRI for all other body parts. The frequency of follow-up will be clinically guided. The role of imaging (assumed) is to 1) detect possible manifestations of PTLD, albeit a precise diagnosis is not possible, 2) guide biopsy, 3) provide feedback regarding the efficacy of treatment, 4) help establish staging/prognosis. Regarding 3 and 4, there is little or no evidence base.

Imaging of Complications in Pediatric Oncology

George A. Taylor
Childrens Hospital, Boston, USA

Long term survival in pediatric patients with cancer has improved dramatically over the last 2 decades due to a better understanding of genetic factors, underlying molecular mechanisms of disease and therapeutic agents. Along with improvements in disease-free survival, there has been an increased awareness of both short-term and long-term effects of cancer occurring during childhood and its treatments. This presentation with review some common and unique complications of pediatric cancers and their imaging appearance.

Short term complications

In the shorter term (less than 1 year), the most common complications of pediatric cancer fall in the categories of infection, graft-vs. host disease, coagulation disorders, and dose-related radiation effects.

Most infections in pediatric oncology patients occur during episodes of neutropenia and may be caused by opportunistic organisms as well as commonly occurring bacterial and viral pathogens. Chest radiography is often sufficient for the initial diagnosis of pulmonary infections, with CT reserved for better characterization and definition of extent of complex pneumonias. With regard to solid organ involvement by fungal disease, heavily T-2- weighted MRI sequences are the most sensitive modality for detection of hepatic and splenic micro-abscesses. However, imaging resolution of disease lags behind clinical resolution, and clinical decisions may need to be based on immunological testing.

It is important to be aware of the higher risk of bleeding in these patients related to thrombocytopenia and altered coagulation caused by acute liver disease. Acute pulmonary hemorrhage often presents as a mixed alveolar and interstitial pattern of pulmonary opacities that may mimic an infection. Unlike infection, pulmonary hemorrhage tends to clear within 24–36 h. Equally important is the higher risk of venous thrombosis and subsequent pulmonary embolus in this population. In our institution, the frequency of positive CT angiograms for suspected pulmonary embolus is about 15% many of which are patients on the oncology service. A less frequent but serious vascular complication is veno-occlusive disease. This is a microangiopathic injury affecting the sinusoidal endothelium of the liver and, less commonly, the small venules of the lung. In the liver, it presents with rapidly appearing ascites, hepatomegaly and hyperbilirubinemia within the first 3 months post bone marrow or stem cell transplantation. Untreated, it has a mortality rate of close to 80%. Grey scale and Doppler sonography play an important role in early diagnosis and follow-up of this condition. The presence of a thickened gallbladder wall and ascites are non-specific, but highly suggestive sonographic findings of this entity. Rapid appearance and progression of hemodynamic alterations of portal hypertension are also very helpful findings. Daily hepatic sonography is often requested during periods of clinical concern, and often results in the onset of treatment with Defibrotide, a short polypeptide with anti-thrombotic effects. Post-treatment mortality can be reduced to approximately 20%.

Treatment with radiation may result in two short-term effects. The first, and more common effect is radiation fibrosis of the mediastinum and areas of exposed lung. Focal bronchiectasis and scarring are typical imaging findings. A second recognized effect has been named recall pneumonitis. Less common than fibrosis, it is caused by a re-activation of radiation-induced tissue damage immediately following the administration of an alkylating agent. Vasodilatation and capillary leak result in acute pulmonary edema in a non-anatomic distribution limited to the overlying radiation field. Treatment with short-term steroids is effective in reversing this effect.

Long-term complications

In the longer term (longer than 1 year), the most common complications of pediatric cancer include growth disturbances, second malignancies, endocrinologic deficiencies, and a number of psycho-social issues.

Radiated tissues typically have a diminished growth potential, often manifesting in distorted anatomy of the spine, thoracic wall, and leg-length discrepancy. Inclusion of the growth plate in the radiation field increases the risk of anatomic alterations.

One of the most worrisome long-term issues in this population is the higher risk of second malignancy. The most common second malignancies are leukemia, lymphoma and breast cancer. In girls treated for mediastinal Hodgkins disease during adolescence, the risk of breast cancer can be as high as 20–40 times the baseline population risk. Radiation therapy also increases the risk of second tumors within the field. Although osteosarcoma is the most feared second skeletal tumor, benign osteochondromas are the most common growths present within a previously irradiated bone. Genetic predisposition syndromes affecting the p-53 suppressor gene (such as the Li Fraumeni syndrome) increase the risk of a variety of second tumors. Increased surveillance is key to improved outomes.

Diminished pituitary axis function following cranial irradiation, and diminished fertility are well known endocrinologic complications of pediatric cancer. Two recently discovered long-term complications include a higher risk of obesity compared to siblings, and a higher risk of diabetes, especially in patients who have received abdominal or total body radiation.

In conclusion, it is important for radiologists to be aware of the potential short- and long-term complications of pediatric cancer so that early diagnosis and effective prevention treatment can be instituted.

Pediatric MRI-safety revisited

Alvhild A. Bjørkum, Owen Arthurs, *Karen Rosendahl*
Haukeland University Hospital, 5020 Bergen, Norway

The increasing use of magnetic resonance imaging (MRI) inevitably poses the question of safety, as magnetic and electromagnetic fields can influence biological systems. In the absence of ferromagnetic devices and equipment, including biomedical implants, there is no reproducible scientific study showing a health hazard associated with exposure to MRI, i.e. a combination of static, gradient and radiofrequency (RF) fields. However, the majority of studies

address the effect of each single type field, while studies on their combined effect in humans are sparse.

Furthermore, most studies have focused on MRI-related implant heating/interaction and occupational health complaints. During the last decade, however, new screening techniques such as proteomics and transcriptomics, as well as cytogenetic assays have played an increasingly larger role in the evaluation of health effects.

Of those addressing possible cellular effects after an MRI, Simi and colleagues reported a temporary, dose-dependent increase in micronuclei induction in lymphocytic cultures from eight healthy individuals after exposure to pulse sequences routinely used for cardiac scanning. The applied micronuclei test is an accepted and widely used method to evaluate chromosome damage and to assess cancer risk. In a second study on cultured lymphocytes, routine clinical 3T head scans resulted in a significant increase in the frequency of single-strand DNA breaks, as well as an increase in chromosome aberrations and micronuclei over time. The thermal effects as a possible cause were considered unlikely in both these studies.

To date, neither genomic nor proteomic studies have been able to identify consistent markers for biological electromagnetic field (EMF)-responses, although the best proteomic candidates are those involved in the translation process and in building the cytoskeleton. Also, a variety of different genes have been identified as up- or down-regulated following EMF-exposure, reflecting difficulties in both pre- and post-analytical issues, as highlighted in a recent review. As there is a well recognized small but significant increase in cancer risk from using ionizing radiation in children, MRI poses a useful cross-sectional alternative and is widely used in pediatric imaging. In order to evaluate these potential safety issues of MRI in children, we evaluated blood samples obtained before and after a routine brain MRI examination in otherwise healthy girls, using a human genome survey microarray

After Regional Ethical Committee approval, 12 Caucasian females aged 9–14 years who were referred for a routine MR-examination were invited to participate in the study. Six of the twelve girls were excluded from further analysis because they either had a) an abnormal MRI scan, b) abnormal clinical findings, or c) abnormal laboratory markers. The other six girls were included in the analysis as they all had a normal unenhanced brain MRI scan for suspected developmental delay, normal clinical and laboratory findings, and were asymptomatic at the time of examination. Mean age was 12 years and 8 months (range 12years 2 month–14years 7 month). All had 2.5 ml venous blood sampled according to a standardized protocol immediately before and after an unenhanced brain MR examination (GE Signa Excite HD 3.0T, Milwaukee, USA) using an 8 channel head coil to obtain a set of conventional T1 and T2 weighted images

The blood samples were collected in PAXgene Blood RNA Tubes and total RNA was extracted. All microarray experiments were performed using the Applied Biosystems 1700 Expression Array system containing 31700 probes against 27868 genes, and around 1000 control probes. The chemiluminescent signal detection, image acquisition and image analysis of the microarrays were performed on the Applied Biosystems 1700 Chemiluminescent Microarray Analyzer. Filtration and normalization of microarray data was performed by using J-Express Pro v.2.7.

Changes were seen in 205 of approximately 14 000 genes in all 6 girls, of which 122 were up-regulated and 83 were down-regulated, using a cut-off of 1.5 fold change. The five most commonly involved cellular and molecular processes (named Process Networks in the database MetaCore by GeneGo) were: 1) cell cycle (G1-S Growth factor regulation (and mitosis), 2) immune (antigen presentation and TCR signaling), 3) inflammation (IgE signaling and NK cell cytotoxicity), 4) development (skeletal muscle development) and 5) cell adhesion (leukocyte chemo taxis and cell junctions).

Similarly, the microarray screening showed distinct changes in gene groups (either constantly up or down-regulated) defined as members of specific gene functional pathways (canonical pathways), of which the top five pathways were: 1) G-Protein mediated regulation p38 and JNK signaling, 2) calcium signaling, 3) antigen presentation by MHC class II, 4) ICOC-ICOSL pathway in T-helper cell, 5) NFAT in immune response. The changes were consistent using two different software packages for analysis and visualization of microarray data (J-express Pro are underlying (data not shown) the data referred to here through the systems biological database MetaCore by GeneGo).

We concluded that clinical MRI examinations may cause lymphocyte gene expression changes, the effects of which are currently unknown. Further proteomic studies are required to confirm and advance some of the results of this pilot study, to be able to evaluate the potential effects of clinical MRI examinations on short and long term health in this context.

In a recent, extensive literature review, 35 studies also using gene expression, so called transcriptomics approaches to examine potential effects of various electric, magnetic and electromagnetic fields were identified. 15 of these addressed "non-mobile phone" types of EMF radiation, including static magnet fields of 3T, 5T and 14.1T. Most of the 15 studies used cultures of primary cells or established cell lines and only 3 were performed in vivo (animals/nematode). None were performed on human volunteers, and none used clinical MRI scans. The results were inconsistent, with no particular gene expression pattern identified, in part reflecting differences in study designs, type and time of EMF exposures, technical equipment used and analysis

performed. The authors underscore the importance of adherence to the MIAME guidelines for high quality gene array studies. In the abovementioned pilot, we followed these guidelines as to adequate biological and technical replication, good quality RNA with evidence of internal standards as well as appropriate statistical analysis to identify false positives. The microarray results will be confirmed using RT-PCR for some of the differentially expressed genes or verified with so-called super-array (gene-arrays with distinct pathway-related representative gene-probes representing several actually changed genes in our material). In addition we are in the process of analyzing proteomic data from the same data set. Preliminary proteomic findings in three of these patients suggest a change in prothrombin precursor in serum after a 3TMRI, with a fragmentation-pattern changed by one amino acid for several of these fragments. Also quantitative mass-spectrometry or selective or multiple reaction monitoring (S/RM-MS) is ongoing for the actual prothrombin precursor fragments.

Further readings

Hartwig V, Giovannetti G, Vanello N, Lombardi M, Landini L, Simi S (2009) Biological effects and safety in magnetic resonance imaging: a review. Int J Environ Res Public Health June;6(6):1778–98

Leszczynski D, de PD, Koczan D, Stoll D, Franke H, Pablo AJ (2012) Five years later: The current status of the use of proteomics and transcriptomics in EMF research. Proteomics June 18

International Commision on Non-Ionizing radiation Protection. Exposure to high frequency electromagnetic fields, biological effects and health consequences (100 kHz–300 GHz) (2009)

Simi S, Ballardin M, Casella M, De MD, Hartwig V, Giovannetti G et al. (2008) Is the genotoxic effect of magnetic resonance negligible? Low persistence of micronucleus frequency in lymphocytes of individuals after cardiac scan. Mutat Res October 14;645(1–2):39–43

Lee JW, Kim MS, Kim YJ, Choi YJ, Lee Y, Chung HW (2011) Genotoxic effects of 3 T magnetic resonance imaging in cultured human lymphocytes. Bioelectromagnetics October;32(7):535–42

Non-cardiac contrast enhanced ultrasound in children: a brief summary of the current state

Kassa Darge[1], Aikaterini Ntoulia[1,2], Susan Back[1], Frederica Papadopoulou[3]

[1]Department of Radiology, The Children's Hospital of Philadelphia, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA, USA

[2]Department of Radiology, University of Ioannina, Ioannina and [3]Thessaloniki, Greece

Definition:

Contrast enhanced ultrasound (CEUS) is an US examination with intravascular or intracavitary administration of an US contrast agent (UCA).

Need for CEUS in children:

1. Elimination or reduction of alternative studies with radiation exposure.
2. Elimination or reduction of alternative studies that require sedation.
3. MRI is no more an all-time alternative to US due to the potential of gadolinium induced nephrogenic systemic fibrosis.
4. Improving overall diagnostic capability and spectrum of US.
5. Incorporation in point-of-care US
6. Pediatric specific intravesical application for diagnosis of vesicoureteric reflux

Promotion of CEUS in children:

1. European Society of Pediatric Radiology (ESPR) Uroradiology Task Force and European Society of Urogenital Radiology (ESUR) Pediatric Working Group: www.espr.org/index.php?option=com_content&view=section&id=23&Itemid=21
2. Society of Pediatric Radiology (SPR) Contrast Enhanced Ultrasound (CEUS) Task Force: www.pedrad.org/displaycommon.cfm?an=1&subarticlenbr=707
3. International Contrast Ultrasound Society (ICUS): www.icus-society.org/index.php

Ultrasound contrast agents:

In children:

1. SonoVue® (Bracco, Milan, Italy): sulphur hexafluoride gas; intravenous and intravesical
2. Optison® (General Electric Healthcare, USA): microspheres of human serum albumin;
   - intravenous and intravesical (in preparation)

Pediatric usage:

- no pediatric approval

1. Off-label
2. Clinical research

Intravesical CEUS:

- Most common pediatric application
- Known as contrast enhanced voiding urosonography (ce-VUS)
- Other intracavitary use in contrast enhanced US genitography

Indication:

– Vesicoureteric reflux

Procedure:

1. Pre-contrast scan of the urinary tract
2. Intravesical administration of normal saline solution and UCA
3. Post-contrast scan of the urinary tract during and after voiding
4. Post-contrast transperineal scan of the urethra during voiding

Technique:

– Low-MI (mechanical index) contrast specific US modality
– Infusion (with normal saline) or injection of UCA
– Post-contrast saline flash after contrast injection
– Grading (1–5) similar to international reflux grading

US contrast:

– SonoVue® - ≤1% of bladder filling
– Optison® - ≤0.5% of bladder filling

Diagnostic comparisons:

– To voiding cystourethrography (VCUG):
– Increase in reflux detection rate by 9% or more depending on technique used
– Vesicoureteric refluxes missed at VCUG and detected solely in ceVUS: 70% grades II-V
– Metanalysis: 26 studies, 2341 children with 4664 pelvi-ureteric units:
  With VCUG as reference method ceVUS sensitivity 90% and specificity 92%

Safety:

– No adverse events related to intravesical UCA reported
– Adverse events associated with catheterization
– Largest prospective primary safety study: SonoVue®, 1010 children, 564 girls and 447 boys, 15 days–17.6 years, 3.7% children catheter-related adverse event
– European survey: 31 centers, 4131 children, 0–18 years

Intravenous CEUS:

– Less widespread than intravesical application

Indications:

– Similar to adult ones with the following having priority in children:

  1. Abdominal tumors
  2. Abdominal trauma
  3. Abdominal inflammatory conditions
  4. Transplant Doppler
  5. Testicular or ovarian torsion
  6. Hip ischemia

Technique:

– Similar to adults
– Dose adjusted for age and indication

Diagnostic comparisons:

– Few studies with small number of patients
– Largest study abdominal trauma: CEUS versus non-CEUS with CT as reference

CEUS 92.9% sensitivity, 100% specificity, 100% negative and 93.8% positive predictive values

Safety:

– Vast safety data in adults, limited in children
– Few contrast enhanced echocardiography safety studies in children
– Most important prospective pediatric safety study: 13 children, 8 boys and 5 girls, mean age 10.8 years, 28 CEUS studies, Optison®, comprehensive adverse event monitoring—4 patients mild transient adverse events
– European survey: 30 centers, 948 children, 0–18 years, 6 minor adverse events in 5 patients

Further readings

Darge K (2008) Voiding urosonography with ultrasound contrast agents for the diagnosis of vesicoureteric reflux in children. I. Procedure. Pediatr Radiol 38:40–53 II. Comparison with radiological examinations. 54–63

Duran C, del Riego J, Riera L, Martin C, Serrano C, Palaña P (2012) Voiding urosonography including urethrosonography: high-quality examinations with an optimised procedure using a second-generation US contrast agent. Pediatr Radiol 42:660–667

McCarville MB, Kaste SC, Hoffer FA, Khan RB, Walton RC, Alpert BS, Furman WL, Li C, Xiong X. (2012) Contrast-enhanced sonography of malignant pediatric abdominal and pelvic solid tumors: preliminary safety and feasibility data. Pediatr Radiol 42:824–833

Papadopoulou F, Evangelou E, Riccabona M, Ntoulia A, Darge K (2012) Contrast-enhanced voiding urosonography for diagnosis of vesicoureteric reflux in comparison to conventional methods: a meta-analysis. ECR Book of Abstracts, Insights Imaging 3: Suppl 1 (SS 1712), B-0860

Riccabona M (2012) Application of a second-generation US contrast agent in infants and children - a European questionnaire-based survey. Pediatr Radiol 42:1471–1480

50th Annual Meeting of the European Society of Paediatric Radiology

Wednesday, June 5th, 2013

Room: A

8.00–17.30 Registration

8.30–10.30 ESPR Officers Meeting

10.30–11.30 Pediatric Radiology Journal Meeting

12.30–13.00 Opening Ceremony

13.00–14.15 Past into the future - 50 years of ESPR
F. Avni, B. Lombay, C. Owens, H. Ringertz, U. Willi

Chaired by: B. Lombay, C. Owens

14.15–15.25 Scientific Session 1. – Neuroradiology

Chaired by: Ch. Adamsbaum, M. Raissaki

14.15 001-LP: The simple sacral dimple: diagnostic yield of ultrasound in neonates
Jennifer Kucera [1], Ian Coley[2], Sara O'hara[1], Bernadette Koch[1], Brian Coley[1]
[1] Cincinnati Children's Hospital Medical Center, Cincinnati (USA)
[2] Nationwide Children's Hospital, Columbus (USA)

14.25 002-SP: Head shape in ex-premature young adults
Stein Magnus Aukland [1], Irene B. Elgen[2], Trond Markestad[2], Karen Rosendahl[3]
[1] Haukeland University Hospital & University of Bergen, Bergen (Norway)
[2] University of Bergen, Bergen (Norway)
[3] Haukeland University Hospital, Bergen (Norway)

14.32 003-SP: The role of imaging in the diagnosis and management of otogenic lateral venous sinus thrombosis in children
Eva Kovacs [1], Zsuzsanna Csakanyi[1], Beata Rosdy[1], Gyorgy Varallyay[2], Zoltan Harkanyi[1]
[1] Heim Pal Children's Hospital, Budapest (Hungary)
[2] Semmelweis University MRKK, Budapest (Hungary)

14.39 004-LP: Non-Gaussian diffusion imaging: Apparent Kurtosis Coefficient (AKC) maps in paediatric brain
Antonio Ciccarone [1], Claudio Fonda, Marco Esposito, Marzia Mortilla, Sara Savelli
Meyer Children's University Hospital, Florence (Italy)

14.49 005-SP: Prevalence of extracranial internal carotid artery stenosis in stroke-free sickle cell anemia children
Suzanne Verlach [1], Monique Elmaleh[2], Ahmed Kheniche[2], Manuela Vasile[1], Guy Sebag[1]
[1] Medical Imaging Department, Centre Hospitalier Intercommunal, Creteil (France)
[2] Pediatric Imaging Department, Assistance-Publique-Hôpitaux de Paris, Hôpital Robert Debré, Paris (France)

14.56 006-SP: The evidence for determination of age of subdural hematomas with CT and MRI: A meta-analysis
Tessa Sieswerda-Hoogendoorn[1], Floor Postema[2], *Rick van Rijn* [1,3]
[1] Department of Forensic Medicine, Netherlands Forensic Institute, The Hague (The Netherlands)
[2] Faculty of Medicine, University of Amsterdam, Amsterdam (The Netherlands)
[3] Department of Radiology, Academic Medical Center Amsterdam, Amsterdam (The Netherlands)

15.03 **007-LP: Congenital midline nasal masses. US, MRI and CT findings**

Cinzia Orazi, Sergio Bottero, Giovanni Carlo De Vincentiis, Francesco Randisi, Paolo Maria S. Schingo, Emanuela Sitzia, Paolo Tomà
Bambino Gesù Children's Hospital, Palidoro - Rome (Italy)

15.13 **008-LP: Early ultrasound of spinal canal and presacral area in neonatal patients with anorectal malformations versus MR of pelvis and spine**

Lenka Mrazkova [1], Lucie Kavalcova[2], Marti Kyncl[3], Richard Skaba[2]
[1] Charles University, 2nd Faculty Of Medicine, University Hospital Motol, Prague (Czech Republic)
[2] Department Of Pediatric Surgery, Charles University, 2nd Faculty Of Medicine, University Hospital Motol, Prague (Czech Republic)
[3] Department Of Radiology, Charles University, 2nd Faculty Of Medicine, University Hospital Motol, Prague (Czech Republic)

15.25–16.00 Coffee Break

16.00–17.05 Scientific Session 2. - Chest/Cardiac

Chaired by: P. Garcia-Pena, V. Donoghue

16.00 **009-LP: Endobronchial tumors in children: radiological findings and differential diagnosis**

Anna Coma, Verónica Del Prete, Pilar García-Peña, Joan-Carles Carreño, Joaquim Piqueras, Goya Enríquez
Pediatric Radiology Dept. – University Hosp. Vall d'Hebron, Barcelona (Spain)

16.10 **010-SP: Inter- and intra reader agreement of cine fluoroscopy in the assessment of tracheobronchomalacia in children**

Ann Nystedt, Lise Heiberg, Eiríkur Gunnlaugsson, Heidi Kjosbakken, Charlotte De Lange, Lil-Sofie Ording Müller
Departement of Paediatric Radiology, Oslo University Hospital, Oslo, Norway

16.17 **011-LP: MDCT evaluation of air trapping severity in children with and without tracheobronchomalacia**

James Carmichael, Claire Lloyd
Evelina Children's Hospital, London, (United Kingdom)

16.27 **012-LP: Dynamic central airways evaluation with MDCT in children**

Aurelio Secinaro, Laura Menchini, Nicola Ullmann, Renato Cutrera, Paolo Tomà
Bambino Gesù Children's Hospital IRCCS, Rome, (Italy)

16.37 **013-SP: Incidence of calcification in Botalli's ligament- a retrospective study on children and young adults**

Cosmin Caraiani [2], Chara Karatziou[3], Tamas-Szora Attila[2], Horia Stefanescu[2], *Erich Sorantin*[2]
[1] Medical University Graz, Graz (Austria)
[2] Medical University, Cluj (Romania)
[3] Universitary Children Hospital, Athens (Greece)

16.44 **014-SP: Low dose chest CT in cystic fibrosis in children: clinical and radiological correlations**

Cecilia Lanza, *Andrea Giovagnoni*, Lucia Amici, Valeria Bolli
Azienda Ospedaliero-Universitaria Ospedali Riuniti, Ancona (Italy)

16.51 **015-SP: Comparative value of MR and CT in preoperative assessment of vascular rings and pulmonary slings**

Aurelio Secinaro [1], Benedetta Leonardi[1], Valentina Silvestri[2], Alessio Franceschini[1], Sonia Albanese[1], Renato Cutrera[1], Adriano Carotti[1], Giacomo Pongiglione[1], Paolo Tomà[1]
[1] Bambino Gesù Children's Hospital Irccs, Rome (Italy)
[2] Catholic University, Policlinico Gemelli, Rome (Italy)

16.58 **016-SP: Computed-tomography pulmonary and coronary arteries patterns in children with tetralogy of Fallot**

Adrian Hrusca[1], Andreea Rachisan[1], Béatrice Bonello[2], Clio Sorensen[3], Alain Fraisse[2], Philippe Petit[3], Bernard Kreitmann[2], Loic Mace[2], Guillaume Gorincour[3]
[1] Department of Pediatrics, University of Medicine and Pharmacy "Iuliu Hatieganu", Cluj-Napoca, Romania
[2] Department of Medical and Surgical Pediatric Cardiology, La Timone Children Hospital, Marseille, France
[3] Department of Pediatric and Prenatal Imaging, La Timone Children Hospital, Marseille, France

Room: B

16.00–16.30 Guerbet Symposium
Update on the clinical use and safety record of DotareM in children
O. Olsen
Great Ormond Street Hospital, London (United Kingdom)

MRI late enhancement for detection of neonate myocarditis induced by lupus
Phalla Ou
Bichat Hospital, Paris (France)

16.30–17.30 Task Force 1: Neuroimaging
Chaired by M. Argyropoulou

Imaging the premature brain
Stroke in childhood

19.00- Welcome reception

Thursday, June 6th, 2013

Room: A

08.00–18.00 Registration

08.15–09.15 Scientific Session 3. - Interventional radiology
Chaired by: D. Pariente, A. Doros

08.15 **017-LP: Midline catheters versus peripherally inserted central catheters (PICC) in children: a randomized clinical trial**
Sébastien Benali [1], Françoise Rypens[2], Jacques Lacroix[2], Laurent Garel[2], Josée Dubois[2]
[1] Université De Montréal, Montréal (Canada)
[2] Chu Ste-Justine, Montréal (Canada)

08.25 **018-SP: Greater saphenous venous access as an alternative in young children**
Richard Towbin, Carrie Schaefer, David Aria, Robin Kaye, Seth Vatsky
Phoenix Children's Hospital, Phoenix (United States)

08.32 **019-SP: Percutaneous cholecystotomy in critically ill immune compromised children**
Carrie Schaefer, David Aria, *Richard Towbin,* Robin Kaye
Phoenix Children's Hospital, Phoenix, (United States)

08.39 **020-SP: The transiliopsoas approach: an alternative route to drain pelvic abscesses in children**
Samuel Borofsky, Chrystal Obi, Anne Marie Cahill, Ganesh Krishnamurthy, Adeka Mcintosh, Marian Gaballah, Marc S Keller
Children's Hospital of Philadelphia, Philadelphia, (United States)

08.46 **021-LP: Bleomycin sclerotherapy for the treatment of microcystic lymphatic malformations (LM)**
Gulraiz Chaudry, Carlos J Guevara, Kristy L Rialon, Steven J Fishman, John B Mulliken, Cindy Kerr, Ahmad I Alomari
Boston Children's Hospital, Boston, (United States)

08.56 **022-SP: Ultrasound guided Botox injection into salivary glands in patients with hypersalivation**
Ramdas Senasi, Ashok Raghavan, Mahilravi Thevasagayam
Sheffield Children's Hospital NHS Trust, Sheffield, (United Kingdom)

09.03 **023-LP: Transjugular intrahepatic portosystemic shunt in children: a series of 33 children**
Danièle Pariente, Stephanie Franchi-Abella, Jerome Waguet, Jean Yves Riou
Hôpital Bicêtre APHP, University Paris XI, Le Kremlin Bicêtre, (France)

R-024: Pre procedure checklist in paediatric screening and interventional procedures
Ramdas Senasi, Christopher Heafey, Neil Prasad, Ashok Raghavan
Sheffield Children's Hospital, Sheffield (United Kingdom)

09.15–10.30 Scientific Session 4. – Oncology
Chaired by: RJ. Nievelstein, Z. Karádi

09.15 **025-LP: Whole body MRI compared to FDG-PET/CT for treatment response assessment in paediatric malignant lymphoma: a pilot study**
Annemieke Littooij [1], Malou Vermoolen [1], Goya Enriquez [2], Shui Yen Soh [3], Thomas Kwee [1], Bart de Keizer [1], Erik Beek [1], Marc Bierings [1], Rutger Jan Nievelstein [1]
[1] University Medical Center Utrecht, Utrecht, (The Netherlands)
[2] Hospital Universitario Vall d'Hebron, Barcelona, (Spain)
[3] Women's and Children's Hospital, Singapore, (Singapore)

09.25 **026-SP: Whole-body multi-parametric MRI Ann Arbor staging of paediatric Hodgkin's lymphoma: evaluation of agreement with PET-CT**
Arash Latifoltojar [1], Paul Humphries[1], Ananth Shankar[2], Stephen Daw[2], Stuart Taylor[1], Shonit Punwani[1]
[1] University College London, London (United Kingdom)
[2] University College London Hospital, London (United Kingdom)

09.32 **027-SP: Initial experiences with IV CEUS applications**
Zoltán Karádi [1], Zoltan Harkányi[2], Miklós Garami[1], Péter Hauser[1]
[1] Semmelweis University, 2nd Department of Pediatrics, Budapest, (Hungary)
[2] Heim Pal Children's Hospital, Budapest, (Hungary)

09.39 **028-LP: CEUS in children with hematological proliferative disorders - a preliminary report**
Wojciech Kosiak, Maciej Piskunowicz, Tomasz Batko, Ninela Irga, Arkadiusz Piankowski
Medical University of Gdansk, Gdansk, (Poland)

09.49 **029-SP: Second generation ultrasound contrast agents in assessment of solid tumors vasculature in children—one center experience**
Tomasz Batko, Wojciech Kosiak, Maciej Piskunowicz, Katarzyna Połczynska, Arkadiusz Piankowski
Medical University of Gdansk, Gdansk, (Poland)

09.56 **030-LP: Comparison of whole body DWIBS MRI with 123I-MIBG scintigraphy in the assessment of children with neuroblastoma, a pilot study**
Katharine Halliday, *Shyam Mohan*, Nigel Broderick, Paul Morgan, Daniel Rodriguez, John Somers
Nottingham University Hospitals, Nottingham, (United Kingdom)

10.06 **031-SP: Our experience about manual fused single photon emission tomography/computed tomography: incremental value obtained by interdisciplinary approach**
Maria Felicia Villani, Maria Carmen Garganese, Milena Pizzoferro, Aurora Castellano, Saverio Malena, Maria Antonietta De Ioris, Paolo Tomà
IRCCS Bambino Gesù Pediatric Hospital, Rome, (Italy)

10.13 **032-SP: Apparent diffusion coefficients before and after neoajuvant chemotherapy in nephrogenic rests and Wilms tumour**
Daniela Fernandes Pinto, Owen Arthurs, Neil Sebire, Oysten Olsen
Great Ormond Street Hospital, London, (United Kingdom)

10.20 **033-SP** Withdrawn

10.30–11.00 Coffee Break

11.00–13.00 Scientific Session 5. – Genitourinary
Chaired by: M. Riccabona, HJ. Mentzel

11.00 **034-LP: Female phenotype in disorders of sexual differentiation (DSD). Role of imaging: US and MRI findings**

Cinzia Orazi, Carla Bizzarri, Marco Cappa, Paolo Maria S Schingo, Massimiliano Silveri, Paolo Tomà
Bambino Gesù Children's Hospital, Palidoro - Rome, (Italy)

11.10 **035-SP: Prepubertal testicular and paratesticular tumors: US appearance emphasizing in color Doppler findings**

Carmina Duran, Luis Riera, Cesar Martin
UDIAT-CD, Sabadell, (Spain)

11.17 **036-SP: Twisted vascular pedicle: a reliable sign of adnexal torsion**

Catherine Baud, Magali Saguintaah, Sevette Nancy Bechard, Julie Bolivar, Stéphanie David, Alain Couture, Olivier Prodhomme
Hôpital Arnaud de Villeneuve, Montpellier, (France)

11.24 **037-LP: The sonographic appearances of HNF-1Beta/TCF2 mutations in childhood**

Fred E Avni [1], Annie Lahoche [1], Marie Cassart [3], Catherine Garel [2]
[1] Jeanne de Flandres Hospital, Lille, (France)
[2] Trousseau, Paris, (France)
[3] Erasme, Brussels, (Belgium)

11.34 **038-SP: Ultrasound evaluation of the kidneys in ex-premature infants with extremely low and very low birth weight: a preliminary study**

Costanza Bruno, Salvatore Minniti, Alessandra Bucci, Milena Brugnara, Roberto Pozzi Mucelli
Policlinico GB Rossi, Verona, (Italy)

11.41 **039-SP Long-term follow-up of kidney ultrasound in children with hemolytic uremic syndrome (HUS)**

Thi Thanh Tam Bui [1], Heiko Billing[2], Abdulsattar Alrajab[1], Elke Wühl[2], Jens-Peter Schenk[1]
[1] Department of Diagnostic and Interventional Radiology, Pediatric Radiology, University Hospital, Heidelberg, (Germany)
[2] Department of Pediatrics I, University Children's Hospital, Heidelberg, (Germany)

11.48 **040-LP: Optison® for contrast enhanced voiding urosonography in children: an in-vitro optimization of intravesical use of a new US contrast agent**

Susan Back, *Kassa Darge*
Department of Radiology, The Children's Hospital of Philadelphia and Perelman School of Medicine, University of Pennsylvania, Pennsylvania, (United States)

11.58 **041-SP: Omphalitis in neonates and infants: Imaging findings and assessment of underlying causes using sonography**

Kwanseop Lee
Hallym University Hospital, Anyang city, (Republic of Korea)

12.05 **042-SP: Split renal function and urinary tract obstruction in children assessed by magnetic resonance urography in comparison with MAG3 scintigraphy**

Christian J. Kellenberger [1], IA Burger [2], M Makki [1]
[1] University Children's Hospital, Zürich, (Switzerland)
[2] University Hospital, Zürich, (Switzerland)

12.12 **043-SP: Why still dynamic renal scan in the diagnostic pathway of pediatric hydronephrosis?**

Maria Carmen Garganese, Maria Felicia Villani, Milena Pizzoferro, Paolo Caione, Nicola Capozza, Simona Gerocarni Nappo, Paolo Tomà
IRCCS Bambino Gesù Pediatric Hospital, Rome, (Italy)

12.19 **044-LP: Functional MR urography (fMRU) – the shorter the examination the better for all involved!**

Kassa Darge, Jorge Delgado, Melkamu Adeb, Leslie LeCompte, Rob Carson, Ann Johnson, Dmitry Khrichenko
Department of Radiology, The Children's Hospital of Philadelphia, Perelman School of Medicine, University of Pennsylvania, Philadelphia (United States)

12.29 **045-SP: Extravesical ectopic ureter: morphological and functional MR urography (fMRU) findings**

Aikaterini Ntoulia, Melkamu Adeb, Leslie LeCompte, Jorge Delgado, Dmitry Khrichenko, Kassa Darge
Department of Radiology, The Children's Hospital of Philadelphia, Perelman School of Medicine, University of Pennsylvania, Philadelphia, (United States)

12.36 **046-SP: Optimization of non-contrast MR angiography for the assessment of crossing renal vessels in children with pelvi-ureteric junction obstruction**
James Carmichael, Claire Lloyd
Evelina Children's Hospital, London, (United Kingdom)

12.43 **047-SP: MRI and acute pyelonephritis in children: Comparison of diffusion-weighted imaging to Gadolinium-enhanced T1-weighted imaging**
Pierre-Hugues Vivier [1], Asmaa Sallem[1], Marion Beurdeley[1], Ruth P Lim[2], Julien Leroux[1], Jérome Caudron[1], Cyril Coudray[3], Agnès Liard[1], Isabelle Michelet[1], Jean-Nicolas Dacher[1]
[1] Chu C. Nicolle, Rouen (France)
[2] Austin Health, Victoria (Australia)
[3] G. E. Healthcare, Villacoublay (France)

12.50 **048-SP: Assessment of the accuracy of MRI in predicting operability and tumour stage in Wilms' tumors, when correlated with surgical findings and histopathology**
Tanyia Pillay, Tracy Kilborn, Sharon Cox, Komala Pillay
Red Cross War Memorial Children's Hospital, University of Cape Town, Cape Town, (South Africa)
049-R: The importance of ultrasound in the evaluation of nephrocalcinosis in neonate and young children
Besa Hidri, Diamant Shtiza, *Fjorda Tuka,* Sonja Butorac (Saraçi), Denis Qirinxhi
Mother Teresa Uhc, Tirana (Albania)

Room: B

11.00–12.30 Task Force 2. Oncology
Chaired by: Anne Smets

At the borders: Fetal and adolescent oncology. Which strategies? (25')
Sylvia Neuenschwander

Imaging of head and neck tumours: Don't lose your head! (25')
Eline Deurloo

The Potential Role of Contrast Enhanced Ultrasound in Pediatric Oncology (25')
Beth McCarville (USA)

Difficult diagnoses (15')

13.00–14.30 Lunch

14.30–15.30 Gold Medallist, Honorary Member
General Assembly

15.30–16.00 Jacques Lefèbvre lecture
Chaired by: C. Owens

Vital organ assignment in the very preterm neonate: Differences in fore- and hindbrain blood flow regulation by simultaneous use of MRI and NIRS
István Seri (United States)

16.00–16.30 Coffee break

16.30–18.30 Scientific Session 6. - Radiation Safety
Chaired by: G. Enriquez, E. Sorantin

16.30 **050-LP: Anthropometry of paediatric patients and of the mathematical MIRD phantoms applied for dose reconstruction (ISIMEP research project of the Federal Republic of (Germany), Förderkennzeichen 02NUK016A)**

Michael Seidenbusch [1], Karl Schneider
Department of Paediatric Radiology, Dr. von Hauner's Children's Hospital, Munich, (Germany)

16.40 **051-SP: Opportunity of dose reduction in pediatric CT-examinations**

Andrea Lakatos [1], Máté Kiss [1], Béla Lombay [2]
[1] Borsod County University Hospital, Miskolc, (Hungary)
[2] Borsod County University Hospital, University of Miskolc, Faculty of Healthcare, Miskolc, (Hungary)

16.47 **052-SP: National guideline for paediatric CT in Finland**

Raija Seuri [1], Ritva Bly[2], Katja Merimaa[2]
[1] HUS Imaging Center, Helsinki Childrens Hospital, Helsinki University Hospital, Helsinki (Finland)
[2] STUK - Radiation and Nuclear Safety Authority, Helsinki, (Finland)

16.54 **053-SP: Paediatric trauma CT head DLP audit in a tertiary paediatric centre**

Ramdas Senasi, Asad Shah, Ashok Raghavan, Rebecca Ward, Melissa Slocombe
Sheffield Children's Hospital, Sheffield, (United Kingdom)

17.01 **054-SP: Radiation risks in major trauma: cervical spine CT & the lifetime associated risk of malignancy in children**

Shema Hameed, Sylwia Niewiarowski, May-Ai Seah, Joanna Danin, Afshin Alavi
St. Mary's Hospital, Imperial College NHS Trust, London, (United Kingdom)

17.08 **055-LP: Cumulative radiation CT dose in non-oncological patients: a single centre 5 years retrospective review**

Sergio Salerno [1], Claudia Geraci [1], Maurizio Marrale [2], Giuseppe La Tona [1], Antonio Lo Casto [1]
[1] University Hospital Policlinico, Palermo, (Italy)
[2] University of Palermo Department Physic, Palermo, (Italy)

17.18 **056-LP: Accuracy in diagnosis of pediatric acute appendicitis: weight-based CT protocols with traditional filtered back projection versus 60% CTDIvol-reduced protocols with iterative reconstruction technique**

Petra Vajtai, Katharine Hopkins, Ryne Didier
Oregon Health and Science University, Portland, (United States)

17.28 **057-LP: Radiation exposure of the mammarian glands in paediatric high resolution computed tomographic (HRCT) examinations. (ISIMEP research project of the Federal Republic of (Germany), Förderkennzeichen 02NUK016A)**

Michael Seidenbusch, Karl Schneider
Department od Paediatric Radiology, Dr. von Hauner's Children's Hospital, University of Munich, Munich, (Germany)

17.38 **058-SP: Retrospective review of current nasojejunal tube insertion practice**

Mary-Louise Greer, *Natasha Sheikh*, Michelle Falkiner
The Hôspital for Sick Children, Toronto, (Canada)

17.45 **059-SP: Paediatric transit studies: Out of date imaging or a useful imaging modality?**

Guy Cooper, *Lavanya Vitta*, Helen Anderson
Royal Alexandra Children's Hospital, Brighton, (United Kingdom)

17.52 **060-SP: Image gently: Image quality and dose assessment in portable chest radiographs in the NICU and PICU before and after implementation of a high-kVp technique**

Anat Yahav [1], Benjamin Z. Koplewitz [2], Katya Rozovsky[2], Jacob Sosna[2], Idris El-Bakri[3]
[1]School of Medicine, Hebrew University, Jerusalem, Israel
[2]Dept. of, Hadassah-Hebrew University Medical Center, Jerusalem, Israel
[3]Division of Medical Physics, CancerCare Manitoba, Canada

17.59 **061-LP: A wide range radiation dose in voiding cystourethrography: where is the problem?**

Andrea Magistrelli, Marco Cirillo, Teresa Corneli, Mario Emanuele Fiorito, Paolo Maria Salvatore Schingo, Paolo Tomà
Bambino Gesù Children's Hospital IRCCS, Rome, (Italy)

18.09 **062-SP: MRI-based bone age assessment**

Robert Marterer [1], Astrid Krauskopf[2], Eva Scheurer[2], Erich Sorantin[1]
[1]Division of Pediatric Radiology, Department of Radiology, Medical University of Graz, Graz, (Austria)
[2] Ludwig Boltzmann Insitute for Clinical Forensic Imaging, Graz, (Austria)

18.16 **063-SP: Preliminary radiographic validation of the electrocardiographic method (EKG) for positioning the tip of central venous catheters in children: can the EKG replace chest radiography?**

Domenico Noviello [1], Francesca Malacario[3], Francesco Esposito[1], Luigi Esposito[3], Patrizia Oresta[1 1], Sonia Tamasi[1], Ugo Graziano [2], Umberto Balestrieri [2]
[1] AORN Santobono - SC Radiologia, Naples, (Italy)
[2] AORN Santobono - SC Chirurgia, Naples (Italy)
[2] Università degli Studi "Federico II", Naples, (Italy)

18.23 **064-SP: Tolerability and diagnostic efficacy of iobitridol in children**

Martin Maurer [1], Oliver Heine [2], Michael Wolf [3]
[1] Charite - Universitätsmedizin Berlin, Berlin, (Germany)
[2] Guerbet GmbH, Sulzbach, (Germany)
[3] Michael Wolf Informationssysteme, Püttlingen, (Germany)

Room: B

16.30–17.30 Task Force 3. Uroradiology
Chaired by: M. Riccabona, FE. Avni, K. Darge

Terminology in paediatric uroradiology—a proposal for standardisation in order to avoid potentially unfortunate misunderstandings (15'+5' discussion)
P-H. Vivier, F. Avni, H. Blickman, M. Riccabona

Impact of recommendations and guideline on clinical practise—does itmatter at all?
Results of an European questionnaire (10'+5' discussion)
M. Riccabona

Contrast-enhanced US of the childs' urinary tract revisited (20'+5' discussion)
K. Ntoulia, K. Darge, M. Riccabona

Friday, June 7th, 2013

Room: A

08.00–18.00 Registration

08.30–10.35 Scientific Session 7. – Gastrointestinal
Chaired by: A. Daneman, G. Mohay

08.30 **065-LP: Measurement of real-time tissue elastography (RTE) in phantom model and comparison of RTE and transient elastography (TE) in pediatric patients with defined liver diseases**

Buket Selmi [1], Gerhard Alzen[2], Volker Klingmueller[2], Guido Engelmann[3], Ulrike Teufel[3], Saroa El Sakka[1], Jens-Peter Schenk[1]
[1] Division of Pediatric Radiology, Department of DIR, University Hospital Heidelberg, Heidelberg, (Germany)
[2] Department of Pediatric Radiology, University Clinic Giessen & Marburg, Giessen, (Germany)
[3] Department of General Pediatrics, University Hospital Heidelberg, Heidelberg, (Germany)

08.40 **066-SP: Can ultrasound replace small bowel follow through in the investigation of children with possible inflammatory bowel disease?**
Denise A Castro [1],Pam Rasalingam[2], Elizabeth Vandenkerkhof[3], Angela Noble[2], Mary-Louise Greer[1], Don A Soboleski[2]
[1] The Hospital for Sick Children, University of Toronto, Toronto, (Canada)
[2] Hotel Dieu Hospital, Queen's University, Kingston, (Canada)
[3] Queen's University, Kingston, (Canada)

08.47 **067-SP: Perforated appendicitis -an underappreciated mimic of intussusception on ultrasound**
Matthew D Schmitz, *Beverley Newman*, Shreyas Vasanawala, Richard Barth
Stanford University School of Medicine - Lucile Packard Children's Hospital, Palo Alto, (United States)

08.54 **068-SP: Ultrasound in detecting and following gastric foreign bodies in children**
Mihajlo Jeckovic [1], Sudha A. Anupindi[2], Svetlana Balj[1], Jovan Lovrenski[1]
[1] Institute for Children and Youth Health Care of Vojvodina, Novi Sad, (Serbia and Montenegro)
[2] The Children's Hospital of Philadelphia, University of Pennsylvania Perleman School of Medicine, Philadelphia, (United States)

09.01 **069-SP: Accuracy of ultrasonographic diagnosis of acute appendicitis in child population**
Natalia Kokhanovsky, Abdel-Rauf Zeina, Nadir Reindorp, Alexandra Levit-Kantor, Alicia Nachtigal
Hillel Yaffe Medical Center, Hadera, (Israel)

09.08 **070-SP: The role of colon hydrosonography in the diagnosis and follow-up of inflammatory bowel disease in children**
Otilia Fufezan [1], Carmen Asavoaie [2], Daniela Serban[3], Dorin Farcau[1]
[1] 3rd Pediatric Clinic, Cluj-Napoca, (Romania)
[2] 1rd Pediatric Clinic, Cluj-Napoca, (Romania)
[3] 2rd Pediatric Clinic, Cluj-Napoca, (Romania)

09.15 **071-SP: Pneumatic versus hydrostatic reduction of intussusception in children: A meta-analysis of 26,224 Cases**
Moti Chowdhury
The Royal Children's Hospital, Melbourne, (Australia)

09.22 **072-SP: Neonatal proximal small bowel obstruction: A pictorial review**
Erin Horsley[2], *Eric Faerber* [1], Jacqueline Urbine[1]
[1] St. Christopher's Hospital For Children, Philadelphia (United States)
[2] Hahnemann University Hospital, Philadelphia (United States)

09.29 **073-LP: Patent ductus venosus: What does that mean?**
Stephanie Franchi-Abella, Aurélie Keslick, Daniele Pariente
Service de Radiopediatrie- Hôpital Bicêtre, Le Kremlin-Bicêtre, (France)

09.39 **074-SP: Fluoroscopic 'Grab images': a new recommended method for reducing the radiation dose of the paediatric population undergoing nasojejunal tube placement.**
Helen Anderson, Lavanya Vitta, Guy Cooper
Royal Alexandra Children's Hospital, Brighton, (United Kingdom)

09.46 **075-LP: Incidental findings at multidetector computed tomography in children who referred emergency department to be evaluated for right lower quadrant pain.**
Jorge Delgado*, Soroosh Mahboubi*
The Children's Hospital of Philadelphia, Philadelphia, (United States)

09.56 **076-SP: Cystic and solid lesions of the spleen in pediatric patients**
Annamária Márczé, Mária Polovitzer, Diána Molnár, Zoltán Harkányi
Heim Pál Children's Hospital, Budapest, (Hungary)

10.03 **077-LP: Heterotaxy syndromes and abnormal bowel rotation.**
Beverley Newman, Raji Koppolu, Daniel Murphy, Karl Sylvester
Lucile Packard Children's Hospital at Stanford University, Stanford, (United States)

10.13 **078-SP: The effect of gadoxetate disodium on the accuracy and confidence of diagnosis in pediatric liver MRI**

Amy Kolbe, Daniel Podberesky, Bin Zhang, Alex Towbin
Cincinnati Children's Hospital Medical Center, Cincinnati, (United States)

10.20 **079-LP: The role of Magnetic Resonance Imaging (MRI) in the management of post-traumatic pancreatic pseudocysts in children**

Tanyia Pillay, Tracy Kilborn, Sharon Cox
Red Cross War Memorial Children's Hospital, University of Cape Town, Cape Town, (South Africa)

10.30 **080-SP: The incidence of clinically silent malrotation detected on barium swallow examination in children**

Moti Chowdhury, Karen Atkin
Royal Children's Hospital, Melbourne, (Australia)

Room: B

08.30–09.00 Task Force 4. CT/Dose
Chaired by: C. Owens, E. Sorantin

09.30–10.30 Task Force 5. Child Abuse
Chaired by: R.R. van Rijn

The use of modalities other than radiography for excluding fractures in suspected abuse
Katharine Halliday

ESPR guideline conventional imaging in suspected physical abuse
R.R. van Rijn, A. Offiah

The use of whole body MRI in suspected physical abuse; a study proposa

10.35–11.00 Coffee break

11.00–12.35 Scientific Session 8. - Foetal/Neonatal
Chaired by: F. Avni, E. Vasquez

11.00 **081-LP: Prenatal ultrasound and magnetic resonance findings in periventricular nodular heterotopia**

Eléonore Blondiaux [1], Chiara Sileo[1], Catherine Nahama-Allouche [1], Marie-Laure Moutard [2], Antoinette Gelot [3], Jean-Marie Jouannic [4], Hubert Ducou Le Pointe [1], Catherine Garel [1]
[1] Service de Radiologie, Hôpital Armand Trousseau, APHP, Université Pierre et Marie Curie, Paris, (France)
[2] Département de Neuropathologie, Service d'Anatomie et Cytologie Pathologiques, Hôpital Armand Trousseau, APHP, Université Pierre et Marie Curie, Paris, (France)
[3] Pôle de Périnatalité, Centre pluridisciplinaire de diagnostic prénatal de l'Est Parisien, Hôpital Armand Trousseau, APHP, Université Pierre et Marie Curie, Paris, (France)
[4] Service de Neurologie Pédiatrique, Hôpital Armand Trousseau, APHP, Université Pierre et Marie Curie, Paris, (France)

11.10 **082-LP: The Gini-coefficient: A new method to assess fetal brain development.**

Adrian Viehweger [1], T. Riffert[2], B. Dhital[2], T. Knösche[2], A. Anwander[2], M. Bauer[3], H. Stepan[4], I. Sorge[1], W. Hirsch[1]
[1] Pediatric Radiology, University Leipzig, Leipzig, (Germany)
[2] Max- Planck- Institute for Human Cognitive and Brain Sciences, Leipzig, (Germany)
[3] Obstetrics, University Hospital Leipzig, Leipzig, (Germany)
[4] Neuropathology, University Hospital Leipzig, Leipzig, (Germany)

11.20 **083-SP: Fetal skeletal development: value of prenatal MRI**

Erika Rubesova [1], Diego Jaramillo [2]

[1] Lucile Packard Children's Hospital at Stanford, Stanford, (United States)
[2] Children's Hospital of Philadelphia, Philadelphia, (United States)

11.27 **084-LP: Prenatal diagnosis of renal anomalies: What is the value of fetal MRI?**
Siobhan Flanagan, Erika Rubesova, Aristeo Lopez, Susan R. Hintz, Richard A. Barth
Lucile Packard Children's Hospital at Stanford, Palo Alto, CA, (United States)

11.37 **085-LP: Renal arterial doppler findings in fetus with pelvis dilatation: a comperative study**
Mehmet Burak Ozkan
Dr. Sami Ulus Women's and Children's Hospital, Ankara, Turkey

11.47 **086-SP: Abdominal fluid-containing masses of the newborn: All you need to know**
Costanza Bruno
Policlinico GB Rossi, Verona, (Italy)

11.54 **087-SP: Gestational landmarks of the immature brain - A sonographic study**
Giulia Perucca [1], Martin Wurz[2], Katrin Klebermass-Schrehof[2], Manfred Weninger[2], Klara Vergesslich-Rothschild[2]
[1] ASO San Giovanni Battista, Torino, (Italy)
[2] Medical University of Vienna, Vienna, (Austria)

12.01 **088-SP: Comparison of intestinal sonography and abdominal radiographs in a neonatal intensive care unit**
Cicero Silva, Alan Daneman, Oscar Navarro, Rahim Moineddin, Daniel Levine, Aideen Moore
The University of Toronto and the Hospital for Sick Children, Toronto, (Canada)

12.08 **089-LP: Non-invasive measurement of intracellular lipid in the neonatal liver by Magnetic Resonance Spectroscopy**
Laurence Abernethy [1], Mark A Turner[2], Colin Morgan[2], Alexander P Murphy[2], Valerie Adams[3], Graham J Kemp[3]
[1] Alder Hey Children's Hospital, Liverpool, (United Kingdom)
[2] Liverpool Women's Hospital, Liverpool, (United Kingdom)
[3] Magnetic Resonance and Image Analysis Research Centre, University of Liverpool, Liverpool, (United Kingdom)

12.18 **090-LP: Postmortal imaging in unknown death newborn - to bring light into the dark**
Katja Glutig [1], Uwe Schmidt, [2], Christine Erfurt, [2], Gabriele Hahn, [3]
[1] University Child and Youth Clinic, Dresden, (Germany)
[2] Institut of Legal Medicine, Dresden, (Germany)
[3] Department of Pediatric Radiology, Technical University, Dresden, (Germany)

12.28 **091-SP: Routine perinatal post mortem radiography: is it still worth it?**
Owen Arthurs, Alistair Calder, Andrew Taylor, Neil Sebire
Great Ormond Street Hospital, London, (United Kingdom)

Room: B

11.00–12.30 Task Force 6. Research
Chaired by: K. Rosendahl, E. Sorantin

The principles of good research—Thornbury model (15')
Karen Rosendahl

How to recognise bad research (15')
Øystein E. Olsen

Why Radiologists should learn Biostatistics? (45')
Giovanni Di Leo

Status, ongoing projects (15')
Erich Sorantin

12.35–14.00 Lunch

14.00–16.00 Scientific Session 9. – Musculoskeletal
Chaired by: P. Kleinman, LS. Ording-Müller

14.00 **092-LP: Neonatal hip dysplasia:factors predicting need for treatment in selected populations**
Alastair Graham Wilkinson, Sally Wilkinson
Royal Hospital for Sick Children, Edinburgh, (United Kingdom)

14.10 **093-LP: Selective ultrasound screening for developmental dysplasia of the hip in newborns: Effects on registered prevalence, treatment, follow-up and late detected cases. Preliminary results**
Lene Bjerke Laborie[1], Kari Brurås[1], Henrik Davidsen[1], Stein Magnus Aukland[1], John Asle Bjørlykke[1], Trond Markestad[2], Hallvard Reigstad[2], Kari Indrekvam[3], Lars Birger Engesæter[3], Karen Rosendahl[1]
[1] Department of Radiology
[2] Department of Paediatrics
[3] Department of Orthopaedic Surgery; Haukeland University Hospital, Bergen, Norway

14.20 **094-SP** Withdrawn

14.27 **095-SP** Withdrawn

14.34 **096-SP: Prevalence and relevance of pediatric spinal fractures in suspected child abuse**
Jeannette Perez-Rossello, Ignacio Barber Martinez de la Torre, *Paul K. Kleinman*
Boston Children's Hospital, Boston, (USA)

14.41 **097-SP: Controversy in neonatal hip dysplasia: Graf type 1 hips may be abnormal and need treating**
Alastair Graham Wilkinson, Sally Wilkinson
Royal Hospital For Sick Children, Edinburgh (United Kingdom)

14.48 **098-SP: Is there a role for MRI in patients with slipped capital femoral epiphysis ?**
Anca Tanase, Marianne Alison, Nathalie Mutuza, Cindy Mallet, Keyvan Mazda, Guy Sebag, Brice Ilharreborde
Robert Debre Hospital, Paris, (France)

14.55 **099-SP: Distal tufts of fingers 2–5 in Rubinstein-Taybi syndrome - new observations**
Alan Oestreich
Cincinnati Children's Hospital Medical Center, Cincinnati, OH, (United States)

15.02 **100-LP: MRI assessment of inflammatory activity and mandibular growth following intra-articular TMJ steroid injection in children with JIA**
Nina Lochbühler [1], Rotraud K. Saurenmann[1], Lukas Müller[2], Christian J. Kellenberger[1]
[1] University Children's Hospital, Zürich, Switzerland
[2] Clinic for Orthodontics and Paediatric Dentistry, Zürich, Switzerland

15.12 **101-SP: Is the degree of contrast-enhancement on MRI (ceMRI) a reliable criterion for the involvement of temporomandibular joints (TMJ) in children with Juvenile Idiopathic Arthritis (JIA)?**
Thekla von Kalle [1], Peter Winkler [1], Tina Stuber [1], Toni Hospach [2]
[1] Pediatric Radiology Olgahospital Klinikum Stuttgart, Stuttgart, (Germany)
[2] Pediatric Rheumatology Olgahospital Klinikum Stuttgart, Stuttgart, (Germany)

15.19 **102-SP: Serial observations of apophyseal joint inflammation in adolescent patients with enthesitis-related arthritis and correlation with concurrent sacroiliitis.**
Kani Vendhan [1], Tom Amies[2], Corinne Fisher[1], Debajit Sen[1], Yiannakis Ioannou[1], Margaret Hall-Craggs[1]
[1] University College London Hospital, London, (United Kingdom)
[2] UCLH NHS Trust, London, (United Kingdom)

15.26 **103-LP: Prevalence of capitellar OCD in chronic radial head subluxation and dislocation**
Delma Jarrett, Paul Kleinman
Boston Children's Hospital, Boston, MA, (United States)

15.36 **104-LP: Challenges and nuances of infant brachial plexus sonography following nerve injury: direct and indirect findings.**
Michael DiPietro, Lynda Yang
University of Michigan, Ann Arbor, Michigan, (United States)

15.46 **105-SP: Imaging features of juxtacortical (periosteal) chondroma in children**
Stephen Miller
St. Jude Children's Research Hospital, Memphis, (United States)

15.53 **106-SP: Bone vibration as a novel assessment of bone density in children.**
Thomas Huggins [1],Amaka Offiah [2], Helga Razagh [2], Rezza Saatchi [2]
[1] University of Sheffield, Sheffield, (United Kingdom)
[2] Sheffield Childrens Hospital, Sheffield, (United Kingdom)

16.00–16.30 Coffee Break

16.30–17.50 Scientific Session 10. - Education/Miscellaneous
Chaired by: Johan G. (Hans) Blickman, B. Vucinici

16.30 **107-LP: Current status of paediatric post-mortem imaging: a European questionnaire-based survey**
Owen Arthurs [1], Rick van Rijn [1], Neil Sebire [1]
[1] Great Ormond Street Hospital, London, (United Kingdom)
[2] Academic Medical Centre, Amsterdam, (The Netherlands)

16.40 **108-SP** Withdrawn

16.47 **109-LP: Child life services in pediatric radiology: A randomized controlled trial**
Johan G. (Hans) Blickman, Mary Tyson, Chelsea Pino, Constance White, Stephanie Lemke
Golisano Childrens Hospital, URMC, Rochester, NY, (United States)

16.57 **110-SP: Safety of gadobutrol in over 1,000 pediatric patients, preliminary analysis of the data from the GARDIAN study, a global multicenter prospective non-interventional study**
Ravi Bhargava [1], Katja Glutig[2], Gabriele Hahn[3], Franz Wolfgang Hirsch[4], Christian Kunze[5], Hans-Joachim Mentzel[6], Juergen F Schaefer[7], Winfried Willinek[8], Petra Palkowitsch[9]
[1] Stollery Children's Hospital, University Of Alberta, Edmonton (Canada)
[2] Children Center Dresden-Friedrichstadt, Dresden (Germany)
[3] University Hospital Carl Gustav Carus Dresden, Pediatric Radiology, Dresden (Germany)
[4] University Hospital Leipzig, Pediatric Radiology, Leipzig (Germany)
[5] Martin-Luther-University Hospital Halle/Wittenberg, Pediatric Radiology, Halle (Germany)
[6] University Hospital Jena, Pediatric Radiology, Jena (Germany)
[7] University Hospital Tuebingen, Radiology, Tuebingen (Germany)
[8] University Hospital Bonn, Radiology, Bonn (Germany)
[9] Bayer Healthcare, Berlin (Germany)

17.04 **111-LP: The SECURE study: Observational post-marketing study on the safety of gadoteric acid - Interim analysis on 1327 children**
Jean-Pierre Pracros, Jacqueline de la Garanderie, Maud Cagneaux
Femme-Mère-Enfant Hospital, pediatric, fetal and gynecological imaging, Lyon, (France)

17.14 **112-SP: Potential for CT-dose reduction in pediatric CT by automated exposure control (AEC) software (CareDose4 D)**
Doris Zebedin, Michael Riccabona, Erich Sorantin, G. Stücklschweiger, H. Guss, Meinrad Beer
University Hospital of Radiology - Graz, (Austria)

17.21 **113-SP: The whirpool sign**
Francesco Esposito [1], Maria Rita Panico[2], Michele Smaldone[2], Marco Catalano[2], Francesca Malacario[2], Patrizia Oresta[1]
[1] A. O Santbono, Napoli, (Italy)
[2] Univeristà Federico II, Napoli, (Italy)

17.28 **114-SP: Fast-track care for pediatric patients with minor trauma of the limb: the leading role of radiologists**
Paolo Maria Salvatore Schingo, *Andrea Magistrelli*, Teresa Corneli, Sebastian Cristaldi, Umberto Raucci, Paolo Tomà
Bambino Gesù Children's Hospital, IRCCS, Rome, (Italy)

17.35 **115-SP: A new microbolus-technique (MB-T) for CTA in babies and toddlers**
Erich Sorantin, Manos Amanakis, Sabine Weissensteiner
Medical University Graz, (Austria)

17.42 **116-SP: Imaging Epstein-Barr virus - The radiology of Post-transplant lymphoproliferative disorder (PTLD) in solid organ transplantatiom.**
Tom Watson, David Hatch, Stephen Marks, Rachel Adams, Alistair Calder, Persis Amrolia, Oystein Olsen, Catherine Owens
Great Ormond Street Hospital for Children NHS Foundation Trust, London, (United Kingdom)

Room: B

14.00–14.45 Covidien Symposium

Pediatric neuro-oncology 2013
Gabor Rudas

Risk management in radiology department
Javier Calvo Gonzales

16.30–17.00 Task Force 7. Musculoskeletal
Chaired by: K. Rosendahl, P. Toma

An update on screening for DDH and Imaging in JIA
Karen Rosendahl

17.50–18.05 Close the Meeting and Call for Amsterdam

20.00–24.00 Annual Dinner

Abstracts of oral presentations

Wednesday, June 5th, 2013

Neuroradiology

001 – LP

The simple sacral dimple: diagnostic yield of ultrasound in neonates

Jennifer Kucera [1], Ian Coley[2], Sara O'hara[1], Bernadette Koch[1], Brian Coley[1]
[1] Cincinnati Children's Hospital Medical Center, Cincinnati (USA); [2] Nationwide Children's Hospital, Columbus (USA)

Purpose-Objective. Although tethered cord syndrome (TCS) and occult spinal dysraphism (OSD) are associated with certain cutaneous stigmata, their incidence in patients with simple sacral dimples (SSD) has not been thoroughly evaluated. Our objective was to determine the frequency of TCS and OSD in healthy patients with SSD.
Material and methods. The spine ultrasound reports of all patients referred for SSD over a 12 year period at two children's hospitals were reviewed. Studies were considered abnormal for a conus below L2-L3, an abnormal filum, or the presence of an intraspinal mass or dysraphism. All patients' medical records were reviewed for associated medical conditions, additional imaging studies, physical exam findings, and neurosurgical intervention.
Results. 243/3991 (6.1%) patients had abnormal ultrasound findings. 107 were excluded due to the presence of other medical conditions. Of the remaining 136 healthy patients, 52/136 (38.2%) had a normal follow up ultrasound or MRI, 49/136 (36.0%) had a low conus without other signs of tethering, 25/136 (18.4%) had minor abnormalities which did not lead to surgical intervention, 5/136 (3.7%) were lost to follow up, and 5/136 (3.7%) underwent detethering. The incidence of surgery in otherwise healthy patients with SSD was 5/3884 (0.13%, 95% CI: 0–0.27%).
Discussion and conclusions. Ultrasound screening is unnecessary in asymptomatic, otherwise healthy, patients with an isolated SSD, as the risk of significant spinal malformations is exceedingly low in this patient population.

002 – SP

Head shape in ex-premature young adults

Stein Magnus Aukland [1], Irene B. Elgen[2], Trond Markestad[2], Karen Rosendahl[3]
[1] Haukeland University Hospital & University of Bergen, Bergen (Norway); [2] University of Bergen, Bergen (Norway); [3] Haukeland University Hospital, Bergen (Norway)

Purpose-Objective. Children born prematurely tend to have an elongated head shape during infancy and early childhood. Whether or not head shape is fully corrected later in life and when, however, is not known. As part of a large, controlled follow-up, we compared head size and shape of ex-premature young adults to that of healthy controls. We also tested for an association between head size- and form and cognitive abilities.
Material and methods. One hundred and three 19-year-old young adults born prematurely (birth weight below 2000 g) and 100 age-matched controls (term born) were included in this population based study. Occipital-frontal diameter and the biparietal diameter were measured on MR images. Cognition was assessed using Wechsler abbreviated Scale of Ability.
Results. The mean head circumference was lower in the ex-premature group than in the control group; 532 mm (SD=20 mm) and 541 mm (SD=22 mm) (p=0.002), respectively. There was a significant group difference in head shape with more elongated head shape among the ex-prematures. Among the ex-prematures a significant association between head size and cognitive abilities was found, but not between head shape and cognition.
Discussion and conclusions. Young adults born prematurely tend to have smaller heads than young adults born at term and an elongated head shape is also seen at age 19 years. Head shape is not associated to cognition.

003 – SP

The role of imaging in the diagnosis and management of otogenic lateral venous sinus thrombosis in children

Eva Kovacs [1], Zsuzsanna Csakanyi[1], Beata Rosdy[1], Gyorgy Varallyay[2], Zoltan Harkanyi[1]
[1] Heim Pal Children's Hospital, Budapest (Hungary); [2] Semmelweis University MRKK, Budapest (Hungary)

Purpose-Objective. Lateral venous sinus thrombosis (LVST) due to otogenic causes is rare, but severe infectious complication, so its early diagnosis and adequate treatment is important. Our aim is to overview its clinical, radiological and therapeutic implications.
Material and methods. Retrospective chart review conducted in a tertiary pediatric hospital. Between 1998 and 2012 nine children (age range 3–8 years) were diagnosed with LVST due to mastoiditis. Seven children underwent emergency CT examination, which estabished the diagnosis of LVST in six. In others LVST was diagnosed with MRI, which was the method of follow up in all cases.
Results. On the first imaging study mastoid cells were opacified in all cases. In three cases perisinous exsudate,

once dehiscence of the bony wall and the presence of intracranial air, once cerebellitis was found. On follow up cerebellitis progressed to frank abscess in one case, twice signs of venous congestion developed. Therapy contained of mastoidectomy, low molecular weight heparin and antibiotics resulted in recanalisation of the sinuses and complete clinical recovery in eight children. One patient remained with a slight permanent visual impairment.

Discussion and conclusions. Patients presenting with signs of oto-mastoiditis may suffer from LVST. In the radiological report variations of venous anatomy, the presence of perisinous exsudate or cerebral inflammation, and the status of the venous and paranasal sinuses should be evaluated as these factors have therapeutic implications.

004 – LP

Non-Gaussian diffusion imaging: Apparent Kurtosis Coefficient (AKC) maps in paediatric brain

Antonio Ciccarone [1], Claudio Fonda, Marco Esposito, Marzia Mortilla, Sara Savelli
Meyer Children's University Hospital, Florence (Italy)

Purpose-Objective. Diffusion Kurtosis Imaging (DKI) provides quantifiable information about the deviation from Gaussian distribution in water diffusion process. In fact diffusion weighted imaging (DWI) has intrinsic limitations that depend on the b-values employed in acquisition. At low b values <500 s/mm2 the behaviour of diffusion water is not mono-exponential, whereas high b values begin to start restricted water diffusion in biological tissue, hence following a non-Gaussian distribution. Our purpose was to apply DKI method to paediatric pathologies (tumours, ischemia) and to investigate the tolerability and feasibility in detecting brain diseases.

Material and methods. We examined 20 patients from newborn to 12 year old. Diffusion weighted imaging was performed with 5 b values from 500 to 2500 with step 500. Fitting all b values we were able to discriminate Diffusion and Kurtosis parameters. A homemade software performed all fittings and DWI, ADC, AKC maps.

Results. The results showed that AKC maps revealed different information for tissue characterization. In tumours, an increase in AKC was associated in increased microstructural changes associated with peripherally reactive tissue, which may be missed by standard DWI analysis. In ischemia, AKC demonstrated more details of pathologic tissue changes, such as alterations associated with the endoplasmic reticulum.

Discussion and conclusions. AKC maps are non-invasive methods that are well tolerated by paediatric patients. They can be applied also to newborns.

005 – SP

Prevalence of extracranial internal carotid artery stenosis in stroke-free sickle cell anemia children

Suzanne Verlach [1], Monique Elmaleh[2], Ahmed Kheniche[2], Manuela Vasile[1], Guy Sebag[1]
[1] Medical Imaging Department, Centre Hospitalier Intercommunal, Creteil (France); [2] Pediatric Imaging Department, Assistance-Publique-Hôpitaux de Paris, Hôpital Robert Debré, Paris (France)

Purpose-Objective. Cerebral arteriopathy is a serious complication of SCA. Strokes are largely due to intracranial arteriopathy, detected by transcranial Doppler and mostly prevented through chronic transfusions. Extracranial internal carotid artery (eICA) arteriopathy was considered rare, therefore not routinely assessed in SCA. However, several recent cases of stroke associated with stenosis or occlusion of the extracranial part of the internal-carotid-artery prompted the inclusion of the eICA assessment in our TCD protocol.

Material and methods. Between June 2011 and February 2012, 435 consecutive stroke-free-SCA-children (median age: 7.9 years) were assessed for eICA by Doppler sonography via submandibular window during their routine TCD appointments. Cerebral MRI and intra/extracranial MRA were performed in 104/435 cases.

Results. eICA velocities were about 30% lower than MCA velocities. eICA tortuosities were echo-detected in 25% cases. eICA velocity ≥160 cm/s was highly predictive of stenosis. Prevalence was 10.3% (45/435). Low hemoglobin and tortuosities were significant and independent risk factors for eICA velocities ≥160 cm/s. Intra- and extracranial stenoses were significant and independent risk factors for silent infarcts.

Discussion and conclusions. The high prevalence of eICA tortuosities, in our series is in accordance with literature supporting the congenital origin of these patterns. Tortuosities are normal variations of the ICA but might be trigger factor for blood-flow disturbances and subsequent endothelial dysfunction, leading to stenosis. Thus, extracranial Doppler assessment should be routinely added to TCD to evaluate the full extent of cerebral vasculopathy in SCA.

006 – SP

The evidence for determination of age of subdural hematomas with CT and MRI: A meta-analysis

Tessa Sieswerda-Hoogendoorn[1], Floor Postema[2], *Rick van Rijn* [1,3]
[1] Department of Forensic Medicine, Netherlands Forensic Institute, The Hague (The Netherlands); [2] Faculty of Medicine, University of Amsterdam, Amsterdam (The Netherlands); [3] Department of Radiology, Academic Medical Center Amsterdam, Amsterdam (The Netherlands)

Purpose-Objective. Subdural hematomas (SDH) are the most commonly identified intracranial manifestation in abusive head trauma. In legal procedures it can be of the essence to assess the age of subdural hematomas. Our aim was to assess the evidence for dating SDH based on imaging findings.
Material and methods. We performed a systematic search in MEDLINE and EMBASE. Inclusion criteria were: human cases, CT and/or MRI, subdural hemorrhage, uncomplicated hemorrhage, known time of trauma. Exclusion criteria were: case reports, use of contrast media, intervention before imaging, structural brain anomalies and premature neonates.
Results. Our search yielded 1693 hits in MEDLINE and 619 hits in EMBASE. After deletion of duplicates a total of 2075 publications were found. Reference lists were hand searched, resulting in 12 additional publications. All publications were analyzed by two independent reviewers. First based on title, then on abstract and finally on full text reading. A total of 21 articles met all inclusion criteria. Eighteen studies investigated the use of CT and five the use of MRI for dating SDH.
Discussion and conclusions. Based on our meta-analysis we conclude that although seen on CT and MRI imaging, there seems to be a general evolution of the SDH. The individual differences and the amount of overlap are so significant, that no reliable time table can be constructed. The use of radiological dating of SDH in legal proceedings should not be used.

007 – LP

Congenital midline nasal masses. US, MRI and CT findings

Cinzia Orazi, Sergio Bottero, Giovanni Carlo De Vincentiis, Francesco Randisi, Paolo Maria S. Schingo, Emanuela Sitzia, Paolo Tomà
Bambino Gesù Children's Hospital, Palidoro - Rome (Italy)

Purpose-Objective. Congenital midline nasal masses are rare anomalies, usually detected at birth, which include nasal dermoids/epidermoids, nasal cerebral heterotopia (previously known as gliomas) and encephaloceles. These developmental nasal masses share similar embryogenetic origins, resulting from defective separation of neuroectodermal from ectodermal tissue during the development of the nose and frontobasis and can potentially have intracranial extension, which is the rule in encephalocele. Dermoids and epidermoids, which can be associated with sinus tracts that open on the nose, represent the most common (up to 61% of lesions). Nasal cerebral heterotopia can present as extra-nasal (60%), intranasal (30%) or as mixed lesions (10%).
Material and methods. We report on US, MRI and CT findings in our series, including 7 dermoids, 4 nasal cerebral heterotopias, 2 encephaloceles and 1 angioma.
Results. US clearly shows the soft tissue mass, CT and MRI allow evaluation of the extent of the intra- and extra-nasal components. MRI better defines the intracranial extension and relation with the subarachnoid space. Bony defects are better shown by CT (the physiological incomplete ossification of the ethmoid in the first year of life should not be confused with a bony defect).
Discussion and conclusions. Imaging is essential in the evaluation of congenital midline nasal masses, for presurgical assessment of the intra- and extra-cranial extension. Definitive diagnosis is only obtained with histological examination.

008 – LP

Early ultrasound of spinal canal and presacral area in neonatal patients with anorectal malformations versus MR of pelvis and spine

Lenka Mrazkova [1], Lucie Kavalcova[2], Marti Kyncl[3], Richard Skaba[2]
[1] Charles University, 2nd Faculty Of Medicine, University Hospital Motol, Prague (Czech Republic); [2] Department Of Pediatric Surgery, Charles University, 2nd Faculty Of Medicine, University Hospital Motol, Prague (Czech Republic); [3] Department Of Radiology, Charles University, 2nd Faculty Of Medicine, University Hospital Motol, Prague (Czech Republic)

Purpose-Objective. MR study in patients with anorectal malformations/AM/is the standard imaging method in detection of associated spinal dysraphism prior to surgery. However, an MR study requires general anesthesia. Reconstructive surgery without information about spinal dysraphism represents a higher risk of complications. The aim of our study was to show if MR could be replaced by early ultrasound of spinal canal and presacral area.
Material and methods. The ultrasound machine Toschiba Aplio MX with high-frequency linear ultrasound probe/range 9–18 MHz/was used. An examination was carried out in pelvic space - in axial and sagittal plane. The pelvis was further examined in perineal approach - to the exclusion of pre-sacral masses. The spinal canal was examined in axial and longitudinal planes from the craniocervical junction to the sacrum. MR 1,5T machines Achieva or Intera were used and T1 and T2 sagittal, T1 coronal and T2 axial planes were done. 13 patients/age 1–90 days/with AM/perineal fistula 6, vestibular fistula 3, without fistula 4/were examined by both methods.
Results. Sacral dysgenesis in 5 patients, tethered cord in 2, meningocele in 1 were found and revealed by both methods.
Discussion and conclusions. Early ultrasound of the spinal canal and presacral area in patients with AM seems to be a

sufficient imaging method in detection of spinal dysraphism and pelvic masses prior to surgery.

Chest/Cardiac

009 – LP

Endobronchial tumors in children: radiological findings and differential diagnosis

Anna Coma, Verónica Del Prete, Pilar García-Peña, Joan-Carles Carreño, Joaquim Piqueras, Goya Enríquez
Pediatric Radiology Dept. – University Hosp. Vall d'Hebron, Barcelona (Spain)

Purpose-Objective. Endobronchial tumors are rare in children and often misdiagnosed. This study illustrates radiologic findings in 7 patients with endoluminal tumors.
Material and methods. Retrospective chart review of children with endobronchial tumors diagnosed in 2000–2012. Chest plain films and CT were performed in all cases, and MRI in one patient.
Results. Seven patients with endobronchial lesions (5 girls, 2 boys, mean age 9.7 years). Six primary tumors (all but 1 malignant) and one secondary to an invasive mediastinal tumor (teratoma). Chest plain film findings: unilateral obstructive emphysema in two patients with tumors in mainstem bronchi, and consolidation with airway bronchograms in five patients with tumors in segmental bronchi. Helical CT with MIP reconstructions identified the lesion.
Discussion and conclusions. Bronchial tumors generally arise in a mainstem bronchus or proximal portion of lobar bronchi. Most are malignant, and they can be primary or secondary. Pediatric radiologists should be familiar with plain film features of chronic bronchial obstruction (recurrent consolidation or atelectasis with airway bronchograms) and indicate appropriate examinations to achieve a prompt diagnosis. CT is the reference standard. Differential diagnosis: chronic foreign body aspiration, endoluminal tuberculoma, and mucus plug in patients with cystic fibrosis. Endobronchial lesions should be considered in the differential diagnosis of airway obstruction. Recurrent pneumonia and atelectasis despite adequate treatment should alert to endobronchial tumors.

010 – SP

Inter- and intra reader agreement of cine fluoroscopy in the assessment of tracheobronchomalacia in children

Ann Nystedt, Lise Heiberg, Eiríkur Gunnlaugsson, Heidi Kjosbakken, Charlotte De Lange, Lil-Sofie Ording Müller
Departement of Paediatric Radiology, Oslo University Hospital, Oslo, Norway

Purpose-Objective. Tracheobronchomalacia (TBM) is a frequent cause of stridor and cough, and a differential diagnosis for therapy-resistent asthma in children. Dynamic CT or MRI is used for the assessment of TBM, but limitations of these techniques include excessive radiation exposure, need for sedation and limited availability. Therefore fluoroscopic assessment of TBM is still widely used. Definitions of TBM in the literature vary and are poorly validated. Moreover there are sparse data on the reliability of fluoroscopic assessment of TBM. We therefore set out to study the inter-and intrareader reliability of this test.
Material and methods. We retrospectively analysed cine fluoroscopy studies of consecutive patients with clinically suspected TBM from two paediatric referral centres in Oslo, Norway, between 1.1. - 30.6. 2012. 111 patients were enrolled and a standard fluoroscopy protocol was applied. Two paediatric radiologists from each hospital read all studies twice with minimum 2 weeks interval. The trachea, the main bronchi were assessed separately. More than 50% reduction of the airway diameter was defined as malacia, with a subgrading of mild (51–70%), moderate (71–90%) and severe (91–100%) airway collapse. Inter- and intrareader agreement was calculated using Cohen's Kappa coefficient.
Results. Our study is ongoing and we wish to present our results at the ESPR 2013.
Discussion and conclusions. There is an urge for reliability studies on fluoroscopic assessment of TBM to evaluate the usefulness of this test.

011 – LP

MDCT evaluation of air trapping severity in children with and without tracheobronchomalacia

James Carmichael, Claire Lloyd
Evelina Children's Hospital, London, (United Kingdom)

Purpose-Objective. To assess the pattern and severity of air trapping in children with and without tracheobronchomalacia (TBM) by dynamic Multidetector Computed Tomography (MDCT). Previously published small studies have suggested significant differences in air trapping between children with and without TBM (Lee et al. 2009) (Zhang 2003). Our aim was to evaluate our data to add to the available literature.
Material and methods. We evaluated CTs of children with and without TBM (determined by bronchoscopic criteria), who underwent MDCT between 2009 and 2012. CTs were assessed by two consultant pediatric radiologists blinded to bronchoscopic findings using established scoring systems (Zhang et al. 2004), evaluating severity and extent of air trapping at defined anatomical positions. Kappa statistics were used to assess inter-observer agreement. The air trapping scores were compared between groups.

Results. We assessed 32 CTs: 18 children (mean age 29 months) with TBM and a control group of 16 children without TBM (mean age 33 months). CT scores of air trapping demonstrated good inter-observer agreement. We found no significant difference in air trapping scores between TBM and control children.
Discussion and conclusions. By adding our data to the existing literature, we show that the relation between TBM and air trapping remains unclear. The complexity of MDCT in children, bronchoscopic technique, and diagnostic criteria of TBM present significant challenges to scientific assessment of this rare, but increasingly diagnosed condition.

012 – LP

Dynamic central airways evaluation with MDCT in children

Aurelio Secinaro, Laura Menchini, Nicola Ullmann, Renato Cutrera, Paolo Tomà
Bambino Gesù Children's Hospital IRCCS, Rome, (Italy)

Purpose-Objective. MDCT allows quick airway and lung assessment in pediatric patients. Images acquired in multiple phases by multiple repeated scans during respiration may be viewed dynamically, allowing more complete airway and pulmonary evaluation than possible with static protocols. The purpose of this study was to evaluate whether low-dose techniques can be applied to dynamic airway CT in children.
Material and methods. The study included 11 infants and non-cooperative children (aged between 1 month and 14 years) with persistent respiratory difficulty who underwent dynamic airway CT (4 with contrast administration, 7 without contrast administration). Continuous either sequential or spiral multirow detector scans were obtained at 280 ms gantry rotation with a cycle time of 430 ms for sequential acquisitions and 1 s for spiral ones. Total time of scanning was between 2.15 and 5 s. A low dose protocol was used with 80 kVp tube voltage and automatic tube current modulation systems. The effective dose for each patient was calculated according to Deak conversion factors.
Results. All studies were of diagnostic quality, frequently providing critical information not available with other diagnostic tests. The mean effective dose for all patients was 1.59 (SD, 0.39) mSv.
Discussion and conclusions. Multirow detector dynamic CT is a new non-invasive tool for evaluation of the airway in non-cooperative pediatric patients with persistent respiratory distress. Effective doses are reasonable, generally less than 2 mSv.

013 – SP

Incidence of calcification in Botalli's ligament- a retrospective study on children and young adults

Cosmin Caraiani [2], Chara Karatziou[3], Tamas-Szora Attila[2], Horia Stefanescu[2], *Erich Sorantin*[2]
[1] Medical University Graz, Graz (Austria); [2] Medical University, Cluj (Romania); [3] Universitary Children Hospital, Athens (Greece)

Purpose-Objective. To determine the incidence of calcifications in Botalli's ligament (cBL) in a young population (patients younger than 30) and to describe patterns of regression in order to differentiate it from other causes of calcifications in the aortico-pulmonary window.
Material and methods. Chest CT examinations of 175 consecutive patients, younger than 30 years were analyzed retrospectively. There was a male predominence in the studied population (116 men and 59 women). Patients with mediastinal oncologic pathology were excluded. Images were analyzed in order to see the presence/absence of calcifications, the size, regression pattern (ellipsoidal, linear, small rounded) of the calcifications and their location on the Botalli's ligament (closer to the aorta or closer to the pulmonary artery).
Results. cBL could be detected in 48 of 175 (27,4%) patients. Regression pattern consisted of 61% small rounded, 21,3% ellipsoidal, 16,6% linear shapes. Two calcifications had particular shapes and could not be integrated in the created categories. Size could be determined with mean-value and was between 13/9 mm and 2/1 mm. The mean size of the calcifications was 4.3/2.6 mm. Most of the calcifications were located close to the aortic insertion of the ligament.
Discussion and conclusions. Calcifications in Botalli's ligament are not rare and the shape of this calcification can, in the most cases, differentiate calcifications in Botalli's ligament from calcified lymph nodes.

014 – SP

Low dose chest CT in cystic fibrosis in children: clinical and radiological correlations

Cecilia Lanza, *Andrea Giovagnoni*, Lucia Amici, Valeria Bolli
Azienda Ospedaliero-Universitaria Ospedali Riuniti, Ancona (Italy)

Purpose-Objective. To study correlations among spirometry, low dose chest Computed Tomography (CT) and Shwachman-Kulczycki (SK) score in pediatric patients with cystic fibrosis.
Material and methods. This was a cross-sectional prospective study . Data from clinical charts, chest CT and

spirometry of 24 patients with CF (aged 5–21 years), were analyzed. Spirometry (FEV1), CT and clinical examination (Shwachman-Kulczycki score) were carried out on the same morning. CT was performed with a volumetric inspiratory scan with 80 Kvp, 20 mA/s, 5-mm slices, 5-mm intervals, pitch 1.35. The dose-length product (DLP) was 20 mGy-cm. The Bhalla score was used for tomographic analysis. For all patients the correlations between the SK score, FEV1 and Bhalla scores were calculated.

Results. In 5 patients with FEV1 <40 and SK score=60, lung CT showed diffuse severe bronchiectasis (III) with bullae, atelectasis or consolidation. Four patients with FEV1=41–70 and SK=60–80 had moderate (II) bronchiectasis, in 2 case with consolidations. In 10 patients with FEV1=71–90 and SK=80–90, CT demonstrated mild (I–II) bronchiectasis with rare bronchial wall thickening and muco plugging. In 5 patients with FEV1 >90 and SK=90–100, CT showed early bronchiectasis.

Discussion and conclusions. In this study the SK score correlated strongly and significantly with FEV1 and lung CT. Low-dose CT can be performed at lower effective doses than can standard CT, approaching those of chest radiography.

015 – SP

Comparative value of MR and CT in preoperative assessment of vascular rings and pulmonary slings

Aurelio Secinaro [1], Benedetta Leonardi[1], Valentina Silvestri[2], Alessio Franceschini[1], Sonia Albanese[1], Renato Cutrera[1], Adriano Carotti[1], Giacomo Pongiglione[1], Paolo Tomà[1]

[1] Bambino Gesù Children's Hospital Irccs, Rome (Italy); [2] Catholic University, Policlinico Gemelli, Rome (Italy)

Purpose-Objective. To compare the usefulness of magnetic resonance (MR) and computed tomography (CT) in the evaluation of pediatric patients with aortic arch anomalies type vascular rings and pulmonary slings, particularly detailing recent developments in imaging techniques.

Material and methods. We retrospectively reviewed 35 pediatric patients, aged between 4 days to 14 years, with true vascular rings. Between 2008 and 2012, 17 of them underwent a CT evaluation and 18 a MR within our institution (Bambino Gesù Children's Hospital, Rome). Unsedated free-breathing CT scans were obtained with high-pitch spiral acquisition. Radiation exposure was minimized with technical adjustment, such as low tube voltage 80 kVp and tube current according to patient weight. MR examinations were performed with a 1.5T scanner. General anesthesia was administered in all patients, if required.

Results. Both CT and MR modalities were effective in demonstrating the complex vascular morphology in all patients. However, CT showed better agreement in the evaluation of possible airway compromise or esophageal impingement and provided tracheal stenosis assessment very close to invasive tracheo-broncoscopy performed in some patients.

Discussion and conclusions. The higher spatial resolution of CT consents easy detection of vascular anomalies and airway involvement associated with complete pre-surgical assessment, shortening traditional multistage work-up. The higher temporal resolution of CT allows quicker examination time, decreasing risks related to general anesthesia and hospitalization.

016 – SP

Computed-tomography pulmonary and coronary arteries patterns in children with tetralogy of Fallot

Adrian Hrusca[1], Andreea Rachisan[1], Béatrice Bonello[2], Clio Sorensen[3], Alain Fraisse[2], Philippe Petit[3], Bernard Kreitmann[2], Loic Mace[2], Guillaume Gorincour[3]

[1] Department of Pediatrics, University of Medicine and Pharmacy "Iuliu Hatieganu", Cluj-Napoca, Romania; [2] Department of Medical and Surgical Pediatric Cardiology, La Timone Children Hospital, Marseille, France;

[3] Department of Pediatric and Prenatal Imaging, La Timone Children Hospital, Marseille, France

Purpose-Objective. In patients with Tetralogy of Fallot (TOF), characterization of anatomy, size and morphology of pulmonary and coronary arborization is essential for surgical management. Aim: To evaluate the feasibility of angio-CT to define the pulmonary and coronary circulation abnormalities in TOF patients.

Material and methods. We retrospectively reviewed patients diagnosed with TOF who underwent an angioCT evaluation before the corrective surgical intervention from February 2006 to September 2012. The parameters studied were sex, mean age at CT, the presence of a genetic condition and the need for a sedation for CT-scan. The imaging data analyzed were the level of the pulmonary stenosis, sizes of the pulmonary arteries, and the presence of an abnormal coronary pathway. CT data were compared to angiography and/or surgical findings.

Results. Thirty-eight patients were included. The mean age of our patients was 4.30±1.90 months (male/female=19/19) with two patients with a TOF in a genetical syndrome context. In 16 cases CT was performed under sedation (42.1%). CT findings for the pulmonary arterial morphology are as follows : 24 (63.1%) patients had infundibular stenosis, 7 (18.4%) had infundibular and/or valvular stenosis and 7 (18.4%) patients had pulmonary arterial abnormalities. AngioCT identified 9 (23.68%) patients with coronary anomalies.

Discussion and conclusions. With the advantage of noninvasive nature, short scanning time and high spatial

resolution, CT can provide accurate information about intracardiac and extracardiac anatomy patients with TOF.

Thursday, June 6th, 2013

Interventional radiology

017 – LP

Midline catheters versus peripherally inserted central catheters (PICC) in children: a randomized clinical trial

Sébastien Benali [1], Françoise Rypens[2], Jacques Lacroix[2], Josée Dubois[2], Laurent Garel[2]
[1] Université De Montréal, Montréal (Canada); [2] Chu Ste-Justine, Montréal (Canada)

Purpose-Objective. To determine the feasibility and safety of midline versus peripherally inserted central catheter (PICC) in pediatric patients.
Material and methods. 153 consecutive children referred to the Department of Radiology for intravenous catheter insertion were prospectively randomized in 2 groups: midline catheter (extremity at the proximal subclavian vein) or PICC lines. All patients were less than 18 years and weighed more than 3 kg. The primary outcome was the dwell-time of the catheter; secondary outcomes were catheter complications (deep vein thrombosis or infection).
Results. Study population: 84 PICC lines and 69 midlines. PICC lines dwell-time was 1–105 days (mean: 20.1, median: 14.5), and midline dwell-time was 3–77 days (mean: 17.9, median: 12.0). Catheter dysfunction was noted in only 1 case (PICC line). No statistically significant difference was observed between the type of catheter and their dwell-time (p=0.214). However, a statistically significant difference between the type of catheter and the incidence of deep vein thrombosis was noticed (p<0.02) (midline: n=5, PICC line: n=0). No catheter-related infection was seen in either groups.
Discussion and conclusions. There is no significant difference between midline and PICC line dwell-time. However, midline catheter safety is yet to be determined since our study results demonstrate a higher incidence of deep vein thrombosis in this group.

018 – SP

Greater saphenous venous access as an alternative in young children

Richard Towbin, Carrie Schaefer, David Aria, Robin Kaye, Seth Vatsky
Phoenix Children's Hospital, Phoenix (United States)

Purpose-Objective. To demonstrate the utility and effectiveness in using the greater saphenous vein (GSV) for placement of peripherally inserted central catheters in young children.
Material and methods. From 2010 to 2012, insertion of central catheters using the GSV was attempted in 86 children ranging from 3 days to 17 years (mean of ~2 years). Indications included congenital heart disease, urinary tract infection, and venous access. Utilizing ultrasound-guidance and/or clinical landmarks, catheters were placed in the GSV at the thigh or ankle level. Ideal catheter tip position was considered at the IVC/RA junction. Immediate and short-term complications are reviewed.
Results. Of the 86 patients, successful placement occurred in 67 (78%), with a mean weight of 9.1 kg. All 19 failures occurred in vessel diameters of ≤1.6 mm (mean of 1.2 mm). Ankle venous access was obtained in 31 patients, all but one weighing <10 kg. A total of 1060 catheter days were reviewed without complications.
Discussion and conclusions. This is the first pediatric case study presented using the saphenous vein for percutaneous venous access. The GSV provides an alternative for upper extremity and internal jugular venous access, particularly in very young children (<10 kg), those with cardiac anomalies, and selected older children. GSV access is safe with a low complication rate. In the lower extremities, GSV access may be the preferred initial access site to preserve future femoral venous access.

019 – SP

Percutaneous cholecystotomy in critically ill immune compromised children

Carrie Schaefer, David Aria, *Richard Towbin,* Robin Kaye
Phoenix Children's Hospital, Phoenix, (United States)

Purpose-Objective. To assess the safety and effectiveness of percutaneous cholecystotomy [PC] in critically ill children who are immunocompromised or post Bone Marrow Transplant with acalculous cholecystitis [AC].
Material and methods. From 2006 to 2012, 8 patients, 10 months to 15.75 years, underwent image guided PC for AC. The diagnosis of AC was made clinically and sonographically. Clinical findings included abdominal distention, pain, fever and abnormal labs. Sonographic findings included GB wall thickening, distention, sludge, pericholecystic fluid, and sonographic Murphy sign. Five children had a BMT for Leukemia or Severe Combined Immune Deficiency [SCID], 18 to 225 days post BMT at time of procedure. Three were not post BMT. Five PCs were performed with ultrasound and fluoroscopic guidance, two

with CT. Labs pre procedure, days 3 and 7 post gallbladder [GB] drain placement were perfomed.
Results. Seven of 8 percutaneous GB drains were placed using a transhepatic approach. There were no complications. Four drains were removed between 44 days and 11 months. Four patients died of causes unrelated to AC, with indwelling GB drains. Two patients underwent cholecystectomy after PC. Two patients returned to normal GB function after PC and did not require cholecystectomy, and two others underwent cholecystectomy .
Discussion and conclusions. PC can be performed in critically ill children with AC and the condition can successfully be treated without associated complications. For some patients, PC may prevent the need for cholecystectomy.

020 – SP

The transiliopsoas approach: an alternative route to drain pelvic abscesses in children
Samuel Borofsky, Chrystal Obi, Anne Marie Cahill, Ganesh Krishnamurthy, Adeka Mcintosh, Marian Gaballah, Marc S Keller
Children's Hospital of Philadelphia, Philadelphia, (United States)

Purpose-Objective. To evaluate an alternative route of pelvic abscess drainage in children via a transiliopsoas approach.
Material and methods. Materials and Methods: Over a five-year period, deep pelvic appendiceal abscess drainages were performed on 14 children via the transiliopsoas approach. All procedures were performed under ultrasound and fluoroscopic guidance. The volume of pus aspirated was recorded. Post-drainage imaging was obtained and reviewed to evaluate technical success. The duration between catheter placement and removal was recorded, and medical records were reviewed to monitor the clinical course following the procedure. Complications and abscess recurrences were documented.
Results. Transiliopsoas needle placement was successful in 14 of 14 patients (100%). Catheter placement was successful in 13 patients. The abscess wall ruptured in one procedure, precluding catheter placement. The mean duration of catheter fixation following the procedure was 4.9 days. Initial clinical success was achieved in all 14 patients (100%). Abscess recurrences were noted in 2 patients (14%), 5 days and 3 months following catheter removal, respectively. There were no other complications.
Discussion and conclusions. The transiliopsoas route is a safe and effective approach for ultrasound guided abscess drainage and catheter placement in children with deep pelvic collections not safely accessible by more traditional interventional methods.

021 – LP

Bleomycin sclerotherapy for the treatment of microcystic lymphatic malformations (LM)
Gulraiz Chaudry, Carlos J Guevara, Kristy L Rialon, Steven J Fishman, John B Mulliken, Cindy Kerr, Ahmad I Alomari
Boston Children's Hospital, Boston, (United States)

Purpose-Objective. Sclerotherapy is the mainstay of treatment of macrocystic LM, but the response to traditional sclerosants is much less favorable in microcystic lesions. Intralesional bleomycin has been reported to be effective in microcystic LM, but its use is limited by concerns regarding pulmonary fibrosis. The purpose of this study was to evaluate the safety and efficacy of bleomycin sclerotherapy in microcystic LM.
Material and methods. The medical records and imaging studies of all patients with microcystic or combined LM who underwent percutaneous image-guided sclerotherapy using bleomycin were retrospectively reviewed. Patients with pre and post procedure imaging were included. The response was classified as complete (>90% size reduction), partial (25–90%) or minimal/no response (<25%).
Results. 34 patients with a mean age of 13.5 years (range 4 months–26 years) were treated. The malformations were located in the head and neck (n=29), extremity (n=3) and trunk (n=2). The number of procedures performed ranged from 1 to 4 (mean 1.6). Up to 1 unit/kg of bleomycin was injected per session, with a maximum of 15 units. There were no immediate or mid-term complications. There was complete response in 47% (n=16), partial response in 50% (n=17) and no response in 3% (n=1).
Discussion and conclusions. Preliminary results indicate that sclerotherapy of microcystic lymphatic malformations using bleomycin is relatively effective and safe in the mid-term.

022 – SP

Ultrasound guided Botox injection into salivary glands in patients with hypersalivation
Ramdas Senasi, Ashok Raghavan, Mahilravi Thevasagayam
Sheffield Children's Hospital NHS Trust, Sheffield, (United Kingdom)

Purpose-Objective. Is Botox injection into salivary glands in patients with hypersalivation beneficial after best medical and surgical therapy?
Material and methods. We retrospectively looked at 16 cases of Botox injection into salivary glands. Clinical notes were obtained using coding references for the procedure. There were no exclusion criteria. Data were collated onto a

proforma and we looked at length and severity of symptoms, previous treatments, procedure and response to treatment. Unfortunately, response to treatment and severity were not fully available in the clinical notes hence we had to call the parents to obtain the relevant information.
Results. Lack of a scoring system for hypersalivation and no clear way to assess post treatment response made it difficult to draw an objective assessment. From what was available from the clinical notes and telephone calls, all patients responded well to the Botox injection although the treatment lasted an average of 6 months and required repeated treatments.
Discussion and conclusions. Botox injection into the salivary gland is an effective alternative to failed medical and surgical treatment. Unfortunately, there was no clear scoring system for hypersalivation or a way to assess response to treatment. We will present a pre- and post treatment evaluation sheet that we have devised for patients and carers to fill in for prospective patients.

023 – LP

Transjugular intrahepatic portosystemic shunt in children: a series of 33 children
Danièle Pariente, Stephanie Franchi-Abella, Jerome Waguet, Jean Yves Riou
Hôpital Bicêtre APHP, University Paris XI, Le Kremlin Bicêtre, (France)

Purpose-Objective. Transjugular intrahepatic portosystemic shunting (TIPS) is an uncommon procedure in children, mainly because of small size of vessels. We report our experience over 20 years, the largest series reported in children to our knowledge.
Material and methods. Placement of TIPS was attempted in 33 children, aged from 8 months to 16 years (mean 8 years). Indications in native liver included variceal bleeding unresponsive to endoscopic treatment (5 biliary atresia, 3 cystic fibrosis, 7 prolonged parenteral nutrition, 4 other cirrhoses) and Budd–Chiari syndrome (4); 10 procedures were performed in transplanted liver (9 split liver) for refractory ascites (8) or variceal bleeding (2).
Results. Failure of placement occurred in 7 patients (22%) including the first 3. In the last 10 years on 25 attempts the success rate improved to 84% (median age 6.5). No complication was observed during the procedure; one transplanted child died 2 weeks later of severe sepsis with a thrombosed stent. Clinical outcome was better for variceal bleeding and Budd-Chiari syndrome than for refractory ascites after transplantation.
Discussion and conclusions. With technical advances that are continuous US guidance, dedicated covered Viatorr® stent graft or custom-made overlapping bare and covered stents for youngest, TIPS can be proposed, whatever the age, when intrahepatic portal branches are well visible on US examination, as it is effective and less invasive than surgical shunt and does not complicate further liver transplantation.

R – 024

Pre procedure checklist in paediatric screening and interventional procedures
Ramdas Senasi, Christopher Heafey, Neil Prasad, Ashok Raghavan
Sheffield Children's Hospital, Sheffield (United Kingdom)

Purpose-Objective. Can a pre procedure checklist improve patient-carer safety and increase staff compliance with regards to safety and infection control?
Material and methods. We introduced a pre procedure check list in our department after a previous audit highlighted deficiencies in infection control and safety checks. Important things to consider prior to any procedure are indication for procedure, radiation safety, infection control, pregnancy status and foreseeable difficulties or complications that can be prevented. Although these practices are already in place, we wanted a way to properly document that this is being done and want to be able to maintain an audit trail. The questionnaire was designed within the department by a radiology trainee, the Lead Radiographer and Department Head. Prior to each procedure, the questionaire will be filled in by the attending radiographer and signed off before the procedure starts.
Results. We will present the pre procedure checklist alongside the results of our initial audit.
Discussion and conclusions. We aim to show that a pre procedure check list is important to maintain patient and staff safety. Documentation is vital as it will prevent unnecessary problems and will protect patient and staff.

Oncology

025 – LP

Whole body MRI compared to FDG-PET/CT for treatment response assessment in paediatric malignant lymphoma: a pilot study
Annemieke Littooij [1], Malou Vermoolen [1], Goya Enriquez [2], Shui Yen Soh [3], Thomas Kwee [1], Bart de Keizer [1], Erik Beek [1], Marc Bierings [1], Rutger Jan Nievelstein [1]
[1] University Medical Center Utrecht, Utrecht, (The Netherlands); [2] Hospital Universitario Vall d'Hebron, Barcelona, (Spain); [3] Women's and Children's Hospital, Singapore, (Singapore)

Purpose-Objective. Whole-body magnetic resonance imaging (WB-MRI), including diffusion-weighted imaging (DWI), is an emerging radiation-free method for oncological imaging. Our previous presented results indicated that whole-body MRI is equal to 18F-fluorodeoxyglucose positron emission tomography with low-dose computed tomography (FDG-PET/CT) during initial staging in the majority of paediatric lymphoma patients. The aim of current study was to investigate if WB-MRI including DWI is as good as FGD-PET/CT in response assessment after treatment.
Material and methods. We prospectively compared 12 FGD-PET/CT scans with 12 WB-MRI scans in 11 children (8 males and 3 females; mean age, 12.8 years; age range, 8–20 years) with malignant lymphoma. Whole-body MRI and FDG-PET/CT were evaluated by independent observers who were blinded to the findings of the other imaging modality. Cheson stage according to whole-body MRI (without and with DWI) was compared to those of FDG-PET/CT.
Results. In all cases FDG-PET/CT demonstrated complete response. Early response assessment with WB-MRI revealed partial response in 4/6 cases. During late response assessment 2/6 cases were disconcordant with FDG-PET/CT. Sites of discrepant staging between WB-MRI and FDG-PET/CT were lymph node stations (n=6), gastrointestinal tract (n=1) and thymus (n=1).
Discussion and conclusions. Our study indicates that WB-MRI cannot replace FDG-PET/CT in the nearby future due to disconcordant staging in 50% of cases. For potentially curable and young patients, the lack of radiation exposure of MRI makes PET/MRI an attractive alternative.

026 – SP

Whole-body multi-parametric MRI Ann Arbor staging of paediatric Hodgkin's lymphoma: evaluation of agreement with PET-CT

Arash Latifoltojar [1], Paul Humphries[1], Ananth Shankar[2], Stephen Daw[2], Stuart Taylor[1], Shonit Punwani[1]
[1] University College London, London (United Kingdom); [2] University College London Hospital, London (United Kingdom)

Purpose-Objective. To investigate the accuracy of whole-body (WB) multi-parametric (MP) MRI for the initial staging of paediatric Hodgkin's lymphoma.
Material and methods. Thirty patients with biopsy proven Hodgkin's lymphoma underwent routine staging with PET-CT and additional WB-MP-MRI with axial WB-T2w STIR-HASTE imaging augmented by axial STIR-EPI WB-DWI (b-values=0, 300, 500 s/mm2) and axial pre- and post-contrast FLASH DCE liver and spleen imaging. Two consultant radiologists reviewed the WB-MP-MRI studies independently using a locked-sequential-read (DWI, T2w and then DCE) paradigm and then in consensus. During each review, presence/absence of disease was recorded at 11 nodal and 11 extra-nodal stations and the Ann Arbor stage determined. As reference standard, PET-CT images were reported for Ann Arbor stage by two experienced nuclear medicine physicians in consensus. Agreement between WB-MP-MRI reads and the PET-CT reference was assessed using Cohen's kappa statistic.
Results. Cohen's kappa for agreement between PET-CT and DWI, DWI+T2w and DWI+T2w+DCE MRI was 0.653, 0.736 and 0.742 for radiologist 1 and 0.693, 0.738 and 0.739 for radiologist 2, respectively. Following radiologist consensus and removal of reader error the Cohen's kappa for agreement between PET-CT and DWI, DWI+T2w and DWI+T2w+DCE MRI improved to 0.780, 0.824 and 0.868 respectively.
Discussion and conclusions. Agreement with PET-CT was very good (kappa=0.87) following consensus radiologist review of WB-MP-MRI studies. A multi-parametric approach to whole-body lymphoma staging improves performance and agreement with PET-CT.

027 – SP

Initial experiences with IV CEUS applications

Zoltán Karádi [1], Zoltan Harkányi[2], Miklós Garami[1], Péter Hauser[1]
[1] Semmelweis University, 2nd Department of Pediatrics, Budapest, (Hungary); [2] Heim Pal Children's Hospital, Budapest, (Hungary)

Purpose-Objective. According to recent papers a growing interest of pediatric contrast enhanced ultrasound (CE-US) is reflected by the collected 5000 cases in Europe, including intravenous applications. Initial experiences of our 18 CEUS studies will be presented.
Material and methods. In the past 3 years, 18 pediatric patients were examined by iv. CEUS in our two institutions (age range: 1 to 18 years, 7 male and 11 female patients). After 0.5–1.5 ml SonoVue bolus injection a saline flush was given. GE Logiq E9 and Philips iU22 US scanners were used for the CEUS studies.
Results. Most of the studies were performed in oncologic patients during or after treatment with special focus on characterizing single or multiple hepatic lesions (hepatoblastoma, n=2, FNH, n=3, adenoma, n=4, metastasis of retroperitoneal neuroblastoma and Wilm's tumor, n=6). Other indications: 1 focal renal infection, and patients to follow up after blunt abdominal trauma with hepatic and splenic injury (n=3). No adverse reaction was noted

associated with CEUS exam. CT, MR or biopsy correlation was obtained in all oncology cases.
Discussion and conclusions. Our preliminary experiences together with the recent published data are suggestive of the increasing significance of iv. applications of CEUS exams in the pediatric population. Sensitivity and specificity of US can be increased with CEUS. The lack of nephrotoxicity and ionizing radiation is especially advantageous in children.

028 – LP

CEUS in children with hematological proliferative disorders - a preliminary report
Wojciech Kosiak, Maciej Piskunowicz, Tomasz Batko, Ninela Irga, Arkadiusz Piankowski
Medical University of Gdansk, Gdansk, (Poland)

Purpose-Objective. We present the possible application of CEUS in pediatric patients with proliferative diseases of the hematopoietic system based on single center experience.
Material and methods. From 1.01.2012 to 12.01.2012 CEUS examinations were performed in 9 patients (mean age 12 years and 2 months) diagnosed with NHL (5), ALL (3) and after BMT (1). In one patient, the examination was performed 4 times, and in one case twice. The indications for CEUS examinations were: inconclusive results of other imaging methods (7), contraindications to the study with X-ray radiation (1), monitoring the response to anti-cancer treatment (1). These criteria were in accordance with the one established by an Independent Ethics Committee.
Results. In all cases, obtained information was relevant from the clinical point of view. In two cases, the CEUS study gave the unequivocal identification of the process opposite to the CT examination which could not recognize the pathology. In 6 cases, CEUS allowed to abandon CT scans.
Discussion and conclusions. Preliminary data suggested that the use of CEUS could significantly reduce the diagnostic X-ray examination in children with hematologic proliferative disorders. Moreover, we have data showing CEUS advantage over CT in the group of children with infectious complications occurring in the course of cancer treatment.

029 – SP

Second generation ultrasound contrast agents in assessment of solid tumors vasculature in children – one center experience
Tomasz Batko, Wojciech Kosiak, Maciej Piskunowicz, Katarzyna Połczynska, Arkadiusz Piankowski
Medical University of Gdansk, Gdansk, (Poland)

Purpose-Objective. We present our own experience in CEUS evaluation of solid tumor vasculature in children throughout the initial diagnosis and treatment monitoring.
Material and methods. Between 11.2011 and 01.2013, 140 CEUS studies were performed in our center. The analysis included 15 CEUS studies in patients with solid tumors. There were cases with the following diagnoses: nephroblastoma, neuroblastoma, mesenterica fibromatosis, osteosarcoma, rhabdomyosarcoma, ganglioneuroma, lipoblastoma. CEUS examinations were performed to evaluate the initial tumor vasculature, to monitor vasculature changes during the treatment, and to assess residual lesions.
Results. CEUS examination in the presented patient group was useful in the initial imaging of solid tumor vascularity and for estimating areas of necrosis. CEUS allows for the differentiation of tumor vasculature in patients with nephroblastoma and neuroblastoma. The assessment of tumor vascularity changes during treatment and monitoring of residual tumor tissue after the treatment was also possible.
Discussion and conclusions. CEUS examination could be useful in the initial diagnosis and treatment monitoring of solid tumors in children. The use of UCA may allow a reduction of the number of imagings with the use of ionizing radiation in this group of patients. The presentations in this work data are limited by the small number of patients with different histological diagnoses. Further, multi-center studies to assess the suitability and safety of UCA in children are needed.

030 – LP

Comparison of whole body DWIBS MRI with 123I-MIBG scintigraphy in the assessment of children with neuroblastoma, a pilot study
Katharine Halliday, *Shyam Mohan*, Nigel Broderick, Paul Morgan, Daniel Rodriguez, John Somers
Nottingham University Hospitals, Nottingham, (United Kingdom)

Purpose-Objective. Current staging of childhood neuroblastoma involves MRI and 123I-MIBG scintigraphy to determine the extent of disease including bone marrow involvement. Both investigations frequently require sedation and/or general anaesthetic. If comparable information could be provided by a single investigation without ionising radiation this would be an advantage. The purpose of this study is to assess the potential of MRI whole body diffusion weighted imaging with background suppression (DWIBS) to replace 123I-MIBG in the assessment of neuroblastoma and to identify whether a larger multicentre trial is indicated.
Material and methods. A total of 16 pairs of anonymised DWIBS and 123I-MIBG imaging studies in 11 patients aged

between 23 days and 8 years were assessed by 3 observers for evidence of disease in the abdomen, liver, thorax, spine, limbs and skull.
Results. MIBG and DWIBS images were available in a total of 192 anatomical regions. Of these, 36 were positive on MIBG and there was diffusion restriction in 33 (91.7%). DWIBS depicted additional abnormalities in 25 areas, some of which subsequently became positive on MIBG, suggesting that DWIBS may sometimes be more sensitive. At initial staging no patient would have been either up or down-staged if DWIBS alone had been performed.
Discussion and conclusions. Whole body DWIBS shows considerable potential in the assessment of patients with neuroblastoma. A larger multicentre study is recommended.

031 – SP

Our experience about manual fused single photon emission tomography/computed tomography: incremental value obtained by interdisciplinary approach
Maria Felicia Villani, Maria Carmen Garganese, Milena Pizzoferro, Aurora Castellano, Saverio Malena, Maria Antonietta De Ioris, Paolo Tomà
IRCCS Bambino Gesù Pediatric Hospital, Rome, (Italy)

Purpose-Objective. To underline the feasibility of manual single photon emission tomography/computed tomography (SPET/CT) fusion, supported by radiologist contribution.
Material and methods. We retrospectively evaluated 450 123I-metaiodobenzylguanidine (123I-MIBG) scintigraphies (planar and SPET images) of 147 children (82 males, age range at presentation 1 month–15 years) referred to our Institution for neuroblastoma from 2003 to 2012. Since 2009, all SPET studies (49 SPET, 23 patients) were processed by manual fusion with CT by a dedicated software. Fusion images were read by a nuclear medicine physician in collaboration with a radiologist.
Results. In 4/23 (17%) patients SPET/CT fused images confirmed the absence of 123I-MIBG uptake showed by planar images; in 14/23 (61%) patients SPET/CT fused images provided additional information about number and site of uptake foci revealed by planar acquisition (skull in 4 patients, spine in 1, lymph-nodes in 1, chest wall in 1 and residual disease in the abdomen in 7); in 5/23 (22%) SPET/CT fused images confirmed planar images findings.
Discussion and conclusions. In our experience, SPET/CT provided additional information as widely known. Also in absence of an hybrid tomograph, image fusion is feasible; collaboration between nuclear medicine physician and radiologist increases diagnostic accuracy.

032 – SP

Apparent diffusion coefficients before and after neoajuvant chemotherapy in nephrogenic rests and Wilms tumour
Daniela Fernandes Pinto, Owen Arthurs, Neil Sebire, Oysten Olsen
Great Ormond Street Hospital, London, (United Kingdom)

Purpose-Objective. To compare apparent diffusion coefficients (ADC) of nephrogenic rests (NR) and Wilms tumour (WT) before and after neoadjuvant chemotherapy.
Material and methods. In an institutional retrospective study the ADC distribution of entire lesions, excluding areas of low or absent gadolinium-enhancement, was investigated. All lesions were confirmed histopathologically.
Results. The series included ten children with a total of twenty-two lesions (25 WT, 7 NR). WT were typically larger than NR ($p<0.05$). The median ADC of NR and WT were not significantly different pre chemotherapy (median, 1.25×10–3 vs 1.12×10–3 mm2/s; $p=0.86$) or post chemotherapy (median, 1.67×10–3 vs 1.55×10–3 mm2/s; $p=0.62$). There was a significant increase in median ADC for both NR ($p=0.031$) and WT ($p<0.01$) following chemotherapy.
Discussion and conclusions. NR and WT have the same cell components (it is the degree of atypia and mitotic activity, in association with the macroscopic features that distinguishes hyperplasia from neoplasia). We hypothesize that ADC therefore is similar between these two groups and is not a promising differentiator.

033 – SP Withdrawn

Genitourinary

034 – LP

Female phenotype in disorders of sexual differentiation (DSD). Role of imaging: US and MRI findings
Cinzia Orazi, Carla Bizzarri, Marco Cappa, Paolo Maria S Schingo, Massimiliano Silveri, Paolo Tomà
Bambino Gesù Children's Hospital, Palidoro - Rome, (Italy)

Purpose-Objective. Disorders of Sexual Differentiation (DSD) can result in ambiguous genitalia and the disorder can be discovered prenatally, at birth, or in infancy. DSD can also be associated with male or female phenotype and the diagnosis can be made much later. In cases with female phenotype, DSD (carrying XX or XY karyotype) becomes evident at puberty, with failure of menarche.

Material and methods. We report on US and MRI findings in our series of 25 DSD patients with female phenotype, observed between 2002 and 2012.
Results. US allows the evaluation of uterus, gonads (ovary, testis, streak-gonad), vagina, inguinal regions. MRI can be required for better spatial/structural definition of internal organs. Primary amenorrhea with absent/delayed breast development, is observed in gonadal dysgenesis (46,XX ovarian failure; 45,XO Turner syndrome; 46,XY, Swyer syndrome), hypogonadotrophic hypogonadism and hypothalamic amenorrhea. Primary amenorrhea with normal breast development and no evidence of uterus, suggests 46,XY complete androgen insensivity syndrome (CAIS) and also 46,XX disorders of Müllerian development. In the presence of uterus, PCOS or outflow obstructions can be evocated.
Patients with 5 alpha-reductase deficiency and late onset CAH can present female phenotype and virilization at puberty; Müllerian structures are absent in the first and present in the latter.
Discussion and conclusions. The role of imaging is of paramount importance in evaluating the anatomical condition for the assessment of gender, in newborns and adolescents.

035 – SP

Prepubertal testicular and paratesticular tumors: US appearance emphasizing in color Doppler findings
Carmina Duran, Luis Riera, Cesar Martin
UDIAT-CD, Sabadell, (Spain)

Purpose-Objective. The purpose of this work is showing the different standard and color Doppler US patterns of the most relevant prepubertal scrotal tumors, using specific color Doppler US presets for the vascular study of prepubertal testis.
Material and methods. A revision of standard and color Doppler US findings in prepubertal testicular tumors (7 patients aged <3 years) diagnosed in our center in the last decade was performed. All studies were performed using the same US equipment and adjustments: 14 MHz linear probe with color Doppler specific presets allowing the detection of low velocity vessels (low wall filter, velocity scale: +/−1.5 cm/s and 70%–90% color gain output).
Results. According to the revision of US studies and final diagnosis, we observed: -Cystic intratesticular tumors with or without septae corresponded to epidermoid cyst in 2 patients. -Heterogeneous intratesticular cystic/solid lesions were teratomas (2 patients). -A solid isoechoic intratesticular mass was finally diagnosed as a Yolk-sack carcinoma.
-2 patients with solid extratesticular tumors (with a layered appearance) corresponded to rhabdomiosarcomas. Concerning color Doppler findings we observed that Yolk-sac tumor and rhabdomyosarcomas showed hyperemia, simulating other lesions like inflammatory diseases or hemangioma.
Discussion and conclusions. Prepubertal scrotal tumors are rare. An accurate assessment of their US appearance (including color Doppler findings) is of vital importance not only for their diagnostics but to select a correct treatment and consequently improve their management.

036 – SP

Twisted vascular pedicle: a reliable sign of adnexal torsion
Catherine Baud, Magali Saguintaah, Sevette Nancy Bechard, Julie Bolivar, Stéphanie David, Alain Couture, Olivier Prodhomme
Hôpital Arnaud de Villeneuve, Montpellier, (France)

Purpose-Objective. To report sonographic findings and diagnostic value of twisted vascular pedicle detection in girls with adnexal torsion.
Material and methods. Sonographic examinations of girls with surgically proved adnexal torsion between 2003 and 2012 were reviewed retrospectively. US features were correlated with surgical and pathologic findings and follow-up.
Results. 35 cases were reviewed in girls aged 2 months–15 years. Torsion of normal ovary (n=20) always occurred in premenarchal period. Affected ovary appeared enlarged with peripheral follicles. Isoechoic homogeneous parenchyma (n=6) reflected viable ovary. Presence of hyperechoic areas within it (n=9) were associated with viable (n=6) or nonviable (n=3) ovary. Diffuse hyperechoic stroma (n=5) was correlated with necrosis (n=4). Color Doppler flow was present in 4, related to ovarian viability. In ovarian torsion with associated mass (n=10), features of cystic teratoma (n=6) or unilocular cyst (n=4) were observed. In all cases, a round mass (AP diameter 10–30 mm) was seen adjacent to ovary or cystic mass, corresponding to twisted vascular pedicle. In isolated fallopian tube torsion (n=5), both ovaries were normal with ispilateral or/and contralateral paratubal cyst(s) and round mass (AP diameter 15–35 mm) adjacent to uterus or/and ovary.
Discussion and conclusions. In girls with acute pelvic pain, twisted vascular pedicle detection is a reliable sign of adnexal torsion.

037 – LP

The sonographic appearances of HNF-1Beta/TCF2 mutations in childhood
Fred E Avni [1], Annie Lahoche [1], Marie Cassart [3], Catherine Garel [2]
[1] Jeanne de Flandres Hospital, Lille, (France); [2] Trousseau, Paris, (France); [3] Erasme, Brussels, (Belgium)

Purpose-Objective. To define the sonographic patterns during childhood in patients with TCF2 mutation. To verify correlation between ultrasound, mutation and renal function
Material and methods. 18 patients (newborn–19 years) were reviewed. Sonographic appearances at diagnosis and during follow-up, mutation and renal function were reviewed
Results. All patients but one had abnormal kidneys antenatally. Postnatally, renal size was normal in 8 patients, bilaterally increased in 3, bilaterally or unilaterally decreased in 7. The renal cortex was hyperechoic in all patients; the CMD was present in 5, absent in 8, dubious in 5 patients. Renal cysts were observed in all but one patient. Cysts were cortical subcapsular in 13, medullary in 2, both cortical and medullary in 2 cases. An asymmetrical involvement was observed in 5; UPJ was associated finding in one patient, multicystic dysplastic kidney in 2. During follow-up, more cysts were observed in 3, the CMD disappeared in 3 others. One kidney "shrunk". Heterozygous deletion involving exons 3–8 of gene TCF2 was the commonest mutation, but the US appearance was not homogeneous. Renal failure was observed in 25% of patients at last follow-up.
Discussion and conclusions. There is a sonographic pattern highly suggestive of TCF2 mutation in children: hyperechoic renal cortex and subcapsular cortical cysts. Still, other patterns can be observed including asymmetrical involvement, renal hypoplasia or medullary cysts. There is no correlation with the mutation.

038 – SP

Ultrasound evaluation of the kidneys in ex-premature infants with extremely low and very low birth weight: a preliminary study

Costanza Bruno, Salvatore Minniti, Alessandra Bucci, Milena Brugnara, Roberto Pozzi Mucelli
Policlinico GB Rossi, Verona, (Italy)

Purpose-Objective. To establish whether, in school-aged children, any relationship exists between the weight at birth, the findings at ultrasound and Doppler evaluation of the kidneys and the parameters of renal function.
Material and methods. A total of 69 children, between the age of 4 ½ and 7 years, weighing at birth <1500 g, subdivided into two groups—extremely low birth weight (ELBW: <1000 g) and very low birth weight (VLBW: 1000–1500 g) were studied. Length, volume, parenchymal thickness and resistive index (RI) were measured in each kidney; the sum of the volumes of the two kidneys was also calculated. Renal function was assessed through the measurement of plasmatic and urinary concentration of several analytes. The statistical significance of the differences found between the two groups of children was evaluated by means of the Mann–Whitney test.
Results. The sum of the volumes of the two kidneys was significantly lower in the ELBW than in the VLBW children (p=0.002). No significant correlation was found between the weight at birth and length, parenchymal thickness and volume of individual kidneys; the distribution of RI values was also even. The urinary concentration of α1-microglobulin (early sign of cortical damage) was significantly higher in the ELBW group.
Discussion and conclusions. A weight at birth <1000 g correlates with a significant reduction of the global renal volume and with early laboratory signs of renal damage. RI values are not related to impaired renal function.

039 – SP

Long-term follow-up of kidney ultrasound in children with hemolytic uremic syndrome (HUS)

Thi Thanh Tam Bui [1], Heiko Billing[2], Abdulsattar Alrajab[1], Elke Wühl[2], Jens-Peter Schenk[1]
[1] Department of Diagnostic and Interventional Radiology, Pediatric Radiology, University Hospital, Heidelberg, (Germany); [2] Department of Pediatrics I, University Children's Hospital, Heidelberg, (Germany)

Purpose-Objective. The change of initial findings in ultrasound on kidneys - echogenicity, corticomedullary differentiation and kidney size - in cases of HUS in children is described to evaluate the importance of these three sonographical parameters. The correlation with laboratory parameters - creatinine, eGFR, creatinine clearance and proteinuria—is examined.
Material and methods. In this retrospective study 39 cases of HUS – 13 cases of atypical HUS, 26 cases of typical HUS, initial diagnosis aged 4 months–10 2/12 years—were analysed. Ultrasounds of the right kidney were evaluated in regard to the parameters echogenicity, corticomedullary differentiation and kidney volume. Laboratory parameters were the serum creatinine, the endogenous creatinine clearance in 24-h urine collection, the eGFR according to Schwartz and the protein content of the 24-h urine collection.
Results. A significant correlation between all laboratory parameters of kidney function and the echogenicity was found, so that the echogenicity seemed to have more informative value than the CMD with regard to the long-term progression. The kidney volume is of importance in the initial phase. Besides the increased echogenicity, all kidney volumes ranged in the higher percentiles.
Discussion and conclusions. The results indicate that ultrasound of the kidneys is an important method in follow-up examinations of patients with HUS.

040 – LP

Optison® for contrast enhanced voiding urosonography in children: an in-vitro optimization of intravesical use of a new US contrast agent

Susan Back, *Kassa Darge*
Department of Radiology, The Children's Hospital of Philadelphia and Perelman School of Medicine, University of Pennsylvania, Pennsylvania, (United States)

Purpose-Objective. The US contrast agent (USCA) SonoVue® (Bracco) is widely used for contrast-enhanced voiding uronosonography (ce-VUS) in Europe. This is not yet available in the USA, but the same generation USCA Optison® (GE) is obtainable. Our objective was to optimize the application of Optison® for ceVUS in-vitro before its use in a comparative multi-center pediatric study.
Material and methods. The experimental design simulated intravesical use. We scanned 20 ml syringes containing saline and/or urine and USCA, varying technical settings and physical conditions, using 9 and 12 MHz linear transducers (Philips iU22). We measured field homogeneity and contrast duration and evaluated contrast dose and shelf life, mechanical Index (MI), urine concentration, injection versus infusion and refrigeration.
Results. 150 experiments were performed. 0.5% volume contrast concentrations proved optimal. Consistent visualization was achieved at MI 0.06–0.14 and 0.11–0.48 for 9/12 MHz transducers, respectively. In urine USCA degraded faster (0–12 min) than saline (2–40+min) and urine-saline dilutions (2–20+min). We observed no significant differences between injecting or infusing contrast. More time post-refrigeration delayed visualization of homogeneous distribution. No contrast duration difference was observed when the same USCA vial was used within 4 days.
Discussion and conclusions. 0.5% USCA volume to bladder filling may suffice for ceVUS. Transducers settings need to be optimized. Emptying bladder prior to intravesical administration of the USCA may be important. Once opened, the USCA is useable throughout the day.

041 – SP

Omphalitis in neonates and infants: Imaging findings and assessment of underlying causes using sonography

Kwanseop Lee
Hallym University Hospital, Anyang city, (Republic of Korea)

Purpose-Objective. The purpose of this study is to evaluate the sonographic findings of omphalitis and usefulness of sonography in the evaluation of underlying causes of omphalitis.
Material and methods. A computerized search of our institutional data revealed 54 patients with omphalitis on ultrasonography from March 2006 to February 2012. We reviewed retrospectively the imaging findings and underlying causes of omphalitis using ultrasonography.
Results. Forty-nine patients (90.7%) revealed hypoechoic change of umbilicus. Others showed isoechoic (3.7%), hyperechoic (1.8%), or heterogeneous echoic (3.7%) changes. In all 54 patients, enlarged ulbilicus on gray scale image with increased vascularity was noted on color Doppler sonography. Using sonography, we could assess the causes of omphalitis. 50 patients (92.6%) were suggested to have urachal remnant inflammation because there was tubular hypoechoic structure between the inflamed umbilicus and anterosuperior portion of the bladder. One neonate was suggested to have omphalomesenteric duct remnant (1.8%). And the remaining 3 (5.6%) showed no underlying causes, suggesting omphalitis only. Three children underwent surgery and urachal remnant was proved in two, omphalomesenteric duct anomaly in one case. The remaining 51 children were treated through conservative management with complete improvement on follow up US.
Discussion and conclusions. Omphalitis has characteristic sonographic findings. Most of the children revealed underlying congenital anomalies including urachal remant inflammation or omphalomesenteric anomaly. Most of the urachal remnant inflammation was treated successfully by conservative management.

042 – SP

Split renal function and urinary tract obstruction in children assessed by magnetic resonance urography in comparison with MAG3 scintigraphy

Christian J. Kellenberger [1], IA Burger [2], M Makki [1]
[1] University Children's Hospital, Zürich, (Switzerland); [2] University Hospital, Zürich, (Switzerland)

Purpose-Objective. To assess accuracy of dynamic contrast-enhanced magnetic resonance urography (MRU) for measuring split renal function (SRF) and obstruction in children compared to MAG3-scintigraphy.
Material and methods. In 11 children (age 3 months–16 years) undergoing both procedures within 1 year (median <2 months), MRU was performed at 1.5 Tesla with a T1–weighted, low-flip-angle (12°) fast-gradient-recalled-echo (FGRE) sequence following iv-hydration, iv-Lasix, and 0.1 mmol/kgBW gadolinium. SRF was determined by renal volumetry, area-under-the-curve (AUC) and Patlak methods; obstruction was assessed qualitatively on excretory curves and by renal transit time (RTT), and compared to MAG3-findings using Pearson correlation and weighted

kappa statistics. Signal intensity (SI) of different gadolinium concentrations [Gd] was measured in vitro for low-flip-angle and FGRE sequences with higher flip-angles.
Results. Obstruction was overdiagnosed by MRU and agreed poorly with MAG3-scintigraphy (K=0.23 for qualitative assessment, 0.32 for RTT). For SRF assessment, renal volume measurements alone correlated best with MAG3-scintigraphy (R=0.89), whereas correlation worsened adding Patlak (R=0.74) or AUC (R=0.67). Because of T2*-effects, the linearity between SI and [Gd] was maintained only up to 2 mmol/l for flip-angle 12°, whereas higher flip-angles (≥30°) improved linearity >7 mmol/l.
Discussion and conclusions. Dynamic MRU using low-flip-angle FGRE does not correlate with MAG3-scintigraphy for assessing urinary tract obstruction and has no added value over renal volume measurements for SRF. Using a higher flip-angle could improve results by increasing linearity of SI up to [Gd] expected to occur in kidneys.

043 – SP

Why still dynamic renal scan in the diagnostic pathway of pediatric hydronephrosis?
Maria Carmen Garganese, Maria Felicia Villani, Milena Pizzoferro, Paolo Caione, Nicola Capozza, Simona Gerocarni Nappo, Paolo Tomà
IRCCS Bambino Gesù Pediatric Hospital, Rome, (Italy)

Purpose-Objective. To assess the functional outcome by MAG3 dynamic renal scan (RS) in pediatric patients with hydronephrosis submitted to pyeloplasty.
Material and methods. 126 patients (93 males, mean age 55 months, range 4–216 months) underwent pyeloplasty for unilateral congenital 3–4 grade hydronephrosis, excluding other urological abnormalities. All patients performed pre-operative and postoperative RS. Split renal function was considered normal (NF) if >45%, mildly impaired (MI) if 40–45%, moderately impaired (MOI) if 30–40% and severely (SI) if <30%. Patients were grouped by age of presentation: ≤2 years in group A (69 patients) and >2 years in group B (57 patients). Mean follow-up: 2.5 years.
Results. In Group A, 45 patients showed NF, 7 MI, 10 MOI and 7 SI; in Group B, 33 NF, 8 MI, 6 MOI and 10 SI, with no statistically significant differences (paired T test) before surgery. After surgery, Group A: 5 NF lost function, 4 MOI recovered function; Group B: 5 MI/MOI gained NF (p< 0.05). In both groups, none of SI gained function.
Discussion and conclusions. Our results show that children with severely impaired kidneys do not improve after pyeloplasty, independent of age at surgery. Surprisingly, children ≤2 years may deteriorate more than older children, despite good initial function and pyeloplasty. RS is a simple, easily performed and still useful method to evaluate different outcome in children with hydronephrosis.

044 – LP

Functional MR urography (fMRU) – the shorter the examination the better for all involved!
Kassa Darge, Jorge Delgado, Melkamu Adeb, Leslie LeCompte, Rob Carson, Ann Johnson, Dmitry Khrichenko
Department of Radiology, The Children's Hospital of Philadelphia, Perelman School of Medicine, University of Pennsylvania, Philadelphia (United States)

Purpose-Objective. Currently, fMRUs require long scan times. The aim was to find ways to reduce scan time without compromising morphological/functional results.
Material and methods. A retrospective review of fMRU's technical aspects was done. Inclusion criteria was the presence of the complete series of sequences (7) of our current fMRU protocol. For each sequence utility and factors affecting its duration were analyzed.
Results. 99 fMRU (m=43, f=56; mean age 6.9 year), fulfilled the criteria. Mean exam duration was 64.5 min (40.5 min–123 min). 3/7 sequences were categorized as essential (100%). Sagittal T2: planning oblique coronal plane; axial T2fs: grading of pelvicalyceal dilatation and measuring pelvic diameter, assessment of corticomedullary differentiation (33.3%=decreased), cortical thinning (54.5%=present); coronal 3D T2fs: coronal plane of urinary tract plus 3D. One sequence was categorized as essential but can be shortened: post-contrast T1fs dynamic. For calculation of differential renal function only images prior to calyceal filling (calyceal transit time, CTT) are required. In 80% of fMRUs the CTT was <3.15 min. Prone positioning may further shorten the renal transit time. 3/7 sequences were categorized as non-essential as they did not provide additional information: sagittal T1fs (96%); coronal T2fs (100%); post-contrast sagittal T1fs (100%). The scan time of the essential sequences with the shortened post-contrast dynamic totals 19 min.
Discussion and conclusions. A 4-sequence (±prone position) comprehensive fMRU with shorter dynamic scan may be achieved in less than 30 min, a major practical advancement!

045 – SP

Extravesical ectopic ureter: morphological and functional MR urography (fMRU) findings
Aikaterini Ntoulia, Melkamu Adeb, Leslie LeCompte, Jorge Delgado, Dmitry Khrichenko, Kassa Darge

Department of Radiology, The Children's Hospital of Philadelphia, Perelman School of Medicine, University of Pennsylvania, Philadelphia, (United States)

Purpose-Objective. To describe the fMRU findings in children with extravesical ectopic ureter.
Material and methods. Retrospective review was conducted of 22 children (female=20, male=2, mean age=20.1 months, range=1 month–6.2 years) with ectopic ureter that had undergone fMRU, including morphologic and functional post-processing. The indications were: prenatal hydronephrosis (n=10), cystic renal disease (n=2), urinary incontinence (n=6), urinary tract infection (n=3) and cloacal anomaly (n=1). In all cases cystoscopy and surgery was carried out.
Results. In 16/22 (73%), without clinical findings of extravesical ectopic ureter, diagnosis was made at a mean age of 4.9 months (range=1–12 months). Out of a total of 64 pelvi-ureter-units (PUUs) in 18 (28.1%) the ectopic ureters drained the upper moiety of duplex kidneys and in 5 (7.8%) single-systems. There was one girl with bilateral ureteral ectopia and bilateral duplex kidneys. The ureteral insertion sites included in girls the urethra (11/58), vagina (5/58) and Gartner's cyst (1/58), and in boys the urethra (1/6) and the seminal vesicle (1/6). fMRU detected the correct ureteral insertion in 58/64(90.6%) PUUs. Mean calyceal transit times were not significantly different (p=0.179) in cases of PUUs with ureteric ectopia compared to those without. Mean patlak differential renal function was significantly lower in PUUs with ectopic ureter (p<0.0001).
Discussion and conclusions. Functional MRU provides comprehensive morphological and functional information in patients with ectopic ureter. The majority of patients are now diagnosed in their infancy.

046 – SP

Optimization of non-contrast MR angiography for the assessment of crossing renal vessels in children with pelvi-ureteric junction obstruction

James Carmichael, Claire Lloyd
Evelina Children's Hospital, London, (United Kingdom)

Purpose-Objective. To assess the usability of non-contrast MR angiography (MRA) techniques in demonstrating crossing renal vessels in children with pelvi-ureteric junction (PUJ) obstruction.
Material and methods. Two non-contrast angiographic techniques were performed in children undergoing MRI assessment for PUJ obstruction: ECG- gated and respiratory-compensated turbo spin echo (TSE) (TRANCE, Phillips) and flow-in labeled, balanced steady-state free procession (bSSFP)(b-TRANCE, Phillips). Parameters including inversion time and flip angle were optimized for the size of vessel and velocity of flow. Images were assessed for quality and appropriate vascular contrast by two pediatric radiologists. Results were assessed for inter-observer agreement and compared to operative findings, when available.
Results. Both MRA techniques were well tolerated in awake children. Crossing renal vessels were depicted with both ECG-gated TSE and SSFP techniques.
Discussion and conclusions. Non-contrast MRA techniques are potentially useful in the pediatric population with relatively short imaging times and avoidance of intravenous access and potential side effects of contrast agents. Careful optimisation of imaging parameters results in high quality images depicting crossing renal vessels in children with PUJ obstruction.

047 – SP

MRI and acute pyelonephritis in children: Comparison of diffusion-weighted imaging to Gadolinium-enhanced T1-weighted imaging

Pierre-Hugues Vivier [1], Asmaa Sallem[1], Marion Beurdeley[1], Ruth P Lim[2], Julien Leroux[1], Jérome Caudron[1], Cyril Coudray[3], Agnès Liard[1], Isabelle Michelet[1], Jean-Nicolas Dacher[1]
[1] Chu C. Nicolle, Rouen (France); [2] Austin Health, Victoria (Australia); [3]G. E. Healthcare, Villacoublay (France)

Purpose-Objective. To evaluate the performance of diffusion-weighted imaging (DWI) for suspected acute pyelonephritis (APN) in children against the reference standard of gadolinium-enhanced T1 weighted (Gd-T1-W). A secondary purpose was also to evaluate the performance of T2-weighted imaging (T2-W).
Material and methods. This retrospective study was institutional review board approved. Thirty-nine patients suspected of acute pyelonephritis underwent MRI including T2-W, DWI and Gd-T1-W, the latter being the reference standard. Each study was read in double-blind fashion by two radiologists. Each kidney was graded as normal or abnormal. Sensitivity and specificity of T2-W and DWI were computed. Agreement between sequences and interobserver reproducibility were calculated with the Cohen κ statistic and McNemar test.
Results. Thirty-nine patients (78 kidneys) were imaged. Thirty-two kidneys (41%) had hypo-enhancing areas on Gd-T1-W images. The sensitivity and specificity of T2-W were 65.6% (21/32) and 100% (46/46) respectively, and 100% (32/32) and 93.5% (43/46) for DWI. DWI did not yield significant differences (p=0.25) with Gd-T1-W and there was excellent agreement (κ=0.92), unlike T2-W (p=0.01) with a fair to good agreement (κ=0.66) with Gd-T1-W. Interobserver reproducibility was better with DWI (κ=0.79) than with T2-W (κ=0.66).

Discussion and conclusions. DWI enabled similar detection of abnormal areas as Gd-T1-W and may provide an injection-free means of evaluation of acute pyelonephritis.

048 – SP

Assessment of the accuracy of MRI in predicting operability and tumour stage in Wilms' tumors, when correlated with surgical findings and histopathology

Tanyia Pillay, Tracy Kilborn, Sharon Cox, Komala Pillay
Red Cross War Memorial Children's Hospital, University of Cape Town, Cape Town, (South Africa)

Purpose-Objective. The pre-operative imaging of Wilms' tumours is critical in determining the timing of surgery by providing detailed anatomical information to decide on operability and aid in planning a surgical approach. Staging of the tumour can be predicted by imaging but is primarily based on findings at the time of surgical exploration and final tumour histology. Traditionally CT scanning has been the main cross-sectional imaging modality used as it is readily available and quick to perform in small children, however concerns over the radiation burden with respect to the long term risk of radiation-induced malignancy have made it a less attractive option. MRI has therefore taken on a greater role in the imaging of childhood tumours; it is now the preferred imaging modality.
Material and methods. A retrospective review of the pre-operative MRI of 38 patients with Wilms tumours treated at our institution between 2008 and 2012. Based on this the pre-operative imaging stage was documented. These results were compared with the findings at surgery as well as the final histology. The accuracy of MRI in predicting operability and tumour stage will be presented.
Results. In 76.3% the stage of disease correlated on imaging, surgery and histology.
Discussion and conclusions. MRI is accurate in predicting operability. There is good correlation between MRI and histology in tumour staging.

049 – R

The importance of ultrasound in the evaluation of nephrocalcinosis in neonate and young children

Besa Hidri, Diamant Shtiza, *Fjorda Tuka,* Sonja Butorac (Saraçi), Denis Qirinxhi
Mother Teresa Uhc, Tirana (Albania)

Purpose-Objective. Importance of ultrasound in assessing nephrocalcinosis and its severity, particularly using a high-frequency transducer. Importance of combining the radiologic findings with other tests in diagnosing its etiology.
Material and methods. Our study included 20 patients diagnosed with nephrocalcinosis in their first 15 months of life, during a 10-year period. In patients' examination ultrasound was used, using also linear-array transducer for a focused examination of the renal pyramids. All patients underwent different blood, biochemical, histologic, genetic tests etc. to explore the origin of nephrocalcinosis.
Results. 3 patients were graded as 1st Grade nephrocalcinosis, 4 patients 2nd Grade, 13 patients 3d Grade. All the patients had bilateral nephrocalcinosis. 8 patients were diagnosed with Renal Tubular Acidosis, 7 patients with Vitamin D intoxication, 3 patients with Oxalosis, 2 patients with Fanconi Syndrome, 1 patient with Bartter Syndrome and 1 patient as Idiopathic.
Main complaint was delay in development (14 patients). Most of the cases were diagnosed with Tubular Renal Acidosis. The linear array transducer helped in the grading process and better evaluation of the pyramid echogenicity using the focused technique.
Discussion and conclusions. The first-choice examination for assessing nephrocalcinosis and in its grading and follow-up is ultrasound, using a linear-array transducer also. The main cause of nephrocalcinosis is Tubular Renal Acidosis. The main reason of presenting to the doctor is delay in development. Different radiologic findings may help suggesting the underlying etiological process.

Radiation Safety

050 – LP

Anthropometry of paediatric patients and of the mathematical MIRD phantoms applied for dose reconstruction (ISIMEP research project of the Federal Republic of (Germany), Förderkennzeichen 02NUK016A)

Michael Seidenbusch [1], Karl Schneider
Department of Paediatric Radiology, Dr. von Hauner's Children's Hospital, Munich, (Germany)

Purpose-Objective. Reconstruction of radiation doses achieved during paediatric X-ray examinations is usually performed by Monte Carlo simulations in mathematical phantoms. Therefore, a close-to-reality replica of the human anatomy and anthropometry in mathematical phantoms is of utmost importance for valid dose reconstructions.
Material and methods. Since 1976, clinical and dosimetric data acquired during paediatric X-ray examinations performed in the Department of Paediatric Radiology, Dr. von Hauner's Children's Hospital, University of Munich, have been stored in an electronic database. The database now encompasses

more than 350.000 conventional radiographs and fluoroscopies, and more than 4.000 computed tomographic examinations. The database stores the body size and body weight of about 33.000 patients of all age groups. For about 2.000 patients, the diameter, volume, density and mass of the lungs were estimated. All of these anthropometric parameters were compared to the corresponding parameters of the mathematical MIRD phantoms designed by the Finnish Radiation and Nuclear Safety Authority STUK, which are commonly used for dose reconstruction in paediatric radiology.
Results. In the mathematical STUK MIRD phantoms, the medians of body height, body weight and thoracic diameter exceeded the corresponding median values of real patients significantly. On the contrary, lung volumes and lung masses were estimated much too low.
Discussion and conclusions. Therefore, a revision of mathematical phantoms is highly recommended to improve radiastion dosimetry in paediatric patients.

051 – SP

Opportunity of dose reduction in pediatric CT-examinations
Andrea Lakatos [1], Máté Kiss [1], Béla Lombay [2]
[1] Borsod County University Hospital, Miskolc, (Hungary); [2] Borsod County University Hospital, University of Miskolc, Faculty of Healthcare, Miskolc, (Hungary)

Purpose-Objective. The advent of MDCT led to high radiation exposure of pediatric population. Choosing the best way of dose reduction from various new technical innovations is a great challenge. Our purpose is to summarize the dose saving strategies. We demonstrate cases where we reached significant dose reduction using AEC (Automatic Exposure Control) in conjunction with decrementing tube current (mAs) and voltage (kV).
Material and methods. During a 30 months period we examined 410 patients, aged 1 day to 14 years with Siemens Somatom Definition AS+ MDCT, and further investigated 92 children who underwent thoracic CT-examinations. In addition to Care Dose 4D AEC software we considered the diameters, age and weight of patients to achieve further dose reduction.
Results. In 28 corpulent patients (30.4%) we subjectively reduced the dose by 10%. In children with average bodyweight, we could reduce the effective dose by 30% in 34 patients (36.9%) and achieved almost 50% reduction in 21 patients (22.8%). In 7 children (7.6%) we reduced the dose by 70%. According to our study the best dose reduction technique is based on the patient's diameters.
Discussion and conclusions. The ALARA concept and radiation protection is an important issue. Using AEC is essential but not enough, additional protocol optimization is needed. Creating individual protocol is hard to achieve. Changing the tube parameters could result in significant dose reduction. The report is part of TÁMOP-4.2.1.B-10/2/KONV-2010-0001, supported by the European Union and European Social Foundation.

052 – SP

National guideline for paediatric CT in Finland
Raija Seuri [1], Ritva Bly[2], Katja Merimaa[2]
[1] HUS Imaging Center, Helsinki Childrens Hospital, Helsinki University Hospital, Helsinki (Finland); [2] STUK - Radiation and Nuclear Safety Authority, Helsinki, (Finland)

Purpose-Objective. The increasing number of paediatric CT-examinations means challenge to both justification and optimization processes. The Finnish Radiation and Nuclear Safety Authority (STUK) has published several guidelines of paediatric imaging together with paediatric radiologists. We describe the recently published national Guideline for paediatric CT.
Material and methods. The differences among equipment is a big challenge for technical optimization. The rapid multislice techniques have changed the use of paediatric CT, especially in body and trauma imaging, and the development of MRI has affected justification of CT. The Guideline includes both technical optimization and indication-based imaging practises.
Results. The technical part includes practical advice for optimizing imaging parameters. It also explains the basic terminology like SFOV/DFOV, AEC and dose indices in practical terms. The vendor-specific chapters include additional detailed information of special features. The clinical part is divided anatomically into head, ENT, chest, abdomen and skeletal, but includes also chapters for trauma CT and PET-CT. Every chapter includes indications and practical advice for the whole procedure like the need of breath hold, use of contrast, etc.
Discussion and conclusions. The rapid development of CT equipment and the differences in technique make giving guidelines challenging. We present the Finnish national guideline for paediatric ct including practical technical knowledge, advice for justification and performance of common paediatric CT examinations.

053 – SP

Paediatric trauma CT head DLP audit in a tertiary paediatric centre
Ramdas Senasi, Asad Shah, Ashok Raghavan, Rebecca Ward, Melissa Slocombe
Sheffield Children's Hospital, Sheffield, (United Kingdom)

Purpose-Objective. Are Paediatric CT Heads performed in our hospital within the UK National Radiation Protection Board Dose limits?
Material and methods. We looked at the DLP values of acute paediatric CT heads of the last fifty patients up to June 2012. Age ranges were from birth to fifteen. Results were group into birth to 1 year old, 1 to 5 years old, 5 to 10 and 10 to 15. The results were referenced against the National Radiation Protection Boards 2005 standards.
Results. We only achieved 100% compliance in the 5–10 age group. Our compliance rates in the other groups were 20% in the birth to one, 93% in the one to five and 94% in the ten to fifteen age groups.
Discussion and conclusions. Several factors lead to none compliance including improper protocols during CT scanning and lack of awareness. The department staff were re-educated on using the proper protocols and keeping radiation as low as reasonably possible. A repeat audit performed 6 months later showed an overall improvement in all groups although we were still below 50% compliance in the birth to 1 age group. This audit highlights the importance using the right protocols when scanning different paediatric age groups. The need to keep paediatric radiation doses low cannot be highlighted enough as the paediatric population are more at risk of radiation-induced cancer.

054 – SP

Radiation risks in major trauma: cervical spine CT & the lifetime associated risk of malignancy in children
Shema Hameed, Sylwia Niewiarowski, May-Ai Seah, Joanna Danin, Afshin Alavi
St. Mary's Hospital, Imperial College NHS Trust, London, (United Kingdom)

Purpose-Objective. Major trauma centres are well established in the UK, with the majority receiving both children and adults. With this comes the increasing demand for imaging with computed tomography, and the associated radiation risks. The purpose of our study is to analyse our paediatric CT cervical spine data over a two-year period. Cumulative effective doses (CED) and subsequent life-time associated risk (LAR) of cancer will be presented.
Material and methods. Data is being collected for a two-year period (2010–2012). All children aged 16 and under are included. Age, sex and injury severity score (ISS) is recorded. CT study parameters are collated, including mA, kV and DLP. The CED is calculated and analysed to assess LAR. The study particularly focuses on the risks of thyroid malignancy.
Results. Over a two-year period 150 studies were performed. Initial data from a 1 year period of 70 CT C-spines show that 30% of patients were under 10 years old. mA ranged between 5 and 25 with kV's of 120, and DLP ranged between 32 and 480 mGy.cm2. Average CED was 1.6 mSv. Complete CED and LAR data will be presented.
Discussion and conclusions. The benefit of performing a CT C-spine in a child should be weighed against the radiation risks carefully. Our study presents the CED and LAR of cancer and cancer-associated mortality in different age-groups, demonstrating the potential associated risks of major trauma imaging in children.

055 – LP

Cumulative radiation CT dose in non-oncological patients: a single centre 5 years retrospective review
Sergio Salerno [1], Claudia Geraci [1], Maurizio Marrale [2], Giuseppe La Tona [1], Antonio Lo Casto [1]
[1] University Hospital Policlinico, Palermo, (Italy); [2] University of Palermo Department Physic, Palermo, (Italy)

Purpose-Objective. CT scans represent the major source of radiation in paediatric patients. Patients referred for cancer are submitted to multiple CT scan for diagnosis and follow-up. Non oncological patients should have less occasion to be submitted to more than one CT scan. To monitor the number of CT scans and cumulative radiation doses for non oncological pediatric patients, a 5 year single centre retrospective review was performed.
Material and methods. We identified 14 non-oncological patients from the Radiology information system (RIS), with a mean age of 11.9 years (range 0–16 years, 6 females and 8 males) who were submitted to more than one CT scan. The diagnosis at hospital admission, clinical query for CT were recorded with the estimated effective doses (mSv) obtained from the published literature and institutional records.
Results. 8/14 patients were referred for trauma, 6/14 for surgical complications (2 abdominal complications, 2 thoracic complications and 2 neurological complications) and were submitted to a mean of 3 different scans. The estimated effective dose values for various body regions was: brain and cervical spine about 4 mSv, thorax about 3 mSv, and abdomen about 9 mSv.
Discussion and conclusions. The usefulness of CT scans in diagnosis and management of trauma and complicated patients is well known; however, the risks of cumulative radiation dose should be considered better in pediatric patients and risk-benefit considerations should be underlined to decrease exposure.

056 – LP

Accuracy in diagnosis of pediatric acute appendicitis: weight-based CT protocols with traditional filtered back projection versus 60% CTDIvol-reduced protocols with iterative reconstruction technique

Petra Vajtai, Katharine Hopkins, Ryne Didier,
Oregon Health and Science University, Portland, (United States)

Purpose-Objective. We compared accuracy in diagnosis of pediatric acute appendicitis using established weight-based CT protocols and traditional filtered back projection (FBP) reconstruction versus 60% CTDIvol-reduced CT protocols using iterative reconstruction technique (IRT).
Material and methods. A retrospective review was performed of pediatric abdomen/pelvis CT examinations done at our university children's hospital between October 2009 and September 2012. Patients aged 1–18 years were included if they underwent CT scan for evaluation of abdominal pain for which appendicitis was included in the differential. Scans were performed with either established weight-based CT protocols and FBP reconstruction (n=200) or 60% CTDIvol-reduced CT protocols and IRT (n=200). CT diagnosis was correlated with surgical pathology and/or clinical follow-up. Diagnostic accuracy of the two CT techniqes was compared by statistical analysis.
Results. There was no statistically significant difference in accuracy between the two types of scans in diagnosis of acute appendicitis.
Discussion and conclusions. Acute appendicitis is a common pediatric surgical emergency, often diagnosed by CT. When scanning children and adolescents, it is important to decrease CT radiation dose to As Low As Is Reasonably Achievable (ALARA), yet still meet diagnostic standards. Our study showed that diagnostic accuracy was maintained using 60% CTDIvol-reduced protocols and IRT as compared to our standard pediatric weight-based protocols with FBP reconstruction.

057 – LP

Radiation exposure of the mammarian glands in paediatric high resolution computed tomographic (HRCT) examinations. (ISIMEP research project of the Federal Republic of (Germany), Förderkennzeichen 02NUK016A)

Michael Seidenbusch, Karl Schneider [1]
Department od Paediatric Radiology, Dr. von Hauner's Children's Hospital, University of Munich, Munich, (Germany)
Purpose-Objective. HRCT examinations of the lungs are performed for the diagnosis of interstitial lung diseases by applying slices with 1 mm slice collimation and a large spacing between the slices. Therefore, the estimation of mammary gland dose requires information whether the mammary gland is covered by the collimated beams or not.
Material and methods. Since 2003, clinical and dosimetric data acquired during CT examinations performed in our department have been stored in databases which now encompass about 200 HRCT examinations of all age groups. By analyzing the localization of the slices, the frequency of mammary gland exposure was estimated. The mammary organ doses were calculated with new conversion factors for 1 mm thick slices (paper under revision).
Results. During HRCT examinations of the chest in paediatric patients, mammary glands were only exposed in 40% of the patients, in 17% one mammary gland and in 23% both mammary glands were exposed. The calculated mammary organ doses were in a range of 2 mSv, with the highest doses in neonates.
Discussion and conclusions. The probability for a mammary gland to be exposed during a chest HRCT examination is about 40% and is higher in infants and in patients above 10 years of age. As mammary gland doses correspond to the natural radiation dose level achieved in 1 year, HRCT is to be considered in fact not as a low dose CT examination.

058 – SP

Retrospective review of current nasojejunal tube insertion practice

Mary-Louise Greer, *Natasha Sheikh*, Michelle Falkiner
The Hôspital for Sick Children, Toronto, (Canada)

Purpose-Objective. To analyze current practice for nasojejunal tube (NJT) intubation to determine if there is a need for an alternative approach, self-guided intubation, to minimize radiation exposure and improve patient tolerance.
Material and methods. A retrospective evaluation of 252 patients <18 year who underwent fluoroscopic-guided NJT intubations between 2007 and 2012 was conducted using PACS audit. Patient demographics including age and weight; procedural details including re-insertion frequency per patient, fluoroscopy time (minutes), frame rate (frames/seconds), radiation dose measured as dose actual percentage (DAP); and size of NJT were recorded. Referrer details and indications were also captured.
Results. In total, 252 children (age, 3 days–17 years 11 months) had 449 NJT insertions performed. Re-insertions occurred in 105 (41.7%) patients, 197/449 (43.9%), with ≥5 reinsertions in 14 (5.6%) patients. Average dose (DAP) was 1.337 mGycm2, fluoroscopy time 4.5 min,

and frame rate 7.5 frames/second. NJT sizes ranged between 6 and 10 French. More detailed analysis of DAP and fluoroscopy time considering weight and age was performed. Most frequent referrals were from neonatal (16.5%) and paediatric (11.9%) intensive care, gastroenterology (12.4%) and general paediatrics (10.5%).

Discussion and conclusions. A majority of NJT intubations are performed in neonates, and a high percentage of intubations occur as re-insertions. This data supports a proposed procedure change, particularly in neonates, to trial self-guided intubation with an expected reduction in radiation dose.

059 – SP

Paediatric transit studies: Out of date imaging or a useful imaging modality?

Guy Cooper, *Lavanya Vitta*, Helen Anderson
Royal Alexandra Children's Hospital, Brighton, (United Kingdom)

Purpose-Objective. Bowel transit studies in the paediatric population have been performed for a number of years to assess motility. The current standard of practise is to perform an abdominal radiograph (AXR) on day 5 post ingestion of radio-opaque markers. Our prospective study demonstrates how the use of fluoroscopic frame grab images can produce diagnostic quality images with a reduction in the radiation exposure dose.

Material and methods. Fluoroscopic frame-grab images were introduced in our unit to replace conventional AXR for imaging colonic transit studies. A 1-year prospective audit of radiation doses (DAPs) from frame-grab images were recorded and compared to standard AXRs (either from national standards or from previous AXR of the child).

Results. 41 fluoroscopic frame-grab images were performed with the average radiation dose of 0.26 cGycm2, compared to 14.25 cGycm2 for the average AXR. The DAP for individual frame grabs were frequently so low that they were below the manufactures recordable limit.

Discussion and conclusions. Our study has shown that fluoroscopic grab images can reduce the radiation dose to the paediatric population undergoing colonic transit studies significantly, when compared to conventional AXR, thus making colonic transit studies a useful and low radiation modality. We provide evidence that our new technique can replace AXR, without loss of diagnostic image quality but reducing the risk of radiation induced malignancy to our paediatric patients.

060 – SP

Image gently: Image quality and dose assessment in portable chest radiographs in the NICU and PICU before and after implementation of a high-kVp technique

Anat Yahav [1], Benjamin Z. Koplewitz [2], Katya Rozovsky[2], Jacob Sosna[2], Idris El-Bakri[3]
[1]School of Medicine, Hebrew University, Jerusalem, Israel; [2]Dept. of, Hadassah-Hebrew University Medical Center, Jerusalem, Israel; [3]Division of Medical Physics, CancerCare Manitoba, Canada

Purpose-Objective. A quality controlled survey revealed that imaging techniques for portable radiography of infants in the NICU and PICU were not standardized in our institution. Doses varied widely and were higher than reported in the literature. Low kVp (50–56) settings were being used despite the introduction of CR several years ago. The purpose of this study was to lower patient dose by introducing a weight-based high-kVp technique and to assess its effect on image quality.

Material and methods. A weight-based high-kVp technique chart was introduced. Tube potentials varied from 60 to 70; tube current was fixed at 0.5 mAs. Effective dose was calculated using the Monte Carlo software PCXMC 2.0. Clinical image quality was assessed based on CEC image quality criteria before and after introduction of high-kVp technique.

Results. Average dose for 193 low-kVp CXRs was 19.54± 9.30 uSv. Average image quality score was 83.2%±9.3%. With high-kVp technique, the average dose for 61 CXRs was 9.45±3.32 uSv. The average image quality score was 83.0%±9%. In both groups, all images were diagnostic.

Discussion and conclusions. Implementation of a standard high-kVp imaging technique for portable chest radiographs of patients between 0 and 3 months old in NICU and PICU resulted in a reduction of ~50% in radiation doses, with no perceivable change in image quality.

061 – LP

A wide range radiation dose in voiding cystourethrography: where is the problem?

Andrea Magistrelli, Marco Cirillo, Teresa Corneli, Mario Emanuele Fiorito, Paolo Maria Salvatore Schingo, Paolo Tomà
Bambino Gesù Children's Hospital IRCCS, Rome, (Italy)

Purpose-Objective. Considerable interinstitutional variability in dose is a finding common to all surveys. In our

hospital a recent survey revealed a wide range in DAP values in pediatric fluoroscopic examinations, too. The aim of this study is to understand the most common human errors in diagnostic fluoroscopic examination and to correct them.

Material and methods. For a period of 2 months (October/November 2012) we asked our staff (radiologists and radiographers) to save and archive all complete fluoroscopy sequences obtained (no last image hold). We analyzed 124 consecutive voiding cistouretrotrographies (VCUG) and for each examination we recorded radiologist's and radiographer's name, patient data, DAP, total exposure time, technique settings (protocol, kid-size preset, Cu filter) and grade of collimation (1: absent; 2: incomplete; 3: right). All examinations were performed on the same equipment (Siemens AXIOM Luminos dFR).

Results. VCUG is one of the few diagnostic examinations that could be standardized. We noticed a wide range in DAP (similar protocol and age group range from 3 to 100 and greater). The most frequent errors are unnecessary fluoroscopy sequences, wrong kid-size settings and incomplete collimation.

Discussion and conclusions. All our staff is now aware of the kind of errors which were usually performed. Some lectures about fluoroscopy techniques and tips&tricks to reduce dose were performed. We are now performing a new survey to check the effectiveness of our intervention.

062 – SP

MRI-based bone age assessment

Robert Marterer [1], Astrid Krauskopf[2], Eva Scheurer[2], Erich Sorantin[1]

[1] Division of Pediatric Radiology, Department of Radiology, Medical University of Graz, Graz, (Austria); [2] Ludwig Boltzmann Insitute for Clinical Forensic Imaging, Graz, (Austria)

Purpose-Objective. For forensic reasons, for example among immigrants of unclear age, the determination of the biological age is necessary. Usually the biological age is assessed by analysis of bone age using left hand X-Rays. Magnetic Resonance Imaging (MRI) represents a radiation-free modality for that purpose. The aim of this study was to compare whether left hand MRI provides the same results for bone age as X-Ray examinations.

Material and methods. 18 children between 5 and 18 years of age were included in this study. Both an X-ray of the left hand as well as an MRI of the same hand was performed on the same day. The determination of bone age was performed twice a) based on Greulich and Pyle and b) on Tanner and Whitehouse.

Results. Mean value and standard deviation of differences in bone age were determined for a) with 11.7± 3.1 years (X-Ray) vs. 11.6±3.2 (MRI) (p=0.66) and for b) with 12.8±2.5 years (X-Ray) vs. 12.4±2.9 years (MRI) (p=0.64).

Discussion and conclusions. MRI provides a non-invasive, reliable method for bone age determination in non-medical questions for example forensic purposes.

063 – SP

Preliminary radiographic validation of the electrocardiographic method (EKG) for positioning the tip of central venous catheters in children: can the EKG replace chest radiography?

Domenico Noviello [1], Francesca Malacario[3], Francesco Esposito[1], Luigi Esposito[3], Patrizia Oresta[1] [1], Sonia Tamasi[1], Ugo Graziano [2], Umberto Balestrieri [2]

[1] AORN Santobono - SC Radiologia, Naples, (Italy); [2] AORN Santobono - SC Chirurgia, Naples (Italy); [2] Università degli Studi "Federico II", Naples, (Italy)

Purpose-Objective. The purpose of our study was to evaluate if the Electrocardiographic Method (EKG) for positioning the tip of Central Venous Catheters (CVC), in children in critical clinical conditions, previously often irradiated, may replace the many chest X-Rays controls.

Material and methods. We performed a prospective study of 50 pediatric patients, positioning the CVC through EKG method, which exploits the use of saline contained in the catheter as intracavitary electrode. Subsequently all patients were subjected to Chest X-Rays control in one or two projections, in supine position, with arms along the body and without forced inspiration.

Results. In 48/50 patients the positioning of the CVC with EKG method appeared correct to Chest X-Rays control. Problems related to anatomic variations have affected the procedure in the remaining 2 patients.

Discussion and conclusions. Given the high percentage (96%) of positive results we believe that the EKG method can replace the post-procedural Chest X-Rays controls, removing the radiation exposure of the child, reducing time and costs. These results should be confirmed in a larger multicenter study, however, already in progress.

064 – SP

Tolerability and diagnostic efficacy of iobitridol in children

Martin Maurer [1], Oliver Heine [2], Michael Wolf [3]
[1] Charite - Universitätsmedizin Berlin, Berlin, (Germany); [2] Guerbet GmbH, Sulzbach, (Germany); [3] Michael Wolf Informationssysteme, Püttlingen, (Germany)

Purpose-Objective. To investigate the tolerability and diagnostic efficacy of iobitridol in children.
Material and methods. An observational study on 61.833 patients receiving iobitridol as an IV contrast medium was performed in 65 German centres. A subgroup analysis was carried out on 193 children (37.7% male, 62.3% female) under 18 years of age (mean age 16.0 years; range, 10–17 years). The 193 patients received iobitridol (mean volume 77.7 ml) mostly in the context of IV urography (142/193; 73.6%) or a CT scan (34/193; 17.6%). Known risk factors were documented, e.g. allergies (9/193; 4.7%) or thyroid disorders (3/193; 1.6%). No anti-allergy premedication was administered. Adverse events including symptoms, treatment and outcome were documented. The image quality and diagnostic significance was assessed for all examinations.
Results. One of the 193 patients (0.5%) developed a non-serious adverse reaction (flushing) during IV urography. The patient recovered after treatment with calcium and Clemastil. No serious adverse reactions were observed. Image quality was very good or good in 98.4% of all examinations and a diagnosis was possible in 100% of all cases.
Discussion and conclusions. Iobitridol was shown to be a well tolerated iodinated contrast medium in a subgroup of 193 children associated with a very low incidence of adverse events and resulting in a good or very good image quality in most cases.

Gastrointestinal

065 – LP

Measurement of real-time tissue elastography (RTE) in phantom model and comparison of RTE and transient elastography (TE) in pediatric patients with defined liver diseases

Buket Selmi [1], Gerhard Alzen[2], Volker Klingmueller[2], Guido Engelmann[3], Ulrike Teufel[3], Saroa El Sakka[1], Jens-Peter Schenk[1]
[1] Division of Pediatric Radiology, Department of DIR, University Hospital Heidelberg, Heidelberg, (Germany); [2] Department of Pediatric Radiology, University Clinic Giessen & Marburg, Giessen, (Germany); [3] Department of General Pediatrics, University Hospital Heidelberg, Heidelberg, (Germany)

Purpose-Objective. To determine the comparability of RTE and TE.
Material and methods. RTE was performed on the Elasticity QA Phantom Model 049 manufactured by CIRS® that has 5 areas with different levels of stiffness defined in kPa. For each area of stiffness 10 measurements were performed and the stiffness was defined as an average of these 10 measurements. RTE and TE were performed on 147 pediatric patients with various liver diseases: metabolic liver disease (29), cystic fibrosis (26), hepatopathy of unknown origin (16), autoimmune hepatitis ($n=16$), and Wilson's disease ($n=13$). RTE-measurements (MEAN und AREA) in the phantom were compared with the phantom stiffness specified in kPa. In addition RTE-Parameters and TE in patients with various liver diseases were compared.
Results. RTE showed a good correlation in the phantom model with the phantom stiffness (MEAN/kPa: $r=-0.97$, AREA/kPa: $r=0.98$). However, the correlation of both methods RTE and Fibroscan was weak in the patient group (MEAN/kPa: $r=-0.27$, AREA/kPa:0.34).
Discussion and conclusions. A rectified correlation of RTE existed in phantom model with kPa. However, a direct correlation in patients with defined liver diseases could not be achieved for RTE and TE. Further studies are needed in patients with histological defined liver structure changes.

066 – SP

Can ultrasound replace small bowel follow through in the investigation of children with possible inflammatory bowel disease?

Denise A Castro [1],Pam Rasalingam[2], Elizabeth Vandenkerkhof[3], Angela Noble[2], Mary-Louise Greer[1], Don A Soboleski[2]
[1] The Hospital for Sick Children, University of Toronto, Toronto, (Canada); [2] Hotel Dieu Hospital, Queen's University, Kingston, (Canada); [3] Queen's University, Kingston, (Canada)

Purpose-Objective. To determine if bowel ultrasound can replace small bowel follow through (SBFT) in the investigation of children presenting with gastrointestinal symptoms of inflammatory bowel disease (IBD).
Material and methods. Prospective study with 56 patients (4–18years) referred from pediatricians or pediatric gastroenterologists for SBFT. All patients presented with typical gastrointestinal symptoms (pain, diarrhea, bloody stool, weight loss, etc.) not yet diagnosed. A dedicated bowel ultrasound was performed and interpreted

immediately before the SBFT. Ultrasound was considered abnormal if there was wall thickening (>4 mm) with or without hypervascularity. Colonoscopies were performed in 37 of the 56 pts.

Results. All 14 patients (out of the 56) who had abnormal SBFT also had abnormal ultrasound and positive colonoscopy findings (13 Crohn, 1 ulcerative colitis). Of the 6 patients (out of the 56) with normal SBFT and abnormal ultrasound, the colonoscopy resulted in a diagnosis of Crohn (5) and ulcerative colitis (1). Fourteen patients had normal colonoscopy and normal ultrasound. Using colonoscopy as the gold standard, ultrasound had a sensitivity of 92%, specificity of 100%, positive predictive value (PPV) of 100% and negative predictive value (NPV) of 88%. For SBFT compared to colonoscopy, sensitivity was 60%, specificity 100%, PPV 100% and NPV 47%.

Discussion and conclusions. Bowel ultrasound can reliably replace SBFT exams in the investigation of children presenting with typical gastrointestinal symptoms of IBD.

067 – SP

Perforated appendicitis -an underappreciated mimic of intussusception on ultrasound

Matthew D Schmitz, *Beverley Newman*, Shreyas Vasanawala, Richard Barth

Stanford University School of Medicine - Lucile Packard Children's Hospital, Palo Alto, (United States)

Purpose-Objective. To describe ultrasound (US) appearance of perforated appendicitis mimicking ileocolic intussusception and discriminatory findings between the two.

Material and methods. The peer review process identified 5 cases (ages 16 months–8 years; 4M, 1F) with initial US findings suggestive of ileocolic intussusception, but subsequent diagnosis of ruptured appendicitis. US and subsequent fluoroscopic and CT images were independently evaluated by 4 pediatric radiologists (3 faculty, 1 fellow).

Results. Review of initial 5 ultrasounds produced diagnostic consensus of findings suggesting ileocolic intussusception in all. In 3 cases, US findings were somewhat discrepant with clinical concerns. Subsequently 4/5 patients had negative enemas, 2 had repeat US with recognition of the correct diagnosis, 3/5 had contrast-enhanced CT demonstrating perforated appendicitis. All 5 had surgical confirmation of perforated appendicitis. All initial US demonstrated multiple concentric rings of bowel signature (target sign, most apparent on transverse views), but none demonstrated definite central mesenteric fat and all showed an outermost thick hyperechoic ring that, in retrospect, represented inflamed fat "walling" off the perforated appendix. 3/3 CT's demonstrated a double ring appearance correlating with the US "target" findings with inner and outer rings representing the dilated appendix and walled off appendiceal rupture respectively.

Discussion and conclusions. Contained perforated appendicitis may produce US findings closely mimicking ileocolic intussusception. Clinical correlation and careful multiplanar evaluation should allow for sonographic suspicion of perforated appendicitis with confirmatory CT if necessary.

068 – SP

Ultrasound in detecting and following gastric foreign bodies in children

Mihajlo Jeckovic [1], Sudha A. Anupindi[2], Svetlana Balj[1], Jovan Lovrenski[1]

[1] Institute for Children and Youth Health Care of Vojvodina, Novi Sad, (Serbia and Montenegro); [2] The Children's Hospital of Philadelphia, University of Pennsylvania Perleman School of Medicine, Philadelphia, (United States)

Purpose-Objective. Foreign body ingestion is relatively common and a potentially serious problem in the pediatric population, traditionally assessed by serial radiographs. The aim of this study is to report our experiences with foreign body ingestion in children and to show the potential value of ultrasound in detecting and following gastro-duodenal foreign bodies.

Material and methods. The medical records of 18 children with gastric foreign bodies, admitted to the emergency department between January 2010 and October 2011, were evaluated retrospectively for type of imaging studies performed, type of foreign body ingested and method of removal.

Results. Gastric foreign bodies were confirmed in all patients by ultrasound. The followings were identified: 8 coins, 5 button batteries, 1 domino, 1 stick of a lollipop, 1 hairclip, 1 screw nut and small plastic cylinders. The mean age of the children was 2 years. All batteries, the domino and two coins were removed endoscopically. The other six coins, the lollipop stick, hairclip and plastic cylinders were recovered in the stool. The screw nut was removed surgically. The mean length of hospital stay was 1.5 days.

Discussion and conclusions. In order to avoid unnecessary radiation exposure of children, ultrasound of water filled stomach has been proven to be a promising, potentially effective method of choice in the diagnosis and follow-up of ingested gastric foreign bodies, especially in cases which are radiolucent.

069 – SP

Accuracy of ultrasonographic diagnosis of acute appendicitis in child population

Natalia Kokhanovsky, Abdel-Rauf Zeina, Nadir Reindorp, Alexandra Levit-Kantor, Alicia Nachtigal
Hillel Yaffe Medical Center, Hadera, (Israel)

Purpose-Objective. To assess the reliability and value of sonographic examinations in the diagnosis of acute appendicitis in children.

Material and methods. During a 16-month period, we retrospectively reviewed sonographic examination performed on 305 pediatric patients with clinically suspected acute appendicitis. Study subjects' average age was 12.3 years. Sonography was the first imaging modality employed. Surgery or clinical follow-up was the "gold standard" for the evaluation of sonographic performance. All examinations were performed using gray-scale graded compression in the supine and left lateral decubitus position. The sonographic criteria for acute appendicitis were detection of a noncompressible, blind-ended, tubular structure measuring greater than 6 mm in maximal diameter. Additional inflammatory findings (enlarged lymphatic nodes, free fluid, echogenic mesenteric fat) were variably detected.

Results. 56 patients had positive sonographic findings of acute appendicitis. The diagnosis was confirmed in 53 patients. From the 249 patients with negative sonographic findings of acute appendicitis, the results for 13 patients proved false-negative, whereas the remaining 236 improved on clinical follow-up. Accordingly, sensitivity was 80.3%, specificity was 98.7% and overall accuracy was 95.1% with negative predictive value of 94.7%.

Discussion and conclusions. Our experience suggests that ultrasonographic examination with the optimal study protocol is a highly accurate method for the diagnosis of acute appendicitis in the child population and should be performed as the first imaging test.

070 – SP

The role of colon hydrosonography in the diagnosis and follow-up of inflammatory bowel disease in children

Otilia Fufezan [1], Carmen Asavoaie [2], Daniela Serban[3], Dorin Farcau[1]
[1] 3rd Pediatric Clinic, Cluj-Napoca, (Romania); [2] 1rd Pediatric Clinic, Cluj-Napoca, (Romania); [3] 2rd Pediatric Clinic, Cluj-Napoca, (Romania)

Purpose-Objective. Inflammatory bowel disease (IBD) used to be considered a rare pathology among the pediatric population, but today it is diagnosed with increasing frequency, especially in adolescence.

The purpose of this paper is to demonstrate that colon hydrosonography (HS) plays a role in the diagnosis and follow-up of IBD in children.

Material and methods. A number of 16 patients (11 males), between 5 and 18 years of age, were included in the study group. All the patients underwent HS and colonoscopy, while selected cases also benefited from upper tract endoscopy and computed tomography.

HS assessed bowel wall thickness, parietal stratification, haustration, lumenal caliber and peristalsis. During the sonographic exam the peri-intestinal fat, lymphadenopathies, peritoneal collections and the presence of complications (stenosis, abscesses, fistulas) were also evaluated. Doppler ultrasonography was used to detect signs of disease activity.

Results. Eight patients were diagnosed with Chron's disease (CD), 6 with ulcerative colitis and 2 with IBD unclassified. Bowel wall thickness was more significant in patients with CD, these patients also showing loss of parietal stratification. Complications were present in 4 out of 8 cases of CD (4 patients with stenosis, 3 with fistulas and abscesses). Three of the patients with CD underwent surgery.

Discussion and conclusions. HS is a minimally invasive technique that allows an adequate assessment of the changes that occur in the gastrointestinal tract and surrounding structures in IBD in children.

071 – SP

Pneumatic versus hydrostatic reduction of intussusception in children: A meta-analysis of 26,224 Cases

Moti Chowdhury
The Royal Children's Hospital, Melbourne, (Australia)

Purpose-Objective. Radiological reduction of intussusception is widely variable, both in technique and reported efficacy. We perform a meta-analysis of the evidence to identify the optimal therapy between the two most adopted techniques, air enema (AER) and ultrasound-guided hydrostatic reduction (UHR).

Material and methods. Using a defined search strategy (Medline/Ovid/Cochrane), studies examining intussusceptions in children treated by AER or UHR (using saline/water-soluble contrast) were identified. Articles with potential sources of bias (studies examining older children/small bowel intussusceptions alone, reduction technique unspecified, or reporting amalgamated results of multiple techniques) were excluded. Meta-analysis was performed for each outcome variable (mean ± SEM), and data compared between the two techniques.

Results. 560 articles were identified, of which 86 fulfilled the entry criteria (five comparing both techniques). AER (17,535 cases) and UHR (8,689 cases) groups were comparable with respect to median age (11.4±1.4 vs. 12.7±2.1 months), duration of symptoms preceding reduction (29.2±4.9 vs. 22.6± 3.4 h) and lead points identified (0.55% vs. 0.68%); p=ns. Compared to AER, UHR achieved higher reduction rates (88.21% vs. 90.54%; $p<0.0001$), incurred fewer recurrences (8.39% vs. 5.93%; $p<0.0001$), with comparable perforations caused (0.40% vs. 0.32%), and intestinal resections required (29.2% vs. 33.5%); p=ns.
Discussion and conclusions. UHR is more effective and incurs fewer recurrences than AER, with comparable morbidity. Given the additional benefits of obviating radiation exposure, it is therefore recommended as the optimal technique for intussusception reduction.

072 – SP

Neonatal proximal small bowel obstruction: A pictorial review

Erin Horsley[2], *Eric Faerber* [1], Jacqueline Urbine[1]
[1] St. Christopher's Hospital For Children, Philadelphia (United States); [2] Hahnemann University Hospital, Philadelphia (United States)

Purpose-Objective. Proximal bowel obstruction is a common entity in the neonate. Although some etiologies of proximal obstruction have pathognomonic imaging findings, others can be somewhat more challenging to diagnose. A pictorial review of the spectrum of neonatal causes of proximal bowel obstruction is demonstrated, with surgical correlation where available.
Material and methods. We retrospectively identified neonatal patients who presented with proximal bowel obstructions. Medical records were reviewed and radiologic studies were correlated with clinical history and surgical/pathological results where indicated.
Results. A retrospective study over a 7 year period demonstrated proximal small bowel obstructions in multiple neonatal patients due to the following etiologies: esophageal atresia, duodenal atresia, hypertrophic pyloric stenosis, duodenal web, malrotation, and malrotation with volvulus.
Discussion and conclusions. Proximal bowel obstruction in the neonate can be the result of many different etiologies.

073 – LP

Patent ductus venosus: What does that mean?

Stephanie Franchi-Abella, Aurélie Keslick, Daniele Pariente
Service de Radiopediatrie- Hôpital Bicêtre, Le Kremlin-Bicêtre, (France)

Purpose-Objective. To describe cases of patent ductus venosus (DV).
Material and methods. Retrospective study of a series of children older than 1 month and presenting with a patent DV.
Results. Fifteen children were included. In five the DV was large (11 to 27 mm diameter) with no sign of chronic liver disease. Diagnosis was performed antenatally in one case and between 6 and 13 years in the others. Four children had complications: cardiopulmonary in 3, neurologic in 2, and hepatic masses in 2. All had a closure of the DV with improvement or resolution of the complications. The other ten children had a thin DV (<4 mm diameter). Median age at diagnosis was 2.5 months. All had cirrhosis related to biliary atresia in 5, metabolic disorders in 2, other etiology in 3. A two-month old infant with metabolic disorder died. Three children underwent liver transplantation younger than 16 months and 2 are on waiting-list. Two children are stable and two are lost from view.
Discussion and conclusions. A patent DV in patients older than 1 month is a pathologic finding. If the DV is large, without liver disease, this is a vascular malformation that necessitates surgical or radiological closure in the first years of life. If the DV is thin, it should be considered as a sign of portal hypertension secondary to neonatal liver disease.

074 – SP

Fluoroscopic 'Grab images': a new recommended method for reducing the radiation dose of the paediatric population undergoing nasojejunal tube placement.

Helen Anderson, Lavanya Vitta, Guy Cooper
Royal Alexandra Children's Hospital, Brighton, (United Kingdom)

Purpose-Objective. Children with chronic pathologies often require long-term enteral nutrition, achieved by nasojejunal (NJ) tubes. The current standard is to perform a radiograph after each tube placement to ensure correct tip position. Often the child requires multiple tube repositioning, leading to multiple x-rays and significant cumulative radiation dose. Our prospective study demonstrates how fluoroscopic 'grab' images can replace conventional imaging, to assess tip position and reduce paediatric radiation dose, without loss of image quality.
Material and methods. We introduced Frame-grab images to replace conventional x-rays to check NJ tip position. The tube could also be manipulated under fluoroscopic guidance at the same time. A 1-year prospective audit of radiation

doses (DAPs) from frame grab images was recorded and compared to standard CXRs (either from national standards or from previous x-rays of the child).
Results. 20 fluoroscopic frame grab images were performed with the average radiation dose of 0.04 cGycm2, compared to 1.83 cGycm2 for the average CXR. The DAP for individual frame grabs were so low that they were frequently below the manufactures recordable limit.
Discussion and conclusions. Replacing CXR with fluoroscopic grab images has significantly reduced the radiation burden to our paediatric patients requiring NJ tubes, thus reducing the risk of radiation induced malignancy in later life. We have now extended the use of fluoroscopic grab images for NG and pH tube positions and colonic transit studies.

075 – LP

Incidental findings at multidetector computed tomography in children who referred emergency department to be evaluated for right lower quadrant pain.
Jorge Delgado, *Soroosh Mahboubi*
The Children's Hospital of Philadelphia, Philadelphia, (United States)

Purpose-Objective. To describe the prevalence of incidental findings (IF) detected on CT performed for appendicitis in children.
Material and methods. Following IRB approval, 165 children (82 M, 86 F), mean age 12.13 years (2.46–17.98) were reviewed and subdivided by age-groups. Cases with diagnosis of appendicitis were divided into perforated/non-perforated. The IFs were categorized into benign anatomic variants, benign pathologic findings and pathologic findings requiring work-up (PRWU). Correlations between groups were calculated using Spearman test.
Results. 77 IFs were found in 57/165 children. IFs happened in 3/10 preschoolers (>2–≤5 year), 21/64 middle childhood (MC) (>5–≤12 year) and 33/91 adolescents (>12–≤18 year). Findings were classified as benign anatomic variants in 12/57, benign pathologic findings in 30/57 and PRWU in 15/57 cases. PRWU were lower in patients with appendicitis, 2/13 (15.3%) vs. no appendicitis, 13/44 (29.5%) but were not statistically significant ($p=0.3$). Diagnosis of appendicitis was positive in 72/165 cases. Dividing by age-groups, preschoolers were positive for appendicitis in 9/10, MC in 37/64 and adolescents in 26/91 cases. Perforated appendix was found in 6/9 preschoolers (66.6%), 12/37 MC children (32.4%) and 2/26 adolescents (7.7%). Significant correlation was found between younger age and higher incidence of perforated appendix ($p<0.001$).
Discussion and conclusions. IFs are common at CT in children referred from the ED for evaluation of appendicitis. The severity of IF was not correlated to the absence/presence of appendicitis. The incidence of perforated appendix is higher in younger than in older children.

076 – SP

Cystic and solid lesions of the spleen in pediatric patients
Annamária Márczé, Mária Polovitzer, Diána Molnár, Zoltán Harkányi
Heim Pál Children's Hospital, Budapest, (Hungary)

Purpose-Objective. Cystic or solid splenic lesions are relatively rare in pediatric patients compared to adults. Focal splenic lesions are usually detected by US or CT examination, often incidentally. The objective is to review the differential diagnosis of these pathologic processes and to present some of our cases.
Material and methods. In the past 5 years, eight pediatric patients (4 female and 4 male patients, aged between 3 months and 15 years)—having different histological entities of the spleen were discovered by ultrasonography — were selected retrospectively. Most lesions were discovered incidentally, except in one patient who experienced heavy left upper quadrant pain. CT, MR and CEUS examinations were performed to clarify the pathologic conditions and were compared to sonographic findings.
Results. Simple and posttraumatic cysts, lymphoma, abscesses, hamartoma occurred in our patient material. Various other cystic and solid splenic lesions can also be listed in the differential diagnosis, such as epidermoid cyst, hemangioma cavernosum, hamartoma, granulomatosis, fungal abcesses, infarction and primary neoplasms.
Discussion and conclusions. To differentiate and characterize focal splenic lesions a contrast enhanced examination should be performed with US, CT or MR following native US, in equivocal cases still guided biopsy is necessary. Beside the imaging studies, the knowledge of detailed case history is indispensable in order to establish correct differential diagnosis.

077 – LP

Heterotaxy syndromes and abnormal bowel rotation.
Beverley Newman, Raji Koppolu, Daniel Murphy, Karl Sylvester
Lucile Packard Children's Hospital at Stanford University, Stanford, (United States)

Purpose-Objective. To investigate imaging of malrotation in heterotaxy with surgical correlation.
Material and methods. Retrospective review of children with heterotaxy (1991–2012) from a cardiology institutional database. Images of children with upper gastrointestinal (UGI) and/or small bowel follow through (SBFT), including appropriate CT/MR, were re-reviewed and compared with original reports and surgical findings.
Results. 16/31 (12M, 4F; 8 right, 8 left isomerism) underwent UGI (age 1 day–5 mths), 11/16 also SBFT. 3/16 agreed as normal. One additional originally called normal and 12/16 abnormal; 9 malrotation, 3 nonrotation. On re-review, together with CT (9) and MR (1) correlation, 13/16 GI studies were called abnormal; 6 malrotation, 7 nonrotation. Mesenteric length in 5 (nonrotation) was designated as long, 5 short and 3 indeterminate (cecal position uncertain). Although visible on CT/MR, bowel rotation features were not included in original interpretation. Seven children had elective bowel surgery. No surgery in 3 normals, 3 nonrotation, 1 discrepant GI/CT findings, 1 malrotation and 1 who died of other causes. Surgeon reported nonrotation in 4/7 and malrotation in 3; discrepant (nonrotation at surgery, malrotation on imaging) with 4 original interpretations and 2 re-reviews.
Discussion and conclusions. Abnormal bowel rotation is common in heterotaxy, all children should undergo early UGI and SBFT studies. Cross-sectional imaging can contribute diagnostically; bowel and mesenteric vessels should be specifically included in evaluation. Nonrotation versus malrotation should be carefully assessed to identify appropriate surgical candidates.

078 – SP

The effect of gadoxetate disodium on the accuracy and confidence of diagnosis in pediatric liver MRI
Amy Kolbe, Daniel Podberesky, Bin Zhang, Alex Towbin
Cincinnati Children's Hospital Medical Center, Cincinnati, (United States)

Purpose-Objective. Gadoxetate disodium (Eovist/Primavist) has been shown to improve the diagnostic accuracy and confidence of MR diagnosis of liver tumors in adults. The objective of this study was to determine if the same held true in pediatric patients.
Material and methods. A retrospective study was performed evaluating all liver MRIs performed with a hepatocyte-specific contrast agent between September, 2010 and August, 2012. Each MRI was duplicated so that one copy contained all sequences including the hepatocyte-phase of imaging and the other copy contained all sequences except the hepatocyte-phase. The two copies were randomized and the studies reviewed in a blinded fashion. For each study, the reviewers recorded the diagnosis and the confidence in diagnosis. Final diagnoses were compared to histopathology (in 52 available cases) to determine the accuracy of diagnosis.
Results. 112 patients were imaged with the hepatocyte-specific contrast agent and 224 studies were evaluated. There was no difference in the accuracy of the diagnosis between the two studies ($p=0.617$); however, the reviewers' confidence in diagnosis significantly increased with inclusion of the hepatocyte-phase of imaging ($p=0.0003$).
Discussion and conclusions. While gadoxetate disodium did not improve the ability to detect or characterize pediatric liver lesions, it did increase the radiologists' confidence in diagnosis. The improved confidence may help to prevent biopsy of benign tumors such as focal nodular hyperplasia. Further research with this agent is indicated.

079 – LP

The role of Magnetic Resonance Imaging (MRI) in the management of post-traumatic pancreatic pseudocysts in children
Tanyia Pillay, Tracy Kilborn, Sharon Cox
Red Cross War Memorial Children's Hospital, University of Cape Town, Cape Town, (South Africa)

Purpose-Objective. Pancreatic damage occurs in 3–12% of children with blunt abdominal trauma. The most important complication is the development of pseudocysts due to duct injury. The clinical course is unpredictable with spontaneous resolution in 30–50% however rupture, haemorrhage, infection and maturation occur in up to 70%.
Material and methods. 6 cases of high-grade pancreatic injury that developed pseudocysts have been seen at our institution since 2008. All patients were managed conservatively and had MRI scans between 2.5 and 6 weeks post injury to assess suitability for drainage.
Results. This study assesses the use of MRI in predicting the need for drainage, the role of MRCP in defining the ductal injury and the optimal sequences to define pseudocyst boundaries.
Discussion and conclusions. Our findings have led to a change in protocol at our hospital. High resolution MRI complements ultrasound and is the recommended imaging prior to possible surgical intervention. • 3 mm High resolution T2 sequences are more useful than MRCP. • Total imaging time is approximately 15 min. Surgical management is most commonly pseudocystgastrostomy therefore pseudocyst wall thickness and relationship to

stomach are the most important findings to be conveyed to the surgeon.

080 – SP

The incidence of clinically silent malrotation detected on barium swallow examination in children

Moti Chowdhury, Karen Atkin
Royal Children's Hospital, Melbourne, (Australia)

Purpose-Objective. Duodenojejunal flexure (DJF) orientation is often examined routinely during contrast swallow studies, including those performed for purely oesophageal/thoracic queries. We examine the incidence of malrotation and excess radiation burden in patients undergoing contrast swallow, without clinical suspicion for malrotation.

Material and methods. 218 consecutive contrast swallow studies were reviewed. Patients whose history may potentially suggest malrotation were identified (n=90), and remaining children grouped based on whether DJF was examined (Group 1; n=88) or not (Group 2; n=40). Data extracted include demographics, radiographic parameters (dosage, screening time, number of images obtained), and examination findings. Outcome measures comprised (1) prevalence of clinically incidental malrotation, (2) influence of additional evaluation of DJF on patient dosage (mean±SEM).

Results. Malrotation was identified in 2/90 patients (2.2%) examined with clinical indications for possible malrotation, but none in Group 1 (13% already had normal DJF confirmed on previous examinations). Groups 1 and 2 were comparable with respect to age and gender (p=ns). Additional evaluation of DJF (Group 1) incurred 54% more images (48.5±2.9 vs. 31.4±3.4 images in group 2; p=0.0002) and 24.9% increased screening time (130.8±9.3 vs. 104.7±13.0 s in group 2; p=0.089), resulting in 32.6% increased patient dosage (1.36±0.21 vs. 1.02±0.16 microGym2/kg in group 2; p=0.19).

Discussion and conclusions. Screening DJF position in studies without clinical suspicion of malrotation has no yield, whilst increasing radiation exposure, and is therefore not recommended routinely.

Foetal/Neonatal

081 – LP

Prenatal ultrasound and magnetic resonance findings in periventricular nodular heterotopia

Eléonore Blondiaux [1], Chiara Sileo[1], Catherine Nahama-Allouche [1], Marie-Laure Moutard [2], Antoinette Gelot [3], Jean-Marie Jouannic [4], Hubert Ducou Le Pointe [1], Catherine Garel [1]

[1] Service de Radiologie, Hôpital Armand Trousseau, APHP, Université Pierre et Marie Curie, Paris, (France); [2] Département de Neuropathologie, Service d'Anatomie et Cytologie Pathologiques, Hôpital Armand Trousseau, APHP, Université Pierre et Marie Curie, Paris, (France); [3] Pôle de Périnatalité, Centre pluridisciplinaire de diagnostic prénatal de l'Est Parisien, Hôpital Armand Trousseau, APHP, Université Pierre et Marie Curie, Paris, (France); [4] Service de Neurologie Pédiatrique, Hôpital Armand Trousseau, APHP, Université Pierre et Marie Curie, Paris, (France)

Purpose-Objective. To describe on ultrasonography (US) and magnetic resonance imaging (MRI) the prenatal findings suggestive of periventricular nodular heterotopia (PNH)

Material and methods. This retrospective case series included fetuses referred for MRI and diagnosed with PNH, which were confirmed by post-natal MRI or autopsy. The type of PNH, associated ventriculomegaly and associated malformations were reported.

Results. 11 fetuses were included (9 females, 2 males) with a mean gestational age at diagnosis of 31 weeks' gestation (23–34). PNHs were small and diffuse (n=7), large and multiple (n=1) or single (n=3). A targeted US scan performed before fetal MRI missed the diagnosis in 4 cases [diffuse (n=1) and single (n=3)]. Another US scan performed after MRI diagnosed PNH in 2 of these 4 cases. Ventriculomegaly was present in 6 cases [uni- (n=4) or bilateral (n=2)]. All PNH appeared as nodules of intermediate echogenicity protruding into the ventricular lumen. In all cases of diffuse PNH, the frontal horns and bodies of the lateral ventricles displayed a square shape with irregular borders. Associated cerebral malformations were observed in 7 cases and included corpus callosum agenesis (n=4 with additional malformations in 2 cases) and retrocerebellar cyst (n=3).

Discussion and conclusions. PNH are underdiagnosed at prenatal US even on targeted scans. Indented ventricular borders on axial views and irregular square shaped lateral ventricles on coronal views are suggestive of PNH at prenatal US.

082 – LP

The Gini-coefficient: A new method to assess fetal brain development.

Adrian Viehweger [1], T. Riffert[2], B. Dhital[2], T. Knösche[2], A. Anwander[2], M. Bauer[3], H. Stepan[4], I. Sorge[1], W. Hirsch[1]
[1] Pediatric Radiology, University Leipzig, Leipzig, (Germany); [2] Max- Planck- Institute for Human Cognitive and Brain Sciences, Leipzig, (Germany); [3] Obstetrics, University Hospital Leipzig, Leipzig, (Germany); [4]

Neuropathology, University Hospital Leipzig, Leipzig, (Germany)

Purpose-Objective. Diffusion weighted imaging (DWI) becomes increasingly important in the assessment of fetal brain development. Here we present a new method which uses an economic concept, the Gini-coefficient, to describe the whole brain with one simple and intuitive measure, which can be used to assess the brain's developmental state.
Material and methods. Post-mortem fetal specimens are used for analysis. They are evaluated by DWI on a 3T scanner using 60 directions (0.7 mm isovoxel, b=1600). Constrained spherical deconvolution (CSD) is used as the local diffusion model. Fractional anisotropy (FA), apparent diffusion coefficient (ADC) and complexity (CX) maps are generated. On this basis, the Gini-coefficient is calculated as a developmental parameter. Developmental maps are generated with the R statistical software.
Results. The Gini-coefficient as calculated with the use of three diffusion parameters (FA, ADC, CX) correlates highly with age, the latter having been assessed by sonography and post-mortem MRI (R squared=0.61). Furthermore, so-called developmental maps are created from the diffusion data. They potentially allow for rapid detection of main cerebral pathologies.
Discussion and conclusions. The correct determination of fetal brain age is often elusive, and requires various diagnostic parameters, such as the degree of gyrification, to be evaluated correctly. The new concept of the Gini-coefficient based on diffusion MRI data together with developmental maps are a valuable addition to this range of parameters.

083 – SP

Fetal skeletal development: value of prenatal MRI

Erika Rubesova [1], Diego Jaramillo [2]
[1] Lucile Packard Children's Hospital at Stanford, Stanford, (United States); [2] Children's Hospital of Philadelphia, Philadelphia, (United States)

Purpose-Objective. Diagnosing fetal skeletal pathology requires understanding normal development. Histologically, advancing gestational age (GA) induces definition of metaphyseal border, physis, perichondral structures and ossification centers. We evaluated whether fetal MRI depicts these changes.
Material and methods. Retrospective multi-institutional study included 35 T2-weighted studies (1.5T, 3T) of fetal knees (20–40 weeks) without skeletal abnormalities. Distribution of GA: under 29 weeks, n=17; 29–34 weeks, n=15; over 35 weeks, n=3. We graded metaphyseal border as irregular, regular with subphyseal band, regular with straight border, or with zone of provisional calcification (ZPC). We assessed presence of physis; perichondrium; femoral, tibial ossification centers; femoral notching; patella.
Results. Irregular metaphyseal border was seen only before 24 (3/35) and well-defined ZPC only after 32 weeks (6/35). Before 28 weeks, we saw a subphyseal band (8/17); from 29 to 34 weeks, a single straight border (9/15). Better-defined metaphyseal border was associated with greater GA (p=0.04). Physeal presence characterized older fetuses (p<0.01), rarely seen before 28 (14/17) but always after 32 weeks. Bone bark was detected in 34/35 fetuses. Femoral ossification centers were seen always after 35 weeks, and tibial at 40 weeks. Mature notched femoral epiphysis was always detected after 32 weeks, a patella after 26 weeks.
Discussion and conclusions. Normal fetal knee MRI shows perichondral structures with progressive physeal and metaphyseal border differentiation. Ossification characteristics after 32 weeks resemble those of a newborn.

084 – LP

Prenatal diagnosis of renal anomalies: What is the value of fetal MRI?

Siobhan Flanagan, Erika Rubesova, Aristeo Lopez, Susan R. Hintz, Richard A. Barth
Lucile Packard Children's Hospital at Stanford, Palo Alto, CA, (United States)

Purpose-Objective. Diagnosis of bilateral renal abnormalities is important for patient counseling/management. However, prenatal ultrasound (US), the primary imaging modality, is not always sufficient to characterize subtle abnormalities. We evaluated the utility of fetal MRI compared to prenatal US for the diagnosis of renal abnormalities and its correlation with postnatal follow-up.
Material and methods. Under institutional IRB, we retrospectively analyzed 41 patients who underwent fetal MRI and same day US between 2006 and 2012 for various renal abnormalities. We reviewed fetal MRI blindly compared to US. We assessed for presence of cysts, morphology, position, and correlated the findings to postnatal US/MRI, VCUG and renal function.
Results. GA ranged from 20 to 37 weeks. In 19/41 cases MRI provided additional information compared to US on renal position, morphology and cysts. In 22/41 cases referred for cystic dysplasia, MRI detected cysts in the contralateral kidney not seen on US in 14/22. 2 cases of crossed fused ectopia were correctly diagnosed by MRI while missed by US. MRI diagnosed 5 duplex kidneys mischaracterized by US. Out of 30/41 patients with postnatal follow-up 15 had renal insufficiency, and 12/15 had

bilateral abnormalities on MRI where only 4/15 were detected by US.

Discussion and conclusions. Fetal MRI is superior to US for detection of important subtle renal abnormalities including cystic disease. Therefore, fetal MRI may improve patient counseling and management, and can assist in predicting postnatal outcome.

085 – LP

Renal arterial doppler findings in fetus with pelvis dilatation: a comperative study

Mehmet Burak Ozkan
Dr. Sami Ulus Women's and Children's Hospital, Ankara, Turkey

Purpose-Objective. To determine the effects of the changes in fetal renal pelvis dilatation with renal arter doppler parametres.

Material and methods. Prenatal sonographic fetal renal anteroposterior diameters of ≥4 mm in the second trimester, which persisted to ≥6 mm in the third trimester, were the inclusion criteria. Thirty-four fetuses which met the inclusion criteria were followed up with fetal renal arter doppler. The control group was composed of 100 fetuses with normal sonographic finding of renal diameter. Doppler examination was performed in the 24th, 32nd and 37th weeks. Fetal kidney interlober segments, fetal renal arteries and abdominal aorta peak systolic, end diastolic velocities, RI, PI values were measured in both two groups.

Results. In 21 fetuses, in which the renal pelvic AP diameter was greater than 7 mm in second trimester had high renal parencymal RI (RI=0.82–0.84). The renal artery S/D values in this group was (1.89+0.43). The control group had lower parencymal RI (0.64–69) and renal arter S/D (1.4+0.34) values compared to abdominal aorta.

Discussion and conclusions. This is the first publication that shows the fetal renal doppler parametres in persistent fetal renal APD. Fetal renal doppler examination should be a part of the routine in fetus examinations with persistent fetal renal APD.

086 – SP

Abdominal fluid-containing masses of the newborn: All you need to know

Costanza Bruno
Policlinico GB Rossi, Verona, (Italy)

Purpose-Objective. To offer a complete overview of the diagnostic hypotheses of the various fluid-containing masses which can be found in the neonatal abdomen.

Material and methods. The abdominal fluid-containing masses of the newborn can be divided into newly-formed masses (ovarian cysts, gastroenteric duplication cysts, choledocal cysts, cystic teratomas and renal cysts) and dilation of pre-existing hollow structures, these latter being either normal viscera (stomach, renal pelvis, ureter, bladder, uterine cavity) dilated because of a downstream obstacle or persistent embryological remnants as observed in cloacal and urogenital sinus malformations. For each abnormality drawings, schemes (also illustrating embryological origin when needed), the radiological images (ultrasound, magnetic resonance, contrast enema and voiding cystourethrography) necessary for a full description, and when useful surgical findings are provided.

Results. For each abnormality drawings, schemes (also illustrating embryological origin when needed), the radiological images (ultrasound, magnetic resonance, contrast enema and voiding cystourethrography) necessary for a full description, and when useful surgical findings are provided.

Discussion and conclusions. The finding of a fluid-containing mass is not a rare event in the evaluation of the neonatal abdomen. General radiologists should be confident with the main imaging findings in order to choose the pathway leading to a correct diagnosis.

087 – SP

Gestational landmarks of the immature brain - A sonographic study

Giulia Perucca [1], Martin Wurz[2], Katrin Klebermass-Schrehof[2], Manfred Weninger[2], Klara Vergesslich-Rothschild[2]
[1] ASO San Giovanni Battista, Torino, (Italy); [2] Medical University of Vienna, Vienna, (Austria)

Purpose-Objective. With a prospective series the purpose of this study was to establish sonographic landmarks of the infant brain in correlation to gestational age.

Material and methods. 60 patients without cerebral pathology (28 males, 32 females) between gestational age (GA) 23 to 34 weeks were examined with a standardized cranial ultrasound protocol. The patients were divided into 3 groups (group 1: 23–26 weeks GA, group 2: 27–30, group 3: 31–34). In addition, cranial ultrasound was performed in 10 healthy full-term infants (group 4: 38–40 GA). Following landmarks of the developing brain were specifically documented: depth of interhemispheric fissure and of Sylvian fissure; height of insula; width, height and depth of cerebellum; length and thickness of corpus callosum and height of cisterna magna. An ANalysis Of VAriance (ANOVA) was performed to identify mean differences between the various gestational age groups.

Results. Reference values for each landmark (mean/median) were derived in all 4 groups. Statistically significant changes between the various groups could be documented for all landmarks except the Sylvian fissure and the thickness of the corpus callosum.
Discussion and conclusions. Using a standardized ultrasound protocol with specific anatomic landmarks can provide distinct parameters of maturation of the infant brain correlating with gestational age. Thus, differentiation between normal and pathologic maturation can be identified.

088 – SP

Comparison of intestinal sonography and abdominal radiographs in a neonatal intensive care unit
Cicero Silva, Alan Daneman, Oscar Navarro, Rahim Moineddin, Daniel Levine, Aideen Moore
The University of Toronto and the Hospital for Sick Children, Toronto, (Canada)

Purpose-Objective. To better understand the various intestinal gas patterns on radiographs in patients in a neonatal intensive care unit by comparing the patterns with the spectrum of appearances on sonography and, secondly, to evaluate the ability of sonography to differentiate necrotizing enterocolitis (NEC) from other intestinal pathologies.
Material and methods. Institutional-review-board-approved prospective evaluation of sonograms and radiographs, by readers blinded to each other, to modality and to clinical information. Patients' charts reviewed by a third blinded reader were used as reference standard for diagnosis. Association was made between sonographic findings, radiographic intestinal gas patterns and diagnoses.
Results. 75 neonates/young infants were included, with gestational ages between 23 and 41 weeks. Sonographic abnormalities were present in patients with all—including normal—radiographic intestinal gas patterns. Absent intestinal perfusion and fluid collections on sonography (suggesting intestinal necrosis and sealed perforation) were only seen in patients with intestinal dilatation with elongation on radiographs. Separation of intestinal loops on radiographs was most commonly due to reasons other than intestinal wall thickening. Increased intestinal echogenicity or free fluid with echoes on sonography correlated with a diagnosis of NEC, whereas anechoic free fluid correlated with absence of NEC.
Discussion and conclusions. The different intestinal gas patterns on radiographs correlate with a spectrum of sonographic findings. There are sonographic findings that either strongly suggest NEC or argue against this diagnosis.

089 – LP

Non-invasive measurement of intracellular lipid in the neonatal liver by Magnetic Resonance Spectroscopy
Laurence Abernethy [1], Mark A Turner[2], Colin Morgan[2], Alexander P Murphy[2], Valerie Adams[3], Graham J Kemp[3]
[1] Alder Hey Children's Hospital, Liverpool, (United Kingdom); [2] Liverpool Women's Hospital, Liverpool, (United Kingdom); [3] Magnetic Resonance and Image Analysis Research Centre, University of Liverpool, Liverpool, (United Kingdom)

Purpose-Objective. Magnetic Resonance Spectroscopy (MRS) is a non-invasive method to quantify liver lipid. The purpose of this study is to investigate the feasibility of MRS for measurement of intracellular lipid in the neonatal liver.
Material and methods. Liver MRS was performed on 48 newborn babies within 4 weeks of full term equivalent age, during natural sleep following a feed, on a 3T Philips Achieva XL MRI scanner. Single voxel proton spectroscopy was performed from two liver voxels measuring 10×10×10 mm. Duplicate measurements were performed on 2 subsets of infants (n=14) for estimation of intra-observer and inter-observer agreement. Analysis was performed using the AMARES algorithm in jMRUI 3.0 to calculate the triglyceride:water ratio.
Results. Satisfactory spectra were obtained, with good signal to noise characteristics. The mean triglyceride:water ratio was 0.42 (range 0–2.43), much lower than in older children and adults (normal range <5). There was good intra-observer and inter-observer agreement, excluding very low values below the threshold for accurate quantification (<0.2). There was a small but statistically significant difference between the right and left lobes (right=0.46, left=0.39, p=0.03).
Discussion and conclusions. MRS at 3T can be used successfully for non-invasive measurement of triglyceride:water ratio in the neonatal liver. This is a potentially valuable technique to evaluate adiposity, nutritional status and hepatotoxicity in vulnerable infants.

090 – LP

Postmortal imaging in unknown death newborn - to bring light into the dark
Katja Glutig [1], Uwe Schmidt, [2], Christine Erfurt, [2], Gabriele Hahn, [3]
[1] University Child and Youth Clinic, Dresden, (Germany); [2] Institut of Legal Medicine, Dresden, (Germany); [3] Department of Pediatric Radiology, Technical University, Dresden, (Germany)

Purpose-Objective. The aim of our study was to describe the need for a standardised imaging before autopsy in the case of an unclear child death. Can combination with a traditional radiographic skeletal overview imaging, multislice computertomography (MSCT) and magnetic resonance imaging (MRI) provide additional important information of the death circumstances of the child to the legal doctor?
Material and methods. In the period between March 2005 until September 2012, 38 dead children were examined. 37 x-ray skeleton overview admissions, 34 MS-CT and in five cases MRI of brain and spine were carried out. Retrospectively all investigations were evaluated by two experienced child radiologists regardless of each other.
Results. The skeletal overview admissions show pathological findings in 6 cases (15.8%): for example fractures of rib and skull and two children had no air in the lung and in the stomach. In the MSCT 18 cases showed a pathology (33.3%): signs of infection, pneumonia, otitis media, pulmonary interstitial emphysema (PIE), fracture, bleeding. Remarkable intracranial and intraspinal bleeding findings could be proved in the MRT (7.9%).
Discussion and conclusions. In case of unclear child death skeletal overview x-ray imaging in combination with MSCT and MRI before the legal-medical autopsy can give enhanced diagnostic information. MSCT can illustrate whether the child was liveborn. The detection of pulmonary interstitial emphysema (PIE) proves suffocation as a cause of neonate death.

091 – SP

Routine perinatal post mortem radiography: is it still worth it?
Owen Arthurs, Alistair Calder, Andrew Taylor, Neil Sebire
Great Ormond Street Hospital, London, (United Kingdom)

Purpose-Objective. Skeletal radiography is routinely performed following fetal death or still birth, to diagnose rare skeletal dysplasias and detect unsuspected bone abnormalities. However, as most significant abnormalities are now detected antenatally, the additional yield of radiography is likely to be low. In this study we reviewed our practice of PM skeletal radiography to assess its current yield and cost effectiveness.
Material and methods. We retrospectively evaluated all perinatal post mortem radiography (AP & lateral babygrams) performed over a 2.5 year period (2010–2012) at our institution. We compared the antenatal history with paediatric radiology reports and the post mortem findings.
Results. 74/739 cases (10%) performed over this period were abnormal. Of these 74, 41 were clinically indicated, and 36/41 (87%) were diagnostic or contributed new findings. Of 33 cases not clinically indicated, only 2 radiographs yielded unexpected findings (2/33=6%). Overall, 705/739 cases (95.4%) were normal or non-contributory.
Discussion and conclusions. Our study confirms a low yield of post mortem radiography. By stopping routine radiography, only 2/739 (0.2%) of cases would have been missed, but this would represent a 90% cost saving on current practice. At our institution, we propose replacing routine perinatal post mortem radiography by selected post mortem CT in suspected abnormalities, to test whether this increases the diagnostic yield.

Musculoskeletal

092 – LP

Neonatal hip dysplasia:factors predicting need for treatment in selected populations
Alastair Graham Wilkinson, Sally Wilkinson
Royal Hospital for Sick Children, Edinburgh, (United Kingdom)

Purpose-Objective. Risk factors for hip dysplasia are many and of uncertain value. They may be different depending upon population selection. Aim: To clarify which factors are associated with need for treatment in the subpopulation of babies referred following primary clinical screening.
Material and methods. 1450 babies (968 female and 482 male) of mean age 8.3 weeks were referred to a treatment centre for ultrasound to determine need for treatment between 2007 and 2012. The stated clinical information on ultrasound requests was reviewed and compared with treatment decision.
Results. Overall 14.3% of babies were treated, 175 females and 33 males. Factors which were associated with a higher treatment rate than this were neonatal instability and position of comfort with extended hips. In the subpopulation referred by the expert physiotherapist 18.6% babies were treated, with higher proportion in babies with neonatal instability, asymmetric groin creases and extended hips. In the subpopulation referred by general practitioners only 2.4% were treated with higher proportion of babies with instability, and not moving the leg properly.
Discussion and conclusions. Traditional risk factors of family history, breech presentation and oligohydramnios are not associated with higher treatment rates in selected populations. Findings on clinical examination are of paramount importance and depend on the age of the baby and the expertise of the examiner.

093 – LP

Selective ultrasound screening for developmental dysplasia of the hip in newborns: Effects on registered prevalence, treatment, follow-up and late detected cases. Preliminary results

Lene Bjerke Laborie[1], Kari Brurås[1], Henrik Davidsen[1], Stein Magnus Aukland[1], John Asle Bjørlykke[1], Trond Markestad[2], Hallvard Reigstad[2], Kari Indrekvam[3], Lars Birger Engesæter[3], Karen Rosendahl[1]
[1] Department of Radiology; [2] Department of Paediatrics; [3] Department of Orthopaedic Surgery; Haukeland University Hospital, Bergen, Norway

Purpose-Objective. To assess the effect of selective ultrasound screening on prevalence and management of Developmental Dysplasia of the Hip (DDH)
Material and methods. During 1991–2007, ultrasound screening for DDH was offered after clinical examination at age 1–3 days to newborns at increased risk, i.e. clinical hip instability, breech presentation, family history of DDH and/or congenital foot deformities, at the region's only delivery unit. Severe sonographic dysplasia and/or dislocatable/dislocated hips were treated immediately with abduction splints while mild dysplasia was followed sonographically until spontaneous resolution or until treatment was started due to lack of improvement. All children were older than 5.5 years at the end of the study. The Regional Ethics Committee approved the study.
Results. Of 81564 newborns, 11538 (14%) had ultrasound. 2430/81564 (3.0%) received early treatment; 1879/81564 (2.3%) from birth and 551/81564 (0.7%) after initial watchful waiting. Another 2711/81564 with mild DDH (3.3%) were followed from birth until spontaneous improvement. 899 low-risk and 32 increased-risk babies were referred late (after 4 weeks of age), of whom 152/81564 (0.2%) were treated; 26/81564 (0.3 per 1000) had dislocatable/dislocated hips. In total 7/81564 (0.09 per 1000) children, four early and three late treatments, developed avascular necrosis (AVN) of the femoral head.
Discussion and conclusions. Sixteen years of a well-established selective ultrasound screening-program for DDH resulted in acceptable rates of early treatment and follow-ups, and low rates of late dislocatable/dislocated hips and of AVN.

094 – SP Withdrawn

095 – SP Withdrawn

096 – SP

Prevalence and relevance of pediatric spinal fractures in suspected child abuse

Ignacio Barber Martinez de la Torre, Jeannette Perez-Rossello, *Paul K. Kleinman*
Boston Children's Hospital, Boston, (USA)

Purpose-Objective. To establish the prevalence of spinal fractures detected on skeletal surveys for suspected child abuse and their association with intracranial injury.
Material and methods. This retrospective study was IRB approved. The ACR standardized initial and follow up skeletal surveys and neuroimaging studies of 520 patients (age 0–4 years; mean, 8 months) acquired from July 2005–July 2010 were reviewed. A positive skeletal survey was defined as having one or more unsuspected fractures.
Results. Eleven patients (age 0–3 years; mean, 14 months) had 16 spinal fractures, all but one involving the vertebral bodies. This constituted 2.1% (11/520) of the total population and 10.7% (11/102) of patients with a positive skeletal survey. Fracture levels ranged from T3-S3; T12 was the most common fracture site ($n=3$). Clinically unsuspected skeletal injuries were seen in 6 patients. In 63% (7/11) the spinal fractures were accompanied by intracranial injury. In the five cases where the spinal fracture was the only positive skeletal finding, 60% (3/5) had intracranial injury. Patients with spinal fractures were at significantly greater risk for intracranial injury than those without spinal injury ($p<0.05$).
Discussion and conclusions. Spinal fractures are not rare in patients with positive skeletal surveys. They may be the only indication of skeletal trauma and are associated with intracranial injuries. The standard skeletal survey should include lateral views of the spine to ensure adequate assessment of these injuries.

097 – SP

Controversy in neonatal hip dysplasia: Graf type 1 hips may be abnormal and need treating

Alastair Graham Wilkinson, Sally Wilkinson
Royal Hospital For Sick Children, Edinburgh (United Kingdom)

Purpose-Objective. Graf type 1 hips with alpha angle of more than 60° are often considered normal. Our experience suggests that this is incorrect and these hips may require treatment. Aim: To assess how many of the babies undergoing treatment with Pavlik harness in our centre have type 1 hips.
Material and methods. First ultrasound examinations in our centre of 279 babies at mean age 5.3 weeks (range 1.4–12.6) treated between 2007 and 2013 were reviewed. All examinations were performed by a single operator. Stability, morphological features and alpha angles were recorded prospectively.

Results. Of these 279 babies 43 (15.4%) had alpha angle of more than 60° in both hips. Of the 86 hips 19 (22%) were unstable and 8 (9%) were lax. Notching of the acetabular margin was noted in 17 (16%) hips and flattening of the femoral head in 17 (20%).
Discussion and conclusions. Normal acetabular angle does not ensure a normal hip. Instability and morphological warning signs may indicate the need for treatment.

098 – SP

Is there a role for MRI in patients with slipped capital femoral epiphysis ?
Anca Tanase, Marianne Alison, Nathalie Mutuza, Cindy Mallet, Keyvan Mazda, Guy Sebag, Brice Ilharreborde
Robert Debre Hospital, Paris, (France)

Purpose-Objective. Surgical treatment of SCFE remains controversial. In situ fixation leads to residual deformity, whereas corrective procedures can lead to femoral head osteonecrosis. Anterior wedge osteotomy without hip dislocation is a new corrective surgical alternative. Our aim was to determine the role of MRI in guiding treatment and monitoring surgical results.
Material and methods. In 25 patients (14 boys, 11 girls) with severe (slip angle >45°) unstable SCFE, anatomic and dynamic contrast-enhanced subtraction MRIs were performed before and 3 months after surgery with anterior wedge osteotomy. Mean follow up was 1 year. Morphology, severity of slippage, signal abnormalities and femoral head vascularization were assessed.
Results. Five patients had bilateral involvement: 30 hips were included. SCFE was chronic in 13 cases, acute-on-chronic in 12 cases and acute in 5 cases. Vascularization was normal/increased before and after surgery in 27 hips. Avascular femoral head was present at diagnosis in 2 cases (post traumatic acute slip). After surgery, avascularization persisted in one case leading to osteonecrosis, whereas complete revascularization occurred 3 months later in the other case. One child developed a partial necrosis after surgery. No pre-slip stage was diagnosed on the contralateral side.
Discussion and conclusions. MRI provides useful information about femoral head vascularization in severe unstable SCFE. Although normal or increased vascularization was demonstrated in most cases, 12% of the patients presented pre or post operative avascularization.

099 – SP

Distal tufts of fingers 2–5 in Rubinstein-Taybi syndrome - new observations
Alan Oestreich
Cincinnati Children's Hospital Medical Center, Cincinnati, OH, (United States)

Purpose-Objective. In addition to the well-known short broad distal phalanx of thumbs in Rubinstein-Taybi syndrome (RTS), the other hand distal phalanges generally show broader than normal tufts and are short. This pattern is different from the broad tufts nearly universally seen in Turner syndrome, and is not pathognomonic for RTS. I review the vagaries of this pattern.
Material and methods. Selected hand radiographs of 210 RTS individuals were reviewed, as well as several cases of Turner (XO) syndrome and one hypopituitary short child.
Results. Short distal phalanges with broad tufts were observed in all RTS reviewed. These distal phalanges were all shorter than normal, especially those whose physes had prematurely fused. In Turner syndrome distal tufts were broad, but the phalanges were not short. Compared to the Turners, the RTS distal phalanx diaphyses were less narrow. One subject with hypopituitary growth hormone deficiency, not a known RTS, had the same pattern as RTS subjects. During the study, one RTS was prospectively diagnosed from distal phalanges 2–5 pattern alone.
Discussion and conclusions. The pattern of short distal hand phalanges with broad tufts without narrow diaphyses is strongly suggestive of RTS and differs from the broad tuft pattern of Turner syndrome. Seeing the pattern, one should then view thumbs and great toes for typical RTS patterns. One can suggest RTS prospectively from the digit 2–5 pattern alone.

100 – LP

MRI assessment of inflammatory activity and mandibular growth following intra-articular TMJ steroid injection in children with JIA
Nina Lochbühler [1], Rotraud K. Saurenmann[1], Lukas Müller[2], Christian J. Kellenberger[1]
[1] University Children's Hospital, Zürich, Switzerland; [2] Clinic for Orthodontics and Paediatric Dentistry, Zürich, Switzerland

Purpose-Objective. To assess whether steroid injection (STI) improves temporomandibular joint (TMJ) arthritis and restores normal mandibular growth in patients with juvenile idiopathic arthritis.
Material and methods. 33 consecutive children, aged 2–10 years (median 5.1y), with new MRI diagnosis of TMJ arthritis and consecutive STI were retrospectively studied. Intra-articular or extra-articular location of the STI (performed

without image guidance) was immediately checked with T2w-images. Inflammatory activity was scored (grades 0–3) on fat-saturated T2w and contrast-enhanced T1w-images initially and at follow-up MRI around 3 months after STI, and regularly after 6–12 months. Mandibular ramus length was measured on 3D-FSPGR projection images. Degree of inflammation and mandibular growth rates were compared between TMJs following extra-articular and intra-articular STI.

Results. TMJ inflammation improved in 56% of joints after intra-articular (n=76) compared to only 17% after extra-articular (n=57) STI, with mean inflammatory grades improving from 1.51 to 0.71 (p<0.001) and 1.33 to 1.21 (p=0.04), respectively. Whereas mean mandibular growth rates were normal (0.0068 mm/d) in TMJs without inflammation (n=7), they were reduced at the first and second MRI follow-up in inflamed TMJs following extra-articular (0.0046 mm/d; 0.0015 mm/d) and negative following intra-articular (−0.0042 mm/d,−0.0013 mm/d) STI (p<0.01). 12 TMJs (18%) with high cumulative intra-articular steroid doses developed progressive bony deformation and intra-articular ossifications.

Discussion and conclusions. Although intra-articular STI in TMJs reduce the inflammatory activity depicted on contrast-enhanced MRI, mandibular growth remains impaired and even appears to be negatively affected.

101 – SP

Is the degree of contrast-enhancement on MRI (ceMRI) a reliable criterion for the involvement of temporomandibular joints (TMJ) in children with Juvenile Idiopathic Arthritis (JIA)?

Thekla von Kalle [1], Peter Winkler [1], Tina Stuber [1], Toni Hospach [2]
[1] Pediatric Radiology Olgahospital Klinikum Stuttgart, Stuttgart, (Germany); [2] Pediatric Rheumatology Olgahospital Klinikum Stuttgart, Stuttgart, (Germany)

Purpose-Objective. To assess synovial thickening and the degree of contrast-enhancement in TMJ of children with JIA and compare them to reference data.

Material and methods. In dynamic ceMRI of 48 children with JIA (6.3–18 year, median 12.5 years) signal intensities (SI) were measured in relation to pre-contrast images. The thickness of the soft joint tissue (synovium and capsule) was assessed. Dynamic ceMRI of 46 children (1.6 to 18 years, median 9.1 years) who were examined for reasons other than TMJ disease served as references. The study is in accordance with requirements of our local ethics committee. Results. In children with JIA and thickened joint tissue maximum enhancement was on average higher than in children without JIA (SI ratios pre- to post-contrast: JIA 1.11, no JIA 0.73). However, intervals of 2 StD showed a wide overlap for both groups (JIA 0.20–2.021, no JIA 0.23–1.23). Only a minority of joints with synovial thickening had a degree of enhancement above +2StD (1.23) of the reference group. Ratios of JIA patients without synovial thickening were within the reference range.

Discussion and conclusions. ceMRI is mandatory to assess synovial thickening in TMJ. As in most of the joints with apparent synovial thickening the enhancement was within the reference range, the degree of contrast enhancement alone does not seem to be a reliable criterion for joint involvement in children with JIA.

102 – SP

Serial observations of apophyseal joint inflammation in adolescent patients with enthesitis- related arthritis and correlation with concurrent sacroiliitis.

Kani Vendhan [1], Tom Amies[2], Corinne Fisher[1], Debajit Sen[1], Yiannakis Ioannou[1], Margaret Hall-Craggs[1]
[1] University College London Hospital, London, (United Kingdom); [2] UCLH NHS Trust, London, (United Kingdom)

Purpose-Objective. To assess apophyseal joint inflammation on serial magnetic resonance (MR) scans in patients with enthesitis-related arthritis (ERA), and to correlate this with sacroiliitis.

Material and methods. We recently described apophyseal joint inflammation in 39% of 62 ERA patients attending our adolescent rheumatology clinic. In the current study, serial contrast-enhanced MR scans of the lumbar spine and sacroiliac joints in 29 of these patients were reviewed. Apophyseal joint inflammation was scored from 0 to 3 (0 being normal, 3 being synovitis + bone marrow oedema). Sacroiliitis was graded stable, improved, deteriorated, or mixed (some regions improving and others deteriorating).

Results. Seventy scans in 29 patients were reviewed. Scan intervals (first to last) were 3 months to 4years 10 months. There were between 2 and 4 scans for each patient. Age range of patients was 8.3 year to 20.9 year. Apophyseal joint inflammation was present in 15/29 patients; of these 14 had concurrent sacroiliitis. Nine of 15 were on disease modifying anti-rheumatic drugs, 3 on anti-TNF therapy, and 3 on NSAIDs. In 6/15 the apophyseal synovitis and sacroiliitis moved together (both became either better or worse). In 9/15 patients the apophyseal synovitis and sacroiliitis moved independently; apophyseal inflammation deteriorated with stable or improving sacroiliitis.

Discussion and conclusions. There can be differential response of apophyseal joint synovitis and sacroiliitis to therapy. This may account for deteriorating pain in the presence of improved sacroiliitis.

103 – LP

Prevalence of capitellar OCD in chronic radial head subluxation and dislocation

Delma Jarrett, Paul Kleinman
Boston Children's Hospital, Boston, MA, (United States)

Purpose-Objective. To determine the prevalence of capitellar osteochondritis dissecans (OCD) in children with chronic radial head subluxation (RHS) or dislocation (RHD).
Material and methods. We searched radiology reports from 1/1/04 to 10/1/12 for patients <19 years old with RHS/RHD. Cases of skeletal dysplasia, intra-articular pathology, fracture of the capitellum, longitudinal deficiency of the radius or radioulnar synostoses were excluded. Images and records were reviewed to determine etiology of RHS/RHD, extent and direction of subluxation/dislocation, and presence of OCD. Difference in prevalence of OCD in patients with RHS versus RHD was calculated using the Fisher exact test.
Results. 162 instances of RHS/RHD were found in 134 patients. Etiologies were: congenital/developmental (99), post traumatic (31), chronic of uncertain etiology (4). 42 RHS, 118 RHD, and 2 unknown status post radial head excision. 14/162 (6%) cases had capitellar OCD. Etiology was congenital/developmental in 8/14 (57%), post traumatic in 6/14 (43%). Relative prevalence of OCD in RHS (13/42= 31%) and RHD (0/118=0%) was statiscally significant ($p<$ 0.0001). In 1 case, position of the radial head was unknown since imaging was following radial head resection.
Discussion and conclusions. Capitellar OCD is common in patients with chronic RHS and the prevalence is significantly greater than with RHD. This supports abnormal radiocapitellar mechanics as the etiology of OCD in this context.

104 – LP

Challenges and nuances of infant brachial plexus sonography following nerve injury: direct and indirect findings.

Michael DiPietro, Lynda Yang
University of Michigan, Ann Arbor, Michigan, (United States)

Purpose-Objective. To describe the challenges of learning and using direct and indirect sonographic assessment of the injured brachial plexus.
Material and methods. 36 children with birth related brachioplexopathy from 2006 to 2012. 18 males, 17 females; 2.5–59 months, mean 7.6 months, median 5 months. 35 children were studied by a single pediatric radiologist over 83 months. Bilateral sonography included: Direct nerve evaluation—intracanalicular, at neural foramina, between and beyond scalenes; Indirect evaluation via rhomboid and serratus anterior for atrophy and diaphragm for phrenic nerve injury.
Results. Interscalene and supraclavicular regions were evaluated in all patients. 35 exhibited echogenic interscalene traction neuromas of assorted size and extent. Its peripheral extension toward the clavicle influenced surgical planning, otherwise size per se did not. Labeling which roots and trunks were encased was sometimes difficult. In 17 cases enlarged root(s) were identified exiting neural foramina. Cervical spinal canal was studied in 27 patients. Intracanalicular pseudomeningoceles were not apparent on sonography even with clear cervical canal visualization. 7 of 25 patients had rhomboid atrophy indicating proximal C5 root injury. 9 of 21 had serratus anterior atrophy innervated by long thoracic nerve (C5,C6,C7). No phrenic nerve palsy was identified in all 33 patients in whom diaphragm motion was studied.
Discussion and conclusions. Root and trunk identification was more difficult to appreciate than muscle atrophy, although with experience it was sometimes quite detailed and specific.

105 – SP

Imaging features of juxtacortical (periosteal) chondroma in children

Stephen Miller
St. Jude Children's Research Hospital, Memphis, (United States)

Purpose-Objective. To present the imaging findings of juxtacortical (periosteal) chondroma, a rare benign and often misdiagnosed bone lesion in children. Diagnostic features and appropriate differential possibilties are discussed.
Material and methods. Retrospective review of the radiology information system (RIS) yielded seven patients with the confirmed diagnosis of juxtcortical (periosteal) chondroma who were seen and treated at our institution from 1998 to 2012. Clinical and demographic data were reviewed. Plain radiographs, CT, and MRI studies were reviewed by a senior pediatric radiologist.
Results. Seven patients with juxtacortical (periosteal) chondroma were identified. There were five boys and three girls, ages 6–16 years (mean=12.3 years). All presented with mild pain and a palpable mass. Six lesions were in long bones and one was in the scapula. Plain radiographs were availabie in 7/7, MRI in 7/7, and CT in 2/7 patients. Diagnostic features on plain radiographs and CT included: soft tissue mass based in periosteum with saucerization of underlying cortex, overhanging margins at the periphery of the mass, and adjacent sclerotic periosteal reaction.

Diagnostic features on MRI included: soft tissue mass hypo- to isointense to muscle on T1 and hyperintense to fat on T2/T2*, peripheral hypointense rim on T1/T2, and peripheral rim-like contrast enhancement.
Discussion and conclusions. Juxtacortical (periosteal) chondroma is a rare benign pediatric bone lesion. Recognition of diagnostic features on plain radiography and CT/MRI can lead to the proper diagnosis.

106 – SP

Bone vibration as a novel assessment of bone density in children.
Thomas Huggins [1],Amaka Offiah [2], Helga Razagh [2], Rezza Saatchi [2]
[1] University of Sheffield, Sheffield, (United Kingdom); [2] Sheffield Childrens Hospital, Sheffield, (United Kingdom)

Purpose-Objective. Bone fragility due to reduced bone density is an important factor to exclude when assessing suspected child abuse. DXA is the gold standard for assessing bone density. However this method is unreliable in children below 5 years. Vibration analysis can successfully identify materials of differing density and may be a cheap, non-invasive method for obtaining information on bone density in cases of suspected child abuse. We aim to test the hypothesis that vibration spectra from children's bones has a strong correlation with the density of those bones as measured by DXA.
Material and methods. Acquisition of vibration spectra from the tibiae and ulnae of 100 children aged 10 to 15 years presenting for DXA scans. Vibration spectra are obtained by impacting the bone(s); an oscilloscope records the frequency domains of resulting vibrations. Vibration spectra can then be correlated with aBMD and z scores as determined by DXA (correlation coefficient).
Results. We have preliminary results from turkey bones and vibration spectra from research staff confirming that higher density bones have a higher resonant frequency.
Discussion and conclusions. To further the work we will repeat the study with a motorised stimulus to induce vibration with a greater sample size. We will extend the age range to children below 10 and move towards collecting spectra analysis on children below 5.

Education/Miscellaneous

107 – LP

Current status of paediatric post-mortem imaging: a European questionnaire-based survey
Owen Arthurs [1], Rick van Rijn [1], Neil Sebire [1]
[1] Great Ormond Street Hospital, London, (United Kingdom); [2] Academic Medical Centre, Amsterdam, (The Netherlands)

Purpose-Objective. The use of post mortem imaging, including skeletal radiography, CT and MRI, is rapidly increasing, in part compensating for the decline in parental acceptance of conventional autopsy techniques. Recent UK government documents encourage the development of clinical guidelines and national standards, particularly with the introduction of cross-sectional techniques. Via the ESPR, we want to generate international standards and comprehensive clinical guidelines for post mortem imaging, and to develop a quorum of interested parties who wish to participate in multinational studies. To begin with, for this study, we surveyed ESPR members to assess the current status of practice.
Material and methods. Questionnaires were emailed to European paediatric radiologists via the ESPR, who were asked about the current service provided. Direct questions about the level of paediatric radiology involvement in the service, the current techniques used, performance and reporting standards of imaging deceased children were asked.
Results. The online survey was performed in early 2013. The results are presented in full.
Discussion and conclusions. By assessing current post mortem imaging standards and willingness of ESPR members to join our group, we will initiate multi-national collaborations in order to take this valuable work forward.

108 – SP Withdrawn

109 – LP

Child life services in pediatric radiology: A randomized controlled trial
Johan G. (Hans) Blickman, Mary Tyson, Chelsea Pino, Constance White, Stephanie Lemke
Golisano Childrens Hospital, URMC, Rochester, NY, (United States)

Purpose-Objective. To assess the impact of a Certified Child Life Specialist (CCLS) in Pediatric Radiology in a randomized controlled fashion.
Material and methods. A randomized controlled trial in the Pediatric Imaging Department assigned patients from 1 to 12 years old to a control or child life intervention group. 137 children were included in the trial. Children undergoing MR (with and without anesthesia), CT (with and without sedation), fluoroscopy exams, X-Ray, ultrasound and nuclear medicine scans were included. Parent satisfaction, staff satisfaction, child satisfaction, parent perception of child pain and distress, and staff perception of child pain and distress were collected in survey form for both groups.

Results. Statistically significant differences ($p<.05$) were noted between the control and child life intervention groups. Key significant findings include higher overall parent satisfaction in the intervention group, higher ratings of the care for the emotional needs of the child in the intervention group, and lower parent and staff perception of child pain and distress. Staff reported significantly higher cooperation during the procedure in the intervention group. Children's ratings of fear were significantly lower in the intervention group.

Discussion and conclusions. These results provide empirical support for the implementation of child life services in pediatric imaging departments to improve parent satisfaction, staff satisfaction and department flow. Financial implications of these results are discussed.

110 – SP

Safety of gadobutrol in over 1,000 pediatric patients, preliminary analysis of the data from the GARDIAN study, a global multicenter prospective non-interventional study

Ravi Bhargava [1], Katja Glutig[2], Gabriele Hahn[3], Franz Wolfgang Hirsch[4], Christian Kunze[5], Hans-Joachim Mentzel[6], Juergen F Schaefer[7], Winfried Willinek[8], Petra Palkowitsch[9]

[1] Stollery Children's Hospital, University Of Alberta, Edmonton (Canada); [2] Children Center Dresden-Friedrichstadt, Dresden (Germany); [3] University Hospital Carl Gustav Carus Dresden, Pediatric Radiology, Dresden (Germany); [4] University Hospital Leipzig, Pediatric Radiology, Leipzig (Germany); [5] Martin-Luther-University Hospital Halle/Wittenberg, Pediatric Radiology, Halle (Germany); [6] University Hospital Jena, Pediatric Radiology, Jena (Germany); [7] University Hospital Tuebingen, Radiology, Tuebingen (Germany); [8] University Hospital Bonn, Radiology, Bonn (Germany); [9] Bayer Healthcare, Berlin (Germany)

Purpose-Objective. To determine the incidence of adverse events (AE) with intravascular administrations of gadobutrol, a non-ionic macrocyclic 1M gadolinium based contrast agent in pediatric patients.

Material and methods. 1,064 unselected pediatric patients (511 48% female, mean age=11.6±4.2 years) from a prospective study involving 17 countries were analyzed to determine type and frequency of AEs.

Results. This is the first study to report the safety of a MR contrast media in more than 1,000 pediatric patients in a routine setting. Only 8 of the 1,064 pediatric patients (0.75%) experienced at least one adverse event (AE). None of the events was considered serious: Two of the AEs were considered unrelated to gadobutrol; The rate of patients with at least one related AE was 0.56%. The two unrelated events were; difficulty in breathing in a 13 year old patient after 24 h and vomiting in a 5 year old patient after 15 min. The onset of AEs was within 5 min post-injection in 5 (83%) patients. One patient experienced an erythema at the injection site starting 10 min after the injection. All patients recovered completely from the AEs.

Discussion and conclusions. The rate of drug related AEs in over 1,000 pediatric patients for CE-MRI was very low with no serious event. The AE profile and pattern of gadobutrol in pediatric patients is similar to the adult patient population.

111 – LP

The SECURE study: Observational post-marketing study on the safety of gadoteric acid - Interim analysis on 1327 children

Jean-Pierre Pracros, Jacqueline de la Garanderie, Maud Cagneaux

Femme-Mère-Enfant Hospital, pediatric, fetal and gynecological imaging, Lyon, (France)

Purpose-Objective. To prospectively assess the safety profile of gadoteric acid and the overall incidence of nephrogenic systemic fibrosis (NSF).

Material and methods. A worldwide post-marketing study (PMS) is conducted to collect safety data in 40,000 patients (adults and children) with or without renal insufficiency who had routine contrast-enhanced magnetic resonance (MR) imaging using gadoteric acid (Dotarem®). For each patient, risk factors at inclusion, indications for MR imaging, and conditions of use of the contrast material are recorded. For any patient identified as renally impaired at the time of inclusion (i.e., estimated creatinine clearance or estimated glomerular filtration rate <60 mL/min/1.73 m^2), at least a 3-month follow-up is performed in order to detect any suspicion or occurrence of NSF.

Results. As of October 23, 2012, the cut-off date for the interim safety analysis, this ongoing PMS included data on 29689 patients out of which 1327 were children (mean age: 9.7 years; range: 0–17 years; male, 52.8%). MR examinations were mainly performed to image the central nervous system (>76%). The main risk factors were central nervous system disorders (20.1%) and allergies (6.0%). No adverse events were observed. Moderate to severe impaired renal function was reported in 2 children (0.2%). No suspicion of NSF was notified.

Discussion and conclusions. This interim safety analysis confirms the very good safety profile of gadoteric acid in children.

112 – SP

Potential for CT-dose reduction in pediatric CT by automated exposure control (AEC) software (CareDose4 D)

Doris Zebedin, Michael Riccabona, Erich Sorantin, G. Stücklschweiger, H. Guss, Meinrad Beer
University Hospital of Radiology - Graz, (Austria)

Purpose-Objective. To evaluate dose reduction potential by AEC-modulation along all axes (CareDose4D), additionally adapting tube current for changed kV-settings (CarekV) in pediatric chest and abdominal CTs.

Material and methods. Dose was measured for infant, child, adolescent pediatric anthropomorphic chest and abdomen phantoms on a 128 row MDCT (Somatom Definition AS+, Siemens, Germany). The quality reference mAs was set to 65 for chest and 185 for abdomen in adolescent phantoms; and lowered by 10% for the child and by 20% for the infant phantoms. Additionally, CT-protocols based on fixed kV-values (80 kV, 100 kV, 120 kV) were compared with values from CarekV acquisitions with automatically adapted kV. Finally, dose for different detector collimation was assessed. In all studies, the dose length product was measured using a centrally positioned ionization chamber with 30 cm sensitive length.

Results. CT protocols with active CareDose4D reduced dose in infant and child abdominal phantoms by 70%, in abdominal adolescent phantoms by 40%; the dose reduction in the chest with CareDose4D was 85% in the infant, 80% in the child, and 60% in the adolescent phantoms. CarekV and thicker collimation only reduced dose to a lesser degree.

Discussion and conclusions. CareDose4D is the most effective way to reduce dose in pediatric chest and abdominal CTs.

113 – SP

The whirpool sign

Francesco Esposito [1], Maria Rita Panico[2], Michele Smaldone[2], Marco Catalano[2], Francesca Malacario[2], Patrizia Oresta[1]
[1] A. O Santbono, Napoli, (Italy); [2] Univeristà Federico II, Napoli, (Italy)

Purpose-Objective. To establish the role of the whirlpool sign (WS).

Material and methods. Patients who underwent sonography for acute disease between September 2011 and December 2012 were included in the study.

Results. The WS is seen when an vascular pedicle usually has a tortuous course creating the whirls. The torsion appears as a round hyperechoic structure with multiple concentric hypoechoic stripes, as a beaked structure with concentric low echoic stripes, or as an ellipsoid or tubular structure with internal heterogeneous echoes. Concentric low echoic intrapedicular structures could be identified as vascular structures by Color-Doppler (CD). It is seen in: Adnexal torsion, Splenic torsion, Midgut volvulus,Testicular torsion.

Discussion and conclusions. In adnexal torsion, the twisted vascular pedicle corresponds to the broad ligament, fallopian tube, and adnexal and ovarian branches of the uterine artery. In splenic torsion, the term "WS" is used to describe the vessels wrapping around the central axis at the splenic hilum. In volvulus, it is created when the superior mesenteric vein and the mesentery wrap around the superior mesenteric artery in a clockwise direction. In testicular torsion, the mass of torsion of the cord has the appearance of a doughnut, a target, a snail shell, or a storm on a weather map. In all cases, visualization is enhanced by the vascular signal at CD. In our initial experience, we noticed that WS is always associated with surgical diseases.

114 – SP

Fast-track care for pediatric patients with minor trauma of the limb: the leading role of radiologists

Paolo Maria Salvatore Schingo, *Andrea Magistrelli*, Teresa Corneli, Sebastian Cristaldi, Umberto Raucci, Paolo Tomà
Bambino Gesù Children's Hospital, IRCCS, Rome, (Italy)

Purpose-Objective. Minor traumas of the limb often wait for a long time for clinical and diagnostic examinations, especially in the flu-period. The aim of this project is to improve management of patients with minor trauma of the limbs by reducing waiting times and useless examinations.

Material and methods. From October to December 2012 all patients with minor limb trauma admitted to our emergency room (ER) were evaluated by radiologists who collected clinical information, performed physical examination and decided the most appropriate imaging modality. Access/discharge time of each patient was recorded. Results from this fast-track (FT) group were compared to results from a control group admitted to ER in the same period of 2011.

Results. The data obtained from the comparison between the two periods demonstrate a reduction in the overall time management (assessment, diagnostics, discharge) of patients with minor injuries of the limbs from an average of 2 h and 32 min to 1 h and 49 min (39%) without affecting the flow of patients referred to the ER for other conditions, even more complex ones.

Discussion and conclusions. FT care for limb fractures optimizes the diagnostic work-flow and decreases overall length of care. FT care may also decrease the workload in emergency rooms, providing more time for other patients.

115 – SP

A new microbolus-technique (MB-T) for CTA in babies and toddlers

Erich Sorantin, Manos Amanakis, Sabine Weissensteiner
Medical University Graz, (Austria)

Purpose-Objective. Due to new volumetric CT data acquisition, rapid circulation time a saline push for reduction of streaky artefacts in mediastinal veins caused by Iodine injection is nearly impossible in children. New power injectors allow the mixture of physiological saline and Iodine-based intravenous contrast media. The aim of the paper is to present a new MB-T for CTA, which allows reduction/elimination of venous artefacts. Additionally the amount of Iodine can be reduced too.
Material and methods. 10 CTAs were performed in 9 children aged 1–23 months (11.3+−8.2) on a volume scanner with 80 kV and automated exposure control. 300 mg/ml Iodine was diluted at a ratio of 2:1 at an injection rate of 2 ml/s, bolus tracking threshold was set to 400HU. Venous artefacts and overall image quality were rated at a four point scale. Additionally vessel enhancement was measured.
Results. Iodine volume ranged from 3 to 10 ml (8.3+−2.2), no artefacts were present in 6 CTAs, minor in 2 and moderate in 2. Image quality was rated as excellent in 3 CTAs, good in 5 and acceptable in 2. Aortic arch peak enhancement of 464.8±245.31HU could be measured, whereas one of 488.0±335.04 HU within the main pulmonary artery.
Discussion and conclusions. MB-T in paediatric CTA allows effective venous artefact reduction and maintaining image quality in 80%. As a side effect Iodine volume could be minimized considerably, thus minimizing side effects.

116 – SP

Imaging Epstein-Barr virus - The radiology of Post-transplant lymphoproliferative disorder (PTLD) in solid organ transplantatiom.

Tom Watson, David Hatch, Stephen Marks, Rachel Adams, Alistair Calder, Persis Amrolia, Oystein Olsen, Catherine Owens
Great Ormond Street Hospital for Children NHS Foundation Trust, London, (United Kingdom)

Purpose-Objective. A review of imaging findings in patients with PTLD from a large international transplant centre performing renal (21–36 per year), heart (15–20), lung (5–10) and allograft bone marrow transplants (300). We describe the varying radiological appearances and the often dramatic response to new and conventional therapies. We suggest an imaging algorithm for PTLD, according to clinical features and the allograft.
Material and methods. A retrospective review of radiology in PTLD.
Results. 22 patients were included: 8 (36%) post-renal transplant (4 cadaveric, 3 live related and 1 live non-related), 5 (23%) post-heart transplant, 7 (32%) post-lung transplant, 1 (5%) following heart and lung transplant and 1 (5%) post-small bowel transplant (performed elsewhere). GI tract involvement was most common (10 cases (45%)). In our 8 lung transplants, the allograft was involved in 4 (50%). A dramatic radiological improvement was often seen following monoclonal antibody therapy.
Discussion and conclusions. Imaging plays a key role in diagnosis and therapeutic response monitoring in PTLD. We suggest that all lung transplant patients presenting with high EBV titres require contrast-enhanced chest CT and abdominopelvic ultrasound at the outset. In patients with specific GI symptoms, early recourse to cross-sectional imaging such as MRI is prudent.

List of poster presentations

Neuroradiology

P-001: Bilateral anterior temporal cystic degeneration in pediatric patients with hypernatremic dehydratation

Mehmet Atalar[1], Rifat Nuri Sener[2]

[1] Cumhuriyet University School Of Medicine, Department Of Radiology, Sivas (Turkey); [2] Ege University School Of Medicine, Department Of Radiology, Izmir (Turkey)

P-002: A clinicoradiological analysis of cranio-facial fibrous dysplasia in childhood

Mehmet Atalar, Ismail Salk

Cumhuriyet University School Of Medicine, Department Of Radiology, Sivas (Turkey)

P-003: X-linked Charcot-Marie-Tooth disease with transient CNS abnormalities in childhood

Shigeko Kuwashima, Takahide Nagashima

Dokkyo Medical University, Department of Radiology, Shimotsuga-Gun (Japan)

P-004: Cranial CT and MRI findings in a pediatric burn patient with light-strike

Ahmet Sığırcı [1], Mehmet Demircan[2], Birsen Harma[2], Yılmaz Dengiz[3]

[1] Inonu Universitesi Turgut Ozal Tıp Merkezi Department Of Radiology, Malatya/Merkez (Turkey); [2] Inonu Universitesi Turgut Ozal Tıp Fakultesi Department Of Pediatric Surgery, Malatya (Turkey); [3] Inonu Universitesi Turgut Ozal Tıp Fakultesi Department Of Radiology, Malatya (Turkey)

P-005: Central septum sign in the diagnosis of giant arachnoid granulations in MRI: a new finding?

Mehmet Atalar

Cumhuriyet University School Of Medicine, Department Of Radiology, Sivas (Turkey)

P-006: Congenital cytomegalovirus of the CNS: a varying spectrum of appearances

Mary Mallon, Eric N. Faerber, Jacqueline Urbine, Erica Poletto

St. Christopher's Hospital For Children, Philadelphia, Pa (United States)

P-007: HR MRI characteristics of cerebellar abnormalities in children with Joubert's syndrome

Alikhan Alikhanov [1], Elena Perepelova[2], Alisa Demushkina[1]

[1] Russian State Children Hospital, Moscow (Russian Federation); [2] Moscow Medical Academy, Moscow (Russia)

P-008: Evaluation of the size of optic nerve and optic nerve sheath in optic pathway glioma in neurofibromatosis type 1

Ali Varan[1], Ozge Sarac[2], Oktay Algın[3], Tulay Kansu[4], Banu Anlar[5]

[1] Hacettepe University Institute Of Cancer, Department Of Pediatric Oncology, Ankara (Turkey); [2] Ankara Ataturk Research And Training Hospital, Department Of Ophthalmology, Ankara (Turkey); [3] Ankara Ataturk Research And Training Hospital, Department Of Radiology, Ankara (Turkey); [4] Hacettepe University School Of Medicine, Department Of Neurology, Ankara (Turkey); [5] Hacettepe University School Of Medicine, Department Of Pediatric Neurology, Ankara (Turkey)

P-009: Brain metastasis from extracranial solid malignant tumors in children

Korcan Aysun Gonen[1], Zeynep Yazici[1], Betul Sevinir[2]

[1] Uludag University, Medical Faculty, Department Of Radiology, Bursa (Turkey); [2] Uludag University, Medical Faculty, Department Of Pediatric Oncology, Bursa (Turkey)

P-010: Neurofibromatosis type 1, a disease with variable imaging expressions. A case rapport of a newborn boy with extraordinary features of NF 1.

Stein Magnus Aukland [1], Anders B. Mjelle[2], Gunnar Moen[2], Andrea Rossi[3], A. James Barkovich[4], Rupavathana Mahesparan[2], Kristian Sommerfelt[2]

[1] Haukeland University Hospital & University Of Bergen, Bergen (Norway); [2] Haukeland University Hospital, Bergen (Norway); [3] Neuroradiology Dept. G. Gaslini Children's Hospital, Genoa (Italy); [4] Department Of Radiology, University Of California, San Francisco (USA)

P-011: Assessment of the 'shunt series' radiographs when investigating the child with a possible acute malfunctioning ventriculoperitoneal shunt

Oliver Hulson[2], Nasim Tahir[1, 2]

[1] Leeds Teaching Hospitals Nhs Trust, Leeds (United Kingdom); [2] Leeds General Infirmary, Leeds (UK)

P-012: Orbital infections in children: report of three cases

Vasiliki Georgopoulou, Thomas Nimas, Maria Sidiropoulou, Antonios Stratis, Emmanouil Zaikos, Anthoula Morichovitou, Tania Chrysopoulou, Nikolaos Barmpas, Efthymia Zafeiriadou

Department Of Computed Tomography, 1St Department Of Radiology, "Hippokrateio"General Hospital, Thessaloniki (Greece)

P-013: Acquired type of Dyke – Davidoff – Masson syndrome: A case report and review of the literature.

Tania Chrysopoulou [1], Maria Sidiropoulou[1], Anthoula Morichovitou[1], Vasiliki Georgopoulou[1], Anagnostis Skordas[1], Charalambos Liasidis[2], Emmanouil Zaikos[1], Eirini Kazantzidou[1], Efthymia Zafeiriadou[1]

[1] Department Of Computed Tomography, 1St Department Of Radiology, "Hippokrateio"General Hospital, Thessaloniki (Greece); [2] Department Of Neurology, "Hippokrateio"General Hospital, Thessaloniki (Greece)

P-014: A brain tuberculoma in 8-month-old infant – case report

Katarzyna Czerwińska [1], Justyna Komarnicka[1], Michał Brzewski[1], Marek Kulus[2]

[1] Department Of Pediatric Radiology Medical University Of Warsaw, Warsaw (Poland); [2] Department Of Pediatric Pneumonology And Allergy Medical University Of Warsaw, Warsaw (Poland)

P-015: Malformations of cortical development: 3T MR imaging features

Murat Kocaoglu [1], Veysel Akgun[2], Emrah Ozcan[2], Selami Ince[2], Mustafa Tasar[2]

[1] Gulhane Military Medical School, Department Of Radiology, Ankara (Turkey); [2] Gulhane Military Medical School, Ankara (Turkey)

P-016: Stroke in childhood

Elisabeth Ladanyi, Bela Lombay, Istvan Lazar

Borsod County Teaching Hospital Departmant Of Ped. Rad., Miskolc (Hungary)

P-017: Imaging finding of hypoxic-ischemic encephalopathy in neonates, infants, and children

Yun-Jung Lim [1], Su-Mi Shin[2]

[1] Haeundae Paik Hospital, Busan (Republic of Korea); [2] SMG-SNU Boramae Medical Center, Seoul (Republic of Korea)

P-018: Brainstem disconnection syndrome: A pictorial review

Moti Chowdhury, A. Michelle Fink, Surekha Kumbla

The Royal Children's Hospital, Melbourne (Australia)

P-019: Devastating metabolic brain disorders of newborn and young infants

Ji Hye Kim, Tae Yeon Jeon, So-Young Yoo, Hong Eo

Samsung Medical Center, Sungkyunkwan University, Seoul (Republic of Korea)

P-020: Rhombencephalosynapsis: A case report

Ashwin Hegde

University Of Nebraska Medical Center, Omaha (United States)

P-021: Sigmoid sinus thrombosis after blunt head trauma in a child - case report and review of the literature

Norbert Utz [1], Christian Haneke[2], Ralf Dörbecker[2], Marcus Katoh[2]

[1] Pediatric Radiology Department Helios Klinikum Krefeld, Krefeld (Germany); [2] Helios-Klinikum Krefeld, Krefeld (Germany)

P-022: Cranial ultrasonography as a screening tool in neonatal intensive care unit, in both symptomatic and asymptomatic neonates.

Savas Defteros, Melphomeni Kosmidou, Aikaterini Zazaliari, Sofia Amanatidou, Panos Prassopoulos

Democritus University Of Thrace, Alexandroupolis (Greece)

P-023: Severe cerebral haemorrhage in two infants with parechovirus infection

Gerald Pärtan[1], Corina Bartl-Vischer [1], Wolfgang Bock [2], Sigrid Brandtner[3], Herbert Kurz [3] Walter Sterniste [2]

[1] Institut F. Roentgendiagnostik, Donauspital Im SMZ Ost, Vienna (Austria); [2] Danube Hospital, Neonatal Intensive Care Unit, Vienna (Austria); [3] Danube Hospital, Department Of Paediatrics, Vienna (Austria)

P-024: Role of MRI in fetal ocular anomalies: what do you "see"?

Marc R. Jordaan, Sandrine Yazbek, Carol E. Barnewolt, Susan A. Connolly, P. Ellen Grant, Caroline D. Robson, Judy A. Estroff, Sanjay P. Prabhu

Boston Children's Hospital, Boston (United States)

P-025: Spinal serendipity – common and unusual incidental findings in paediatric lumbar spine MRI

Marc R. Jordaan, Sandrine Yazbek, Sanjay P. Prabhu

Boston Children's Hospital, Boston (United States)

P-026: Non-traumatic conditions of the pediatric sacrum: multimodality imaging

Shannon N. Zingula, Laurence J. Eckel, Alice Patton

Mayo Clinic, Rochester, Minnesota (United States)

P-027: Comparison of a novel semi-automatic segmentation technique and manual tracing technique for MR volumetric measurements of the pituitary gland in children and adolescents

Hans-Joachim Mentzel [1], Therese Lincke [1], Claudia Vilser [2], Karim Kentouche [2], Diane Renz [3], Martin Stenzel [1], Horst K Hahn [4]

[1] Dept Pediatric Radiology, University Hospital, Jena (Germany); [2] University Hospital, Jena (Germany); [3] Mevis, Bremen (Germany); [4] MEVIS, Bremen, Germany

Chest/Cardiac

P-028: Phlebectasia of persistent left superior vena cava accompanying a giant cervico-mediastinal lymphangioma
Mehmet Atalar [1], Gokhan Koyluoglu[2], Sinasi Manduz[3]
[1] Cumhuriyet University School Of Medicine, Department Of Radiology, Sivas (Turkey); [2] Cumhuriyet University Hospital, Department Of Pediatric Surgery, Sivas (Turkey); [3] Cumhuriyet University Hospital, Department Of Cardiovascular Surgery, Sivas (Turkey)

P-029: Role of ultrasound of the thorax in children
Jeevesh Kapur
National University Hospital, Singapore (Singapore)

P-030: Pulmonary sclerosing hemangioma: a case report
Martina Gatti [1], Simone Sala[2]
[1] Department Of Radiology - University Of Ferrara, Ferrara (Italy); [2] Department Of Radiology - Arcispedale S. Anna, Ferrara (Italy)

P-031: Assessment of diaphragmatic function using dynamic Magnetic Resonance Imaging.
Ankit Vyas, Erich Sorantin, Alexandra Lohnegger
Div. Pediatric Radiology, Dept. Of Radiology, Medical University Graz (Austria)

P-032: Plastic bronchitis mimicking foreign body obstruction on chest radiograph
Simranjit Peritam Singh [1], Jason Bronstein[2], Kalliope Tsirilakis[2], Morris Edelman[2], Sukhjinder Singh[2]
[1] University Of Texas Southwestern Medical School, Dallas (USA); [2] Cohen Children's Medical Center, New Hyde Park, Ny (USA)

P-033: Examination of a method to evaluate pulmonary venous obstruction using contrast CT images to total anomalous pulmonary venous connections
Makoto Shimada [1], Shuji Abe [2], Shouji Tani[2], Masanori Nishikawa[2], Koichi Yabunaka[3], Toshizo Katsuda[4], Hidetoshi Yatake[5], Taisuke Enoki[6]
[1] Department Of Radiology, Osaka Medical Center And Research Institute For Maternal And Child Health, Izumi (Japan); [2] Osaka Medical Center And Research Institute For Maternal And Child Health, Izumi (Japan); [3] Katsuragi Hospital, Kishiwada (Japan); [4] National Cerebral And Cardiovascular Center, Suita (Japan); [5] Kaizuka City Hospital, Kaizuka (Japan); [6] Osaka Kyoiku University, Osaka (Japan)

P-034: Imaging of pulmonary hydatid disease in children
Ali Yikilmaz [1], Sureyya Burcu Gorkem[2], Dursun Alper Hayırlıoğlu[1], Firdevs Ikbal Gucer[1], Abdulhakim Coskun[2]
[1] Istanbul Medeniyet University Goztepe Training And Research Hospital, Istanbul (Turkey); [2] Erciyes University, Children's Hospital, Kayseri (Turkey)

P-035: Traumatic tracheal rupture in children: report of two cases.
Nikolaos Barmpas, Maria Sidiropoulou, Anthoula Morichovitou, Anagnostis Skordas, Eirini Kazantzidou, Vasiliki Georgopoulou, Thomas Nimas, Tania Chrysopoulou, Efthymia Zafeiriadou
Department Of Computed Tomography, 1St Department Of Radiology, "Hippokrateio"General Hospital, Thessaloniki (Greece)

P-036: White out of the Lung - not so "black and white"
Tanyia Pillay, Nicky Wieselthaler
Red Cross War Memorial Children'S Hospital, University Of Cape Town, Cape Town (South Africa)

P-037: Computed tomography before bidirectional Glenn anastomosis in infants with functional single ventricle
Evangelos Mourtos, Marika Lidegran, Annika Öhman
Astrid Lindgren Children's Hospital, Karolinska University Hospital, Karolinska Institutet, Stockholm (Sweden)

P-038: Activated charcoal bronchial aspiration with abscess formation: a case report
Damjana Ključevšek, Mojca Tomažič, Martin Thaler, Anton Kenig
University Clinical Centre, Children's Hospital, Ljubljana (Slovenia)

P-039: Rare complication of foreign body aspiration—case report
Eva Kovacs, Balazs Nemeth, Eva Gacs
Heim Pal Children's Hospital, Budapest (Hungary)

P-040: Imaging tetralogy of Fallot in children by High Field Open (HFO) 1.0 Tesla MRI scanner: a pictorial essay
Dimitra Loggitsi [1], Georgia Papaioannou [1], Nikolaos Kritikos [1], John Zampelis [1], Evangelia Manopoulou [1], Aphrodite Tzifa [2]
[1] CT/MRI Department, Mitera Hospital, Athens (Greece); [2] Pediatric Cardiology Department, Mitera Hospital, Athens (Greece)

P-041: Imaging valvular heart disease in children by High Field Open (HFO) 1.0 Tesla MRI scanner: a pictorial essay
Dimitra Loggitsi [1], Georgia Papaioannou [1], Nikolaos Kritikos [1], Panagiotis Tagalakis [1], Evangelia Manopoulou [1], Aphrodite Tzifa [2]
[1] CT/MRI Department, Mitera Hospital, Athens (Greece); [2] Pediatric Cardiology Department, Mitera Hospital, Athens (Greece)

P-042: Evaluation of tracheomalacia in children using Computed Tomography. Correlation with bronchoscopic results.
Efthimia Alexopoulou, Gerasimos Kremmydas, Vasilios Grammeniatis, Konstantinos Douros, Argyro Mazioti, Stylianos Argentos, Konstantinos Priftis
University General Hospital "Attikon", Athens (Greece)

P-043: US evaluation of the thymus gland in pediatric patients.
Sonia Tamasi[1], Rosanna Mamone[1], Michele Smaldone[2], Umberto Balestrieri[2], Domenico Noviello[1], Patrizia Oresta[1]
[1] A.O.R.N. Santobono, Pausilipon, Naples (Italy); [2] University "Federico Ii", Naples (Italy)

P-044: Qualitative and quantitative assessment of CT MIP in pediatric lung nodule detection
Kerri Highmore, Mary-Louise Greer, David Manson
The Hospital For Sick Children, Toronto (Canada)
P-045: MRI: is there a role in congenital lung malformations?
Maria Rita Panico [1], Carmine Mollica[2], Luigi Camera[1], Marco Salvatore[1], Pier Paolo Mainenti[2]
[1] UNIVERSITA' FEDERICO II, Napoli (Italy); [2] Biostructure and Bioimaging Institute (IBB), National Council of Research (CNR), Napoli Italy)
P-046: Visual selection of end-diastolic and end-systolic cardiac phase at cMRI
Robert Marterer, Erich Sorantin[1]
Division Of Pediatric Radiology, Department Of Radiology, Medical University Of Graz, Graz (Austria)
P-047: Horseshoe lung associated with scimitar syndrome
Korcan Aysun Gonen [1], Ozlem Mehtap Bostan[2], Yakup Canitez[2], Zeynep Yazici[1]
[1] Uludag University, Medical Faculty, Department Of Radiology, Bursa (Turkey); [2] Uludag University, Medical Faculty, Department Of Pediatrics, Bursa (Turkey)
P-048: Chest CT in children on ECMO (extra-corporeal membrane oxygenation)
Susie Goodwin, Elise Randle, Alistair Calder, Aparna Hoskote
Great Ormond Street Hospital, London (United Kingdom)
P-049: Aeration disturbances- congenital or acquired?
Daniela Bakalinova Pugh, Maha Almarashi, Amina Abdelqadir Mohamed
Sheikh Khalifa Medical City, Abu Dhabi (United Arab Emirates)

Interventional radiology

P-050: Pre procedure checklist in paediatric screening and interventional procedures
Senasi Ramdas, Christopher Heafey, Neil Prasad, Ashok Raghavan
Sheffield Children's Hospital, Sheffield (United Kingdom)
P-051: Imaging findings in epithelioid hemangioendothelioma (EHE) with clinical correlation
Dawn Engelkemier, Ahmad Alomari, Harry Kozakewich, Cameron Trenor, Gulraiz Chaudry
Children's Hospital Boston, Boston, Ma (United States)
P-052: Endovascular management of type 2 congenital extrahepatic portosystemic shunt (CEHPSS): our experience
Frédéric Thomas-Chaussé [1], Josée Dubois[1], Rafik Ghali[2], Gilles Soulez[3]
[1] Chu Ste-Justine, Montreal (Canada); [2] Hopital Maisonneuve-Rosemont, Montreal (Canada); [3] Centre Hospitalier De L'université De Montréal, Montréal (Canada)
P-053: Why tunneled common femoral central venous catheters are useful in children
Richard Towbin, Robin Kaye, Carrie Schaefer, David Aria, Seth Vatsky, Scott Joergensen
Phoenix Children's Hospital, Phoenix, United States
P-054: Intervention in paediatric hepatobiliary disorders
Nasim Tahir, Asim Shah
Leeds Children's Hospital, Leeds (United Kingdom)
P-055: Treatment of a Complicated Venous Malformation with Associated Pulmonary Embolism using Radiofrequency Ablation
Richard Towbin, Carrie Schaefer, Robin Kaye, David Aria, Seth Vatsky
Phoenix Children's Hospital, Phoenix, United States
P-056: Treating Complex Vascular Anomalies with Novel Techniques
Richard Towbin, Carrie Schaefer, Robin Kaye, David Aria
Phoenix Children's Hospital, Phoenix, United States
P-057: Pediatric cerebral vascular malformations: diagnosis and treatment
Ildikó Schmidt, Istvan Lazar, Bela Lombay
Borsod County University Hospital, Miskolc (Hungary)

Oncology

P-058: Case report: undifferentiated high-grade pleomorphic sarcoma (malignant fibrous histiocytoma) in a 12-year old girl with tuberous sclerosis
Eu Leong Harvey James Teo, Kenneth Chang Tou En
Kk Women's And Children's Hospital, Singapore (Singapore)
P-059: Intravenous application of second generation ultrasound contrast agents – safety consideration based on one center prospective study
Maciej Piskunowicz, Wojciech Kosiak, Tomasz Batko, Elzbieta Adamkiewicz-Drozynska, Arkadiusz Piankowski
Medical University Of Gdansk, Gdansk (Poland)
P-060: Monitoring cystic lymphangioma therapy with Sirolimus using MRI: A case report of four pediatric patients
Sebastian Tschauner [1], Erich Sorantin[1], Emir Haxhija[2]
[1] Division Of Pediatric Radiology, Medical University Graz, Graz (Austria); [2] Division Of General Pediatric And Adolescence Surgery, Medical University Graz, Graz (Austria)
P-061: A large solid hepatic tumour with a central scar– only FNH?
Katarzyna Czerwińska [1], Agnieszka Biejat[1], Michał Brzewski[1], Andrzej Kamiński[2], Michał Matysiak[3], Jadwiga Małdyk[4]
[1] Department Of Pediatric Radiology Medical University Of Warsaw, Warsaw (Poland); [2] Department Of Pediatric Surgery Medical University Of Warsaw, Warsaw (Poland); [3] Chair And Clinic Of Hematology And Oncology Medical University Of Warsaw, Warsaw (Poland) ; [4] Institute Of Pathomorphology In Clinical Paediatrics Medical University Of Warsaw, Warsaw (Poland)

P-062: Rare imaging manifestations of childhood leukemia/lymphoma

Kathrin Maurer, Verena Spiss, Karin Unsinn
Medical University Innsbruck, Innsbruck (Austria)

P-063: Excessive thoracic wall lump in a newborn

Georgios Manganas [1], Christina Meleti [1], Evangelia Manopoulou [1], Evi Vassiliadou [2], Stelios Ypsiladis [2], Spyros Yarmenitis [1], Georgia Papaioannou [1]
[1] Department Of Pediatric Radiology, Mitera Maternity And Chlildren's Hospital, Athens (Greece); [2] Department Of Pediatric Surgery, Mitera Maternity And Chlildren's Hospital, Athens (Greece)

P-064: A rare case of metastatic extragonadal germ cell tumor with silent clinical presentation diagnosed with the help of whole-body DWI

Evangelos Mourtos, Linda Guler, Sylvie Kaiser, Åke Jakobson, Stefan Geiberger
Astrid Lindgren Children's Hospital, Karolinska University Hospital, Karolinska Institutet, Stockholm (Sweden)

P-065: The role of computed tomography in the evaluation of pulmonary complications in children submitted to autologous and allogeneic bone marrow transplantation.

Luciana Pinto Balthazar Da Silveira, Henrique Manoel Lederman, Gilberto Szarf, Adriana Seber
Federal University Of São Paulo, São Paulo (Brazil)

P-066: The role of MRI in differentiating nephrogenic rests from Wilms tumour following chemotherapy

Daniela Fernandes Pinto, Owen Arthurs, Neil Sebire, Oystein Olsen
Great Ormond Street Hospital, London (United Kingdom)

P-067: Influence of bone marrow transplantation on pituitary gland volume and pituitary hormone values in children and adolescents

Therese Lincke [1], Horst Hahn [2], Karim Kentouche [3], Diane Renz [4], Claudia Vilser [3], Stenzel Martin [1], Hans-Joachim Mentzel [1]
[1] Dept Pediatric Radiology, University Hospital, Jena (Germany); [2] MeVis, Bremen (Germany); [3] University Hospital, Jena, (Germany); [4] Dept of Radiology, Charite Berlin, Germany

Genitourinary

P-068: Bilateral xanthogranulomatous pyelonephritis (XGPN) in a 21 month old child.

Jumana Hussain [1], Saeeda Latif[2], Anil Kumar[2], S. Chakraborty[3]
[1] Oxford Radcliffe Hospitals, Oxford (United Kingdom); [2] Wexham Park Hospital, Slough (UK); [3] John Radcliffe Hospital, Oxford (UK)

P-069: Infants be distinguidhed by means of the differential resistive index?

Costanza Bruno, Giuliana Caliari, Marco Zaffanello, Roberto Pozzi Mucelli Policlinico Gb Rossi, Verona (Italy)

P-070: Posterior nutcracker syndrome: simultaneous visualizations of vessels and renal collecting system with biphasic intravenous contrast enhanced MRI

Selami Ince, Murat Kocaoğlu, Veysel Akgün, Mustafa Taşar Department Of Radiology, Gulhane Military Medical School, Ankara (Turkey)

P-071: Torsion of undescended testis: gray scale and color Doppler US findings

Selami Ince, Veysel Akgun, Murat Kocaoglu, Mutlu Saglam Department Of Radiology, Gulhane Military Medical School, Ankara (Turkey)

P-072: Dynamic contrast-enhanced MR urography for congenital urinary tract anomalies

Mikiko Miyasaka [1], Shunsuke Nosaka[1], Eriko Otsubo[1], Hiroshi Nagamatsu[1], Katsuhiko Ueoka[1], Yuichi Hasegawa[1], Izumi Kanemitsu[1], Masato Uchikoshi[2], Kiefer B[3], Masaki Hidekazu[1]
[1] National Center For Child Health And Development, Tokyo (Japan); [2] Siemens Japan K.K., Tokyo (Japan); [3] Siemens Ag, Erlangen (Germany)

P-073: Ultrasonographic findings of torsed testicular appendage in prepubertal children: overlap with epididymitis and torsion of testis

Su-Mi Shin [1], Yun-Jung Lim[2]
[1] SMG-SNU Boramae Medical Center, Seoul (Republic of Korea); [2] Inje University Haeundae Paik Hospital, Pusan (Republic of Korea)

P-074: Micturition problems in reccurent urinary tract infections

László Szabó [1, 2], Mária Deák[3], Ilona Bajusz[2], Katalin Losonczi[2], Gyula Réti[4], Béla Lombay[3]
[1] Borsod County Teaching Hospital, Miskolc (Hungary); [2] Pediatric Nephrology, Borsod County University Hospital, Miskolc (Hungary); [3] Pediatric Radiology, Borsod County University Hospital, Miskolc (Hungary); [4] Pediatric Surgery And Urology Borsod County University Hospital, Miskolc (Hungary)

P-075: An abdominoscrotal hydrocele in infant – a cystic lesion in the abdomen

Katarzyna Czerwińska [1], Michał Brzewski[1], Zofia Majkowska[1], Tomasz Mosior[1], Maria Roszkowska-Blaim[2], Stanisław Warchoł[3]
[1] Department Of Pediatric Radiology Medical University Of Warsaw, Warsaw (Poland); [2] Department Of Pediatric Nephrology Medical University Of Warsaw, Warsaw (Poland); [3] Department Of Pediatric Surgery Medical University Of Warsaw, Warsaw (Poland)

P-076: A rare congenital benign testis tumour in a newborn

Katarzyna Czerwińska [1], Michał Brzewski[1], Zofia Majkowska[1], Andrzej Kamiński[2], Michał Matysiak[3], Jadwiga Małdyk[4]

[1] Department Of Pediatric Radiology Medical University Of Warsaw, Warsaw (Poland); [2] Department Of Pediatric Surgery Medical University Of Warsaw, Warsaw (Poland); [3] Chair And Clinic Of Hematology And Oncology Medical University Of Warsaw, Warsaw (Poland); [4] Institute Of Pathomorphology In Clinical Paediatrics Medical University Of Warsaw, Warsaw (Poland)

P-077: Pediatric bladder imaging - fundamental approaches and interesting cases

Aisling Snow, Jeanne S. Chow

Boston Children's Hospital, Boston (USA)

P-078: Usefulness of pelvis US to differentiate central precocious puberty from atypical premature thelarche

Gye Yeon Lim [1], Min Ho Chung[2]

[1] Department of Radiology, St. Mary's Hospital, The Catholic University of Korea, Seoul (Republic of Korea);

[2] Department of Pediatrics, St. Mary's Hospital, The Catholic University of Korea, Seoul (Republic of Korea)

P-079: Chronic peritoneal dialysis in children: The rule of ultrasound in the diagnosis of peritoneal catheter obstruction

Francesco Esposito [1], Maria Rita Panico[2], Domenico Noviello[1], Marco Catalano[2], Michele Smaldone[2], Francesca Malacarico[2], Patrizia Oresta[1]

[1] Aorn Santobono, Napoli (Italy); [2] Universita' Federico Ii, Napoli (Italia)

P-080: Voiding urosonography: a pictorial essay of the lower urinary tract pathology

Carmina Duran, Luis Riera, Javier del Riego, Cesar Martin

UDIAT-CD, Sabadell (Spain)

P-081: Acute traumatic and non traumatic scrotal emergencies: a review of US and color Doppler findings.

Cinzia Orazi, Maria Chiara Lucchetti, Paola Marchetti, Maria Antonietta Barbieri, Paolo Maria S. Schingo, Massimiliano Silveri, Paolo Tomà

Bambino Gesù Children's Hospital, Palidoro - Rome (Italy)

P-082: Fallopian tube diseases in peripubertal girls: hydrosalpinx and tubal torsion. Possible pathogenesis.

Cinzia Orazi, Maria Chiara Lucchetti, Paola Marchetti, Paolo Maria S. Schingo, Paolo Tomà

Bambino Gesù Children's Hospital, Palidoro - Rome (Italy)

P-083: A rare case of spontaneous regression of cystic dysplasia of the testis

Polina Pavicevic, Vojkan Vukadinovic, Miroslav Djordjevic

University Childrens Hospital, School Of Medicine University Of Belgrade, Belgrade (Serbia)

P-084: The importance of ultrasound in the evaluation of nephrocalcinosis in neonate and young children

Besa Hidri, Diamant Shtiza, *Fjorda Tuka,* Sonja Butorac (Saraçi), Denis Qirinxhi

Mother Teresa Uhc, Tirana (Albania)

P-085: Ultrasound imaging of the paediatric scrotum

David Hatch, Susie Goodwin

Great Ormond Street Hospital, London (United Kingdom)

P-086: Ultrasound features of paediatric renal transplant complications

David Hatch, Marina Easty

Great Ormond Street Hospital, London (United Kingdom)

P-087: Pictorial review of palpable inguinal masses in girls

Yun-Woo Chang

Soonchunhyang University Hospital, Seoul (Republic of Korea)

P-088: Renal lymphangiectasia: sonographic features in long-term follow-up

Silvia Rocha, Marcia Wang Matsuoka, Gisele Correa Almeida, Luciana Panizza, Andrea Langone Ferme, Mauricio Yamanari, Luiz Antonio Nunes Oliveira

Instituto Da Criança Do Hospital Das Clínicas Da Faculdade De Medicina Da Universidade De São Paulo, São Paulo (Brazil)

P-089: Various urethral pathologies in voiding cystourethrography

Mithat Haliloglu [1], Berna Oguz[2]

[1] Hacettepe University School Of Medicine, Department Of Radiology, Ankara (Turkey); [2] Hacettepe University School Of Medicine, Ankara (Turkey)

P-090: The importance of pyelectasis – report of a clinical study in progress

Gyula Pásztor [1], Pál Pásztor [2], Csaba Bereczki[2], Edit Kukla[1], András Palkó[3]

[1] Euromedic Diagnostics Hungary Ltd. (Hungary); [2] University of Szeged Faculty of Pediatrics, Szeged (Hungary); [3] University of Szeged Faculty of Radiology (Hungary)

Radiation Safety

P-091: Painful paediatric hip: frog leg lateral only!

Josephine Bomer, HC Holscher, F Klerx-Melis

Haga Teaching Hospital/Juliana Children's Hospital, Den Haag (Netherlands)

P-092: Low dose chest CT in children with cystic fibrosis: assessment of image quality. Our experience

Cecilia Lanza, Lucia Amici, Giovanni Pieroni, Valeria Bolli, *Andrea Giovagnoni*

Azienda Ospedaliero-Universitaria Ospedali Riuniti, Ancona (Italy)

P-093: Lung CT in cystic fibrosis young patients: comparison of effective doses measured with two different methods

Irene Borzani, Mauro Campoleoni, Valentina Minotto-Lederer, Shary Milano, Eliseo Ruggieri, Pietro Biondetti
Fondazione Irccs Ca' Granda - Ospedale Maggiore Policlinico, Milan (Italy)

P-094: Paediatric CT quality consistency: comparison of average equivalent water diameter and age/weight scanning protocols

Ed Roberts, Larry Mak, Michael Ditchfield
Southern Health, Melbourne (Australia)

P-095: Radiation dose reduction and protocol optimization for pediatric head CT in evaluation of craniosynostosis

Laurence Eckel, Alice Patton, Lifeng Yu, Gesina F Keating, Nicholas M Wetjen
Mayo Clinic, Rochester (United States)

P-096: Iterative MDCT image quality and dose reduction in paediatric head protocols for traumatic lesions and neurosurgery controls

Antonio Ciccarone, Simona Quaglierini, Leonardo Lelli, Marco Di Maurizio, Sara Savelli, Claudio Fonda
Meyer Children's University Hospital, Florence (Italy)

P-097: Foreign body ingestion in pediatric population: is there a role for low-dose radiography and fluoroscopy?

Andrea Magistrelli, Paolo Maria Salvatore Schingo, Teresa Corneli, Roberta Lombardi, Marco Cirillo, Paolo Tomà
Bambino Gesù Children'S Hospital, IRCCS, Rome (Italy)

Gastrointestinal

P-098: A pictorial review of CT features of gastrointestinal disease in children

Moti Chowdhury, Surekha Kumbla
Royal Children's Hospital, Melbourne (Australia)

P-099: CT and MR appearance of hepatic angiosarcoma (HAS) in a 10-year-old girl

Henry Chan
Chang Gung Memorial Hospital, Keelung (Taiwan, Province Of China)

P-100: Primary neoplastic tumors of the pancreas in three children

Živa Zupančič, Senja Mali, Diana Gvardijančič, Anton Kenig
University Medical Centre Ljubljana, Ljubljana (Slovenia)

P-101: Primary synovial sarcoma of the abdominal wall: a case report and review of literature

Supika Supika Kritsaneepaiboon, Surasak Sangkhathat, Winyou Mitarnun
Songklanagarind Hospital, Prince Of Songkla University, Hat Yai (Thailand)

P-102: Congenital splenic cysts: a report of two cases.

Maria Sidiropoulou [1], Anagnostis Skordas[1], Vasiliki Georgopoulou[1], Emmanouil Zaikos[1], Thomas Nimas[1], Maria Badouraki[2], Antonios Stratis[1], Anthoula Morichovitou[1], Efthymia Zafeiriadou[1]
[1] Department Of Computed Tomography, 1St Department Of Radiology, "Hippokrateio"General Hospital, Thessaloniki (Greece); [2] 1St Department Of Radiology, "Hippokrateio"General Hospital, Thessaloniki (Greece)

P-103: Keeping it simple: Ultrasound for paediatric appendicitis. Overview of the spectrum of ultrasound findings.

Alan Quigley, Samuel Stafrace
Royal Aberdeen Children's Hospital, Aberdeen, Scotland (United Kingdom)

P-104: Imaging findings in common pathologies causing neonatal and infantile bowel obstruction: a pictorial overview

Alan Quigley, Samuel Stafrace
Royal Aberdeen Children's Hospital, Aberdeen, Scotland (United Kingdom)

P-105: Small bowel study MRI: Pictorial overview of technique and pathological findings in the paediatric population investigated for suspected inflammatory bowel disease.

Samuel Stafrace [1], Steven Yule[2]
[1] Royal Aberdeen Children's Hospital, Aberdeen, Scotland (United Kingdom); [2] Aberdeen Royal Infirmary, Aberdeen, Scotland (United Kingdom)

P-106: Role and feasibility of MRCP in pediatric pathologies

Mehrak Anooshiravani, A Kanavaki, E Maturana, L Merlini, B Wildhaber, S Hanquinet
Geneva University Hospital, Geneva (Switzerland)

P-107: MR imaging in a case of primary epiploic appendagitis in a 12 years girl

Sergio Salerno, Paola Carcione, Marcello Cimador, Giuseppe Lo Re, Massimo Midiri
University Hospital Policlinico, Palermo (Italy)

P-108: Imaging in paediatric intestinal failure associated liver disease (IFALD)

Tom Watson, Kieran Mchugh, Susan Hill
Great Ormond Street Hospital For Children Nhs Foundation Trust, London (United Kingdom)

P-109: Administering oral contrast, a novel solution.

Siva Muthukumarasamy [1], Dipalee Durve[2]
[1] Guy's And St Thomas' Nhs Trust, London (United Kingdom); [2] Evelina London Children's Hospital, London (United Kingdom)

P-110: Role of MR cholangiopancreatography in the evaluation of pediatric pancreatic diseases

Maria Rita Panico [1], Carmine Mollica[2], Luigi Camera[1], Pier Paolo Mainenti[2], Marco Salvatore[1]

[1] Universita' Federico Ii, Napoli (Italy); [2] Biostructure And Bioimaging Institute (Ibb), National Council Of Research (Cnr), Napoli (Italia)

P-111: Can diffusion weighted imaging with background supression (DWIBS) substitute contrast enhanced T1-weighted images in the pediatric population with Crohn disease?

Norbert Utz, Antje Ballauff, Cornelia Haas, Karsten Thiel, Marcus Katoh
Helios Klinikum Krefeld, Krefeld (Germany)

P-112: Multiple biliary hamartomas (von Meyenburg complexes): US diagnosis.

Cinzia Orazi, Fausto Maria Fassari, Paolo Maria S Schingo, Paolo Tomà
Bambino Gesu' Pediatric Hospital, Palidoro-Rome (Italy)

P-113: Uncommon extraosseous calcifications in children

Stephen Miller [1], Erika Mann[2]
[1] St. Jude Children's Research Hospital, Memphis (USA); [2] Hospital For Sick Children, Toronto (Canada)

P-114: Pictorial review: pathologies seen on contrast enemas in premature babies, neonates and infants

Amit Maniyar, Mandip Heir, Fiona Dickinson, Andrew Rickett, Anthony Dux
University Hospitals Of Leicester, Leicester (United Kingdom)

P-115: Acoustic Radiation Force Impulse Imaging (ARFI): Preliminary results of normal values of spleen stiffness in healthy children

Teresa Cañas[1], Teresa Fontanilla[1], María Miralles[1], Araceli Maciá[2]
[1] Hospital Universitario Puerta de Hierro Majadahonda, Madrid (Spain); [2] UNED, Madrid (Spain)

P-116: US for pediatric Crohn's disease in the right lower quadrant – can we do as good as MRE?

Anat Ilvitzki[1], Inn Verganov[2] Osnat Konnen
[1]Departement of radiology, pediatric radiology unit, Rambam Health Care Campus, Haifa, (Israel); [2]Departement of pediatric radiology, Schneider Children's Hospital, Petach Tikva, (Israel)

Foetal/Neonatal

P-117: Neonatal cranial ultrasound

Michael Paddock
West Middlesex University Hospital, London (United Kingdom)

P-118: Congenital nasolacrimal duct mucocele - case report and review of the literature.

Vasiliki Georgopoulou, Antonios Stratis, Maria Sidiropoulou, Anthoula Morichovitou, Nikolaos Barmpas, Tania Chrysopoulou, Anagnostis Skordas, Eirini Kazantzidou, Efthymia Zafeiriadou
Department Of Computed Tomography, 1St Department Of Radiology, "Hippokrateio"General Hospital, Thessaloniki (Greece)

P-119: Contribution of fetal CT in the prenatal diagnosis of Binder phenotype

Kathia Chaumoitre[1], Isabelle Berakdar [2], S Coze[1], G Gorincour[3], C Chau[2], V Brevaut Malaty[4], C D'ercole[2], M Panuel[1]
[1] Imaging department Hôpital Nord; [2] Obstetrics and Gynecology department Hôpital Nord; [3] Pediatric imaging department Hôpital Timone Enfant; [4] Neonatology department Hôpital Nord

P-120: The outcome of urinary tract dilatations in newborns after pre-term caesarian section indicated by congenital uropathy

Miklós Merksz[3], Mária Polovitzer [1], Béla Lombay[2], Mária Deák[2], András Kiss[3], Krisztina Meichelbeck[4], Zsuzsanna Székhelyi[0], Péter Berkő[0], Gyula Réti[7], László Szabó[8]
[1] Pediatric Radiology, Heim Pál Children'S Hospital, Budapest (Hungary); [2] Pediatric Radiology, Borsod County University Hospital, Miskolc (Hungary); [3] Pediatric Urology, Heim Pál Children'S Hospital, Budapest (Hungary); [4] Internal Medicine And Pediatric Nephrology Heim Pál Children Hospital, Budapest (Hungary); [5] Neonatology, Borsod County University Hospital,, Miskolc (Hungary); [6] Gynecology And Maternity Centre, Borsod County University Hospital, Miskolc (Hungary); [7] Pediatric Surgery And Urology Borsod County University Hospital, Miskolc (Hungary); [8] Faculty Of Health Science, Semmelweis University, Budapest (Hungary)

P-121: Head ultrasound at the neonatal intensive care unit (NICU) including color Doppler sonography beyond intraventricular hemorrhage (IVH) and periventricular leucomalacia (PVL)

Flavia Menegotto, Ricardo Faingold
Montreal Children's Hospital/Mcgill University, Montreal (Canada)

P-122: Fetal brain MRI in fetuses with twin to twin transfusion syndrome after laser treatment

Stephanie Coze [1], Kathia Chaumoitre[1], Jean Baptiste Haumonte [1], Barthelemy Tosello [2], Claude D'ercole [1], Michel Panuel [1], Nadine Girard [3]
[1] Hopital Nord, Marseille (France); [2] Hopital De La Conception, Marseille (France); [3] Hopital De La Timone, Marseille (France)

P-123: Imaging findings of transplacental disseminated herpes simplex type 2 infection: a case report

Hiroko Hara, Chiho Sato, Chikako Morioka, Kanako Ijyu, Junpei Mukai, Yoshihiro Minosaki, Kikuko Oku
Kawaguchi Municipal Medical Center, Kawaguchi-City, Saitama (Japan)

P-124: Assessment of the quality of portable X-ray examinations on a neonatal intensive care unit.

Sylwia Niewiarowski [1], Shema Hameed[2], Afshin Alavi[2], May-Ai Seah[2], Joanna Danin[2]
[1] St Mary's Hospital, Imperial College Healthcare Nhs Trust, London (United Kingdom); [2] St Mary's Hospital, London (United Kingdon)

P-125: Quantitative ultrasound of the peripheral skeleton in the newborn

Elena Basemann [1], Claus Dörfel [2], Axel Hübler [2], Martin Stenzel [1], Hans-Joachim Mentzel [1]
[1] Dept Pediatric Radiology, University Hospital, Jena (Germany); [2] Dept of Pediatrics, University Hospital Jena, Germany

P-126: Congenital left atrial appendage aneurysm in a fetus: A rare prenatal diagnosis

Sara Savelli [1], Venturella Vangi [2], Lucia Pasquini [2], Marco Di Maurizio [1], Anna Perrone [1], Claudio Fonda[1]
[1] Meyer Children's Hospital, Firenze (Italy); [2] Careggi University Hospital, Firenze (Italy)

Musculoskeletal

P-127: Erdheim-Chester disease in a 14-year old girl with Type 2 Diabetes mellitus and Pre-B cell acute lymphoblastic leukemia: A case with previously unreported radiological features

Eu Leong Harvey James Teo, Varanasi Venkata Rama Krishna, Kenneth Tou En Chang
Kk Women's And Children's Hospital, Singapore (Singapore)

P-128: Sonographic features of juvenile xanthogranuloma

Oscar Navarro, Gino Somers
The Hospital For Sick Children, Toronto (Canada)

P-129: MRI of adolescents sports injuries

Goran Djuricic [1], Bojan Vucinic[1], Milan Apostolovic[2], Tatjana Knezevic[1], Goran Vukomanovic[1]
[1] University Children's Hospital Belgrade, Belgrade (Serbia); [2] Institute For Orthopaedic Surgery "Banjica", Faculty Of Medicine University Of Belgrade, Belgrade (Serbia)

P-130 Withdrawn

P-131: Early MRI in the management of scaphoid fractures in children

Aikaterini Kanavaki, Amira Dhouib, Laura Merlini, Mehrak Anooshiravani, *Sylviane Hanquinet*
Geneva's University Hospital, Geneva (Switzerland)

P-132: Pictorial overview of the plain film appearances of normal variants and common artefacts seen on skeletal surveys performed in children with suspected child abuse.

Alan Quigley, Samuel Stafrace
Royal Aberdeen Children's Hospital, Aberdeen, Scotland (United Kingdom)

P-133: Elbow muscle strength and ultrasonografic findings in young baseball pitchers: preliminary results

Rutkauskas Saulius [1] Algidas Basevicius[1], Sigitas Kamandulis[2], Mantas Mickevicius[2], Vytautas Streckis[2]
[1] Lithuanian University Of Health Sciences, Kaunas (Lithuania); [3] Lithuanian Sports University, Kaunas (Lithuania)

P-134: Gorham's disease: radiography and MRI findings of a case

Emrah Ozcan, Veysel Akgun, Murat Kocaoglu, Mutlu Saglam
Gulhane Military Medical School, Department Of Radiology, Ankara (Turkey)

P-135: Osteogenesis imperfecta & non-accidental injury in the neonate: where do we stand?
Joy Barber, Samantha Negus
St George's Hospital, London (United Kingdom)

P-136: Neonatal hip dysplasia: normal values for alpha angle and femoral head coverage should include age, sex and laterality variations.
Alastair Graham Wilkinson, Sally Wilkinson
Royal Hospital For Sick Children, Edinburgh (United Kingdom)

P-137: Neonatal hip dysplasia: effect of treatment on alpha angle and femoral head coverage.
Alastair Graham Wilkinson, Sally Wilkinson
Royal Hospital For Sick Children, Edinburgh (United Kingdom)

P-138: So you think you know about rickets?
Joy Barber, Alex Weller, Tom Watson, Alistair Calder[2]
[1] St George's Hospital, London (United Kingdom); [2] Great Ormond Street Hospital, London (United Kingdom)

P-139: Review of causes of hip pain in children
Nidhi Jain, Julian Chakraverty, Moni Sah, Sridhar Kamath, *Alison Evans*
University Hospital Of Wales, Cardiff (United Kingdom)

Education/Miscellaneous

P-140: SMA-related pseudomass as a form of reverberation artifact in a 10 year old boy
Natalia Kokhanovsky, Abdel-Rauf Zeina, Nadir Reindorp, Alicia Nachtigal
Department Of Radiology, Hillel Yaffe Medical Center, Hadera, Haifa (Israel)

P-141: The diversity of the Meckel's diverticulum
Eu Leong Harvey James Teo
Kk Women's And Children's Hospital, Singapore (Singapore)

P-142: Radiologic appearances of big abnormal masses (BAMs) and weird abnormal masses (WAMs) in pediatric patients
Mary Mallon, Jacqueline Urbine, Eric N. Faerber
St. Christopher's Hospital For Children, Philadelphia, Pa (United States)

P-143: Langerhans cell histiocytosis in children: imaging findings
Cecilia Lanza, Andrea Giovagnoni, Caterina Gambini, Lucia Amici, Valeria Bolli
Azienda Ospedaliero-Universitaria Ospedali Riuniti, Ancona (Italy)

P-144: Referrals and injury patterns in paediatric trauma : experiences from major trauma centre
Susan Cheng Shelmerdine, Rhianydd E. Williams, Kavita Lutchmeesingh, Rosemary Allan, S. Negus
St George's Hospital, London (United Kingdom)

P-145: Radiographic appearance of uncommon devices in the paediatric abdomen
Arlen Urquia [1], Owen Arthurs[2], Tom Watson[2], Susie Goodwin[2]
[1] Hospital Universitario De Burgos, Burgos (Spain); [2] Great Ormond Street Hospital, London (United Kingdom)

P-146: Beyond congenital diaphragmatic hernia: a case report
Irene Maria Borzani, Lorena Canazza, Alessandra Carnevali, Maurizio Torricelli, Pietro Biondetti
Fondazione Irccs Ca' Granda - Ospedale Maggiore Policlinico, Milan (Italy)

P-147: New method for eye-lens radiation exposure reduction during pediatric head CT based on automatic exposure control
Shuji Abe [1], Makoto Shimada[2], Shouji Tani[2], Masanori Nishikawa[2], Koichi Yabunaka[3], Masayoshi Mizuta[4], Hidetoshi Yatake[5], Toshizo Katsuda[6], Shigeru Sanada[7]
[1] Department Of Radiology, Osaka Medical Center And Research Institute For Maternal And Child Health, Izumi (Japan); [2] Osaka Medical Center And Research Institute For Maternal And Child Health, Izumi (Japan); [3] Katsuragi Hospital, Kishiwada (Japan); [4] University Hospital, Kyoto Prefectural University Of Medicine, Kyoto (Japan); [5] Kaizuka City Hospital, Kaizuka (Japan); [6] National Cerebral And Cardiovascular Center, Suita (Japan); [7] School Of Health Sciences, College Of Medical, Pharmaceutical And Health Sci-Ences,Kanazawa University, Kanazawa (Japan)

P-148: Feeding tubes in the paediatric population- how, when and why
Ramdas Senasi [1], Ashok Raghavan[1], Derek Roebuck[2]
[1] Sheffield Children's Hospital, Sheffield (United Kingdom); [2] Great Ormond Street Children's Hospital, London (United Kingdom)

P-149: Out of hours paediatric ultrasound service evaluation
Ramdas Senasi, Elizabeth Rogan, Andrew Yesudian, David Hughes
Sheffield Children's Hospital, Sheffield (United Kingdom)

P-150: Vallecular cyst complicated by infection: case report and review of the literature.
Maria Sidiropoulou, Emmanouil Zaikos, Vasiliki Georgopoulou, Thomas Nimas, Tania Chrysopoulou, Anthoula Morichovitou, Nikolaos Barmpas, Eirini Kazantzidou, Efthymia Zafeiriadou
Department Of Computed Tomography, 1St Department Of Radiology, "Hippokrateio"General Hospital, Thessaloniki (Greece)

P-151: Pitfalls in pediatric radiology: a pictorial essay
Dawn Engelkemier, George Taylor
Children's Hospital Boston, Boston, Ma (United States)

P-152: Learning preference of postgraduate medical trainees in the teaching of practical neonatal US

Patricia Bister-Set[1], Jacqueline Hughes [1], Dirk Bister[2], Claire Smith[1], Anna Curley[1]

[1] Addenbrookes University Hospital, Cambridge (United Kingdom); [2] Guy's University Hospital, London (UK)

P-153: The role of ultrasound and Doppler in evaluation of Takayasu's arteritis: a case report.

Damjana Ključevšek [1] Anton Kenig[1], Tomaž Ključevšek[2], Gašper Markelj[1], Mojca Tomažič[1], Martin Thaler[1]

[1] University Clinical Centre Ljubljana, Children's Hospital, Ljubljana (Slovenia); [2] University Clinical Centre, Institute For Radiology, Ljubljana (Slovenia)

P-154: Nephrogenic Systemic Fibrosis – Do you know the risk, and what to do to mitigate it?

Joy Barber, Alex Weller

St George's Hospital, London (United Kingdom)

P-155: Ultrasound of the floor of the mouth in children

Kaseem Ajilogba

Royal Hospital For Sick Children, Edinburgh (United Kingdom)

P-156: Klippel-Trenaunay, Klippel-Trenaunay-Weber and Parkes Weber Syndromes. Should we still use these eponyms?

Cristian Garcia, Alejandro Zavala, Florencia De Barbieri, Claudio Berrios, Rodrigo Parra

Pontificia Universidad Catolica, Santiago (Chile)

P-157: Imaging of pediatric head and neck infections: multimodality approach

Georgios Manganas, Evangelia Manopoulou, Christina Meleti, Spyros Yarmenitis, Georgia Papaioannou

Department Of Pediatric Radiology, Mitera Maternity And Chlildren's Hospital, Athens (Greece)

P-158: Low-cost medical image segmentation system including quad-buffered stereoscopic 3D visualization for teaching purposes

Reinhard Kaufmann, Erich Sorantin, Alexander Kolli

Medical University Graz, Department Of Radiology, Graz (Austria)

P-159: Incidental abnormalities of the vena cava inferior identified on CT and MRI in children

Natalia Barmpaliou [1], Eva Kvanta [2]

[1] Karolinska University Hospital, Astrid Lindgren Children's Hospital, Pediatric Radiology Dept., Stockholm (Sweden); [2] Karolinska University Hospital, Astrid Lindgren Children's Hospital, Stockholm (Sweden)

P-160: To err is human – common resident diagnostic errors in pediatric emergency radiography

Marc Jordaan, Michele Walters, George Taylor

Boston Children's Hospital, Boston (United States)

P-161: Paediatric thyroid masses

Caron Parsons [1], Heather Stirling[1], Claire Miller[2], Emma Helm[1]

[1] University Hospital Coventry & Warwickshire, Coventry (United States); [2] Birmingham Children's Hospital, Birmingham (United Kingdom)

P-162: Fusion and subtraction post-processing in body-MRI

Tom Watson, Oystein Olsen

Great Ormond Street Hospital For Children Nhs Foundation Trust, London (United Kingdom)

P-163: Imaging complications of solid organ and bone marrow transplantation

Tom Watson, David Hatch, Helen Spencer, Persis Amrolia, Paul Veys, Oystein Olsen, Catherine Owens

Great Ormond Street Hospital For Children Nhs Foundation Trust, London (United Kingdom)

P-164: Rare and unusual pediatric conditions are always present

Savas Deftereos, Aikaterini Zazaliari, Eugenia Vranou, Panos Prassopoulos

Democritus University Of Thrace, Alexandroupolis (Greece)

Functional Imaging

P-165: Functional assessment of the placenta with multiparametric MRI at 4.7T on a murine model of placental insufficiency

Marianne Alison [1,2], Gwennhael Autret [1], Daniel Balvay [1], Gihad Chalouhi [1], Thibault Quibel [1], Benjamin Deloison[1], Laurent Salomon [1], Charles André Cuenod [1,3], Olivier Clement [1,3], Guy Sebag [2], Nathalie Siauve [1,3]

[1] Inserm UMR 970, Paris (France); [2] Hôpital Robert Debré, Paris (France); [3] Hôpital Européen Georges Pompidou, Paris (France)

Abstracts of poster presentations

Neuroradiology

001

Bilateral anterior temporal cystic degeneration in pediatric patients with hypernatremic dehydratation

Mehmet Atalar[1], Rifat Nuri Sener[2]
[1] Cumhuriyet University School Of Medicine, Department Of Radiology, Sivas (Turkey); [2] Ege University School Of Medicine, Department Of Radiology, Izmir (Turkey)

Purpose-Objective. The purpose of this article is to document a new finding in hypernatremic dehydratation, consisting of development of bilateral cystic degeneration in the anterior temporal lobes.
Material and methods. Eight pediatric patients (5 boys and 3 girls; ages ranging from 2 to 9 years) are included in this study. Review of patient histories revealed that all had been hospitalized during the first two years of life due to severe hypernatremic dehydratation. MR imaging examinations were performed when they presented later with temporal lobe seizures. T1-weighted, and T2-weighted images (including FLAIR) were obtained. Echo-planar diffusion-weighted imaging was available in case of four patients.
Results. All patients had bilateral cyst-like changes at the tips of the temporal lobes on T1-and T2-weighted images. They were surrounded by gliotic tissue with irregular borders. Temporal horns of the lateral ventricles revealed dilatation and distortion due to tissue loss and gliosis. The pons, brainstem, basal ganglia, and cerebellum were not involved. On diffusion-weighted imaging ADC values in the lesions ranged from 1.60 to 2.45 X10-3 mm2/s, which were apparently lower than that of CSF, and higher than that of normal white matter.
Discussion and conclusions. This study reveals that anterior temporal lobes are vulnerable to hypernatremic dehydratation. Cystic degeneration likely due to macrocystic encephalomalacia can develop bilaterally as a permanent sequelae of the condition leading to temporal lobe seizures.

002

A clinicoradiological analysis of cranio-facial fibrous dysplasia in childhood

Mehmet Atalar, Ismail Salk
Cumhuriyet University School Of Medicine, Department Of Radiology, Sivas (Turkey)

Purpose-Objective. Fibrous dysplasia (FD) is a disorder of unknown etiology which may be monostotic or polyostotic. We herein aimed to present seven cases diagnosed as FD in our clinic.
Material and methods. A total of 7 pediatric patients (5 males and 2 females, patients' age ranging from 5 to 15 years old) with complete medical records and radiological appearances were included in this study. All of these patients were non-syndromic, had FD involving only the craniofacial region, and had no skin pigmentation or other evidence of endocrine problems. All patients underwent CT screening (during which all patients underwent three-dimensional CT scan). Two patients received MRI screening of the head. Data analyses were performed on the clinical manifestations, time of onset, signs and symptoms, involvement of craniofacial bones, and radiological appearances of the tumors in this patient group.
Results. The patients most commonly presented with enlarging mass and cosmetic complaints. The patients evaluated showed fibro-osseous lesions involving the maxillary, mandible, sphenoid, frontal and ethmoid bones. Four patients had the monostotic form and the other three had the polyostotic form on radiological examinations. Three-dimensional CT images show the extension of the lesions.
Discussion and conclusions. Knowledge of radiological features of craniofacial FD is of paramount importance for surgical planning and post-treatment follow-up.

003

X-linked Charcot-Marie-Tooth disease with transient CNS abnormalities in childhood

Shigeko Kuwashima, Takahide Nagashima
Dokkyo Medical University, Department of Radiology, Shimotsuga-Gun (Japan)

Purpose-Objective. We report a patient with X-linked Charcot-Marie-Tooth disease accompanied by mild encephalopathy with reversible splenial lesions in brain MRI.
Material and methods. A 16-year-old man suffered from episodic dysphasia during 2 days. On admission, he had dysphasia, dysphagia, right upper limb monoplesia, and right lower limb weakness. He noticed high-arched feet. The nerve conduction study described the presence of sensory-motor polyneuropathy.
Results. Brain MRI showed bilateral symmetric confluent hyperintense lesions in the splenium of the corpus callosum and centrum semiovale, with restricted diffusivity on diffusion weighted imaging. At follow-up MRI performed 2 weeks later, these MRI abnormalities were markedly reduced. MRI was consistent with mild encephalopathy with reversible splenial lesions (MERS). Gene analysis identified GJB1 mutation. We diagnosed the patient as having X-linked Charcot-Marie-Tooth disease (XCMT).
Discussion and conclusions. CMT denotes a group of hereditary motor sensory neuropathy that differs relatively little by phenotype. XCMT has both demyelinating and axonal features. As an X-linked disorder, males are more severely affected than females. XCMT can usually involve the CNS symptoms that present with ADEM-like lesion in the brain MRI. XCMT is due to mutation in GJB1, which codes for connexin 32. Some XCMTs with GJB1 mutations have shown transient CNS symptoms with abnormal brain MRI. The radiologists should consider the possibility of CMTX in these MRI findings in case of male patients.

004

Cranial CT and MRI findings in a pediatric burn patient with light-strike

Ahmet Sığırcı [1], Mehmet Demircan[2], Birsen Harma[2], Yılmaz Dengiz[3]
[1] Inonu Universitesi Turgut Ozal Tıp Merkezi Department Of Radiology, Malatya/Merkez (Turkey); [2] Inonu Universitesi Turgut Ozal Tıp Fakultesi Department Of Pediatric Surgery, Malatya (Turkey); [3] Inonu Universitesi Turgut Ozal Tıp Fakultesi Department Of Radiology, Malatya (Turkey)

Purpose-Objective. The nervous system is particularly susceptible to damage from lightning strikes. The mortality rate is approximately 20–33%. We report cranial CT and MR image findings of an 8 year old boy following lightning strike.
Material and methods. In an open field an 8 year old boy was struck by lightning. His anterior chest, back and feet suffered second- and third-degree burns. At the time of the lightning strike he had cardiac arrest. Immediate resuscitation was performed and his vital functions were maintained. There was loss of consciousness and paralysis. We aimed to present the findings of cranial CT and MR images.
Results. On cranial CT, there were symmetric hypodense areas in the basal ganglia and bilateral white matter, more specifically in the globus pallidus. There were findings of cranial edema. On cranial MR images, there was increased signal intensity on FLAIR and T2 and restriction of diffusion on DW images in bilateral globus pallidus, posterior leg of internal capsules, anterior part of mesencephalon, ventrolateral areas of thalamus, caudate nucleus, splenium of corpus callosum and bilateral deep cerebral white matters. Cytotoxic edema was considered to be significant in terms of imaging findings.
Discussion and conclusions. Due to the lightning strike, the deep grey matter and white matter areas, especially the globus pallidus, posterior leg of internal capsule and mesencephalone were affected symmetrically.

005

Central septum sign in the diagnosis of giant arachnoid granulations in MRI: a new finding?

Mehmet Atalar
Cumhuriyet University School Of Medicine, Department Of Radiology, Sivas (Turkey)

Purpose-Objective. The purpose of this presentation is to present a new imaging finding for evaluating the giant arachnoid granulations (AGs) with magnetic resonance imaging (MRI).
Material and methods. AGs which are greater than 5 mm or which occupy more than 50% of the sinus 349 in diameter in consecutive cranial MR examinations were enrolled. MR examinations were performed with 1.5 Tesla MR device (Excelart, Toshiba, Tokyo, Japan); T2W turbo spin echo (TSE), SE T1W, diffusion MR, fluid attenuated inversion recovery (FLAIR) and MR venography were obtained.
Results. A total of 20 arachnoid granulations were detected in cranial MR of 17 pediatric patients . The mean age was 9.7 years (1–17 years); 10 were females and 7 were males. Three patients had more than one AG. The localization of AGs were right transverse sinus in 9, left transverse sinus in 7, straight sinus in 3 cases and torcular herophili in 1 case. The mean diameter of arachnoid granulations was 7.3 mm (5–12 mm). Giant AGs were filling more than 50% of the sinus diameter. All AGs had a vascular formation as a hypointense focus in their center, which was called “central septum sign”
Discussion and conclusions. High-resolution MR imaging demonstrated a central vascular structure in all observed giant AGs and defined it as “central septum sign”. Presence of the “central septum sign” is a high-resolution MR imaging finding which will facilitate diagnosis of AGs.

006

Congenital cytomegalovirus of the CNS: a varying spectrum of appearances

Mary Mallon, Eric N. Faerber, Jacqueline Urbine, Erica Poletto
St. Christopher's Hospital For Children, Philadelphia, Pa (United States)

Purpose-Objective. A review of the varying spectrum of the imaging appearance of cytomegalovirus (CMV) infection of the central nervous system, the most common congenitally acquired infection in the United State, is presented here.
Material and methods. We performed a retrospective review of multimodality CNS imaging looking for intracranial findings compatible with congenital cytomegalovirus infection.
Results. Retrospective analysis produced an overview of the typical imaging findings seen most often in congenitally acquired CMV infection of the CNS. These findings include varied manifestations of intracranial calcification, migrational abnormalities and coexistent opportunistic infections. These abnormalities are evident in multiple modalities, as demonstrated here. In addition, one case of CNS infection by lymphocytic choriomeningitis (LCM) was discovered, an exact radiological mimic of congenital CMV infection.
Discussion and conclusions. All radiologists reading pediatric CNS imaging studies must be aware of the typical findings of congenital CMV infection. That radiologist must also be familiar with the appearance of LCM infection which can be indistinguishable by imaging from CMV.

007

HR MRI characteristics of cerebellar abnormalities in children with Joubert's syndrome

Alikhan Alikhanov [1], Elena Perepelova[2], Alisa Demushkina[1]
[1] Russian State Children Hospital, Moscow (Russian Federation); [2] Moscow Medical Academy, Moscow (Russia)

Purpose-Objective. Joubert's syndrome (JS) is a rare autosomal recessive condition characterized by partial or complete absence of the cerebellar vermis, leading to neonatal breathing abnormalities, jerky eye movements, hypotonia, ataxia, impaired equilibrium, and mental handicap. This study aims to describe the high resolution MR imaging cerebellar findings in children with JS .
Material and methods. A total of 5 children with clinical, neuroimaging and genetics evidence of JS were retrospectively reviewed. All patients were imaged in a period from 1 to 2 years postnatal life and all of them were followed by HR MRI at older age. Studies was performed using either 1.5 T or 3.0 T MRI scanners. Images were analyzed independently by three pediatric neuroradiologists and findings were agreed upon by consensus.
Results. The diagnosis of JS was based on typical MR appearances as the 'molar tooth sign', originating from the association of cerebellar vermis hypoplasia, horizontally-oriented and thickened superior cerebellar peduncles and a deepened interpeduncular fossa. High resolution protocol of MRI allows to identify in all cases different types of cerebellar pathology: areas of focal cerebellar dysplasias, disarrangement of cerebellar sulci, symptoms of "cortical dimple" and regions of cerebellar atrophy.
Discussion and conclusions. Traditional routine MRI may be insufficient to evaluate full spectra of cerebellar pathology in children with JS. High resolution protocol may depict greater detail providing important information in children with JS.

008

Evaluation of the size of optic nerve and optic nerve sheath in optic pathway glioma in neurofibromatosis type 1

Ali Varan[1], Ozge Sarac[2], Oktay Algın[3], Tulay Kansu[4], Banu Anlar[5]
[1] Hacettepe University Institute Of Cancer, Department Of Pediatric Oncology, Ankara (Turkey); [2] Ankara Ataturk Research And Training Hospital, Department Of Ophthalmology, Ankara (Turkey); [3] Ankara Ataturk Research And Training Hospital, Department Of Radiology, Ankara (Turkey); [4] Hacettepe University School Of Medicine, Department Of Neurology, Ankara (Turkey); [5] Hacettepe University School Of Medicine, Department Of Pediatric Neurology, Ankara (Turkey)

Purpose-Objective. To evaluate the size of the optic nerve and optic nerve sheath in neurofibromatosis type 1 (NF-1) patients with or without optic pathway glioma (OPG) with 3D-SPACE sequence in 3 tesla magnetic resonans imaging (MRI) unit.
Material and methods. Sixteen NF-1 patients with OPG (group 1), and 17 NF-1 patients without OPG (group 2) were included in this prospective study. All patients received conventional contrast-material enhanced brain MRI, and 3D-SPACE sequence. The size of the optic nerve and optic nerve sheath was measured on routine fat-saturated T2 weighted STIR and 3D-SPACE images. Patients with optic nerve glioma were excluded from the optic nerve and optic nerve sheath analysis.
Results. The average size of the optic nerve and optic nerve sheath measured with both MRI techniques did not show any significant difference between group 1 and group 2 ($p > 0.05$). The variables measured with either STIR or 3D-SPACE imaging techniques were correlated with each other in both groups 1 and 2 ($p < 0.05$).

Discussion and conclusions. Our study demonstrated that OPG presented in the optic pathways including optic chiasm, optic tractus, and optic radiations did not significantly effect the size of the optic nerve and optic nerve sheat. 3D-SPACE sequence is an efficient sequence for evaluation of NF-1 patients.

009

Brain metastasis from extracranial solid malignant tumors in children

Korcan Aysun Gonen[1], Zeynep Yazici[1], Betul Sevinir[2]
[1] Uludag University, Medical Faculty, Department Of Radiology, Bursa (Turkey); [2] Uludag University, Medical Faculty, Department Of Pediatric Oncology, Bursa (Turkey)

Purpose-Objective. True intraparenchymal brain metastasis of extracranial solid tumors is rare in children. The aim of this study is to investigate the radiological features of brain metastasis in pediatric extracranial malignant tumors.

Material and methods. Within a 10-year period, 484 children with extracranial solid tumors excluding lymphoma were diagnosed and treated at the pediatric oncology department. Patients with parenchymal brain metastasis were assessed. Lesions secondary to direct extension from the skull or dura were excluded.

Results. Five (4 female, 1 male) of 484 patients (1%) with extracranial solid tumors developed brain metastases. The median age of the patients was 4 (2 to 15) years. The diagnosis was Wilms' tumor in two patients, neuroblastoma, embryonal rhabdomyosarcoma and small-cell neuroendocrine carcinoma in one each. The brain lesions were multiple in all patients except one and supratentorial in four and both supratentorial and infratentorial in one. The patient with neuroblastoma had a solitary, hemorrhagic mass. In one patient with Wilms' tumor, some of the metastasis was calcified and additionally, leptomeningeal carcinomatosis was found. In patients with rhabdomyosarcoma and small-cell neuroendocrine carcinoma, there were large cystic masses.

Discussion and conclusions. Hematogenous brain metastasis is rare in children with extracranial solid tumors and the radiological appearances of these metastases are not specific. However, the diagnosis may be suspected if the existence of the primary tumor is known or the brain lesions are multiple.

010

Neurofibromatosis type 1, a disease with variable imaging expressions. A case rapport of a newborn boy with extraordinary features of NF 1

Stein Magnus Aukland [1], Anders B. Mjelle[2], Gunnar Moen[2], Andrea Rossi[3], A. James Barkovich[4], Rupavathana Mahesparan[2], Kristian Sommerfelt[2]
[1] Haukeland University Hospital & University Of Bergen, Bergen (Norway); [2] Haukeland University Hospital, Bergen (Norway); [3] Neuroradiology Dept. G. Gaslini Children's Hospital, Genoa (Italy); [4] Department Of Radiology, University Of California, San Francisco (USA)

Purpose-Objective. Here we present a male newborn with gross and unusual manifestations of Neurofibromatosis Type 1(NF1). Imaging shortly after birth detected severe pathological findings in the left hemisphere and left orbita.

Material and methods. NF1 is an autosomal dominant neurocutaneous disease known for its vast variability of expression and involvement of multiple organ systems. The clinical features of NFl are quite variable, but in the majority of cases, cutaneous lesions and/or family history of NF1 cause suspicion of presence of the disease prior to brain imaging.

Results. The boy born at term presented with severe exopthalmus on the left side. Brain MRI at day 1 showed expansion of the left hemisphere with several parenchymal haemorrhages, expansion in the left optic canal, contrast-enhancing lesion in the left cavernous sinus, left sphenoid bone dysplasia, aplasia of the left internal carotid artery and large ipsilateral intracranial gelatinous mass in the subarachnoidal space.

Discussion and conclusions. Neurofibromatosis Type 1 (NFl) is known for its vast variability of expression, including a broad range of cranial imaging expressions. In addition to confirming the diagnosis, neuroimaging may be of great value in raising the suspicion of such a disease, as in this case, where the diagnosis was delayed due to a clinically unusual manifestation and initial lack of recognition of the more basic signs of NF1.

011

Assessment of the 'shunt series' radiographs when investigating the child with a possible acute malfunctioning ventriculoperitoneal shunt

Oliver Hulson[2], Nasim Tahir[1, 2]
[1] Leeds Teaching Hospitals Nhs Trust, Leeds (United Kingdom); [2] Leeds General Infirmary, Leeds (UK)

Purpose-Objective. To assess the utility of the 'shunt series' in conjunction with head CT in the assessment of the child with a possible shunt malfunction.

Material and methods. All inpatient requests for shunt series were identified for a six-month period in a paediatric teaching hospital. Radiographic findings were documented along with findings from the corresponding head CT examination.

Results. During the 6 month period, 81 studies were identified in 30 patients. The mean age of the patients was 5.4 years. The mean number of shunt series in the 12 months prior to the index admission was 2.7. The mean number of CT head examinations was 4. The shunt tubing was normal in all 81 individual shunt series. Incidental findings were reported in eight individual studies. When considering the associated CT study, a minor increase in ventricle size was reported for 4 patients, a significant increase was reported for 4 patients and no significant interval change was reported in 20 patients.

Discussion and conclusions. In all patients with confirmed hydrocephalus, the shunt series was normal, showing that these radiographs are an insensitive assessment of shunt functionality, resulting in an increased radiation burden with no apparent clinical benefit. A better approach in the assessment of a possible shunt malfunction would be to perform the shunt series only after hydrocephalus is confirmed, or the surgical team requires the series in pre-operative planning.

012

Orbital infections in children: report of three cases

Vasiliki Georgopoulou, Thomas Nimas, Maria Sidiropoulou, Antonios Stratis, Emmanouil Zaikos, Anthoula Morichovitou, Tania Chrysopoulou, Nikolaos Barmpas, Efthymia Zafeiriadou

Department Of Computed Tomography, 1St Department Of Radiology, "Hippokrateio"General Hospital, Thessaloniki (Greece)

Purpose-Objective. Familiarity with infectious - inflammatory orbital abnormalities is crucial to radiologists as they represent more than half of primary orbital disease processes. The most common orbital infections are cellulitis and subperiosteal abscess, most commonly associated with paranasal sinusitis. If left untreated, they can lead to such complications as permanent vision impairment and meningoencephalitis. Our aim is to retrospectively evaluate Computed Tomography (CT) findings in three pediatric patients with orbital infections and to present relevant review of the literature.

Material and methods. We present the CT findings of three boys aged 2, 4 and 10 years, diagnosed with orbital infections. All patients suffered from paranasal sinusitis and presented with marked proptosis of the right globe.

Results. All patients had CT findings of paranasal sinusitis as well as swelling of the eyelid and its adjacent soft tissues. Two patients were diagnosed with a subperiosteal abscess (SA) and the other with periorbital phlegmon. In both cases of SA, a swollen right medial rectus muscle was depicted while in one case of SA demineralization of the lamina papyracea was observed.

Discussion and conclusions. In acute orbital infection, adequate physical examination of the eye is often made impossible due to swelling of the eyelid. CT is an established method and plays key role in timely demonstrating the presence and location of an orbital infection, thus enabling its early treatment.

013

Acquired type of Dyke – Davidoff – Masson syndrome: A case report and review of the literature

Tania Chrysopoulou [1], Maria Sidiropoulou[1], Anthoula Morichovitou[1], Vasiliki Georgopoulou[1], Anagnostis Skordas[1], Charalambos Liasidis[2], Emmanouil Zaikos[1], Eirini Kazantzidou[1], Efthymia Zafeiriadou[1]

[1] Department Of Computed Tomography, 1St Department Of Radiology, "Hippokrateio"General Hospital, Thessaloniki (Greece); [2] Department Of Neurology, "Hippokrateio"General Hospital, Thessaloniki (Greece)

Purpose-Objective. Dyke-Davidoff-Masson syndrome (DDMS) is a rare condition characterized by asymmetry of cerebral hemispheric growth with atrophy or hypoplasia of one side and midline shift and ipsilateral osseous hypertrophy with hyperpneumatisation of sinuses, mainly frontal and mastoid air cells. The etiology of DDMS is classified into two groups: in the congenital type, cerebral damage occurs during intrauterine life. In the acquired type, cerebral insults (due to trauma, infection or vascular abnormalities of the cerebral circulation) occur during the perinatal period or later. We report a case of DDMS (acquired type), emphasizing on imaging features and review of the literature.

Material and methods. A 17-year-old female presented with a generalized tonic-clonic seizure. Her past medical history included severe craniocerebral injury at the age of 9 months. She was under anticonvulsant treatment until the age of 12 years. Results of EEG revealed unstable alpha rhythm in the left cerebral hemisphere.

Results. Brain CT demonstrated atrophy of left cerebral hemisphere with dilatation of ipsilateral lateral ventricle, ipsilateral widening of Sylvian fissure and sulci, shift of midline to the left and a gliotic lesion at the left occipital lobe. Ipsilateral thickening of the calvarium and hyperpneumatisation of the left frontal sinus and the mastoid air cells were also demonstrated.

Discussion and conclusions. Assessment of proper history, thorough clinical examination along with imaging features can provide the diagnosis of DDMS.

014

A brain tuberculoma in 8-month-old infant – case report

Katarzyna Czerwińska [1], Justyna Komarnicka[1], Michał Brzewski[1], Marek Kulus[2]
[1] Department Of Pediatric Radiology Medical University Of Warsaw, Warsaw (Poland); [2] Department Of Pediatric Pneumonology And Allergy Medical University Of Warsaw, Warsaw (Poland)

Purpose-Objective. Intracranial tuberculosis is rare and more often in small children. Tuberculous meningitis, tuberculoma and tuberculous brain abscess are the most common forms. In adults tuberculomas are more commonly reported in the supratentorial, but in children in the infratentorial compartment. Brain tuberculoma can be the first sign of disease.

Material and methods. Our case was an 8-month-old boy, who was treated for 3 weeks for disseminated tuberculosis (lung, urinary tract, meninges), with sudden worsening of the general condition and new focal neurologic signs. A chest radiography showed increased pulmonary infiltration and more consolidations than earlier. Brain US, previously without changes, showed in the right hemisphere a solid, hiperechoic, poorly demarcated lesion, which slightly pressed to lateral ventricle. Biphasic CT revealed many, round, diffuse hyperdense enhancement lesions in whole brain with hypodense oedema regions around the largest lesions (7 mm in diameter) in the right hemisphere.

Results. After modifying the anti-tubercular chemoterapy, 3 weeks later the brain US showed no changes. Five months later brain CT revealed only one, small, enhanced lesion in the region of right cisterna ambiens. There was no complications of intracranial tuberculosis.

Discussion and conclusions. Tuberculosis still exists. Early correct diagnosis of tuberculosis in infants is important, because if undiagnosed or mistreated, it could lead to hematogenous or bronchogenic spread. Brain tuberculoma should be kept in mind in the differential diagnosis of brain tumours.

015

Malformations of cortical development: 3T MR imaging features

Murat Kocaoglu [1], Veysel Akgun[2], Emrah Ozcan[2], Selami Ince[2], Mustafa Tasar[2]
[1] Gulhane Military Medical School, Department Of Radiology, Ankara (Turkey); [2] Gulhane Military Medical School, Ankara (Turkey)

Purpose-Objective. Malformations of cortical development (MCD) are a heterogeneous group of disorders of central nervous system. The aim of this pictorial review is to exhibit the MR imaging and diffusion tensor imaging (DTI) features of MCD by using 3T scanner.

Material and methods. High resolution conventional MR images and DTI of MCD were reviewed. Associated abnormalities were also described.

Results. Embryonal development of cerebral cortex is divided into cell proliferation, cell migration and cortical organization. Anomalies of these stages may result in several disorders, some of which include polymicrogyria, schizencephaly, classic and cobblestone lissencephaly, hemimegalencephaly, heterotopia and focal cortical dysplasia.

Discussion and conclusions. The MRI has pivotal role in evaluating cortical formation abnormalities, their distribution, and associated anomalies.

016

Stroke in childhood

Elisabeth Ladanyi, Bela Lombay, Istvan Lazar
Borsod County Teaching Hospital Departmant Of Ped. Rad., Miskolc (Hungary)

Purpose-Objective. In this paper reasons and types of pediatric stroke during a 7 years period were assessed. The frequency of the stroke was compared with the results of our previous similar study. The importance of imaging modalities for the exact diagnosis was also summarized.

Material and methods. Patients with suspected stroke aged 1–18 years were investigated by CT and MRI in the Department of Pediatric Radiology of Borsod County Teaching Hospital. Acute phasis of stroke was investigated with spiral CT 1 slice or 128 slice Siemens SDAS, MRI was made by 1.5T Siemens MS and DSA was made in 5 cases by Siemens AA machine.

Results. During the last 7 years 89 patients with suspicion of stroke were investigated. The patients had severe headache, different paralysis and collapse. Among 23 patients with verified stroke 12 were ischemic and 11 hemorrhagic cases. Sinus thrombosis was found in 4 cases and other neurological specific lesions were in 62 cases.

Discussion and conclusions. Stroke pathophysiology has several complex mechanisms, it may be caused by vascular malformations, metabolic, cardiological and hematological diseases. Between 1995 and 2002, 2 cases/yr while between 2005 and 2012, 3 cases/year were registrated; a mild increasing was seen. MRI is the preferred modality but CT is useful in cases of hemorrhagic stroke. DSA opinion is important in case of vascular malformations and is also a therapeutic possibility in part of the cases.

017

Imaging finding of hypoxic-ischemic encephalopathy in neonates, infants, and children

Yun-Jung Lim [1], Su-Mi Shin[2]
[1] Haeundae Paik Hospital, Busan (Republic of Korea); [2] SMG-SNU Boramae Medical Center, Seoul (Republic of Korea)

Purpose-Objective. To present specific imaging findings of hypoxic-ischemic encephalopathy (HIE) in preterm/term neonates, infants and children and review the chronologic process of the injury.

Material and methods. From April 2011 to December 2012, 31 neonates, infants and children were suspected to encounter HIE and were diagnosed by ultrasound (US) and Magnetic resonance (MR) imaging and clinical findings. Among them, 19 were preterm (<36 weeks gestational age) neonates, ten were term (≥36 weeks gestational age) neonates, and two were children who suffered from drowning. Chronological changes of the brain evaluated by US and MR imaging after hypoxic-ischemic insults are reviewed. Specific imaging findings and relevant pathophysiologic processes are also reviewed.

Results. According to different stages of brain maturity, severity and duration of the insult, and time of imaging studies, imaging findings were characteristic. In preterm infants, brain US and MR revealed periventricular leukomalacia (n=14), germinal matrix hemorrhage (n=5). In term infants and children, seven were parasagittal borderzone injury and five were severe HIE involving gray matter structure.

Discussion and conclusions. Characteristic imaging findings of HIE can be observed depending on various factors such as brain maturity, severity and duration of insult, and type and time of imaging studies. It would be essential for radiologists to acknowledge such findings and perform adequate imaging modalities.

018

Brainstem disconnection syndrome: A pictorial review

Moti Chowdhury, A. Michelle Fink, Surekha Kumbla
The Royal Children's Hospital, Melbourne (Australia)

Purpose-Objective. Brainstem disconnection syndrome (BDS) remains poorly understood and given its rarity, potentially unrecognised. We present a pictorial review of BDS incorporating our own experience with cases described in the literature as an educational exhibit to promote their recognition.

Material and methods. Patients diagnosed with BDS were identified from our radiological database and their respective imaging independently reviewed by two paediatric neuroradiologists. Radiological findings, clinical and genetic data, where available, were collated. Using a defined search strategy in Medline/OVID, further reported cases in the literature were identified and equivalent data parameters extracted; the cumulative findings are pictorially illustrated.

Results. Ten cases of BDS are described, two from our radiological database and eight in the literature. Magnetic resonance imaging (one fetal, nine postnatal) most commonly demonstrates a triad of absent/thread-like pontine connection of the brainstem (100%), cerebellar hypoplasia (100%), and absent/hypoplastic basilar artery (67%). Less common findings include cerebral/midline structure (optic nerve, pituitary, hypothalamus) hypoplasia, dysplastic vestibulocochlear complex, dysmorphism, and non-neurological anomalies (cardiac, vesicoureteric reflux, talipes). Most common clinical manifestations comprise temperature instability, central respiratory failure, absent sucking/corneal reflex, seizures and cranial nerve deficits. All cases are fatal (range 5 days to 8 weeks).

Discussion and conclusions. The pictorial review serves as an educational tool illustrating both typical and sporadic features of BDS. Given its fatal prognosis, early fetal/postnatal diagnosis promotes parental counseling and support.

019

Devastating metabolic brain disorders of newborn and young infants

Ji Hye Kim, Tae Yeon Jeon, So-Young Yoo, Hong Eo
Samsung Medical Center, Sungkyunkwan University, Seoul (Republic of Korea)

Purpose-Objective. Early postnatal onset metabolic brain disorders often present with acute symptoms of encephalopathy & life threatening metabolic derangement, and they fall into the category of devastating metabolic diseases. The purpose of this poster is to review clinical and imaging findings of metabolic brain disorders of newborn and infants.

Material and methods. We reviewed clinical presentations and neuroimaging findings of inborn metabolic disorders presenting in newborn and infantile period including amino acid metabolism disorders, fatty acid oxidation defects, primary lactic acidosis, lysosomal or peroxisomal disorders, organic acidemias, and urea cycle disorders. Several differential diagnoses such as hypoxic ischemic encephalitis, child abuse, bilirubin encephalopathy will also be included for comparison.

Results. Although non-specific brain edema, atrophy & delayed or hypomyelination are seen on MRI in neonatal metabolic disorders, several characteristic imaging patterns may be identified with DWI & MR spectroscopy enhanced diagnostic accuracy.

Discussion and conclusions. Neuroimaging has a significant role to establish prompt & efficient diagnostic work-up strategies to prevent death & severe neurologic sequelae and diagnostic approach should include assessment of clinical presentations, neuroimaging, & proper screening tests to schedule adequate emergency treatment.

020

Rhombencephalosynapsis: A case report

Ashwin Hegde
University Of Nebraska Medical Center, Omaha (United States)

Purpose-Objective. The purpose of this presentation is to review the MR imaging characteristics of rhombencephalosynapsis, a rare congenital malformation of the cerebellum characterized by fusion of the cerebellar hemispheres, vermian hypogenesis and fusion of the dentate nuclei.
Material and methods. A 2 year old female was brought to a neurologist to follow up on the patient's development after a reported history of hydrocephalus at birth on a limited ultrasound. The patient's head circumference was normal and had a normal neurologic exam. The physical exam also revealed mild facial dysmorphism with a wide nasal bridge and a systolic murmur. A 1.5T MRI with and without contrast was performed to formally evaluate the patient's neuroanatomy.
Results. MRI of the brain demonstrated an absent cerebellar vermis and fusion of the cerebellar hemispheres in the midline, characteristic of rhombencephalosynapsis. The patient also had callosal dysgenesis with an underdeveloped isthmus and splenium of the corpus callosum. Genetic testing revealed a deletion of chromosome 2p21 six3 gene, which is related to holoprosencephaly.
Discussion and conclusions. Rhombencephalosynapsis is a very rare congenital abnormality of cerebellar development with characteristic MRI findings. A result of failed vermian differentiation with fused cerebellar hemispheres and dentate nuclei, rhombencephalosynapsis may also be associated with other developmental anomalies.

021

Sigmoid sinus thrombosis after blunt head trauma in a child - case report and review of the literature

Norbert Utz [1], Christian Haneke[2], Ralf Dörbecker[2], Marcus Katoh[2]
[1] Pediatric Radiology Department Helios Klinikum Krefeld, Krefeld (Germany); [2] Helios-Klinikum Krefeld, Krefeld (Germany)

Purpose-Objective. Presentation of a 4 year old child who developed a thombosis of the right sigmoid sinus after closed head injury.
Material and methods. Case report and review of the literature.
Results. Cranial CT after head trauma showed a skull fracture close to the right sigmoid sinus. MRI revealed a thrombosis of the right sigmoid sinus in the follow-up scan 24 h after the injury without any thrombosis-associated parenchymal lesions. After low-dose anticoagulation of 8 weeks complete recanalisation of the right sigmoid sinus was demonstrated in the MRI follow-up.
Discussion and conclusions. Dural sinus thrombosis associated with trauma is rare in children with an estimated frequency of 4–6%. Several theories regarding the mechanism leading to dural venous thrombosis in skull trauma exist including obstruction of the dural sinuses from traumatic rifts, compression of the sinus from intracranial edema or bleeding, intramural hemorrhage caused by rupture of small sinuoids and injury of the endothelial lining. Although most reports describe dural sinus thrombosis associated with skull fracture, there have been few reports of this complication in the absence of a fracture as well. Clinical signs of traumatic sinus thrombosis are unspecific. Gait ataxia, headache and vomiting have been reported and should raise suspicion of sinus thrombosis when they persist or develop several days after the injury.

022

Cranial ultrasonography as a screening tool in neonatal intensive care unit, in both symptomatic and asymptomatic neonates

Savas Defteros, Melphomeni Kosmidou, Aikaterini Zazaliari, Sofia Amanatidou, Panos Prassopoulos
Democritus University Of Thrace, Alexandroupolis (Greece)

Purpose-Objective. To evaluate accuracy and value of ultrasound (US) scanning in predicting neurodevelopmental and sensorineural outcome in Neonate Intensive Care Unit patients with or without clinical symptoms and to detect high-risk populations that might need cranial US screening.
Material and methods. In this retrospective study, 242 newborns underwent US and neurological evaluation in first 3-days of life. 61 (25.21%) were term and 181 (74.79%) were preterm neonates. In all patients medical records (US, MRI studies, long-term outcome) were available. Abnormal US findings were classified as non-significant (NS), including normal and normal variations or significant (with two subgroups: minor and major).

Results. 124 (51.24%) neonates were estimated as NS group (most common normal variation was presence of cavum septum pellucidum). Minor anomalies (e.g. mild intraventricular hemorrhage) were found in 64 (26.45%) neonates. Major anomalies were found in 54 (22.31%) neonates, (e.g. obstructive hydrocephalus, corpus callosum agenesis, etc.). Two (0.83%) infants had Silver-Russell syndrome and neonatal seizure, initially underestimated as NS cases. The incidence of minor and major anomalies detected by cranial US in fullterm neonates is 11.48% (7/61) and 3.28% (2/61), respectively.
Discussion and conclusions. Cranial US screening-test is of great value in preterm neonates and may play a role in early diagnosis of intracranial anomalies of otherwise healthy neonates. Routine screening cranial US seems to be recommended for all infants born at 32 weeks' gestation or earlier. Cranial US as screening-test in healthy fullterm needs further evaluation.

023

Severe cerebral haemorrhage in two infants with parechovirus infection

Gerald Pärtan[1], Corina Bartl-Vischer [1], Wolfgang Bock [2],, Sigrid Brandtner[3], Herbert Kurz [3] Walter Sterniste [2]
[1] Institut F. Roentgendiagnostik, Donauspital Im SMZ Ost, Vienna (Austria); [2] Danube Hospital, Neonatal Intensive Care Unit, Vienna (Austria); [3] Danube Hospital, Department Of Paediatrics, Vienna (Austria)

Purpose-Objective. Presentation of severe haemorrhagic cerebral lesions in the course of cerebral HPeV infections in two preterm male infants (born at 34+1 and 33+4 weeks of gestation, respectively). Both boys previously thriving well presented at 4 and 2 weeks, respectively post partum with symptoms encompassing seizures in both and fever, diarrhea and sucking weakness in any one of both cases.
Material and methods. Imaging at the time of onset of symptoms was done with CT and consecutively US and MRI in the first case, and with US and MRI in the other one. MRI included diffusion- and susceptibility weighted sequences.
Results. Haemorrhage in the basal ganglia in both cases, and intraventricular and white matter haemorrhage, respectively in any one of both cases were shown. Consecutively, widespread destruction of white and grey matter with hydrocephalus evolved in both cases.
Discussion and conclusions. To date, human parechoviruses (HPeV), specifically HPeV3, have been described as cause of neonatal viral encephalitis, with cerebral white matter injury, but not hemorrhagic lesions which we have demonstrated with the two cases presented here. The course of symptoms and imaging findings can be regarded as evidence for the parecho virus infection and not the preterm birth as the cause of the lesions. The twin brother of one of the boys showed white matter lesions compatible with the previously described pattern of parechovirus encephalitis.

024

Role of MRI in fetal ocular anomalies: what do you "see"?

Marc R. Jordaan, Sandrine Yazbek, Carol E. Barnewolt, Susan A. Connolly, P. Ellen Grant, Caroline D. Robson, Judy A. Estroff, Sanjay P. Prabhu
Boston Children's Hospital, Boston (United States)

Purpose-Objective. To illustrate the role of MRI in diagnosis of fetal ocular anomalies. To describe the MRI measurements used to detect ocular anomalies. To illustrate salient imaging features of pertinent ocular anomalies. To provide a diagnostic aid for radiologists who interpret fetal imaging.
Material and methods. We present examples of fetal ocular anomalies from our tertiary care center to illustrate imaging features of syndromic and non-syndromic conditions of the fetal eye. We include a table of normal morphometric measurements used to diagnose ocular anomalies. Cases are substantiated by correlation with prenatal ultrasound and postnatal imaging.
Results. Fetal ocular anomalies such as cataract, microphthalmia, anophthalmia, and coloboma can be seen on fetal MRI studies. Morphometric measurements confirm hypertelorism and hypotelorism seen on ultrasound. Recognizing these findings helps make syndromic and non-syndromic diagnoses in conjunction with other CNS and non-CNS anomalies. These diagnoses can have significant clinical implications for patients and families.
Discussion and conclusions. As relatively uncommon disorders, fetal ocular anomalies may be under-recognized on routine prenatal imaging. Radiologists should be versed in the diagnostic approach to these conditions, as early diagnosis is imperative for the management of the infant with congenital ocular disease. With availability of faster, higher resolution sequences, detection of ocular anomalies on fetal MRI is becoming increasingly possible. These anomalies may be a manifestation of certain genetic syndromes, and may guide the radiologist's systematic assessment for coexistent fetal anomalies.

025

Spinal serendipity – common and unusual incidental findings in paediatric lumbar spine MRI

Marc R. Jordaan, Sandrine Yazbek, Sanjay P. Prabhu
Boston Children's Hospital, Boston (United States)

Purpose-Objective. The aim of this exhibit is to inform the reader of the importance of detailed assessment of the entire

imaged field when interpreting paediatric lumbar MRI. Through case examples, we reinforce that a systematic approach to the interpretation of these studies improves the likelihood of detecting incidental, yet clinically significant extra-spinal abnormalities.

Material and methods. We present a series of incidental extra-spinal abnormalities first detected on routine lumbar spine MRI in our neuroradiology department. A brief clinical history, salient imaging findings and a succinct discussion of clinically relevant information is provided for each case. We also outline a systematic approach to interpretation of paediatric lumbar spine MRI through case examples.

Results. Incidental findings are distributed across organ systems and are often located at the periphery of the imaged field-of-view.

Discussion and conclusions. So-called "incidental" findings are not unusual phenomena in the world of imaging, and have garnered significant attention and discussion in recent radiology literature. A systematic approach to interpretation of paediatric lumbar spine MRI improves the likelihood that clinically relevant extra-spinal abnormalities will not go undetected.

026

Non-traumatic conditions of the pediatric sacrum: multimodality imaging

Shannon N. Zingula, Laurence J. Eckel, Alice Patton
Mayo Clinic, Rochester, Minnesota (United States)

Purpose-Objective. The goal of this educational exhibit is to demonstrate the normal anatomy of the pediatric sacrum and various developmental abnormalities, and to illustrate the imaging findings of a wide spectrum of pathologic sacral conditions.

Material and methods. Sacral anatomy and pathology will be reviewed, including absence/incomplete development, infective and neoplastic conditions, derived from a retrospective review of our institutional database.

Results. Radiographs, sonograms, computed tomographic and magnetic resonance images of normal structures and pathologic entities will be presented. Potential misdiagnoses are discussed.

Discussion and conclusions. There is a wide spectrum of pathologic conditions that may involve the bony sacrum and the surrounding tissues, which includes not only osseous and fibrocartilaginous elements of the sacroiliac joints, but also the neural and meningeal components. These include absence or incomplete development of the sacrum, infections such as sacroiliitis, and non-aggressive conditions such as Tarlov cyst and anterior meningocele. Neoplasms such as aneurysmal bone cyst, primitive neuroectodermal tumor, chordoma, Ewing sarcoma, osteosarcoma, and metastatic disease may affect the sacrum. Furthermore, teratoma, with unusual predisposition to involve the sacrococcygeal spine, and various non-bony sacral canal neoplasms such as nerve sheath neoplasms and drop metastases will also be discussed. Therefore, with the spectrum of abnormalities that can affect it, the sacrum is an important site of spinal pathology, as an isolated entity or as a manifestation of an underlying systemic condition or syndrome.

027

Comparison of a novel semi-automatic segmentation technique and manual tracing technique for MR volumetric measurements of the pituitary gland in children and adolescents

Hans-Joachim Mentzel [1], Therese Lincke [1], Claudia Vilser [2], Karim Kentouche [2], Diane Renz [3], Martin Stenzel [1], Horst K Hahn [4]
[1] Dept Pediatric Radiology, University Hospital, Jena (Germany); [2] Dept of Pediatrics, University Hospital Jena, Germany; [3] Dept of Radiology, Charite Berlin, Germany; [4] MEVIS, Bremen, Germany

Purpose-Objective. The purpose of this study was to evaluate a novel semi-automatic MR-based segmentation technique for volumetric measurements of the pituitary gland. The computer-assisted segmentation technique is based on an interactive watershed transform after resampling and gradient computation.

Material and methods. 28 children and adolescents (19 males; age 1.5–26.2 years) were included. T1w 3D non-enhanced MP-RAGE sequences at 1.5 T with 1 mm isotropic voxel size were acquired. Volumetric measurements were performed using the ILAB-4 software (MeVis Medical Solutions, Bremen, Germany) and compared with a calculated volume based on the ellipsoid formula after manual tracing of the glands boundaries. The measurements were executed by two observers. Statistical analysis was performed using SPSS 20.0 (IBM Corp.).

Results. The Interclass correlation coefficient (ICC) for the volunteers was between 0.961 and 0.997 using the manual tracing technique, and 0.990 and 0.9997 using ILAB-4. The difference between the semi-automatic and the manual technique was between 0.031 mm^3 and 0.068 mm^3; the standard deviation was smaller using ILAB-4. Time requirements for ILAB-4 was 30–50 s and for the manual tracing technique 70–170 s plus additional calculation time.

Discussion and conclusions. The analysed semi-automatic ILAB-4 software is a valid, fast and easy to perform technique for volumetric analysis of the pituitary gland in children and adolescents.

Chest/Cardiac

028

Phlebectasia of persistent left superior vena cava accompanying a giant cervico-mediastinal lymphangioma

Mehmet Atalar [1], Gokhan Koyluoglu[2], Sinasi Manduz[3]
[1] Cumhuriyet University School Of Medicine, Department Of Radiology, Sivas (Turkey); [2] Cumhuriyet University Hospital, Department Of Pediatric Surgery, Sivas (Turkey); [3] Cumhuriyet University Hospital, Department Of Cardiovascular Surgery, Sivas (Turkey)

Purpose-Objective. Lymphatic malformations (LM) are rare, often presenting as congenital abnormal growth of lymphatic vessels diagnosed most commonly in the pediatric population. Venous anomalies are rarely seen with cystic hygromas. In this exhibit, we present the MDCT and MDCT- angiography findings in an unusual case of phlebectasia of persistent left superior vena cava (PLSVC) accompanying that of lymphatic malformation.
Material and methods. A 6-week-old full-term male was brought to the emergency department with a 2-week history of progressive left neck swelling and tenderness. On examination, the left lateral neck was notable for an 8×6 cm soft mass that transiently expanded with crying. Multimodality imaging evaluation of the neck and thorax showed multiloculated cystic lesions on the left side of the neck spreading through the soft tissues. MDCT and MDCT-angiography examinations were performed with low radiation dose techniques.
Results. Multidedector computed tomography (MDCT) examination reveals location and extent of the cystic hygroma and a PLSVC connected with dilated coronary sinus.
Discussion and conclusions. Due to different MDCT post-processing techniques, even complex vascular malformations are visualized in an understandable way even for preoperative planning. Knowledge of venous anomalies may be helpful to the surgeon planning resection of a cystic hygroma.

029

Role of ultrasound of the thorax in children

Jeevesh Kapur
National University Hospital, Singapore (Singapore)

Purpose-Objective. To evaluate the role of ultrasound in assessment of intra-thoracic abnormalities in children and its impact on further management.
Material and methods. All the pediatric (0–16 year age group) chest ultrasounds referred to the department (National University Hospital) over the last 2 years were reviewed. The ultrasounds for intrathoracic abnormalities were evaluated and the outcome and management of the patients were assessed.
Results. A total of 42 studies were performed for evaluation of thoracic and lung disease and follow up. There were 10 cases of consolidations, 5 cases of consolidation with underlying cavitation, 6 cases of empyema, 10 cases of simple pleural effusion, 4 cases of pulmonary sequestration, 3 cases of suspected mediastinal mass (enlarged thymus), 2 cases of diaphragmatic palsy/eventration, and 2 intrathoracic tumors.
Discussion and conclusions. 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.

030

Pulmonary sclerosing hemangioma: a case report

Martina Gatti [1], Simone Sala[2]
[1] Department Of Radiology - University Of Ferrara, Ferrara (Italy); [2] Department Of Radiology - Arcispedale S. Anna, Ferrara (Italy)

Purpose-Objective. To describe imaging findings of Pulmonary Sclerosing Hemangioma
Material and methods. A solitary mass in right lung was detected on chest radiography in a 13 years old female patient. Abdominal ultrasound, chest computed tomography (CT) scan and blood tests were performed.
Results. Abdominal ultrasound was normal. Chest CT confirmed a well-circumscribed lobular lesion of 32×28 mm in the right lower lobe, without calcification. After contrast medium administration, heterogeneous enhancement of the lesion was observed. No regional lymph node enlargement was present. Negative results were obtained in the blood analysis for tumor markers. Quantiferon test was negative. Surgical removal of the right lower lobe was performed; pathological examination revealed pulmonary sclerosing hemangioma (PSH).
Discussion and conclusions. PSH is an uncommon benign tumor first desribed in 1956. The actual prevalence of PSH is not known due to the relatively asymptomatic nature of the disease that is usually diagnosed as a single asymptomatic nodule in the periphery of the lung with well defined margins. Differential diagnoses include carcinoids, hamartoma, malignant teratoma, arterio-venous malformations and inflammatory lesions. PSH shows benign imaging findings such as poor growth, non-invasiveness, absence of lymph nodes enlargement. When

a benign lung tumor is suspected, long term observation is reasonable. However, if CT findings are not definitive patients should undergo surgical resection, mainly in large lesions as in the case that we have observed.

031

Assessment of diaphragmatic function using dynamic Magnetic Resonance Imaging

Ankit Vyas, Erich Sorantin, Alexandra Lohnegger
Div. Pediatric Radiology, Dept. Of Radiology, Medical University Graz (Austria)

Purpose-Objective. Diaphragmatic function can be assessed semiqantitatively by ultrasound, fluoroscopy and Magnetic Resonance Imaging (MRI). The purpose of the study is to present a novel method for assessment of diaphragmatic function in volunteers.

Material and methods. Seven volunteers (average age 25.36±1.30 years) were investigated by functional MRI using an optimized TRUE FISP sequence (acquisition time less than 40 ms). A sequence of coronal images in a midthorax position was acquired during spontaneously breathing. Afterwards, for every individual image of the dynamic sequence, the lung area was segmented semi automatically and the corresponding area calculated. The difference between the area of maximal inspiration to maximal expiration was computed and regarded as surrogate parameter of diaphragmatic function. All values were normalized to the area of maximal inspiration and to body surface area (BSA). In addition the ratio between right and left lung was calculated.

Results. The percentual change of the cross sectional area from inspiration to expiration was on average for right hemithorax 34.39±23.06% and for left 44.43±33.46%, values normalized to BSA were for the right side 1017.53± 362.77 mm^2/m^2BSA and for the left 969.48± 410.49 mm^2/m^2BSA. Ratio between right to left hemithorax areas could be computed with an average of −0.98±0.41.

Discussion and conclusions. Based on dynamic MRI quantitative assessment of diaphragm function is possible and normal values were established.

032

Plastic bronchitis mimicking foreign body obstruction on chest radiograph

Simranjit Peritam Singh [1], Jason Bronstein[2], Kalliope Tsirilakis[2], Morris Edelman[2], Sukhjinder Singh[2]
[1] University Of Texas Southwestern Medical School, Dallas (USA); [2] Cohen Children's Medical Center, New Hyde Park, Ny (USA)

Purpose-Objective. We present a 17 month old male with a history of asthma who presented to the ED with severe respiratory distress refractory to nebulizers and steroids. Initial Chest X-ray demonstrated severe asymmetric hyperinflation of the right upper lobe and the patient was taken urgently for bronchoscopy for suspected foreign body removal. Unexpectedly, bronchoscopy revealed bronchial casts in the right upper lobe segments and left lower lobe bronchus, consistent with plastic bronchitis. This case illustrates a unique presentation of plastic bronchitis with severe hyperinflation on chest radiographs mimicking foreign body aspiration.

Material and methods. See above

Results. See above

Discussion and conclusions. See above

033

Examination of a method to evaluate pulmonary venous obstruction using contrast CT images to total anomalous pulmonary venous connections

Makoto Shimada [1], Shuji Abe [2], Shouji Tani[2], Masanori Nishikawa[2], Koichi Yabunaka[3], Toshizo Katsuda[4], Hidetoshi Yatake[5], Taisuke Enoki[6]
[1] Department Of Radiology, Osaka Medical Center And Research Institute For Maternal And Child Health, Izumi (Japan); [2] Osaka Medical Center And Research Institute For Maternal And Child Health, Izumi (Japan); [3] Katsuragi Hospital, Kishiwada (Japan); [4] National Cerebral And Cardiovascular Center, Suita (Japan); [5] Kaizuka City Hospital, Kaizuka (Japan); [6] Osaka Kyoiku University, Osaka (Japan)

Purpose-Objective. Total anomalous pulmonary venous connections (TAPVC) are frequently accompanied by pulmonary venous obstruction (PVO). CT and echocardiography are performed for imaging-based diagnosis of TAPVC. Although echocardiography is mainly used to evaluate PVO, objective evaluation may be difficult in some cases. Thus, we focused on the fact that pulmonary congestion occurs when PVO is severe, and assumed that the CT value in the lung field changes. The objective of this study was to clarify the relationship between changes in the CT value and PVO, and investigate a method to objectively evaluate PVO in contrast CT images.

Material and methods. The subjects were 12 surgical patients with PVO findings by echocardiography who underwent contrast CT and echocardiography at the same time. The evaluation of PVO was judged by comparison between changes in the lung-field CT value and echographic findings. The mean CT value of all slices was adopted as the lung field CT value.

Results. Changes in PVO by echocardiography were noted in 10 of 12 patients, and changes in the CT value and echographic findings were consistent in 7 of them (70%).

The postoperative CT value was lower than the preoperative value in all 12 patients.
Discussion and conclusions. Pathological changes can be detected by observing changes in the lung-field CT value. CT is capable of objectively evaluating PVO, showing its superiority to echography.

034

Imaging of pulmonary hydatid disease in children
Ali Yikilmaz [1], Sureyya Burcu Gorkem[2], Dursun Alper Hayırlıoğlu[1], Firdevs Ikbal Gucer[1], Abdulhakim Coskun[2]
[1] Istanbul Medeniyet University Goztepe Training And Research Hospital, Istanbul (Turkey); [2] Erciyes University, Children's Hospital, Kayseri (Turkey)

Purpose-Objective. To evaluate the chest radiography, CT, US and MRI findings of pulmonary hydatid disease (HD) in children.
Material and methods. Eighteen patients (11 males and 7 females, age ranged from 4 to 15 years) with surgically or clinically proven pulmonary HD were enrolled in the study. Clinical and imaging findings in all patients were reviewed between 2009 and 2013. Chest roentgenograms and CT scans were present in all patients. Additional MRI and ultrasound images were also evaluated when present. The radiological features including localization, number, diameter, wall thickness, detached membranes, presence of bronchogenic rupture or infection were determined.
Results. There were 20 cysts in 18 patients. 16 patients had solitary cyst and 2 of the patients had 2 separate cysts in both lungs. The most common localization was lower lobes (9/20). The diameter of the cysts ranged between 4 cm and 13 cm with a mean of 6.5 cm. The most common presentation of the cysts was round or ovoid fluid cyst with air (9/20). In 7 patients, there was uniloculated fluid cyst without air. Detachment of the membranes correlated with associated infection ($p<0.05$). The cyst size did not correlate with detachment of the membranes ($p>0.05$).
Discussion and conclusions. HD of the lung presents with complicated or non-complicated cysts in the lung. The radiological features are quite characteristic. Knowledge of these radiologic features will help to make the early diagnosis and treatment.

035

Traumatic tracheal rupture in children: report of two cases
Nikolaos Barmpas, Maria Sidiropoulou, Anthoula Morichovitou, Anagnostis Skordas, Eirini Kazantzidou, Vasiliki Georgopoulou, Thomas Nimas, Tania Chrysopoulou, Efthymia Zafeiriadou
Department Of Computed Tomography, 1St Department Of Radiology, "Hippokrateio"General Hospital, Thessaloniki (Greece)

Purpose-Objective. Tracheal trauma is an uncommon occurrence in children because of their anatomy that provides the ability to absorb blunt forces. Tracheal disruption is a rare occurrence appearing in only 0.34% to 1.5% of all blunt neck trauma cases. The posterior membranous part of trachea is the commonest site of rupture. We describe the CT findings of two children with traumatic tracheal rupture and present relevant review of the literature.
Material and methods. The medical and imaging records of two girls (aged 5 and 2 years, respectively) diagnosed with traumatic tracheal rupture were retrospectively reviewed. The 5-year-old girl hit the anterior part of her neck on the corner of a low wooden stool. The 2-year-old girl presented with blunt chest trauma after a closet fell on her.
Results. The 5-year-old girl presented with cough and swelling of the face, neck and chest. Neck and chest CT revealed a posterior tracheal defect at T1 thoracic vertebrae level. The 2-year-old girl was admitted with respiratory distress. The performed neck and chest CT depicted a posterior membranous tracheal tear approximately 2.5 cm above the carina. Both girls demonstrated pneumomediastinum, bilateral pneumothorax, and extensive subcutaneous emphysema of the neck and thorax.
Discussion and conclusions. Membranous injuries are treated more often with a conservative approach, as both of our patients, who were discharged home in good condition.

036

White out of the Lung - not so "black and white"
Tanyia Pillay, Nicky Wieselthaler
Red Cross War Memorial Children'S Hospital, University Of Cape Town, Cape Town (South Africa)

Purpose-Objective. White out of the lung on chest x-ray is most commonly caused by either a pleural effusion or consolidation. In a patient with a non-resolving white out of the lung, other causes need to be considered.
Material and methods. Ultrasound is a good first line investigation, however most complicated cases will go on to have further imaging.
Results. We highlight 4 patients who presented with a white out of the lung and were found to have unusual pathologies.
Discussion and conclusions. In a patient with a non-resolving white out of the lung, other causes need to be considered. Histology is usually required for a definitive diagnosis.

037

Computed tomography before bidirectional Glenn anastomosis in infants with functional single ventricle

Evangelos Mourtos, Marika Lidegran, Annika Öhman
Astrid Lindgren Children's Hospital, Karolinska University Hospital, Karolinska Institutet, Stockholm (Sweden)

Purpose-Objective. To describe our experience with CT in the evaluation of patients with functional single ventricle before the Glenn procedure

Material and methods. During a 18-month period six infants with complex congenital heart disease resulting in functionally univentricular hearts were examined, using a second generation dual source CT scanner, as part of pre-Glenn evaluation. Mean age was 2.1 months with body weights ranging from 3.4 to 6.4 kg.

Results. The majority were examined with a high-pitch dual source spiral CT protocol whereas in one patient prospective ECG-triggered sequential scanning was used. Most were examined without sedation with only two patients receiving a mild sedative. Mean effective dose was 1.1 mSv. The complex anatomy of the heart and extracardiac structures was depicted in detail, including the size and configuration of the pulmonary arteries. Four out of six patients were accepted for the Glenn procedure without the need for further evaluation. Findings were confirmed at operation.

Discussion and conclusions. Cardiac catheterization or recently MRI are most frequently used for routine evaluation before the Glenn procedure in patients with single-ventricles. However, catheterization is invasive and both methods generally require general anesthesia which carries significant risks in this patient group. We suggest that cardiovascular CT be used as a safe alternative to catheterization and MRI in the evaluation of infants with single-ventricle physiology before Glenn anastomosis.

038

Activated charcoal bronchial aspiration with abscess formation: a case report

Damjana Ključevšek, Mojca Tomažič, Martin Thaler, Anton Kenig
University Clinical Centre, Children's Hospital, Ljubljana (Slovenia)

Purpose-Objective. Activated charcoal (AC) is part of the standard treatment for most toxic ingestions and is considered a benign therapy. We report a case of aspiration of AC into the lung that resulted in the development of lung abscess.

Material and methods. A 13-year-old girl, who had attempted suicide, was treated with AC administered through nasogastric tube. She vomited soon after procedure. Few hours later she became febrile and complained about left sided chest pain. Chest X-ray showed left-sided aspiration pneumonia with pleural effusion. Antibiotic treatment was introduced. In the following days, chest X-rays and US examinations showed progressive abscess formation and multiloculated pleural effusion. She underwent bronchoscopy: an abundant quantity of blackish material was obtained. Left bronchial system was edematous and narrowed. MR of thorax confirmed big lung abscess with empyema. First, thoracic drainage was performed with intrapleural administration of fibrinolytic agents. This was followed by decortication and abscess removal.

Results. She was released from hospital 3 weeks after surgery. Chest X-ray showed left-sided pleural effusion with inhomogenous opacities of affected parenchyma.

Discussion and conclusions. Complications resulting from AC use mainly affect the respiratory, rarely the gastrointestinal tract. Early pulmonary involvements include obstructive laryngitis, bronchospasm, pneumonia, respiratory failure, abscess formation. Granuloma, bronchiolitis obliterans, chronic changes in lung parenchyma and lung mass can be found in AC-laden areas even years later. Therefore, the girl should be followed-up for years.

039

Rare complication of foreign body aspiration – case report

Eva Kovacs, Balazs Nemeth, Eva Gacs
Heim Pal Children's Hospital, Budapest (Hungary)

Purpose-Objective. Despite significant advances in emergency airway management and endoscopic technology, airway foreign bodies still lead to significant morbidity and pose an important risk of death in the pediatric population. We overview the possible complications of foreign body aspiration through a case report.

Material and methods. An 18 months old boy was referred to the oncologist because of bilateral neck swelling, following a few days of coughing, low grade fever and flue-like symptoms.

Results. On physical examination subcutan emphysema was found, with weakened breath sounds on the right. CXR showed mediastinal shift, right-sided air trapping, pneumomediastinum and subcutaneous emphysema. Since the patient ate fish on the day before, tracheal or esophageal injury was suspected and an emergency CT examination of the neck and chest was performed. Beside the above-mentioned findings, a foreign body was detected in right main bronchus.

A piece of peanut was removed via bronchoscopy. Because of pneumomediastinum, a mediastinal drain was inserted. After surgery the patient's condition improved, but 3 days later bilateral PTX was detected, and pleural drains were inserted. The patient recovered completely.

Discussion and conclusions. Foreign body aspiration is a life-threatening condition occurring most frequently in children under the age of four. Parents should be educated to avoid giving nuts to young children and to keep them in baby seats during meals.

040

Imaging tetralogy of Fallot in children by High Field Open (HFO) 1.0 Tesla MRI scanner: a pictorial essay

Dimitra Loggitsi [1], Georgia Papaioannou [1], Nikolaos Kritikos [1], John Zampelis [1], Evangelia Manopoulou [1], Aphrodite Tzifa [2]
[1] CT/MRI Department, Mitera Hospital, Athens (Greece); [2] Pediatric Cardiology Department, Mitera Hospital, Athens (Greece)

Purpose-Objective. MRI represents the method of choice for monitoring ventricular and valve function in the follow-up of Tetralogy of Fallot patients. In our institution we use a High Field Open (HFO) 1.0Tesla MR scanner to perform advanced cardiac MRI.

Material and methods. During an 18-month period 34 children with TOF aging from 6 days to 18 years underwent cardiac MRI study by HFO 1.0Tesla MRI scanner (Panorama, Philips). The indication was routine follow-up after total repair while 3 of the patients were imaged prior to surgical repair. Studies in children younger than 6-year-old were performed under either sedation or intubation. cMRI consisted of T1 black-blood sequences, Cine imaging, Velocity-encoded phase contrast mapping, Gadolinium-enhanced MRA and 3D SSFP MR coronary angiography.

Results. In all children morphology and anatomy were assessed. Biventricular volumetry and function were evaluated (LVEDVI=64.7 ml/m2, LVESVI=22.7 ml/m2, LVEF=63.2%, RVEDVI=133 ml/m2, RVESVI=62.87 ml/m2, RVEF=52.3%). Pulmonary regurgitant fraction (RF) was found to be on average 36.44%, while 35% of patients revealed a RF of more than 40%. In 7 patients the black blood images revealed severe branch pulmonary artery stenosis and 3 of them were treated with balloon angioplasty and stent placement.

Discussion and conclusions. Advanced cMRI is the technique of choice when assessing pulmonary incompetence and right ventricular hemodynamics in Fallot pediatric patients. HFO 1.0 T MRI provides functional assessment and excellent image quality comparable to 1.5 T conventional MRI scanners.

041

Imaging valvular heart disease in children by High Field Open (HFO) 1.0 Tesla MRI scanner: a pictorial essay

Dimitra Loggitsi [1], Georgia Papaioannou [1], Nikolaos Kritikos [1], Panagiotis Tagalakis [1], Evangelia Manopoulou [1], Aphrodite Tzifa [2]
[1] CT/MRI Department, Mitera Hospital, Athens (Greece); [2] Pediatric Cardiology Department, Mitera Hospital, Athens (Greece)

Purpose-Objective. Cardiac MRI (cMRI) has a great utility in the assessment of valve disease as the information provided allows an accurate visualization of the valves and a comprehensive evaluation of its consequences for the heart as well as any associated lesions. In our institution we use a High Field Open (HFO) 1.0Tesla MR scanner to perform advanced cMRI.

Material and methods. During a 24-month period 55 children aging from 6 days to 18 years underwent cMRI study in a HFO 1.0Tesla MRI scanner (Panorama, Philips). The indication of the examination included aortic valve diseases (n=15, bicuspid-dysplastic valves, regurgitation, supravalvar stenosis), pulmonary valve diseases (n=40, regurgitation related to repaired Tetralogy of Fallot, atresia, subvalvar stenosis), Ebstein anomaly (n=1) and Shone's heart (n=2). cMRI consisted of SSFP Cine sequences in all standard planes, Velocity-encoded (VENC) phase contrast mapping and Gadolinium-enhanced MR angiography.

Results. Accurate visualization of the abnormal valves was feasible with standard SSFP cine sequences. Regurgitant fraction was quantified. Direct planimetry of the stenotic valves was perfomed. Biventricular volumetry and function was evaluated to appreciate the effect of the valve on the heart.

Discussion and conclusions. cMRI is an invaluable tool in the assessment of valvular heart disease, adding significant complimentary information to transoesophageal echocardiography. HFO 1.0T MRI provides functional assessment and excellent image quality comparable to 1.5T conventional MRI scanners and is better tolerated by pediatric patients.

042

Evaluation of tracheomalacia in children using Computed Tomography. Correlation with bronchoscopic results

Efthimia Alexopoulou, Gerasimos Kremmydas, Vasilios Grammeniatis, Konstantinos Douros, Argyro Mazioti, Stylianos Argentos, Konstantinos Priftis
University General Hospital "Attikon", Athens (Greece)

Purpose-Objective. We studied the most suitable approach to the evaluation and diagnosis of tracheomalacia correlating results from CT and Flexible Bronchoscopy (FB).
Material and methods. Dynamic helical CT scan was performed in 18 patients (aged 5–14 years) suspected of tracheomalacia presenting with symptoms (barking cough ± recurrent chest infections). All patients underwent FB, during deep sedation and spontaneous breathing. Four children who suffered from parenchymal lung diseases but no "barking" cough were used as controls. The ratio of anteroposterior/tranverse diameter was measured in the thoracic inlet and the carina level, in full inspiration and end expiration.
Results. FB confirmed tracheomalacia in all patients; in 7/18 cases lesions were located in the upper part of the trachea. CT showed localized narrowing of the intrathoracic trachea in 8 patients. The measured ratios (AP/TS diameter) between the study and the control group were lower in the study group: at the carina level in inspiration 0.81±0.08 vs 0.97±0.08, $p=0.001$, and at expiration 0.66±0.13 vs 0.89±0.12, $p<0.001$; at the thoracic inlet in inspiration 0.96±0.13 vs 1.12±0.11, $p=0.023$, and at expiration 0.77±0.25 vs 1.02±0.10, $p=0.033$, for patients and controls, respectively.
Discussion and conclusions. CT scan provides a more accurate estimation of endothoracic tracheomalacia as it is not influenced by the effects of general anaesthesia. However, FB is valuable in the assessment of patients with extrathoracic tracheomalacia since CT cannot be easily recommended as a safe approach (avoiding radiation exposure to the thyroid).

043

US evaluation of the thymus gland in pediatric patients
Sonia Tamasi[1], Rosanna Mamone[1], Michele Smaldone[2], Umberto Balestrieri[2], Domenico Noviello[1], Patrizia Oresta[1]
[1] A.O.R.N. Santobono, Pausilipon, Naples (Italy); [2] University "Federico Ii", Naples (Italy)
Purpose-Objective. We investigated the US appearance of the thymus in normal pediatric subjects to gather information for use in pediatric patients with suspected thymus conditions, using a safe, irradiation-free technique.
Material and methods. We performed a US examination of the anterior mediastinum and the neck in 50 children (22 males and 28 females) ranging in age from 6 months to 11 years. We used a Sonora LOGIC 700 MD General Electrics unit with 7.5–13 MHz linear probes and acquired transverse and longitudinal scans on the chest wall and the neck, integrated with intercostal scans.
Results. The thymus had the same echogenicity as the liver parenchyma in 37 children (74%), lower echogenicity in 3 (6%, age range 6–12 months) and higher echogenicity with heterogeneous structure in 10 children (20%, age range 8–11 years). The gland was in central and symmetric localization in 32 children (64%) while it exhibited a slight deviation leftwards in 12 (24%) and rightwards in 6 children (12%).
Discussion and conclusions. Radiological studies of the thymus are really difficult to perform because the gland is extremely variable in size, extension and shape. We believe that US is an effective technique for studying the thymus in all its involution stages and provides information similar to CT and MRI. Also, US does not use radiations and needs no sedation, which improves safety for young patients.

044

Qualitative and quantitative assessment of CT MIP in pediatric lung nodule detection
Kerri Highmore, Mary-Louise Greer, David Manson
The Hospital For Sick Children, Toronto (Canada)

Purpose-Objective. Maximum Intensity Projection (MIP) imaging has been shown to increase sensitivity for detection of lung nodules in adults. This initial study reports detection of lung nodules in a pediatric oncology population using post-processing MIP images.
Material and methods. 30 Chest CT scans in pediatric oncology patients obtained consecutively in October 2011 were included for evaluation of lung metastases, with REB approval. Two pediatric radiologists analyzed 5 mm and 8 mm reconstructed MIP images and standard lung window (LW) acquisitions. Sensitivities of pulmonary nodule size, location and diagnostic confidence were calculated for each reader independently.
Results. In 29 CT exams, one excluded as >20 nodules, up to 47 lung nodules were identified (age 1.4–18.0 years). More lung nodules were detected with 8 mm versus 5 mm MIP images ($p=0.0052$), not LW acquisitions ($p=1.000$). One reader demonstrated a higher degree of confidence when calling pulmonary nodules on 8 mm MIP images compared to both other variables ($p=0.0352$).
Discussion and conclusions. In children, 8 mm MIP images allow for improved confidence characterizing lung nodules compared with 5 mm MIP or LW acquisitions, and improved lung nodule detection compared with 5 mm MIP imaging. Compared with LW acquisitions, absolute nodule numbers were higher, but not statistically significant. Although promising, more data is required to support standard pediatric use of MIP post-processing.

045

MRI: is there a role in congenital lung malformations?

Maria Rita Panico [1], Carmine Mollica[2], Luigi Camera[1], Marco Salvatore[1], Pier Paolo Mainenti[2]
[1] UNIVERSITA' FEDERICO II, Napoli (Italy); [2] Biostructure and Bioimaging Institute (IBB), National Council of Research (CNR), Napoli Italy)

Purpose-Objective. To demonstrate the role of magnetic resonance imaging (MRI) in the diagnosis of congenital lung malformations (CLP).
Material and methods. Studies have evaluated 20 MRI performed in patients (13F, age range: 2 days–19 months) with suspected CLP ultrasound examination (U.S.) in the fetus.
Results. All studies were conducted under anesthesia of 1.5T acquiring T2 TSE sequences (TR 666 msec, TE, 80 msec) with respiratory gating, 2D BFFE T2 sequences (TR 3.4 msec, TE: 1, 7 msec) and T1 FFE 3D angiographic sequences (TR: 4 msec TE: 1.9 msec). MRI studies were of good quality in 18/20, but always diagnostic, and were well tolerated by patients. MRI showed 12 pulmonary sequestration, 2 cases of scimitar syndrome, 4 adenoid cystic malformation in the left upper lobe and one intra-parenchymal bronchogenic cyst in the left upper lobe.
Discussion and conclusions. MRI can also be used to distinguish different types of cystic adenomatoid malformations, identify the anomalous vessels of pulmonary sequestration. Balanced sequences (steady-state free precession sequences) allow performance of unenhanced thoracic vascular studies, which are useful in the diagnosis of intralobar or extralobar sequestration. In summary, MRI, which is modality accurate and non-invasive can provide additional data useful in establishing prognosis and in management of CLP.

046

Visual selection of end-diastolic and end-systolic cardiac phase at cMRI

Robert Marterer, Erich Sorantin[1]
Division Of Pediatric Radiology, Department Of Radiology, Medical University Of Graz, Graz (Austria)

Purpose-Objective. The Argus® software for evaluating cardiac performance parameters determined end-diastolic and end-systolic phase automatically, but this selection is just based on empirically determined frequency. End-diastolic phase is always the first and the end-systolic always the eleventh phase. Visual inspection of this selection is a standard procedure. The aim of this study was to show how often there is a difference between automatic and visual selection and whether it leads to effects on cardiac performance parameters.
Material and methods. 86 patients with corrected congenital heart defects were included in this study. Values of the original analysis, taking into account visual selection, served as reference values. A second analysis was performed under the assumption that the automatic selection of the end-diastolic and end-systolic phase is always correct.
Results. There was a difference between automatic and visual selection of end-diastolic phase for left and right ventricle in 50%. In 79% of cases there was a difference in the selection of left ventricular and in 78% in the selection of right ventricular end-systolic phase. Every difference causes a statistic significant change of stroke volumes and ejection fraction ($p<0.01$).
Discussion and conclusions. Visual selection of end-diastolic and end-systolic phase in the evaluation of cardiac performance parameter with the Argus® software should always be done, since otherwise it would lead to incorrect calculation of the cardiac performance parameters.

047

Horseshoe lung associated with scimitar syndrome

Korcan Aysun Gonen [1], Ozlem Mehtap Bostan[2], Yakup Canitez[2], Zeynep Yazici[1]
[1] Uludag University, Medical Faculty, Department Of Radiology, Bursa (Turkey); [2] Uludag University, Medical Faculty, Department Of Pediatrics, Bursa (Turkey)

Purpose-Objective. We present two cases of horseshoe lung associated with scimitar syndrome diagnosed by multidedector CT (MDCT).
Material and methods. Two baby girls of 3 and 4 months of age who presented with respiratory distress and heart murmur were examined with echocardiography and MDCT.
Results. Physical examination of the two patients was unremarkable, except for heart murmur. The chest roentgenograms showed displacement of the heart and mediastinum to the right with smaller right lung. Echocardiography revealed dextroposition, secundum atrial septal defect, and bilateral slight peripheric pulmonary stenosis in the first case. In the other case, dextroposition, severe pulmonary hypertension, secundum atrial septal defect, and tricuspid insufficiency were determined on echocardiography. On thoracic MDCT of the patients, the right lung and pulmonary artery were hypoplastic with cardiomediastinal shift to the right. There was an abnormal right pulmonary vein draining into the vena cava inferior on the lower zone of the right lung (scimitar vein). In addition, the posterobasal portions of both lungs were fused through a midline isthmus behind the heart. On the basis of these findings, a diagnosis of horseshoe lung associated with scimitar syndrome was made.

Discussion and conclusions. Horseshoe lung is a rare congenital anomaly. The most common abnormality accompanying the horseshoe lung is the scimitar syndrome. All aspects of this complex anomaly can be demonstrated during a single imaging session via MDCT.

048

Chest CT in children on ECMO (extra-corporeal membrane oxygenation)

Susie Goodwin, Elise Randle, Alistair Calder, Aparna Hoskote
Great Ormond Street Hospital, London (United Kingdom)

Purpose-Objective. Pictorial review illustrating the utilisation of chest CT in children on ECMO performed at our institution. Technical aspects and radiological findings will be considered, as well as clinical details, influence on patient management and final outcome.
Material and methods. Retrospective review of scans performed for children on ECMO over a 9-year period. Scans were reviewed for radiological findings and technique. Medical notes were analysed for clinical details, influence on patient management, adverse events associated with transfer, and final outcome.
Results. 19/414 (4.5%) children on ECMO underwent CT chest between May 2003 and May 2012. CT imaging illustrated a wide range of ECMO complications including massive haemothoraces with mediastinal/cardiac compression, migrated ECMO cannula and pericardial effusion, pleural effusions and pneumothoraces. Various underlying pathologies included alveolar proteinosis, severe lung necrosis, abnormal pulmonary vasculature and vascular ring. No reported adverse events were related to patient transfer to the scanner. CT results led to procedure in 84%, withdrawal of care in 5% and no direct impact on care in 11%. 26% children survived to CICU discharge.
Discussion and conclusions. Chest CT was infrequently performed for paediatric ECMO (extra-corporeal membrane oxygenation) patients, but was useful in selected patients, diagnosing and illustrating wide-ranging chest pathology and ECMO-related complications. Scan technique is important to optimise contrast enhancement. CT scans identified clinically important complications leading to valuable intervention in 84% of patients, with no transfer-related complications reported.

049

Aeration disturbances- congenital or acquired?

Daniela Bakalinova Pugh, Maha Almarashi, Amina Abdelqadir Mohamed
Sheikh Khalifa Medical City, Abu Dhabi (United Arab Emirates)

Purpose-Objective. The purpose of this pictorial review is to evaluate the imaging of congenital and acquired aeration disturbances in paediatric patients and point out the role of the radiologist in selection of the patients for surgical treatment.
Material and methods. Patients with aeration disturbances on the chest x-ray treated in our hospital for congenital and acquired lung problems were included in the study. Their imaging studies were selected and reviewed. Birth history and clinical evaluation were reviewed for all these patients. Multi-imaging approach was conducted and included.
Results. Results showed that most aeration disturbances were not congenital, but developed during the course or as a sequlae of infection. The patients who had proved congenital malformation were treated surgically.
Discussion and conclusions. Most aeration disturbances are not congenital. Aeration disturbances are frequently associated with pulmonary infection. Advances in neo-natology have altered the natural history of lung disease, introducing new challenges for the paediatric radiologist. Aeration disturbances may spontaneously disappear. The role of radiologists is to help in selecting cases for surgical treatment which should not be considered until a clinical cause and relationship effect between aeration disturbances, the symptoms and benefits of surgical treatment are fulfilled.

Interventional radiology

050

Pre procedure checklist in paediatric screening and interventional procedures

Senasi Ramdas, Christopher Heafey, Neil Prasad, Ashok Raghavan
Sheffield Children's Hospital, Sheffield (United Kingdom)

Purpose-Objective. Can a pre procedure checklist improve patient-carer safety and increase staff compliance with regards to safety and infection control?
Material and methods. We introduced a pre procedure check list in our department after a previous audit

highlighted deficiencies in infection control and safety checks. Important things to consider prior to any procedure are indication for procedure, radiation safety, infection control, pregnancy status and foreseeable difficulties or complications that can be prevented. Although these practices are already in place, we wanted a way to properly document that this is being done and want to be able to maintain an audit trail. The questionnaire was designed within the department by a radiology trainee, the Lead Radiographer and Department Head. Prior to each procedure, the questionaire will be filled in by the attending radiographer and signed off before the procedure starts.

Results. We will present the pre procedure checklist alongside the results of our initial audit.

Discussion and conclusions. We aim to show that a pre procedure check list is important to maintain patient and staff safety. Documentation is vital as it will prevent unnecessary problems and will protect patient and staff.

051

Imaging findings in epithelioid hemangioendothelioma (EHE) with clinical correlation

Dawn Engelkemier, Ahmad Alomari, Harry Kozakewich, Cameron Trenor, Gulraiz Chaudry
Children's Hospital Boston, Boston, Ma (United States)

Purpose-Objective. EHE is a rare vascular malignancy with varying biologic behavior. The purpose of the study was to identify the imaging findings and clinical characteristics of patients with EHE.

Material and methods. Clinical records and imaging were reviewed in patients referred to our Vascular Anomalies Center in a 30-year period.

Results. There were 28 patients (11 M) with a histologic diagnosis of EHE. The mean age at presentation was 22.7 years (range 4–67 years). The most common presenting symptoms were pain (n=12) and mass (n=5). Six were asymptomatic. The most commonly affected organs were lung (n=25), liver (n=18), and bone (n=14). Multiple sites of involvement were seen in 23 case. Imaging was available in 18 with lung, 12 with liver and 5 with osseous involvement. In the lungs, multiple bilateral nodules were seen in 14 cases, with a solitary nodule or reticulonodular pattern seen in the remainder. In the liver, multiple nodules with peripheral predominance (11/12) and subcapsular retraction (8/12) were most commonly identified. A "lollipop" sign was seen in all and target enhancement was noted in the majority (8/10). The spine was the most commonly involved osseous site (6/14). All lesions were lytic without surrounding soft tissue mass.

Discussion and conclusions. EHE most commonly affects the lung, liver and bone. The most characteristic imaging features are seen in the liver with target enhancement, "lollipop" sign and subcapsular retraction.

052

Endovascular management of type 2 congenital extrahepatic portosystemic shunt (CEHPSS): our experience

Frédéric Thomas-Chaussé [1], Josée Dubois[1], Rafik Ghali[2], Gilles Soulez[3]
[1] Chu Ste-Justine, Montreal (Canada); [2] Hopital Maisonneuve-Rosemont, Montreal (Canada); [3] Centre Hospitalier De L'université De Montréal, Montréal (Canada)

Purpose-Objective. To present the endovascular technique and imaging work-up used in the management of type 2 CEHPSS.

Material and methods. Retrospective study (2008–2012) of 4 consecutive male patients (age: 1 month to13 years old) with type 2 CEHPSS treated by endovascular approach. The aim of the study is to present: imaging work-up used, choice/technique of endovascular management and complications (according to Society of Interventional Radiology standards).

Results. In 3 cases, the shunt was discovered during the work-up for either a cutaneous hemangioma or multiple hepatic masses. In one patient, the shunt was discovered incidentally during the evaluation of a severe case of pulmonary arterial hypertension. All patients had abdominal US, CT and MRI as part of the initial evaluation. Standard angiography was used to both plan treatment and evaluate the results. In all cases, the fistula was occluded by endovascular approach using: covered stent (n=2), Amplatzer plug (n=1) and coils (n=1). All patients had a successful closure of the fistula. There was no evidence of portal hypertension during follow-up. One case of jugular vein thrombosis with entry site infection was observed (grade D complication according to SIR standards). No complications (grade A) were observed in the 3 other patients.

Discussion and conclusions. Our experience showed that endovascular management of type 2 CEHPSS is safe and efficient. Standard angiography remains the best way to evaluate and plan the treatment.

053

Why tunneled common femoral central venous catheters are useful in children

Richard Towbin, Robin Kaye, Carrie Schaefer, David Aria, Seth Vatsky, Scott Joergensen
Phoenix Children's Hospital, Phoenix, United States

Purpose-Objective. To demonstrate why tunneled common femoral venous access (TCFVA) is safe and effective in children.

Material and methods. Over 2 years, 82 TCFVA catheters were placed in 71 patients ranging in age from 1 day to 19.5 years (median of 5 months). Indications included congenital heart disease in 34% and non-cardiac related illnesses in 66%. Ultrasound-guidance was used to gain venous access. Three to 10 French catheters were inserted via the femoral vein, with catheter tip positioned at the IVC/RA junction. Immediate procedural and short-term (30 days post-procedure) complications were reviewed.

Results. 100% technical success was achieved. 74 of 82 insertions occurred without procedural or short-term complications. Two procedural complications occurred including; inadvertent arterial catheterization and an accidental catheter removal. Short-term complications included catheter occlusion in a single patient 6 days post-operatively and catheter infection in 5 patients 11–25 days after placement.

Discussion and conclusions. TCFVA is a safe and effective alternative to traditional upper extremity access in the pediatric population, with complication rates paralleling published data. TCFVA is important in children with congenital heart disease to preserve supracardiac venous access for future operative procedures and to avoid thrombosis of native vessels or shunts. Additionally, TCFVA is a good alternative for children <10 kg, non-ambulatory patients, and when traditional supracardiac vessels are not available due to indwelling lines or vessel occlusion.

054

Intervention in paediatric hepatobiliary disorders

Nasim Tahir, Asim Shah
Leeds Children's Hospital, Leeds (United Kingdom)

Purpose-Objective. To describe the role of interventional radiology in paediatric hepatobiliary disorders.

Material and methods. This is an educational exhibit which will demonstrate a range of radiological interventions available for paediatric hepatobiliary disorders.

Results. A selection of cases performed in a large super-regional paediatric liver centre in the UK will be presented and discussed.

Discussion and conclusions. Paediatric interventional radiology is a challenging subspecialty which requires a multi-team approach. It plays a key role in diagnosing and treating liver problems. The recent increase in liver transplants, many of which are now split liver grafts, has increased the application of interventional radiology in order to improve graft and patient survival. It also helps avoid surgical revision and retransplantation. The interventions can be broadly categorised into vascular and non-vascular procedures. Vascular interventions include angiography, angioplasty, stenting, shunts (eg transjugular intrahepatic portosystemic shunt – TIPSS) and embolisation of lesions. Non-vascular procedures include biopsy, drainages and biliary interventions using endoscopic or percutaneous transhepatic approaches. The procedures themselves can lead to complications. It is therefore important to be aware of indications and technical considerations prior to any intervention. The expected results and post-intervention imaging appearances are also important.

055

Treatment of a Complicated Venous Malformation with Associated Pulmonary Embolism using Radiofrequency Ablation

Richard Towbin, Carrie Schaefer, Robin Kaye, David Aria, Seth Vatsky
Phoenix Children's Hospital, Phoenix, United States

Purpose-Objective. A 12 year-old male with extremity enlargement, a complex lower extremity type 4 venous malformation, presented with chronic leg pain and acute chest pain secondary to pulomonary emboli. Imaging and venography demonstrated an extensive venous malformation with varicosities as large as 16 mm. The varicose component drained inferiorly into the popliteal vein and cephalad into the femoral vein via the greater saphenous vein.

Material and methods. Due to the large size of the venous malformation, flow direction, and complication of pulmonary embolism, traditional sclerotherapy was delayed until closure of the varicosities was attained. The varicosities were successfully closed using intravascular radiofrequency ablation (RFA). The residual component of the venous malformation was treated variably with ethanol and Sotradecol foam.

Results. There were no procedural complications and the patient's post-operative course was uneventful. On follow-up visits the patient is symptom-free and the venous malformation has decreased in size.

Discussion and conclusions. In conclusion, complex venous malformations with large direct communication to the deep venous system require a staged treatment approach. The connection to the deep venous system can be closed

with thermal ablation or mechanical devices, in this case RFA, followed by conventional sclerotherapy.

056

Treating Complex Vascular Anomalies with Novel Techniques

Richard Towbin, Carrie Schaefer, Robin Kaye, David Aria
Phoenix Children's Hospital, Phoenix, United States

Purpose-Objective. An 8 year-old girl with a complex medical history including trisomy 21, multiple cardiac anomalies, and chronic anemia of mixed etiology, presented with chronic gastrointestinal bleeding. Over the preceding year, she had become cyanotic and on physical examination, digital clubbing was noted. Laboratory evaluation revealed elevated serum ammonia levels. Abdominal ultrasound demonstrated a congenital portacaval shunt. Due to the large size of the shunt, traditional embolization agents such as coils could not safely be utilized. Although not generally used for this purpose, the decision was made to occlude the fistula with an atrial septal defect (ASD) occlusion device (clamshell).
Material and methods. The ASD occlusion device was deployed at the inferior vena cava and portal vein communication without immediate complication.
Results. The patient's post-operative course was uneventful and the patient was discharged on post-operative day #2. Follow-up visits demonstrated resolution of the clinical signs and symptoms and imaging demonstrated closure of the shunt.
Discussion and conclusions. This experience highlights the use of a novel technique for treatment of a large, symptomatic portacaval shunt.

057

Pediatric cerebral vascular malformations: diagnosis and treatment

Ildikó Schmidt, Istvan Lazar, Bela Lombay
Borsod County University Hospital, Miskolc (Hungary)

Purpose-Objective. Cerebrovascular disease is uncommon in children and adolescents. Vascular malformations are the cause of nearly all nontraumatic intracranial hemorrhages in children beyond the neonatal stage. Although the computed tomographic angiography (CTA) and magnetic resonance angiography (MRA) have high sensitivity and specificity in identifying vascular malformations, catheter angiography remains essential to careful analysis of disorders of the cerebral vasculature. The treatment of pediatric cerebrovascular disease continues to advance rapidly. Endovascular techniques now permit palliation or cure of many disease entities. The purpose of this study was to evaluate the spectrum of cerebral vascular malformations in pediatric population, diagnosed and treated in our children hospital.
Material and methods. Between 2005 and 2013 MRA was performed in 305 cases, 25 were positive for cerebral vascular malformation, CTA was performed in 31 cases, 4 were positive for cerebral vascular malformation and digital subtraction angiography was performed in 6 cases.
Results. The spectrum was various: narrowed or ectatic vessels, vascular stenoses and occlusions, aneurysm, AVMs, DVAs, cavernomas, vein of Galen malformation, moyamoya, fibromuscular dysplasia.
Discussion and conclusions. These vascular abnormalities are diagnosed and treated by a multidiciplinary team including pediaticians, pediatric neurologists and neurosurgeons, pediatric and interventional radiologists. Patients having residual malformations should be followed-up with MRA or sometimes with DSA.

Oncology

058

Case report: undifferentiated high-grade pleomorphic sarcoma (malignant fibrous histiocytoma) in a 12-year old girl with tuberous sclerosis

Eu Leong Harvey James Teo, Kenneth Chang Tou En
Kk Women's And Children's Hospital, Singapore (Singapore)

Purpose-Objective. The purpose of this poster is to report a rare case of an undifferentiated high-grade Pleomorphic Sarcoma (PS) in a 12-year old girl with Tuberous Sclerosis (TS). This is only the second case reported to date.
Material and methods. The patient is a known case of TS with cortical tubers and subependymal nodules in the brain, cardiac rhabdomyoma, renal cysts and angiomyolipomas, facial angiofibromas and periungal fibromas. She presented with a 2-month history of a soft-tissue mass in the medial aspect of her right thigh. Ultrasound and MRI showed a soft tissue mass measuring 9.5×7.6×5.9 cm in size, which was slightly hyperintense to muscle on T1-weighted imaging, heterogenous on T2-weighted imaging and showed marked enhancement post-gadolinium administration.
Results. Biopsy showed the lesion to be composed of high-grade sarcomatous tumour cells interspersed with atypical giant tumour cells with hyperchromatic bizarre nuclei consistent with the diagnosis of high-grade PS. Immunohistochemical stains did not reveal a lineage of differentiation. The lesion was completely resected with clear margins and the patient is currently on follow-up without evidence of recurrence or metastasis.

Discussion and conclusions. Tuberous sclerosis is an autosomal dominant genetic neurocutaneous syndrome characterized by the growth of benign tumours in the body. Malignant lesions are rare. An association between TS and PS has only been reported once previously in the literature, with this being the second case.

059

Intravenous application of second generation ultrasound contrast agents—safety consideration based on one center prospective study

Maciej Piskunowicz, Wojciech Kosiak, Tomasz Batko, Elzbieta Adamkiewicz-Drozynska, Arkadiusz Piankowski
Medical University Of Gdansk, Gdansk (Poland)

Purpose-Objective. The problem of no registration and off-label use of UCA in children is the cause of discussion both in Europe and in the United States of America. However, UCAs are used intravenously in children in many centers in Europe and around the world. Up until October 2012 none of the publications on the intravenous administration of UCA have reported any adverse effects. In the first retrospective work based on questionnaires six minor adverse effects had been recorded after intravenous contrast administration. We would like to present one center's experiences with the use of UCA and discuss the safety of UCA in the context of severe adverse reaction we noticed.
Material and methods. By the end of 2012, 140 examinations with i.v. administration of UCA were carried out in children aged from 14 days to 17 years and 7 months (mean 10.6 years ± SD 6.3), evaluating i.a. changes in the liver, kidneys, spleen, testicles, lungs, and lymph nodes.
Results. We recorded one severe adverse reaction in a 10 years old girl with suspicion of GIST.
Discussion and conclusions. Although, intravenous administration of UCA in children has been considered as quite safe, our case showed potential risk of its use. Further, prospective multicentre evaluation of UCA usefulness and safety in children is essential.

060

Monitoring cystic lymphangioma therapy with Sirolimus using MRI: A case report of four pediatric patients

Sebastian Tschauner [1], Erich Sorantin[1], Emir Haxhija[2]
[1] Division Of Pediatric Radiology, Medical University Graz, Graz (Austria); [2] Division Of General Pediatric And Adolescence Surgery, Medical University Graz, Graz (Austria)
Purpose-Objective. Benign lymphangiomas are pediatric tumors usually spreading within the child's head and neck. Shrinking the tumor size by administering immunosuppressant drugs like Sirolimus has been a recent treatment approach. However, monitoring therapeutic success by using ultrasound or measuring the neck circumference is an intricate problem because of the polymorphic tumor shapes. Contrary to this, MRI volumetric analysis can be a valuable alternative.
Material and methods. T2 weighted MRI images of four female pediatric patients aged between 0.58 and 3.99 years who were suffering from cystic head and neck lymphangiomas were analyzed. The images were imported to Slicer (open source software for medical data analysis, http://www.slicer.org) from routine MRI scans that were done once before and twice after the start of therapy. Subsequent to semiautomated 3D segmentation, cyst volumes were quantified and defined as surrogate parameter for tumor extent. The biggest neck circumference was computed too.
Results. Significant reductions in cyst volumes between 25% and 51% of the initial size could be found in all four patients at the last scan. Apart from that, neck circumference measurements had a poor correlation (r=0.247) compared to MRI volumetric cyst analysis.
Discussion and conclusions. It can be assumed that MRI tumor volume quantification is superior to clinical neck circumference measurements when re-examining the therapy progress of cystic lymphangiomas. Due to the diffuse cyst structures MRI seems to be favorable over ultrasound.

061

A large solid hepatic tumour with a central scar– only FNH?

Katarzyna Czerwińska [1], Agnieszka Biejat[1], Michał Brzewski[1], Andrzej Kamiński[2], Michał Matysiak[3], Jadwiga Małdyk[4]
[1] Department Of Pediatric Radiology Medical University Of Warsaw, Warsaw (Poland); [2] Department Of Pediatric Surgery Medical University Of Warsaw, Warsaw (Poland); [3] Chair And Clinic Of Hematology And Oncology Medical University Of Warsaw, Warsaw (Poland); [4] Institute Of Pathomorphology In Clinical Paediatrics Medical University Of Warsaw, Warsaw (Poland)

Purpose-Objective. Focal nodular hyperplasia (FNH) is an unusual hepatic tumour in children however, it represents the second most common pediatric benign liver mass. It occurs in young children and adolescents and should be distinguished from other hepatic lesions, especially malignant ones.
Material and methods. Three girls (4, 8 and 10 years old) with large hepatic masses incidentally noticed on imaging studies performed for unrelated symptoms were studied. All patients were examined with US and CT and laboratory tests

for tumour markers were taken. The final diagnosis was obtained after tumour resection and histopathological examination. Two lesions were FNH and one was hepatocellular carcinoma (HCC).
Results. On US examination all the lesions were solid and had variable echogenicity. At CT all the tumours showed diffuse hyperdense enhancement during the artelial phase (two heterogenous) with rapid washout of contrast material becoming isodense to the liver on venous phase. In two patients a central scar was detected. Although in one of the cases the lesion had a characteristic image (hyperdense, with a central scar at CT), a small hyperenhancement, a satellite lesion and an eleveted α-fetoprotein level were observable - the histolopathologic diagnosis was HCC.
Discussion and conclusions. Benign liver tumours in children are more unusual than malignant ones. Imaging techniques (US,CT) are not always reliable in differentiating benign from malignant tumours. The atypical image of the lesions should always be taken into consideration. To establish the final diagnosis, histopathological examination is mandatory.

062

Rare imaging manifestations of childhood leukemia/lymphoma
Kathrin Maurer, Verena Spiss, Karin Unsinn
Medical University Innsbruck, Innsbruck (Austria)

Purpose-Objective. The typical constellation of leukemia is leukocytosis with blasts, thrombocytopenia and anemia, diagnosis is confirmed by bone marrow examination. Lymphomas are characterized by a tumorous mass. In patients with atypical presentation imaging may play an important role to establish the right diagnosis. We present 3 children with rare imaging manifestations of leukemia/lymphoma.
Material and methods. Three cases are reported and relevant images shown. A 3 years old boy presented with diffuse peritoneal thickening, a hypoechoic lesion in the liver and hyperechoic kidneys. A 14 years old girl suffered from „numb chin syndrome“and showed loss of lamina dura in a panaromic view of her teeth, later on she developed induration and swelling of both breasts due to leukemic infiltration. In an 18 months old boy a reddish coin-shaped skin lesion on the back was observed, 3 months later a deviation of his left eye led to the diagnosis of a tumor in his left nasal sinus with extension into the orbit.
Results. Diffuse Burkitt lymphoma of the peritoneum was diagnosed in the first patient, Burkitt-cell leukemia in the second and acute myeloic leukemia in the third.
Discussion and conclusions. Rapid expansion of tumor cell load in childhood leukemia/Burkitt lymphoma may cause serious complications if diagnosis is delayed. Knowledge of rare imaging manifestations of childhood leukemia/Burkitt lymphoma is important for a timely diagnosis.

063

Excessive thoracic wall lump in a newborn
Georgios Manganas [1], Christina Meleti [1], Evangelia Manopoulou [1], Evi Vassiliadou [2], Stelios Ypsiladis [2], Spyros Yarmenitis [1], Georgia Papaioannou [1]
[1] Department Of Pediatric Radiology, Mitera Maternity And Chlildren's Hospital, Athens (Greece); [2] Department Of Pediatric Surgery, Mitera Maternity And Chlildren's Hospital, Athens (Greece)

Purpose-Objective. The case of a female neonate with an excessive right-sided thoracic lump is presented.
Material and methods. Imaging approach included plain film, multislice CT and MRI.
Results. A benign congenital lesion in keeping with multifocal mesenchymal hamartoma was suggested. The diagnosis was confirmed post-operatively.
Discussion and conclusions. The rare case of a congenital multifocal mesenchymal hamartoma is presented and the literature is reviewed.

064

A rare case of metastatic extragonadal germ cell tumor with silent clinical presentation diagnosed with the help of whole-body DWI
Evangelos Mourtos, Linda Guler, Sylvie Kaiser, Åke Jakobson, Stefan Geiberger
Astrid Lindgren Children's Hospital, Karolinska University Hospital, Karolinska Institutet, Stockholm (Sweden)

Purpose-Objective. We present a case with initial hip and knee pain and primary imaging finding of vertebra plana due to a metastizing germ cell tumor and point out the added value of whole body DWI.
Material and methods. Clinical, laboratory and imaging findings are presented along with a brief review on the differential diagnosis of vertebra plana.
Results. A previously healthy 3 years old boy was admitted with a long duration of hip and knee pain. Blood tests and pelvic Xray were negative. Lumbar Xray revealed a vertebra plana in L3, suggestive of Langerhans cell Histiocytosis. MRI of the vertebral spine showed a compressed vertebra with

surrounding soft tissue mass. Subsequent coronal whole-body DWI sequence demonstrated high signal intensity in the root of penis. Complementary ultrasound revealed a soft tissue abnormality in the same area. Biopsies from the penis root and the vertebra showed germ cell tumor cells. CT of the lungs revealed multiple small metastases. During the clinical course an acute decompression was performed due to progressive paralyzing.
Discussion and conclusions. Long standing hip and knee pain is a symptom that should be evaluated with imaging due to possible pathology in the vertebral column. In vertebra plana, processes of inflammatory or tumorous origin should be ruled out and the whole body DWI can hereby be a helpful tool.

065

The role of computed tomography in the evaluation of pulmonary complications in children submitted to autologous and allogeneic bone marrow transplantation
Luciana Pinto Balthazar Da Silveira, Henrique Manoel Lederman, Gilberto Szarf, Adriana Seber
Federal University Of São Paulo, São Paulo (Brazil)

Purpose-Objective. To evaluate the main computed tomography (CT) findings in pulmonary complications after autologous and allogeneic bone marrow transplantation in pediatric patients.
Material and methods. This study included 158 patients treated with autologous and allogeneic bone marrow transplantation (BMT) from January 2008 to October 2011. All chest CT scans performed in this population over a period of up to 6 months after the transplantation were reviewed by a radiologist with experience in pediatric oncology radiology. Imaging findings were correlated with age at the time of BMT, patient's sex, underlying disease, type of transplant (autologous or allogeneic) and time post-transplant.
Results. After transplantation, 63 (39.9%) patients had pulmonary complications. The most frequent underlying diseases observed among patients were leukemias (32.9%) and non-Hodgkin lymphoma (15.8%), with statistically significant relationship between leukemia and pulmonary complications ($p<0.030$). Pulmonary complications in the first 30 days after transplantation were observed in 31 (56.4%) patients. Pulmonary edema was diagnosed by CT in 29 (52.7%) patients, fungal infection in 7 (12.7%) and viral infection in 6 (10.9%). Among the findings in chest CT, the presence of ground-glass attenuation was considered a risk of death from pulmonary complications ($p=0.018$). There was no statistical correlation between diagnosis and death for pulmonary complications ($p=0.650$).
Discussion and conclusions. Chest CT scans proved to be an important complementary method for identifying the cause of pulmonary complications.

066

The role of MRI in differentiating nephrogenic rests from Wilms tumour following chemotherapy
Daniela Fernandes Pinto, Owen Arthurs, Neil Sebire, Oystein Olsen
Great Ormond Street Hospital, London (United Kingdom)

Purpose-Objective. To determine which features on MRI are helpful to differentiate nephrogenic rests (NR) and Wilms tumour (WT).
Material and methods. Retrospective study in 13 children with suspected bilateral WT, imaged using conventional sequences before and after neoadjuvant chemotherapy. Images were assessed according to number of lesions visualised per kidney and the imaging characteristics of each lesion.
Results. 13 children had 24 kidneys that were histologically analysed, providing 37 lesions overall (20 WT and 17 NR). WT were typically larger than NR ($p<0.01$)), but there was no significant difference in size-reduction following chemotherapy ($p=0.855$). 35% of NR were located in the peripheral cortex and 12% exclusively in the renal sinus. Lesion content was significantly different between both groups ($p=0.01$) with 29% of NR being cystic. All WT were heterogeneous on T2 weighted imaging while 53% of NR were homogeneous ($p<0.01$). All WT showed enhancement after contrast while 35% of NR did not enhance ($p<0.01$). 70% of WT had high signal intensity areas on T1-w sequences, compared with none of the NR ($p<0.01$). 60% of WT had minimal or significant cystic or necrotic changes after chemotherapy compared with 18% of NR ($p=0.012$).
Discussion and conclusions. Although there are significant differences in size, signal- and enhancement-characteristics, and in response to chemotherapy between WT and NR, we were unable to identify a promising differentiator based on conventional MR-sequences.

067

Influence of bone marrow transplantation on pituitary gland volume and pituitary hormone values in children and adolescents
Therese Lincke [1], Horst Hahn [2], Karim Kentouche [3], Diane Renz [4], Claudia Vilser[3], Stenzel Martin[1], Hans-Joachim Mentzel [1]
[1] Dept Pediatric Radiology, University Hospital, Jena (Germany); [2] MeVis, Bremen (Germany); [3] University Hospital, Jena, (Germany); [4] University Hospital, Berlin, (Germany)
Purpose-Objective. The purpose of this study was to assess the influence of bone marrow transplantation (BMT) on the volume of the pituitary gland and different pituitary hormone values in children and adolescents.

Material and methods. 28 children and adolescents (19 males; age 1.5–26.2 year) were included. T1w 3D native MP-RAGE sequences at 1.5 T with 1 mm isotropic voxel size were acquired before BMT and on day 100 and 300 after successful transplantation. Volumetric data were collected using the ILAB-4 software (MeVis Medical Solutions, Bremen, Germany). Luteinising hormone, follicle stimulating hormone, thyroid stimulating hormone, prolactin were evaluated before and after BMT. Data were correlated to the pituitary volume. Statistical analysis was performed using SPSS 20.0 (IBM Corp.).
Results. The pituitary gland volume (median) was 0.45 mL before BMT, 0.43 mL on day 100, and 0.44 mL on day 300 after BMT ($p>0.05$). There were also no significant changes of the hormone levels after BMT. There was a correlation between hormone levels and the estimated volume.
Discussion and conclusions. Our data suggest that children and adolescents in whom BMT was carried out, do not show pathological decrease in the pituitary volume. There were no significant negative effects of BMT on the pituitary hormone levels, either.

Genitourinary

068

Bilateral xanthogranulomatous pyelonephritis (XGPN) in a 21 month old child

Jumana Hussain [1], Saeeda Latif[2], Anil Kumar[2], S. Chakraborty[3]
[1] Oxford Radcliffe Hospitals, Oxford (United Kingdom); [2] Wexham Park Hospital, Slough (UK); [3] John Radcliffe Hospital, Oxford (UK)

Purpose-Objective. We present an unusual case of a 21 month old male child, admitted with severe sepsis, failure to thrive and, on examination, bilaterally enlarged kidneys. Results of ultrasound and CT imaging with US guided biopsy led to a diagnosis of bilateral, Xanthogranulomatous pyelonephritis (XGPN).
Material and methods. The patient was assessed with ultrasound in the first instance. Appearances were initially interpreted as bilateral renal masses. The right-sided lesion was described in the first assessment as a Wilm's tumour. Further imaging with CT and subsequent US guided biopsy revealed inflammatory masses with some suggestion of xanthogranulomatous disease, including foamy granulomatous macrophages on a background of acute and chronic inflammatory material with early calcification.
Results. The patient was diagnosed, in light of the histological findings, with bilateral XGPN. The normal management of these cases is resection of the involved kidney. However, in this case of bilateral disease the child was treated conservatively with a protracted course of Ceftriaxone.
Discussion and conclusions. The patient recovered well, with normal renal function and subsequent follow up imaging with ultrasound revealed morphologically normal kidneys. The patient regained weight and haematological indices returned to normal. XGPN is rare in children, most commonly seen in patients in the sixth to seventh decade, with a female predominance. Bilateral XGPN has not been reported in the published literature in a child of this age.

069

Infants be distinguidhed by means of the differential resistive index?

Costanza Bruno, Giuliana Caliari, Marco Zaffanello, Roberto Pozzi Mucelli Policlinico Gb Rossi, Verona (Italy)

Purpose-Objective. To evaluate whether obstructive and non-obstructive unilateral uropathies of infants can be differentiated on the basis of the Doppler measurement of the Differential Resistive Index (DRI)
Material and methods. 68 infants (age range: 2–12 months) presenting with unilateral hydronephrosis underwent both renography and Doppler examination 10 min after furosemide injection. At Doppler, a value was assigned to the Resistive Index of each kidney by means of three different measurements obtained in the interlobar arteries. The DRI of each infant was defined as the difference of the Resistive Index in the affected and in the non-affected kidney. An affected kidney was considered obstructed if a 0.08 or higher DRI resulted. Kidneys were then classified as obstructed and non-obstructed on the basis of the results of MAG3 excretory renography.
Results. According to renography 17/68 affected kidneys were classified as obstructed and 51/68 as non-obstructed. 1 false negative and 2 false positive diagnoses of obstruction occurred with DRI, leading to a 94.1% sensitivity, 96% specificity, 88.8% PPV, 98% NPV, and 95.5% accuracy of the Doppler examination in the diagnosis of obstructive uropathy.
Discussion and conclusions. The differences in the Resistive Index after furosemide injection of affected and non-affected kidneys may prove useful in the workout of infants' unilateral uropathies.

070

Posterior nutcracker syndrome: simultaneous visualizations of vessels and renal collecting system with biphasic intravenous contrast enhanced MRI

Selami Ince, Murat Kocaoğlu, Veysel Akgün, Mustafa Taşar
Department Of Radiology, Gulhane Military Medical School, Ankara (Turkey)

Purpose-Objective. The posterior nutcracker syndrome refers to compression of the retroaortic left renal vein, which can cause haematuria, proteinuria, gonadal varices, or a combination of these symptoms. The aim of this presentation is to illustrate the biphasic intravenous (iv) contrast enhanced MRI findings of the left renal vein and adjacent vessels.
Material and methods. A 15-year-old male with a history of proteinuria was referred for further work up with MRI following a suspected left renal vascular abnormality on US. We used a modified MRI technique. First, a half dose of iv contrast material was administered. After a 5-min delay for contrast excretion, the second half dose was given immediately before MRI. Maximum intensity projection and multiplanar images were generated.
Results. MRI showed the finding of an enlarged retro-aortic left renal vein, which appeared to be compressed between the aorta and the lumbar vertebral body.
Discussion and conclusions. The posterior nutcracker syndrome is a rare cause of orthostatic proteinuria in children. MRI of the renal vessels by using biphasic iv contrast injection should be considered as noninvasive and non ionizing diagnostic procedures in demonstrating the anatomical characteristics of nutcracker syndrome.

071

Torsion of undescended testis: gray scale and color Doppler US findings

Selami Ince, Veysel Akgun, Murat Kocaoglu, Mutlu Saglam
Department Of Radiology, Gulhane Military Medical School, Ankara (Turkey)

Purpose-Objective. Torsion of an undescended testis is uncommon. Symptoms of a torsed undescended testis are highly nonspecific and the presentation is variable, requiring emergent surgical exploration. Color Doppler US is recognized as the preferred imaging modality for testicular torsion due to its high specificity, sensitivity. In this case we aim to present gray scale and color Doppler US findings and the differential diagnosis of undescended testicular torsion.
Material and methods. A 6 month old irritable infant with a mass in his left groin was referred for US. Clinical diagnosis was inguinal hernia. Gray scale and color Doppler ultrasound was performed.
Results. Both testicles were not detected in scrotum. The right testis appeared in the inguinal canal with a normal size and homogeneous echotexture. The left testis was also in the inguinal canal with increased dimensions, and heterogeneous echotexture. No testicular Doppler signal was detected and diagnosis of testicular torsion was made.
Discussion and conclusions. Ultrasound has pivotal role in ruling out the possibility of incarcerated hernia and diagnosing testicular torsion. It is non invasive and has a diagnostic accuracy and can distinguish intratesticular and scrotal wall flow.

072

Dynamic contrast-enhanced MR urography for congenital urinary tract anomalies

Mikiko Miyasaka [1], Shunsuke Nosaka[1], Eriko Otsubo[1], Hiroshi Nagamatsu[1], Katsuhiko Ueoka[1], Yuichi Hasegawa[1], Izumi Kanemitsu[1], Masato Uchikoshi[2], Kiefer B[3], Masaki Hidekazu[1]
[1] National Center For Child Health And Development, Tokyo (Japan); [2] Siemens Japan K.K., Tokyo (Japan); [3] Siemens Ag, Erlangen (Germany)

Purpose-Objective. Dynamic contrast-enhanced MR urography (DCE-MRU) is useful to diagnose congenital urinary tract anomalies and to evaluate differential renal function (DRF). DRF is calculated on the basis of renal volume (vDRF) and the Patlak number (pDRF). In the past reports, vDRF is similar to values obtained with DMSA and pDRF is closer to the DRF of DTPA. However, there are few reports comparing DCE-MRU and MAG3 results. The purpose of this study was to evaluate DRF compared with DCE-MRU and renal scintigraphy.
Material and methods. During 11 months, 12 children with congenital urinary tract anomalies underwent DCE-MRU. Of 12 cases, there were 6 with hydronephrosis, 4 with double collecting system, 1 with calyceal dilatation and 1 with ectopic ureter. The scan sequences included T2-weighted images and dynamic contrast imaging using 3D-FLASH. We analyzed both vDRF and pDRF using the new software of Patlak-Rutland plot technique. Of these 12 cases, there were 5 cases with both DMSA and MAG3, 5 cases with DMSA, and 2 cases with MAG3. We compared vDRF and DMSA, and pDRF and MAG3.
Results. vDRF was similar to DMSA in all cases. In 4 out of 7 cases with MAG3, pDRF was similar to MAG3.
Discussion and conclusions. DCE-MRU is a powerful diagnostic tool that provides not only detailed anatomy but also functional information. Moreover, the DRF using DCE-

MRU shows acceptable results compared with both DMSA and MAG3.

073

Ultrasonographic findings of torsed testicular appendage in prepubertal children: overlap with epididymitis and torsion of testis

Su-Mi Shin [1], Yun-Jung Lim[2]
[1] SMG-SNU Boramae Medical Center, Seoul (Republic of Korea); [2] Inje University Haeundae Paik Hospital, Pusan (Republic of Korea)

Purpose-Objective. To characterize the sonographic findings of torsed testicular appendage in prepubertal children.
Material and methods. Ten children aged 6 to 12 years (mean, 9.6 years) underwent gray-scale and color Doppler sonography. Five patients had follow-up sonography and two patients underwent surgery.
Results. Sonography demonstrated an extratesticular upper pole nodule in nine (90%) children. In two of them the nodule was found at the follow-up sonography, which mimicked epididymitis initially. Secondary inflammatory changes included enlarged epididymis in 8 (80%), scrotal wall edema in 6 (60%), hydrocele in 4 (40%), and swollen testis in 2 (20%) children. One (10%) child with no evidence of an extratesticular nodule had whirlpool appearance of the spermatic cord and enlarged testis, which mimicked torsion of the testis.
Discussion and conclusions. Ultrasonographic findings of secondary inflammatory changes in the absence of evidence of an extratesticular nodule may suggest an erroneous diagnosis of epididymitis or torsion of testis in prepubertal children with torsed testicular appendage.

074

Micturition problems in reccurent urinary tract infections

László Szabó [1, 2], Mária Deák[3], Ilona Bajusz[2], Katalin Losonczi[2], Gyula Réti[4], Béla Lombay[3]
[1] Borsod County Teaching Hospital, Miskolc (Hungary); [2] Pediatric Nephrology, Borsod County University Hospital, Miskolc (Hungary); [3] Pediatric Radiology, Borsod County University Hospital, Miskolc (Hungary); [4] Pediatric Surgery And Urology Borsod County University Hospital, Miskolc (Hungary)

Purpose-Objective. To reveal the function and morphological anomalies together are very important and the videourodynamics (VUD) combined with conventional Voiding Cystourethrography (VCUG) with Cystomanometry seemed to be the most appropriate method.
Material and methods. During a 19-year study period 485 children with recurrent urinary tract infections prospectively underwent videourodynamic (VUD) to further define their urinary tract abnormalities. 198 infants were under 1 year of age (Group I), 185 children were between 1 and 6 years (Group II), 102 patients were between 7 and 12 years (Group III). All children had history, clinical examination, urine analysis and culture; serum creatinine examination; and ultrasonography before VUD. Measurement of CM was registered onto a computer and VUR was documented with plain films and later in a PACS system. The first choice of treatment was 3rd generation cephalosporin antibiotics.
Results. The VUD diagnosis was of normal bladder function in 78 (16%) children (Group I:24, Group II:34, Group III:20), Vesico-Ureteric Reflux (VUR) alone in 213 (44%) (Group I:96, Group II:60, Group III:57), VUR and unstable bladder dysfunction in 112 (23%) (Group I:43, Group II:54, Group III:15), and unstable bladder dysfunction alone in 82 (17%) (Group I:32, Group II:36, Group III:14).
Discussion and conclusions. The advantage of these studies is that they combine the objectivity of urodynamics with the visual radiographic image, making for a far more logical interpretation of the results.

075

An abdominoscrotal hydrocele in infant—a cystic lesion in the abdomen

Katarzyna Czerwińska [1], Michał Brzewski[1], Zofia Majkowska[1], Tomasz Mosior[1], Maria Roszkowska-Blaim[2], Stanisław Warchoł[3]
[1] Department Of Pediatric Radiology Medical University Of Warsaw, Warsaw (Poland); [2] Department Of Pediatric Nephrology Medical University Of Warsaw, Warsaw (Poland); [3] Department Of Pediatric Surgery Medical University Of Warsaw, Warsaw (Poland)

Purpose-Objective. An abdominoscrotal hydrocele (ASH) is a rare lesion and should be considered in the differential diagnosis of cystic lesion in the abdomen in a child.
Material and methods. A first abdominal US examination in a 6 weeks old boy, performed because of urinary tract infection, revealed no pathological changes. The next US, after 3 months, showed a cystic lesion (53×27×20mm) on the right side, above the bladder, filled with anechoic fluid. One month later in US the size of the lesion increased and CT demonstrated a communication between a cystic mass in the abdomen and a right scrotal hydrocele—an ASH.

Results. ASH is a congenital condition. It consists of hydrocele that extends from the scrotum through the internal inguinal ring into the abdominal cavity. Our patient had no other symptoms and was observed by US examination. Following the next 4 months the size of the ASH decreased remarkably.
Discussion and conclusions. US is the most valuable tool for confirming diagnosis of ASH. CT should be used only when US fails to establish the nature of the mass. One should remember about this rare entity in differential diagnosis of cystic abdominal mass. Spontaneous resolution of ASH is rare but one can wait with surgical treatment in an asymptomatic patient.

076

A rare congenital benign testis tumour in a newborn
Katarzyna Czerwińska [1], Michał Brzewski[1], Zofia Majkowska[1], Andrzej Kamiński[2], Michał Matysiak[3], Jadwiga Małdyk[4]
[1] Department Of Pediatric Radiology Medical University Of Warsaw, Warsaw (Poland); [2] Department Of Pediatric Surgery Medical University Of Warsaw, Warsaw (Poland); [3] Chair And Clinic Of Hematology And Oncology Medical University Of Warsaw, Warsaw (Poland); [4] Institute Of Pathomorphology In Clinical Paediatrics Medical University Of Warsaw, Warsaw (Poland)

Purpose-Objective. Testis tumours in the prepubertal population are rare and 75% are benign. Cystic lesions in the testis of children are also rare and most cases are benign tumours.
Material and methods. A full-term newborn was admitted to hospital because of a left scrotal mass from the day of birth. A testicular US on 2nd day of life revealed in the left scrotum a well-defined, large, complex cystic mass with significant septal blood flow on Doppler study. The serum tumour markers and a karyotype examination were performed. After surgical resection a histologicaly examination revealed juvenile granulosa cell tumour (JGCT).
Results. JGCT is a benign, rarely diagnosed subset of testicular sex-stromal tumours. Most cases occur in patients in the first 6 months of life. It typically presents as a painless, unilateral scrotal mass. The tumour is hormonally inactive and does not elevate serum tumor markers, as in our patient. JGCT is associated with chromosome X abnormalities, but in our case the karyotype was normal. The child stays under oncological observation.
Discussion and conclusions. Testis tumours in the prepubertal population are rare and 75% are benign. JGCT of the testis should be kept in mind in the differential diagnosis of scrotal masses in newborns.

077

Pediatric bladder imaging - fundamental approaches and interesting cases
Aisling Snow, Jeanne S. Chow
Boston Children's Hospital, Boston (USA)

Purpose-Objective. This poster reviews the normal and pathologic appearances of the urinary bladder in pediatric patients. We aim to strengthen the imager's fundamental knowledge and enhance their diagnostic capabilities.
Material and methods. The embryology and normal imaging appearances of the bladder are described in detail with the aid of diagrams and radiologic images. Sonographic, fluoroscopic, radionulcide and cross sectional imaging of a wide range of bladder pathologies is reviewed. We also reference key literature that the viewer may find beneficial in their everyday work.
Results. The imaging of rare and commonplace bladder pathologies is presented in an engaging didactic format.
Discussion and conclusions. Urinary bladder pathologies are common in the pediatric population and imaging of the urinary bladder has an important place in pediatric radiology. Using text, diagrams and imaging examples we lead the viewer from the embryologic development of the urinary bladder through to normal, normal variant and pathologic appearances.

078

Usefulness of pelvis US to differentiate central precocious puberty from atypical premature thelarche
Gye Yeon Lim [1], Min Ho Chung[2]
[1] Department of Radiology, St. Mary's Hospital, The Catholic University of Korea, Seoul (Republic of Korea); [2] Department of Pediatrics, St. Mary's Hospital, The Catholic University of Korea, Seoul (Republic of Korea)

Purpose-Objective. The purpose of this study is to determine US parameters of pelvic internal genital organs using transabdominal US, that can be useful for distinguishing central precocious puberty (CPP) and atypical PT.
Material and methods. Sixty patients with diagnosed CPP and 38 with atypical PP underwent transabdominal pelvis US. The diagnosis was based on clinical criteria. Pelvic US parameters analyzed were: (1) uterus: fundal anteroposterior (AP) diameter, cervical AP diameter, the ratio between the fundal and cervical diameter (FCR), and length; (2) ovaries: diameter, volume, maximal diameter of the largest follicle.
Results. The girls with CPP had a greater uterine fundal AP diameter (1.04±0.35 vs. 0.76±0.26, $p<0.0001$) and FCR (1.52±0.44 vs. 1.23±0.38, $p=0.001$) than the girls with PT.

For the ovary, differences were noted in length (1.96±0.53 vs. 1.65±0.41, p=0.02) and maximal diameter of the largest follicle (0.62±0.20 vs. 0.54±0.23, p=0.02) between the girls with CPP and PT. Cut-off points predictive for CPP were as follows: uterine fundal AP diameter >0.9 cm (sensitivity, 60%; specificity, 81.6); FCR >1.2 (sensitivity, 70%; specificity, 63.2%); maximal diameter of the largest follicle >0.5 cm (sensitivity, 70%; specificity, 50%); length >1.9 cm (sensitivity, 58.3%; specificity, 73.7%).

Discussion and conclusions. Our results suggest that pelvic US may be a successful complementary modality for distinguishing between CPP and PT in patients with an equivocal response on the GnRH stimulation test.

079

Chronic peritoneal dialysis in children: The rule of ultrasound in the diagnosis of peritoneal catheter obstruction

Francesco Esposito [1], Maria Rita Panico[2], Domenico Noviello[1], Marco Catalano[2], Michele Smaldone[2], Francesca Malacarico[2], Patrizia Oresta[1]
[1] Aorn Santobono, Napoli (Italy); [2] Universita' Federico Ii, Napoli (Italia)

Purpose-Objective. Over the past two decades, continuous ambulatory peritoneal dialysis has emerged as the first-choice dialysis modality in children awaiting for transplantation. Despite the improvements observed in catheter survival over the past several years, the obstruction is one of the reasons for immediate catheter non-function. This study assessed usefulness of ultrasound (US) in visualizing the obstruction of CPD catheter and identifying the etiology.

Material and methods. Between January 2000 and November 2012, 38 patients were treated with chronic peritoneal dialysis and examined with US.

Results. We have had 12/38 cases with catheter malfunction related to its obstruction. In eight patients US showed a strongly hypo-echoic area with internal echoes of echogenic material fragmented, into the lumen and around the distal tip of the catheter. In the other four patient, US demonstrated displacement of catheter in bowel loops and an amorphous material as homogeneous echoic area around distal tip.

Discussion and conclusions. US can provide accurate diagnostic information on peritoneal catheter obstruction showing the presence of endolumen strands (detritus) of fibrin and/or other materials and recognizing the omental wrapping too. In this way it makes it possible to carry out further therapeutic strategies, which is of greater importance in children thanks to its repetibility, non invasiveness and the absent exposure to ionizing radiations.

080

Voiding urosonography: a pictorial essay of the lower urinary tract pathology

Carmina Duran, Luis Riera, Javier del Riego, Cesar Martin
UDIAT-CD, Sabadell (Spain)

Purpose-Objective. Voiding urosonography (VUS) has been demonstrated as being able to obtain high quality morphologic studies of the urinary tract. This poster is a pictorial essay of the lower urinary tract pathology VUS has been able to identify to the present.

Material and methods. Between October 2005 and December 2012, we performed VUS in about 1300 patients (<16 years). We used a 6–4 MHz probe to study the entire urinary tract including the urethra through a transperineal and/or transpelvic approach. To perform VUS, we used a specific harmonic imaging mode based on pulse inversion with a predetermined low (0.16–0.22) mechanical index and administered 1st or 2nd generation ultrasound contrast agents intravesically.

Results. Pathological urethral findings: 6 cases of posterior urethral valves, 2 diverticulum of the prostatic utricle, 1 patient with anterior urethral valves and 1 patient with congenital stricture of the bulbar urethra. Moreover 3 bladder diverticula, 1 spinning top urethra, 1 urogenital sinus, 5 ureteroceles and 1 ectopic ureter in a duplex collecting system were identified. Variants of normality visualized: a prostatic duct reflux and 6 Cobb's Collar.

Discussion and conclusions. Despite the low prevalence of congenital lower urinary tract lesions VUS is progressively proving that, with an accurate technique, it is able not only to perform a correct morphological study of the male urethra, but also allows the specific diagnosis of congenital urinary tract anomalies.

081

Acute traumatic and non traumatic scrotal emergencies: a review of US and color Doppler findings

Cinzia Orazi, Maria Chiara Lucchetti, Paola Marchetti, Maria Antonietta Barbieri, Paolo Maria S. Schingo, Massimiliano Silveri, Paolo Tomà
Bambino Gesù Children's Hospital, Palidoro - Rome (Italy)

Purpose-Objective. Acute testicular pain and scrotal swelling are common presenting complaints in the Emergency Department (ED) and include traumatic and non-traumatic conditions.

Material and methods. We present a review of Ultrasound and color Doppler findings in a series of 400 patients (age 20 days–18 years), who presented with acute scrotum (January 2011–December 2012).

Results. The most common causes were non-traumatic and included testicular torsion, torsion of the appendages and epididymitis, with different distribution with age. Imaging characteristics of testicular torsion include B-mode signs (spermatic cord "spiral twist") and color Doppler signs (reduced/absent arterial flow signals). Extra-vaginal torsion is seen mainly in newborns, occurring prenatally in most cases; intra-vaginal torsion is more common in adolescents.
Torsion of appendages and epididymo-orchitis presents increased flow signals. The peak of prevalence of epididymo-orchitis is under 2 years of age. Torsion of appendages is the most frequent condition, mainly occurring in pre-pubertal boys. Trauma can result in testicular hematoma, rupture/fracture, disrupted albuginea, scrotal effusion (hematocele), scrotal wall/spermatic cord thickening or hematoma. Color Doppler can assess blood flow in viable testicular tissue.
Neoplasms can rarely present with acute scrotum. Other conditions include idiopathic scrotal edema and incarcerated inguino-scrotal hernia.
Discussion and conclusions. Early and accurate diagnosis is essential for proper treatment and management of acute scrotal emergencies. Ultrasound and Color Doppler are the imaging modalities of choice.

082

Fallopian tube diseases in peripubertal girls: hydrosalpinx and tubal torsion. Possible pathogenesis

Cinzia Orazi, Maria Chiara Lucchetti, Paola Marchetti, Paolo Maria S. Schingo, Paolo Tomà
Bambino Gesù Children's Hospital, Palidoro - Rome (Italy)

Purpose-Objective. Fallopian tube diseases are only rarely involved in acute pelvic pain in childhood and adolescence. Hydrosalpinx develops due to a blocked, dilated fallopian tube with accumulation of fluid. The enlarged salpinx bears the risk of torsion, even without involvement of the ovary. The pathogenesis of tubal diseases in this age group is still obscure.
Material and methods. We report on imaging and clinical findings in our series of 25 (not sexually active) patients: 21 with hydrosalpinx (1 complicated with torsion), 4 primarily presenting with tubal torsion. They were all examined by US and 16 of them underwent MRI.
Results. Imaging findings (fallopian tube dilation, characters of the contents, wall thickening and vascular pattern) were correlated with the age at onset, the pubertal stage and the clinical setting.
Discussion and conclusions. Abdominal/pelvic infections or adhesions, due to previous inflammatory conditions or abdominal surgery, functional masses (eg. corpus luteum) and anatomical conditions (eg. abnormal length of mesosalpinx), may be possible underlying factors for the development of tubal dilation. Pelvic venous congestion, frequently associated with peri-pubertal changes, together with an hyperperistaltic condition of the salpynx itself, may act as a trigger event for hydrosalpinx, and perhaps for possible subsequent tubal torsion, presenting with acute onset. Early recognition and correct discrimination between medical and surgical causes of tubal diseases are important to avoid unnecessary surgery and subsequent harmful adhesions.

083

A rare case of spontaneous regression of cystic dysplasia of the testis

Polina Pavicevic, Vojkan Vukadinovic, Miroslav Djordjevic
University Childrens Hospital, School Of Medicine University Of Belgrade, Belgrade (Serbia)

Purpose-Objective. Cystic dysplasia of the rete testis (CDT) is a rare disorder, characterized by irregular cystic spaces within the mediastinum or rete testis. The natural course of CDT is not fully understood. There are few cases in the literature presenting spontaneous regression of these lesion.We are presenting a case of CDT in an 8-year-old boy, with ipsilateral multicystic dysplastic kidney, in whom spontaneous regression occurred by ultrasoniographic follow up examination.
Material and methods. At the time of diagnosis the 2-year-old boy presented with asymptomatic scrotal swelling was found to have a palpable mass in the upper pole of the left testicle. A scrotal ultrasound revealed left testicular enlargement with almost entirely replaced testicular parenchyma with multiple cystic elements. Ipsilateral multicistic dysplastic kidney was also revealed by ultrasound.
Results. Follow up scrotal ultrasound until the age of 7 years demonstrated unchanged multicystic appearance of the left testicle. At age 8 years,ultrasound revealed almost homogenous texture of the testicular parenchyma, with no residual cyst.
Discussion and conclusions. Cystic dysplasia of the testis (CDT) is a rare lesion which consists of cystic dilation of the rete testis and it is frequently associated with renal anomalies. The role of ultrasound is of primary importance for clinical diagnosis and follow-up of untreated forms. Our case of spontaneous regression suggests that conservative management, through regular observation with US, may be the treatment of choice for this disorder.

084

The importance of ultrasound in the evaluation of nephrocalcinosis in neonate and young children

Besa Hidri, Diamant Shtiza, *Fjorda Tuka,* Sonja Butorac (Saraçi), Denis Qirinxhi
Mother Teresa Uhc, Tirana (Albania)

Purpose-Objective. Importance of ultrasound in assessing nephrocalcinosis and its severity, particularly using a high-frequency transducer. Importance of combining the radiologic findings with other tests in diagnosing its etiology.
Material and methods. Our study included 20 patients diagnosed with nephrocalcinosis in their first 15 months of life, during a 10-year period. In patients' examination ultrasound was used, using also linear-array transducer for a focused examination of the renal pyramids. All patients underwent different blood, biochemical, histologic, genetic tests etc. to explore the origin of nephrocalcinosis.
Results. 3 patients were graded as 1st Grade nephrocalcinosis, 4 patients 2nd Grade, 13 patients 3d Grade. All the patients had bilateral nephrocalcinosis. 8 patients were diagnosed with Renal Tubular Acidosis, 7 patients with Vitamin D intoxication, 3 patients with Oxalosis, 2 patients with Fanconi Syndrome, 1 patient with Bartter Syndrome and 1 patient as Idiopathic. Main complaint was delay in development (14 patients). Most of the cases were diagnosed with Tubular Renal Acidosis. The linear array transducer helped in the grading process and better evaluation of the pyramid echogenicity using the focused technique.
Discussion and conclusions. The first-choice examination for assessing nephrocalcinosis and in its grading and follow-up is ultrasound, using a linear-array transducer also. The main cause of nephrocalcinosis is Tubular Renal Acidosis. The main reason of presenting to the doctor is delay in development. Different radiologic findings may help suggesting the underlying etiological process.

085

Ultrasound imaging of the paediatric scrotum

David Hatch, Susie Goodwin
Great Ormond Street Hospital, London (United Kingdom)

Purpose-Objective. To review the anatomy, imaging technique and pathology of disorders of the scrotum in children using ultrasound images and case examples.
Material and methods. Cases of testicular ultrasound studies in our institution database from the past two years were reviewed, and are presented as clinical case studies with the appropriate accompanying imaging.
Results. We classified the range of scrotal pathology encountered into two categories. The "painful scrotum" includes examples such as epididymitis, torsion, haematocele, trauma and inguinal hernia. The "scrotal mass" can be further subdivided into testicular and extra-testicular masses; with examples such as yolk sac tumour, teratoma, rhabdomyosarcoma, epididymal cysts and hydroceles, respectively. Clinical history, patient presentation and a description of the sonographic appearances are included with the supporting literature.
Discussion and conclusions. Ultrasound imaging is valuable in the assessment of paediatric scrotal abnormalities as it offers the most suitable direct extension of clinical examination. Knowledge and understanding of the relevant anatomy and imaging features of scrotal pathology is essential for patient management.

086

Ultrasound features of paediatric renal transplant complications

David Hatch, Marina Easty
Great Ormond Street Hospital, London (United Kingdom)

Purpose-Objective. To present sonographic imaging findings of complications that occur following renal transplantation in children.
Material and methods. All renal transplants in our radiology database for the past 3 years (2010–2012) were reviewed and evaluated to identify complications. These cases have been correlated with clinical information, complementary imaging and available literature to provide supporting evidence.
Results. A range of ultrasound images/case studies demonstrating renal transplant complications/pathologies will be presented along with techniques of ultrasound image optimization to improve diagnosis. Complications include immediate post-surgical events, acute and chronic rejection, vascular complications and more unusual findings. Discussion regarding complementary imaging modalities are included in the relevant cases along with supporting clinical information from the wider literature.
Discussion and conclusions. Ultrasound plays a vital role in renal transplant assessment as it provides an extension to clinical examination and biochemistry. Knowledge and understanding of these appearances is essential as diagnosis will direct patient management including subsequent intervention or biopsy, and further imaging such as angiography or nuclear medicine studies.

087

Pictorial review of palpable inguinal masses in girls

Yun-Woo Chang
Soonchunhyang University Hospital, Seoul (Republic of Korea)

Purpose-Objective. The purpose of this exhibit is 1. To illustrate the presenting palpable inguinal masses in female children. 2. To discuss disease entities associated with canal of nuck 3.To explain imaging findings, including ultrasonography, CT, and MR imaging for evaluation of inguinal disease.

Material and methods. We illustrate various diseases for palpable inguinal masses in female girls using the various imaging modalities.

Results. Contents are organization of 1. Anatomy of canal of nuck 2. Disease review according to location layer in inguinal area using the various imaging modality. 3. Hernia of ovary, uterus, infracted mesentery, bowel, hydrocele.

Discussion and conclusions. The major teaching points of this exhibit are: 1. Various organs contain an inguinal hernia presenting as an inguinal mass in female children. 2. Knowledge of the anatomy of canal of nuck and direct visual examination of the lesion may aid the differential diagnosis of canal of nuck lesions in female children.

088

Renal lymphangiectasia: sonographic features in long-term follow-up

Silvia Rocha, Marcia Wang Matsuoka, Gisele Correa Almeida, Luciana Panizza, Andrea Langone Ferme, Mauricio Yamanari, Luiz Antonio Nunes Oliveira
Instituto Da Criança Do Hospital Das Clínicas Da Faculdade De Medicina Da Universidade De São Paulo, São Paulo (Brazil)

Purpose-Objective. The objective of this study is to present sonographic features of renal lymphangiectasia in one child followed in our Department over the past 10 years.

Material and methods. Sonographic, color Doppler and CT scan records are shown in order to illustrate renal lymphangiectasia findings.

Results. Case report is given of a girl who, at 4 years of age, underwent routine abdominal ultrasound, which revealed diffusely hyperechoic enlarged right kidney with loss of corticomedullary differentiation. Subsequent follow-up ultrasound examinations showed progressive appearance of cystic formations, which were, initially, very tiny, located in peripheral cortical region. Over the years, cystic lesions became larger and located in more peripheral regions, till they reached the current stage of multiple perirenal thin-walled fluid collections with anechogenic content. In addition, Color Doppler study revealed renal vein trombosis.

Discussion and conclusions. Renal lymphangiectasia is a rare, benign condition characterized by developmental malformation of the perirenal lymphatic system, expressed by parapyelic and perirenal fluid collections, which may progress from asymptomatic condition to chronic renal failure. It can be focal, unilateral or bilateral and may be found in pediatric or adult patients. Pediatric differential diagnosis includes polycystic renal disease, urinoma, renal lymphoma with perirenal involvement and renal tumors. Management is often conservative, due to the benign behavior of the lesion. In most cases diagnosis can be done by imaging methods only, since imaging findings are quite characteristic.

089

Various urethral pathologies in voiding cystourethrography

Mithat Haliloglu [1], Berna Oguz[2]
[1] Hacettepe University School Of Medicine, Department Of Radiology, Ankara (Turkey); [2] Hacettepe University School Of Medicine, Ankara (Turkey)

Purpose-Objective. Voiding cystourethrography is the main imaging modality to evaluate the urethra. The purpose of this exhibit is to demonstrate spectrum of urethral pathologies of children in voiding cystourethrography (VCUG).

Material and methods. Embryology and anatomy of the urethra and VCUG technique will be briefly discussed. Images will include: posterior urethral valves, Mullerian duct remnants, hypospadias, Cowper's duct, anterior urethral valves, urethral duplication, urethral stricture and trauma, rectourethral fistula, rectovesical fistula, and urethrovaginal fistula.

Results. The findings will be demonstrated clearly.

Discussion and conclusions. VCUG is essential for the evaluation of the anatomy and abnormalities of the bladder and urethra. The results of VCUG may determine whether additional imaging modalities are required or not.

090

The importance of pyelectasis—report of a clinical study in progress

Gyula Pásztor [1], Pál Pásztor [2], Csaba Bereczki[2], Edit Kukla[1], András Palkó[3]
[1] Euromedic Diagnostics Hungary Ltd. (Hungary); [2] University of Szeged Faculty of Pediatrics, Szeged (Hungary); [3] University of Szeged Faculty of Radiology (Hungary)

Purpose-Objective. The aim of the ongoing study is to categorize the pyelectasis diagnosed in newborns or early childhood. We would like to confirm the presumption that low grade pyelectasis (Grade 1.) has no clinical relevance while presently 3–4 negative ultrasound results are required to terminate clinical follow up.
Material and methods. Approximately 250 patients have been involved and to be monitored in the following months. All of them were diagnosed with some grade of pyelectasis as a newborn, primarily with ultrasound. They have been grouped according to the degree of distension of the collecting system.
Results. According to our experience, Grade 1 pyelectasis has so low significance that—in symptom-free cases—the radiological follow up is not necessary at all.
Discussion and conclusions. The radiological follow up is not necessary at all, particularly because it can develop disease awareness, and unnecessarily overloads the available examination capacity. We would like to report the result and the experiences of this ongoing study in June, 2013.

Radiation Safety

091

Painful paediatric hip: frog leg lateral only!

Josephine Bomer, HC Holscher, F Klerx-Melis
Haga Teaching Hospital/Juliana Children's Hospital, Den Haag (Netherlands)

Purpose-Objective. In case of hip complaints in children it has been common practice to acquire both AP and Frog Lateral (FL) radiographs. The combination of these views has a high diagnostic yield, but also doubles radiation exposure. It has been our observation that oftentimes the FL view is diagnostic when the AP is not. We therefore investigated the diagnostic accuracy of obtaining a solitary FL view as compared to the combination of the AP and FL view.
Material and methods. Hip radiographs of 529 children (aged 2–15 years) were retrospectively assessed by two independent radiologists. Using a database system, for each patient the solitary FL view and the combination of the AP and FL views were viewed separately and in a random order. We used the Kappa test to calculate agreement between the assessment of both views and the solitary FL view.
Results. Agreement between the solitary FL view and the combination of the AP and FL view using the kappa test was 0.989.
Discussion and conclusions. The diagnostic accuracy of the solitary FL radiograph in case of hip complaints in children is as high as the current standard of both AP and FL views. Therefore a solitary FL radiograph may be obtained. This substantially reduces radiation exposure. If an adequate FL view cannot be performed, an additional AP view is required.

092

Low dose chest CT in children with cystic fibrosis: assessment of image quality. Our experience

Cecilia Lanza, Lucia Amici, Giovanni Pieroni, Valeria Bolli, *Andrea Giovagnoni*
Azienda Ospedaliero-Universitaria Ospedali Riuniti, Ancona (Italy)

Purpose-Objective. The aim is to determine if the monitoring of respiratory disease progression in children with cystic fibrosis can be made using low dose CT markedly reducing the radiation exposure.
Material and methods. From June 2008 to June 2012 we performed 106 lung CT in children (mean 15 year) with stable CF. All patients underwent a volumetric inspiratory CT scan completed with 4 sequential expiratory slices. The dose-length product (DLP) was used to quantify the amount of radiation used to perform examination. In the first 2 years CT protocol was performed with 100–120 Kvp, 70–80 mA/s, 5-mm slices, 5-mm intervals, reconstructed in 2.5 mm thick sections. Afterwards we reduced Kvp to 80, mA/s to 20–30, 0.5-s gantry rotation time, pitch of 1.35. Two senior radiologists reviewed diagnostic image quality independently by scoring anatomical structures (Bhalla score) using a four-point scale (1=excellent, 2=good, 3=sufficient, 4=non-diagnostic).
Results. At the beginning the mean DLP was 200 mGy-cm, while afterwards we had a significant reduction in radiation (DLP: 20 mGy-cm). The radiologists evaluated image quality as excellent in 98% of CTs in the first 2 years, while after reduction dose diagnostic acceptability was graded as (63%) good and (37%) sufficient, but the quality was never so poor as to be non diagnostic.
Discussion and conclusions. In our experience, it is possible to obtain good radiological information by markedly reducing radiation exposure.

093

Lung CT in cystic fibrosis young patients: comparison of effective doses measured with two different methods

Irene Borzani, Mauro Campoleoni, Valentina Minotto-Lederer, Shary Milano, Eliseo Ruggieri, Pietro Biondetti
Fondazione Irccs Ca' Granda - Ospedale Maggiore Policlinico, Milan (Italy)

Purpose-Objective. The aim of this study is to review the evaluation method to calculate effective doses (E) in cystic fibrosis (CF) in young patients (3–19 year) undergoing lung CT and to better understand the factors affecting these doses.
Material and methods. We collected dosimetric data (kV, CTDIvol and DLP) of 34 CTs, which took place between January 2010 and December 2011, and the diameters of pts to calculate SSDE. All CT scans were performed with ATCM (GE SmartmA). Effective doses were calculated according to two different methods: the traditional one, which considers the scanner DLP and the conversion factors published in the nineties, which only referred to adults, and a second method that considers two steps: 1- the calculation of a corrected DLP* on the basis of pts size and in consideration of SSDE, 2- the application of the new factors for pediatric pts (Deak 2010)
Results. The comparison between effective doses calculated with the two methods shows a significant difference. For small children, the second, more appropriate method indicates that E can be up to three times higher.
Discussion and conclusions. E can be calculated with different techniques, which show different accuracies according to physical aspects and scanner types. It is of real importance to be aware of the latest and accurate mathematical models, which take into account more variables, related to the pts and the scanner technology.

094

Paediatric CT quality consistency: comparison of average equivalent water diameter and age/weight scanning protocols

Ed Roberts, Larry Mak, Michael Ditchfield
Southern Health, Melbourne (Australia)

Purpose-Objective. To determine if paediatric body CT image quality consistency is improved by using average equivalent water diameter (AEWD) compared to conventional age/weight scanning protocols.
Material and methods. Consecutive paediatric patients undergoing chest or abdominal CT were recruited at a paediatric tertiary centre. The CT studies were divided into 2 groups. i) protocols based on weight and age, (37 patients, age range 2 weeks–15 years, mean age 6.3 years, weight range 3.9–67 kg, mean weight 25.8 kg) and ii) protocols based on AEWD from the preliminary scanogram (28 patients, age range 3–18 years, mean age 10 years, weight range 12–80 kg, mean weight 35.2 kg). Patient age, weight, height and abdominal/chest circumference were recorded. Effective dose was obtained from console data and converted to effective dose using phantom based pediatric conversion coefficients. Image quality was assessed empirically by 3 senior radiologists and quantitatively by comparative regional noise measurement in liver, spleen and soft tissue.
Results. All CT studies were considered to be of diagnostic quality. Protocols based on weight and age had a larger variability in noise, subjective quality and effective dose when compared to protocols based on AEWD.
Discussion and conclusions. Is has previously been established that paediatric patients of the same age vary significantly in height and weight. Paediatric body CT scanning using protocols based on AEWD rather than age/weight based protocols produces more consistent image quality and effective radiation dose.

095

Radiation dose reduction and protocol optimization for pediatric head CT in evaluation of craniosynostosis

Laurence Eckel, Alice Patton, Lifeng Yu, Gesina F Keating, Nicholas M Wetjen
Mayo Clinic, Rochester (United States)

Purpose-Objective. CT remains the primary imaging method to evaluate craniosynostosis. Given the many pediatric patients who need CT for evaluation of craniosynostosis, we believe additional radiation reduction in CT needs to be investigated. The objective of this work was to determine the minimum radiation dose that still adequately evaluates craniosynostosis.
Material and methods. Raw data from clinical pediatric head CTs performed on a 128-slice CT scanner (Definition Flash, Siemens Healthcare) was collected and transferred to an external workstation. The exams included 4 heads on pediatric patients, ranging in age from 0 months to 2 years. Using a validated noise insertion tool developed in our institute, three different noise levels were inserted into each raw dataset, resulting in unique datasets simulating 50%, 25%, and 10% of the original dose level. Each dataset was reconstructed using both original filtered-back projection (FBP) and sinogram affirmative iterative reconstruction (SAFIRE) methods.
Results. The acceptable dose relative to current clinical pediatric techniques was 10%. Based on the results from reconstruction, the average CTDIvol for patients was reduced by 90%. Using the conversion factor for a 5 year old patient, the dose was effectively reduced to approximately 0.1 mSv, roughly equivalent to that of a chest radiograph.
Discussion and conclusions. Dose reductions of 90% were realized while maintaining acceptable image quality to answer the specific clinical question of craniosynostosis.

096

Iterative MDCT image quality and dose reduction in paediatric head protocols for traumatic lesions and neurosurgery controls

Antonio Ciccarone, Simona Quaglierini, Leonardo Lelli, Marco Di Maurizio, Sara Savelli, Claudio Fonda
Meyer Children's University Hospital, Florence (Italy)

Purpose-Objective. The purpose of our study is to assess the image quality and radiation dose of new MDCT paediatric head protocols with an innovative iterative reconstruction technique iDose4 (Philips Healthcare). Clinical questions under examination were head traumatic lesions, hydrocephalus controls with/without ventriculoperitoneal shunt, pre- or post- neurosurgery controls.
Material and methods. Low contrast detectability (LCD) was evaluated statistically, in a 16 cm water phantom. The choice of the water arises from the fact that in pediatric patients the quantity of water inside is more major than in case of adults. At different protocols employed for each clinical question, adding computer simulated 3 mm disc shaped LCD objects onto water images, 2 experienced radiologists graded the perceived image noise, low contrast separation, small structure visibility and diagnostic confidence. A clinical validation of lowest dose protocols with good diagnostic confidence was performed.
Results. For each clinical question, a reduction in average CTDI of 20% has been reached in our new scanning protocols with iterative reconstruction as compared to our previous protocols before optimizing dose reduction and LCD. Radiologists reported non significant reduction of the detection in low-visibility structures and diagnostic confidence.
Discussion and conclusions. In a CT study, the image quality and dose reduction depend on the clinical question. A focused clinical question to be answered needs a better image quality with increasing dose protocols.

097

Foreign body ingestion in pediatric population: is there a role for low-dose radiography and fluoroscopy?

Andrea Magistrelli, Paolo Maria Salvatore Schingo, Teresa Corneli, Roberta Lombardi, Marco Cirillo, Paolo Tomà
Bambino Gesù Children'S Hospital, IRCCS, Rome (Italy)

Purpose-Objective. Foreign body (FB) ingestion is a common problem in the pediatric population and a frequent cause for emergency room visits. Up until today abdominal plain-radiography is considered the gold-standard for FB identification and characterization, for assessment of complications or expected safe passage. The aim of this study is to assess the suitability of alternative, low-dose, diagnostic imaging techniques in identification and characterization of FB, assessment of complications and monitoring of the expected safe passage.
Material and methods. From October 2012 we have evaluated 62 consecutive patients admitted to our emergency room with history/suspected FB ingestion with one of the following settings:

– standard plain-radiography (ABD);
– low-dose RAD (121 kV/<0,5 mAs);
– fluoroscopy.

The radiographic appearance and location of ingested FB were evaluated. For each modality we evaluated the mean DAP ($\mu Gy*cm^2$), image quality, sensitivity and specificity.
Results. 14 patients were examined with ABD, 27 patients with RAD and 21 patients with fluorospot. In our series there were no false negative or positive exams. The mean dose in ABD exams was 12.28 $\mu Gy*cm^2$ (range 1.01–39.38), in RAD exams 0.62 $\mu Gy*cm^2$ (0.01–1.81) while in the fluorospot series 0.11 $\mu Gy*cm^2$ (range 0.01–0.56).
Discussion and conclusions. Both techniques are powerful methods to investigate presence/absence of FB with a "fair" dose. Anyway low-dose setting is more acceptable and less affected by dose variability if compared to fluoroscopy settings.

Gastrointestinal

098

A pictorial review of CT features of gastrointestinal disease in children

Moti Chowdhury, Surekha Kumbla
Royal Children's Hospital, Melbourne (Australia)

Purpose-Objective. Radiosensitivity concerns in children reflect the sparing use of multi-detector computerized tomography (MDCT) imaging, particularly of the abdomen and pelvis. Its benefits, including spatial resolution advantages, however confer it a sensitive diagnostic tool complementing other modalities where diagnosis remains uncertain. We provide the first reported pictorial review of CT features of gastrointestinal disease in children as an educational exhibit to promote their recognition.
Material and methods. Patients with diagnoses affecting the bowel and mesentery and evaluated with MDCT were identified from our radiological database. All studies were performed with intravenous and with/without oral contrast,

and images reformatted. Imaging findings were correlated, where available, with other imaging modalities, non-radiological investigations and histological findings in patients who underwent surgery/tissue-biopsy.
Results. MDCT features of the following diagnoses are pictorially illustrated: Acute appendicitis, Appendagitis epiploicae, Burkitt's Lymphoma, Coeliac disease, Crohns disease, Duodenal haematoma, Duplication cysts, Graft-versus-Host Disease, Henoch-Schonlein Purpura, Inflammatory Myofibroblastic tumour, Internal Hernia, Midgut volvulus, Neutropenic colitis, Non-pancreatic mesenteric pseudocyst, Omental infarction, Small bowel intussusception, Tuberculosis, and Ulcerative Colitis. The radiological diagnosis was confirmed in most cases.
Discussion and conclusions. The pictorial review serves as an educational tool illustrating characteristic and distinguishing CT features of gastrointestinal disease described in children. Its spatial resolution, vascular/enhancing properties, and advantages where other modalities may be unavailable emergently or may preclude diagnosis demonstrate its utility as a valuable complementary diagnostic tool.

099

CT and MR appearance of hepatic angiosarcoma (HAS) in a 10-year-old girl

Henry Chan
Chang Gung Memorial Hospital, Keelung (Taiwan, Province Of China)

Purpose-Objective. To discuss the images of a hepatic angiosarcoma (HAS) in a 10-year-old girl with tissue proof.
Material and methods. We report a case of HAS in a 10-year-old girl complaining of a palpable mass in the right upper abdomen for months.
Results. A huge and heterogeneous enhanced mass occupying the right lobe of the liver was shown in an enhanced CT scan. The MR images showed a huge lobulated hypervascular tumor containing peculiar whorl like nodular components and vascular spaces. A vascular-origin mass was impressed, the diagnosis of hepatic angiosarcoma was confirmed under microscopic examination.
Discussion and conclusions. Hepatic angiosarcoma is rare in children with less than 30 cases described. These lesions are aggressive and generally carry a poor prognosis. The imaging findings are somewhat variable. In CT images, few angiosarcoma lesions were hypoattenuating to the liver on both arterial and portal venous phase images, some becoming isoattenuating on portal venous phase images, clearly different from blood pool attenuation. An unusual pattern of layered linear high-attenuation central enhancement was described before. Although HAS in children remains a diagnostic challenge before histologic study, the CT and MR findings in this case suggest some clues for the diagnosis. Although rare, hepatic angiosarcoma should be included in the differential diagnosis when a variable-enhanced soft tissue liver mass is found in a child.

100

Primary neoplastic tumors of the pancreas in three children

Živa Zupančič, Senja Mali, Diana Gvardijančič, Anton Kenig
University Medical Centre Ljubljana, Ljubljana (Slovenia)

Purpose-Objective. To present three cases of primary neoplastic tumors of the pancreas and to report on the relevant data, as pancreatic tumors are a rare pathology in children.
Material and methods. In a retrospective review of three cases of primary neoplastic tumors of the pancreas, diagnosed within a two-year period, we evaluated data on clinical, laboratory, imaging and biopsy findings, treatment decisions, histological diagnosis and clinical outcome.
Results. In a 7-month-old boy with bilirubinaemia, a 14-year-old girl with vomiting and acute epigastric pain, and a 10-year-old girl after appendectomy, a pancreatic tumor was detected by US; MR followed. The tumors were in the pancreatic head, well defined, 2–4 cm in diameter; tumors in the girls were polycystic, the tumor in the boy was solid. Biliary duct dilation was present in the boy. Percutaneous needle biopsy in the boy and 10-year-old girl showed no malignant cells. As the 10-year-old girl was asymptomatic and MR suggested serous cystadenoma, no treatment was indicated. She is followed by US. Surgery was indicated for the symptomatic boy and older girl. Both had Wipple's operation with pancreatic head resection. Histological diagnosis in the boy was inflammatory miofibroblastic tumor, and in the girl solid pseudopalillary tumor. Patients are now well.
Discussion and conclusions. The tumors turned out to be benign. Surgery, although aggressive, was unavoidable in two symptomatic children. In the asymptomatic girl, ongoing observation is indicated.

101

Primary synovial sarcoma of the abdominal wall: a case report and review of literature

Supika Supika Kritsaneepaiboon, Surasak Sangkhathat, Winyou Mitarnun
Songklanagarind Hospital, Prince Of Songkla University, Hat Yai (Thailand)

Purpose-Objective. To describe a case of synovial sarcoma of the anterior abdominal wall (SSAW) in an adolescent girl and review of literature.
Material and methods. A 12-year old girl presented with a palpable painless mass at left lower abdomen rapidly increasing in size for a month. CT scan revealed a heterogeneous enhancing mass originating from left external oblique muscle and the mass was surgically removed subsequently. The histology was compatible with biphasic synovial sarcoma.
Results. Synovial sarcoma is an uncommon malignant soft tissue tumor occurring at extremities near the large joints in middle-aged patients. The rare unexpected sites could be found at head and neck regions, retroperitoneum, mediastinum, bone, nerve, blood vessels as well as the visceral organs and believed to derive from primitive mesenchymal cells. Only one SSAW case in adolescence has been reported. Imaging findings of SSAW are not pathognomonic, although stipple calcifications can be found in about 30% of cases. Necrotic and hemorrhagic areas are also common. Cross sectional imaging are helpful to evaluate extension and treatment planning. The three histologic subtypes are monophasic, biphasic and poorly differentiated types. Surgical wide excision is the treatment of choice, adjunctive by radiation, chemotherapy or both, nevertheless, the recurrence still ranges from 28% to 36%.
Discussion and conclusions. Primary SSAW should be considered in the differential diagnosis when presenting in an adolescent girl with stipple calcifications in abdominal wall mass.

102

Congenital splenic cysts: a report of two cases

Maria Sidiropoulou [1], Anagnostis Skordas[1], Vasiliki Georgopoulou[1], Emmanouil Zaikos[1], Thomas Nimas[1], Maria Badouraki[2], Antonios Stratis[1], Anthoula Morichovitou[1], Efthymia Zafeiriadou[1]
[1] Department Of Computed Tomography, 1St Department Of Radiology, "Hippokrateio"General Hospital, Thessaloniki (Greece); [2] 1St Department Of Radiology, "Hippokrateio"General Hospital, Thessaloniki (Greece)

Purpose-Objective. Splenic cysts (SC) are a rare condition with an incidence of 0.07% and classified as primary or secondary cysts according to the presence of an inner cellular lining. Primary SCs comprise 30–40% of total cysts and are encountered more commonly in children and young adults. Primary SCs are subdivided into parasitic or nonparasitic subgroups. Nonparasitic SCs are further subdivided as congenital (epidermoid and dermoid) or neoplastic. Herein, we present two cases with congenital splenic cysts (CSC), their imaging evaluation and review of the literature.
Material and methods. The medical records of two patients (one 14-year-old girl and one 7-year-old boy) diagnosed for CSC were evaluated retrospectively. The clinical, imaging and surgical findings were reviewed. The presenting symptoms, physical examination and imaging findings were noted.
Results. The 14-year-old girl was admitted with complaint of flank pain. Ultrasonography (US) of the upper abdomen showed a 5.7 cm×5.3 cm well defined splenic cystic lesion. Computer tomography (CT) confirmed the splenic cyst. The 7-year-old boy presented with left hypochondrial pain. US and CT revealed a 9.5 cm multilobular splenic cystic lesion with septations. Furthermore, CT depicted increased attenuation of the cyst interior. Both children were treated surgically.
Discussion and conclusions. CSCs are the most common nonparasitic SCs in children. Most CSCs are asymptomatic. US and CT reveal CSCs as incidental findings and contribute to preoperative diagnosis and evaluation.

103

Keeping it simple: Ultrasound for paediatric appendicitis. Overview of the spectrum of ultrasound findings

Alan Quigley, Samuel Stafrace
Royal Aberdeen Children's Hospital, Aberdeen, Scotland (United Kingdom)

Purpose-Objective. Ultrasound is an essential tool and an established technique in the assessment of children with suspected acute appendicitis. In this poster we aim to demonstrate the spectrum of ultrasound appearances in this common clinical scenario.
Material and methods. Our local database over the last 4 years has been retrospectively interrogated and the ultrasound examinations of children referred for assessment for suspected acute appendicitis have been reviewed.
Results. The most common ultrasound appearances of acute appendicitis and its complications were identified. The following appearances are described and illustrated: normal appendix, inflamed appendix, appendicoliths, appendicular phlegmon, retrocaecal appendicitis, omental reaction, peritonitis and periappendicular abcess collections.
Discussion and conclusions. An image based description of the ultrasound technique and spectrum of pathological appearances encountered is presented. Knowledge of such ultrasound appearances is essential for the radiologist working in the setting where children may present with acute appendicitis or its complications.

104

Imaging findings in common pathologies causing neonatal and infantile bowel obstruction: a pictorial overview

Alan Quigley, Samuel Stafrace
Royal Aberdeen Children's Hospital, Aberdeen, Scotland (United Kingdom)

Purpose-Objective. Intestinal obstruction is a common clinical scenario in any busy neonatal/paediatric unit. The purpose of the poster is to demonstrate the spectrum of radiological appearances in infants with confirmed congenital or acquired intestinal obstruction.
Material and methods. Our local teaching database was interrogated and cases of intestinal obstruction in neonates and infants reviewed with surgical correlation.
Results. The imaging appearances of the common causes of proximal and distal neonatal and infantile obstruction are described and illustrated. Cases identified include: pyloric stenosis, duodenal atresia, duodenal stenosis, malrotation, mid gut volvulus, ileal atresia, meconium ileus, Hirschprung's disease, meconium plug syndrome, colonic atresia and anorectal abnormalities.
Discussion and conclusions. This educational poster illustrates the radiological signs of common causes of neonatal and infantile bowel obstruction.

105

Small bowel study MRI: Pictorial overview of technique and pathological findings in the paediatric population investigated for suspected inflammatory bowel disease

Samuel Stafrace [1], Steven Yule[2]
[1] Royal Aberdeen Children's Hospital, Aberdeen, Scotland (United Kingdom); [2] Aberdeen Royal Infirmary, Aberdeen, Scotland (United Kingdom)

Purpose-Objective. Small bowel study (SBS) MRI has become a mainstream test in the investigative pathway of children with suspected inflammatory bowel disease. This has largely replaced the use of contrast fluoroscopy and CT. The purpose of this poster is to outline our technique and demonstrate examples of the MRI signs helpful in confidently interpreting this investigation.
Material and methods. Our local database was interrogated and the SBS MRIs of children who had undergone this test over the last 3 years were retrospectively reviewed.
Results. We have altered and fine tuned our protocol technique over the recent years. The current technique and diagnostic usefulness of each sequence performed is outlined. Pathological appearances identified, described and illustrated amongst others include thickened terminal ileum, mesenteric oedema, mesenteric hyperaemia, mesenteric lymphadenopathy, strictures, fistulae and abnormal mural enhancement.
Discussion and conclusions. SBS MRI has become a mainstream component of the investigative pathway in suspected small bowel inflammatory bowel disease in children. This educational poster aids the paediatric radiologist increase in confidence in the interpretation of this test.

106

Role and feasibility of MRCP in pediatric pathologies

Mehrak Anooshiravani, A Kanavaki, E Maturana, L Merlini, B Wildhaber, S Hanquinet
Geneva University Hospital, Geneva (Switzerland)

Purpose-Objective. To study feasibility and contribution of magnetic resonance cholangio-pancreatography (MRCP) in the work-up of congenital and acquired biliary and pancreatic pathologies in children.
Material and methods. We reviewed MRCP images of 37 patients aged between 29 days and 16 year addressed for various clinical presentations: cholestasis, trauma, tumor, clinical pancreatitis and hepatic transplantation. All patients had an initial ultrasound, followed by MRCP (Avento Siemens 1.5 T). Some patients also had an abdominal CT and a few underwent percutaneous cholangiography or ERCP. MR sequences consisted of: T2 axial and coronal slices HASTE (3–5 mm), 2D HASTE (20–40 mm, breathholding when possible), 3D FSE(1,2 mm free breathing and respiratory gating) with MIP reconstructions.
Results. MRCP was useful in the diagnosis of the following pathologies : liver transplants with biliary stenosis (10), choledocal cysts (10, three of which also had choledocolithiasis), sclerosing cholangitis (5), traumatic pancreatic or biliary lesions (2), abdominal neoplasms with biliary tract involvement (2), cystic fibrosis (1), pancreatitis (2), venous cavernomas with subsequent biliary compression (2), no anomalies (2), no contribution (1).
Discussion and conclusions. In children, biliary and pancreatic lesions are frequently diagnosed with advanced US techniques. Further investigation by MRCP, a non-invasive and non-irradiating tool with fast sequences, presents a clear advantage in a more precise visualisation of the entire biliary tract, allowing better management of the abnormalities and complications.

107

MR imaging in a case of primary epiploic appendagitis in a 12 years girl

Sergio Salerno, Paola Carcione, Marcello Cimador, Giuseppe Lo Re, Massimo Midiri
University Hospital Policlinico, Palermo (Italy)

Purpose-Objective. Primary epiploic appendagitis (PEA) is an inflammation of epiploic appendages usually self-limited, that may rarely result in abscess formation and infrequently affect childhood. MR findings of PEA are presented, stressing the useful tools of MR in differential diagnosis and treatment monitoring without ionizing radiation.

Material and methods. A 12 years old girl with acute abdominal pain, fever and leucocytosis with a clinical and ultrasound examination revealing a painful right abdominal mass consistent with an abscess was submitted to MR to ascertain the origin of the abscess.

Results. 1.5 T MR scan examination was performed before and after contrast medium showing a mass medially in the colon hepatic flexure, with thick septa that enhanced after contrast and a thickening of the omental fat involving the epiploic appendage, excluding appendicitis or Crohn disease. A follow up scan performed after 1 week of antibiotics treatment with low response on MRI showed slight reduction in size. Laparotomy with partial excision of epiploon, draining of abscess cavities, nodal biopsy was performed. At pathology the excised epiploon was widely occupied by inflammatory lympho-ganulomatoid tissue.

Discussion and conclusions. PEA rarely results in a abscess, which origin could be difficult to demonstrate with US or CT excluding appendicitis or Crohn disease. MR imaging can provide exquisite anatomic, functional information without the need for ionizing radiation for the evaluation of small-bowel disorders.

108

Imaging in paediatric intestinal failure associated liver disease (IFALD)

Tom Watson, Kieran Mchugh, Susan Hill
Great Ormond Street Hospital For Children Nhs Foundation Trust, London (United Kingdom)

Purpose-Objective. 1. To review the common hepatobiliary pathology in patients with IFALD from a tertiary level nutrition unit. 2. To determine well the concomitant liver function tests correlate with the imaging.

Material and methods. Retrospective review of the radiology PACS system and gastroenterology database. All patients with IFALD were included. All hepatobiliary imaging was evaluated.

Results. 43 (24 male) children were included. All parenteral nutrition (PN) had been administered for between 4 months and 17 years. 293 ultrasounds and 8 MRIs were performed on the children during their time on PN. 39 (91%) patients had abnormal imaging on one or more ultrasounds. Concomitant LFTs were analyzed and the positive and negative predictive values were 52% and 41% respectively. Gallbladder pathology was the most common pathology, seen in 26 (60.4%) patients. 4 (15%) of these patients underwent a cholecystectomy which is above the expected rate in the general population. The time interval between initiation of PN and onset of biliary abnormalities ranged from 2 months to 16 years.

Discussion and conclusions. Biliary pathology is common in children on long-term PN and LFTs do not appear to correlate with the imaging findings. Regular imaging is important to monitor for those patients who require surgical intervention.

109

Administering oral contrast, a novel solution

Siva Muthukumarasamy [1], Dipalee Durve[2]
[1] Guy's And St Thomas' Nhs Trust, London (United Kingdom); [2] Evelina London Children's Hospital, London (United Kingdom)

Purpose-Objective. To review and present methods of administering oral contrast in children.

Material and methods. In the paediatric age group, the quality of an upper GI contrast study may be significantly compromised by ones ability to persuade the child to drink sufficient contrast medium. Persuading children to drink a white powdery substance in any significant quantity is one of the skills that all paediatric radiologists need to hone. We describe different methods of oral contrast administration, including our own novel way of increasing compliance in this age group of fussy eaters. Our technique involves partially replacing the contents of a well known soft drink with oral contrast.

Results. The bottle design with its opaque exterior and large perforated nozzle make it an ideal device for administering oral contrast. Its familiarity, popularity and taste also make it readily accepted by both children and their parents.

Discussion and conclusions. We would recommend this technique in children over the age of 1 year.

110

Role of MR cholangiopancreatography in the evaluation of pediatric pancreatic diseases

Maria Rita Panico [1], Carmine Mollica[2], Luigi Camera[1], Pier Paolo Mainenti[2], Marco Salvatore[1]
[1] Universita' Federico Ii, Napoli (Italy); [2] Biostructure And Bioimaging Institute (Ibb), National Council Of Research (Cnr), Napoli (Italia)

Purpose-Objective. Role of magnetic resonance imaging (MRI) of the abdomen and magnetic resonance cholangiopancreatography Wirsungraphy (RMCP) in pediatric pancreatic disease.
Material and methods. We analyzed MRI and MRCP in 28 patients (15 F, range: 1 year–19 years) performed for suspected pancreatitis (n=6), hyperamylasemia (n=7), pancreatic insufficiency in patients with cystic fibrosis (n=3), pancreatic insufficiency (n=4), recurrent pancreatitis (n=8).
Results. MRCP and MRI documented the followings: chronic pancreatitis (4) and pancreatic lipomatosis (2) in group 1. In group 2: autoimmune pancreatitis (4), and acute pancreatitis (3). In group 3: chronic pancreatitis (2) and pancreatic cyst (1). In group 4: chronic pancreatitis (2), adipose involution (1) and fibrous involution (1). In group 5: adipose involution (2) and pancreas with configuration bifida with Wirsung dominant (3), pancreas divisum with Santorinicele (2), with abnormality of the pancreatic ductal system at the level of the cephalic region of the type "pancreatic loop" (1).
Discussion and conclusions. With the development of MRI and MRCP, with the ability to provide an accurate delineation of pancreatic ductal tree, these methods are proposed as a valuable diagnostic tool in the work-up of patients with suspected pancreatic disease in order to replace invasive techniques. The results demonstrated the possibility of obtaining a high quality final images, preventing the repetition of exams and guiding the management later.

111

Can diffusion weighted imaging with background supression (DWIBS) substitute contrast enhanced T1-weighted images in the pediatric population with Crohn disease?

Norbert Utz, Antje Ballauff, Cornelia Haas, Karsten Thiel, Marcus Katoh
Helios Klinikum Krefeld, Krefeld (Germany)

Purpose-Objective. To assess the diagnostic value of DWIBS in the evaluation of inflammatory bowel changes in pediatric patients and young adults with Crohn's disease.
Material and methods. MRI was performed after oral application of 2.5% mannitol solution 1 h prior the scan. Imaging was obtained using a 1.5T Ingenia including T2 WI, DWIBS, T1 WI before and after contrast media application. We evaluated in a single-center retrospective analysis 15 MRI studies in 13 patients (age 10–22 years, median age 15 years) during a 12 month period. Image analysis of the bowel wall included wall thickening and extraintestinal complications (stenoses, lymphadenopathy, fistulas, abdominal free fluid). Evaluation of the images was performed independently by two pediatric radiologists. MR findings were correlated with clinical markers and endoscopy findings. Furthermore diffusion images were fused with T2 WI.
Results. 13 of 14 small bowel lesions were detected by DWIBS. One superficial lesion of the terminal ileum that was detected in coloscopy 6 months prior the scan could not be identified with DWIBS. All 34 lesions in the large bowel were detected. In two cases areas of restricted diffusion did not correspond to the T2 WI.
Discussion and conclusions. DWIBS shows high diagnostic accuracy and has the potential to substitute CE imaging. A reduction of scan time would be the benefit for the patients after a larger number of patients is evaluated for statistical analysis.

112

Multiple biliary hamartomas (von Meyenburg complexes): US diagnosis

Cinzia Orazi, Fausto Maria Fassari, Paolo Maria S Schingo, Paolo Tomà
Bambino Gesu' Pediatric Hospital, Palidoro-Rome (Italy)

Purpose-Objective. Multiple biliary hamartomas (MBH), also called von Meyenburg complexes (vMCs), represent a rare benign liver malformation, characterized by multiple bile duct hamartomas and biliary microhamartomas, hystologically cystic dilated bile ducts, less than 10 mm in diameter, containing cholesterol crystals, surrounded by abundant fibrous stroma. Simple hepatic cysts or polycystic liver, besides kidney diseases, may coexist.
Material and methods. We report on imaging findings in 2 patients who underwent US routine examination. One was also studied by means of magnetic resonance (MRI) and magnetic resonance cholangiopancreatography (MRCP). The other patient was retrospectively found to be affected since 10 years before, carrying no symptoms.
Results. On US we found multiple small hyperechoic dot-like lesions, due to tiny cystic lesions with distal reverberation ("comet-tail" artifact). On MRI these lesions were

hyperintense on T2- and hypointense on T1-weighted images, respectively. MRCP showed multiple tiny round and irregularly shaped hyperintense lesions.
Discussion and conclusions. MBH are asymptomatic and usually found incidentally. Imaging findings, that is multiple small comet-tail echoes on US, tiny cystic lesions scattered throughout the liver, normal extra- and intra-hepatic bile ducts on MRI and MRCP, can be considered highly suggestive manifestations of vMCs, so that follow-up imaging, without histological confirmation is suggested, with the exception of patients with extra-hepatic malignant tumors.

113

Uncommon extraosseous calcifications in children
Stephen Miller [1], Erika Mann[2]
[1] St. Jude Children's Research Hospital, Memphis (USA); [2] Hospital For Sick Children, Toronto (Canada)

Purpose-Objective. The purpose of this exhibit is to demonstrate the imaging appearances of uncommon calcifications seen in the soft tissues, peritoneum, hollow viscera, and solid viscera of children. This presentation will allow the reader to formulate an appropriate differential diagnosis for these unusual extraosseous calcific processes occasionally encountered in pediatric patients.
Material and methods. Cases of rare and unusual extraosseous calcifications were identified through a search of the PACS systems of two large North American pediatric teaching hospitals. Images were reviewed by two experienced pediatric radiologists. Representative examples are presented in a pictorial format.
Results. Representative examples of tumoral calcinosis, fibrodysplasia ossificans progressiva (FOP), posttraumatic myositis ossificans, dermatomyositis, extraosseous osteosarcoma, desmoid pseudopseudohypoparathyroidism (PPHP), venolymphatic malformation, Maffucci syndrome, brown fat necrosis, and pilomatricoma within the soft tissues are presented. Within the chest and abdomen, cases of inflammatory fibroblastic pseudotumor, meconium peritonitis, graft versus host disease (GVHD), retroperitoneal teratoma, ovarian and testicular torsion, testicular germ cell tumor, pancreatic calcifications, renal calcification, and bladder calculi are demonstrated.
Discussion and conclusions. Extraosseous calcifications in children are usually related to renal and gallbladder calculi. However, there is a large number of disease processes within children that may result in unusual calcifications. Proper recognition of these calcific foci can aid in establishing a definitive diagnosis which may direct appropriate therapy.

114

Pictorial review: pathologies seen on contrast enemas in premature babies, neonates and infants
Amit Maniyar, Mandip Heir, Fiona Dickinson, Andrew Rickett, Anthony Dux
University Hospitals Of Leicester, Leicester (United Kingdom)

Purpose-Objective. To present different congenital pathologies seen on contrast enemas with a brief description and review of literature.
Material and methods. Retrospective review of contrast enemas performed over a period of 3 years from April 2009 on premature babies, neonates and infants presenting with lower GI (gastro intestinal) symptoms to a pediatric radiology department based at tertiary level hospital.
Results. Pathologies such as Hirschsprung's disease, meconium plug syndrome, meconium ileus, meconium cyst, colonic atresia and colonic ischemic stricture were demonstrated and correlated with clinical findings.
Discussion and conclusions. These are few of the common findings seen on contrast enema in premature babies, neonates and infants. Awareness of these findings is mainstay for radiological evaluation of surgical gastrointestinal cases with lower GI symptoms in these age groups.

115

Acoustic Radiation Force Impulse Imaging (ARFI): Preliminary results of normal values of spleen stiffness in healthy children
Teresa Cañas[1], Teresa Fontanilla[1], María Miralles[1], Araceli Maciá[2]
[1] Hospital Universitario Puerta de Hierro Majadahonda, Madrid (Spain); [2] UNED, Madrid (Spain)

Title. Acoustic Radiation Force Impulse Imaging (ARFI): Preliminary results of normal values of spleen stiffness in healthy children
Objectives. The main goal is to describe normal values of spleen stiffness in healthy children using a non-invasive technique called acoustic radiation force impulse imaging (ARFI).
Methods. We performed a prospective study with healthy children between 0 and 14 years of age. We considered four age groups (first month of life, between second month and first year, from 1 to 7 years, between 7 and 14 years). At the examination, anthropometric data were collected: age, gender, weight and the body mass index (BMI).

ARFI was performed in an ACUSON 2000 device with 4 mHz and 9 mHz transducers. Shear waves velocities were measured in five regions of interest in the spleen with both transducers. They were expressed as a mean and standard deviation (SD).
SPSS 15.0 was used for statistical analysis.
Results. The mean value and SD observed with 4 mHz was 2.17 (SD 0.35) and 2.15 (SD 0.23) with 9 mHz . The confidence intervals at 95% were 2.082–2.258 and 2.093–2.207 with both transducers.
No significant differences were found between both transducers.
Discussion. In patients with chronic liver diseases, liver fibrosis staging is crucial for the evaluation of future disease complications. As liver fibrosis progresses, portal hypertension becomes the mayor cause of mobility and mortality. Splenomegaly is a well-known indicator of cirrhosis caused by increased portal and splenic congestion. However limited research exists about the capacity of spleen assessment by ARFI for prediction of portal hypertension. To evaluate pathologic cases, it is necessary to know the normal stiffness values in the healthy population. In our knowledge, there are no papers about spleen stiffness in children.

116

US for pediatric Crohn's disease in the right lower quadrant—can we do as good as MRE?
Anat Ilvitzki[1], Inn Verganov[2] Osnat Konnen
[1]Departement of radiology, pediatric radiology unit, Rambam Health Care Campus, Haifa, (Israel); [2]Departement of pediatric radiology, Schneider Children's Hospital, Petach Tikva, (Israel)

Purpose-Objective. Crohn's disease affects the pediatric population, mainly teenagers but also younger patients. Imaging is used repeatedly and should be radiation free. A few years ago Magnetic Resonant Enterography (MRE) became available and it seems to be a comparable or even better substitute for CT and small bowel follow through. With some disadvantages such as low availability, high costs and being a difficult study for children, there is need for a second modality. In recent years ultrasound (US) has been extensively used in IBD, and was found to have good sensitivity and specificity for diseases of the ileum and ascending colon.
As 70% of Crohn's disease is located in the right lower quadrant (RLQ), and with the excellent conspicuity of US in this region, US can be used routinely and MRE in selected scenarios.
This study aims to compare the diagnostic performance of dedicated US to that of MRE in the RLQ region in the pediatric population with IBD.
Material and methods. We retrospectively examined 32 sets of studies, MRE and US, done on 25 pediatric patients with Crohn's disease between 5.10 and 12.12. Median time lag between studies was 14.5 days. Mean age of the patients was 15 years. All studies were reevaluated by two pediatric radiologists, well experienced in both bowel US and MRE. Studies were examined on bowel segment basis, in the RLQ, assessing signs of disease and complications. The US findings were then correlated with those of MRE. We calculated the sensitivity, specificity, accuracy, PPV and NPV of US for diagnosing disease and complications in each bowel segment in the RLQ compared to MRE.
Results. The sensitivity, specificity and accuracy rates of US for diagnosing Crohn's disease in the RLQ were 94%, 87.5%, and 91.9%, and for complications 81.4%, 96.9%, and 93.5%, respectively, all compared to MRE.
Discussion and conclusions. In the RLQ we found US to be highly accurate for identifying Crohn's disease and its complications. As 70% of the disease is located in this area, these results can be translated into practical algorithm in daily practice. We suggest that MRE be done in every Crohn's patient once for a general view of disease distribution, for perianal disease and prior to operative interventions. In all other cases, and as frequently as needed by clinicians, US should be the modality of choice.

Foetal/Neonatal

117

Neonatal cranial ultrasound
Michael Paddock
West Middlesex University Hospital, London (United Kingdom)

Purpose-Objective. To produce departmental cranial ultrasound guidelines. To improve documentation, planning of scans and time management. To enhance trainee opportunities in performing and interpreting scans leading to confident independent practice.
Material and methods. Part 1 Senior speciality paediatric trainee questionnaire: to assess confidence in performing and interpreting (P&I) cranial ultrasound scans (CrUS); data interpretation questions (published questionnaires, author's permission to use) to gauge ability to identify abnormalities,

to decide immediate management and discuss prognosis. Part 2 Full audit cycle of CrUS compliance, implementation and assessment of changes. Audit (cycle 1) over 12-day consecutive period with re-audit 6 months later (cycle 2) after implementing changes.

Results. Part 1 Trainees reported little confidence with P&I. All identified major abnormality in each image. Part 2 Cycle 1 Poor compliance, documentation and lack of follow up. Loose scans with no date, time or comment. Changes implemented. Weekly teaching with Radiologist experienced in CrUS. Comprehensive guideline and proforma for every baby admitted to the unit. Presentation of results. Cycle 2 Improved compliance rate from 60.0% to 71.4%. Improved documentation from 28.6% to 100% including signature and level of supervision. 80% of scans documented had plan for follow up scan.

Discussion and conclusions. Trainee confidence in P&I scans improves with regular Radiology teaching sessions. Dedicated guidelines and proforma improve assessment for scanning, compliance, documentation and work load planning, improving care and service provision.

118

Congenital nasolacrimal duct mucocele - case report and review of the literature

Vasiliki Georgopoulou, Antonios Stratis, Maria Sidiropoulou, Anthoula Morichovitou, Nikolaos Barmpas, Tania Chrysopoulou, Anagnostis Skordas, Eirini Kazantzidou, Efthymia Zafeiriadou

Department Of Computed Tomography, 1St Department Of Radiology, "Hippokrateio"General Hospital, Thessaloniki (Greece)

Purpose-Objective. Congenital nasolacrimal duct mucocele (CNDM) is an uncommon condition in the newborn that presents with respiratory distress and feeding difficulties. We describe the Computed Tomography (CT) findings of an interesting case of CNDM in a newborn and present literature review.

Material and methods. A newborn boy presented with respiratory distress, loud breathing and right medial canthus oedema. His vital signs were stable. As the clinicians were unable to pass a nasoenteric tube via the right nares, the infant underwent CT.

Results. CT was performed from the lower aspect of the orbits through the nasal cavity. At the level through the midnasal passage CT showed a 11 mm×7 mm low density, soft tissue mass in the anterior right nasal cavity. A 11 mm×10 mm well-defined, thin-walled, cystic right medial canthus mass representing an enlarged lacrimal sac was also depicted. Transverse bone window CT scan obtained through the upper nasal passage showed dilatation of the right nasolacrimal duct within the osseous nasolacrimal canal. This triad of findings is diagnostic of CNDM. Nasolacrimal duct probings were performed and resulted in relief of respiratory difficulties.

Discussion and conclusions. CNDM although rare, is the second most common cause of neonatal nasal obstruction. Respiratory distress is the most dangerous complication and requires prompt treatment. The imaging modality of choice is unenhanced CT, which allows to clearly identify the triad of findings associated with CNDM.

119

Contribution of fetal CT in the prenatal diagnosis of Binder phenotype

Kathia Chaumoitre[1], Isabelle Berakdar [2], S Coze[1], G Gorincour[3], C Chau[2], V Brevaut Malaty[4], C D'ercole[2], M Panuel[1]

[1] Imaging department Hôpital Nord; [2] Obstetrics and Gynecology department Hôpital Nord; [3] Pediatric imaging department Hôpital Timone Enfant; [4] Neonatology department Hôpital Nord

Purpose-Objective. Binder phenotype (BP) is characterized by midface and nasal hypoplasia resulting in a flattened profile. Several etiologies have been described. We report the contribution of fetal CT.

Material and methods. Retrospective study of seven fetuses suspected of BP by US and explored by CT between 23 and 34 weeks' gestation. Three fetuses also had a brain MRI.

Results. Fetal CT confirmed nasal hypoplasia in all cases with a naso-frontal angle between 140 and 160° (mean, 150°) and allowed an analysis of the whole fetus. Epiphyseal calcifications were discovered with CT in four cases versus only one by US. Other unsuspected features were observed: platyspondyly (one case), coronal vertebral cleft (two cases), and delay in pubic bones ossification (one case). MRI discovered a subdural hematoma in one case. A termination of pregnancy was requested by parents in three cases. Autopsy was refused in two cases. BP's etiology was certain in five cases: brachytelephalangic chondrodysplasia punctata in three cases, maternal vitamin K deficiency in one case and type II collagenopathy in one case.

Discussion and conclusions. Fetal CT allows analysis of facial abnormalities. In our series, CT was more accurate

than US in detection of epiphyseal calcifications and associated vertebral abnormalities. However, both CT and US were unable to detect brachytelephalangy.

120

The outcome of urinary tract dilatations in newborns after pre-term caesarian section indicated by congenital uropathy

Miklós Merksz[3], Mária Polovitzer [1], Béla Lombay[2], Mária Deák[2], András Kiss[3], Krisztina Meichelbeck[4], Zsuzsanna Székhelyi[0], Péter Berkő[0], Gyula Réti[7], László Szabó[8]
[1] Pediatric Radiology, Heim Pál Children'S Hospital, Budapest (Hungary); [2] Pediatric Radiology, Borsod County University Hospital, Miskolc (Hungary); [3] Pediatric Urology, Heim Pál Children'S Hospital, Budapest (Hungary); [4] Internal Medicine And Pediatric Nephrology Heim Pál Children Hospital, Budapest (Hungary); [5] Neonatology, Borsod County University Hospital,, Miskolc (Hungary); [6] Gynecology And Maternity Centre, Borsod County University Hospital, Miskolc (Hungary); [7] Pediatric Surgery And Urology Borsod County University Hospital, Miskolc (Hungary); [8] Faculty Of Health Science, Semmelweis University, Budapest (Hungary)

Purpose-Objective. Urinary tract dilatation is a frequent problem in the intrauterine life, but many of these patients need no treatment at all after birth. The role of caesarian sections in correction of congenital uropathies was questioned recently.
Material and methods. A retrospective analysis of the patients of two large case-volume paediatric institutions was done. During a period of 8 years, 379 neonates were followed due to intrauterine diagnosis of urinary tract dilatations (197 at the Department of Urology, Heim Pál Children's Hospital in Budapest and 182 in Miskolc), including 14 cases where the urological anomaly was the indication for pre-term induction of labour.
Results. Of the 14 neonates who had been delivered prematurely, none were operated before the postconceptional age of 40 weeks, and 3 subsequently required no surgical intervention at all. Two neonates developed life-threatening conditions that presumably could have been avoided without caesarean section.
Discussion and conclusions. Intrauterine upper urinary tract dilatations often resolve spontaneously. Furthermore, when surgical intervention is necessary, it can be done safely in full-term babies. Premature caesarian section because of urinary tract dilatation can no longer be accepted, and calls for good cooperation between the obstetrician, the paediatric urologist and nephrologist, in order to coordinate the management of the case.

121

Head ultrasound at the neonatal intensive care unit (NICU) including color Doppler sonography beyond intraventricular hemorrhage (IVH) and periventricular leucomalacia (PVL)

Flavia Menegotto, Ricardo Faingold
Montreal Children's Hospital/Mcgill University, Montreal (Canada)

Purpose-Objective. To review the role of the Neonatal head ultrasound (HUS) at the NICU and to illustrate common and uncommon pathologies, particularly, new applications of color Doppler sonography (CDS) in neonatal HUS.
Material and methods. This exhibit discusses our standard HUS protocol including pulse Doppler and CDS technique at the NICU. It illustrates a variety of clinical conditions, including new applications of CDS in brain perfusion. It also briefly reviews common conditions such as IVH and PVL.
Results. This pictorial review shows different clinical conditions including meningoencephalitis, abscess, hypoxic-ischemic injury (HII), stroke, extra-axial bleeds, IVH, PVL and also an unusual depiction of brain death. We illustrate gray scale appearance of these pathological conditions, as well as dynamic CDS assessment of brain perfusion and pulse Doppler.
Discussion and conclusions. HUS remains a widely recognized and reliable bedside modality to assess and follow-up sick neonates at the NICU, without the use of ionizing radiation. This exhibit discusses and illustrates common and uncommon clinical conditions including new applications of CDS in cerebral tissue perfusion.

122

Fetal brain MRI in fetuses with twin to twin transfusion syndrome after laser treatment

Stephanie Coze [1], Kathia Chaumoitre[1], Jean Baptiste Haumonte [1], Barthelemy Tosello [2], Claude D'ercole [1], Michel Panuel [1], Nadine Girard [3]
[1] Hopital Nord, Marseille (France); [2] Hopital De La Conception, Marseille (France); [3] Hopital De La Timone, Marseille (France)

Purpose-Objective. To evaluate the impact of fetal brain magnetic resonance imaging (MRI) in fetuses with TTTS after laser treatment.
Material and methods. We present a retrospective study of 18 pregnancies with TTTS (mother age 24–42) between 2009 and 2012 after laser treatment. Fetal brain MRI was performed in 26 out of 36 fetal brains with diffusion-

weighted imaging. Median gestational age was 27 weeks at first fetal brain MRI (range: 24–34), with in utero follow up MRI in 6 fetuses and at term equivalent age for 10 newborns.

Results. MRI was considered normal in 18 and abnormal in 8 fetuses: 3 ventricular asymmetry, 2 mild ventriculomegaly, 1 hemorrhagic injury all suspected at the ultrasound examination and 1 polymicrogyria and 1 ischemic injury only diagnosed at MRI (7%). All pregnancies have been followed resulting in 20 live-births, 3 medical termination of pregnancy, 2 intrauterine fetal demise and 1 stillborn. Periventricular leukomalacia was seen in 20% of cases imaged postnatally with in utero normal brain anatomy.

Discussion and conclusions. Systematic brain MRI after laser treatment in fetuses with TTTS allowed the depiction of severe brain injury unsuspected at the ultrasound examination. A standardized protocol is needed for monitoring TTTS with longitudinal pre- and postnatal brain MRI that includes diffusion images to detect cerebral injury in this disease with high risk of brain damage.

123

Imaging findings of transplacental disseminated herpes simplex type 2 infection: a case report

Hiroko Hara, Chiho Sato, Chikako Morioka, Kanako Ijyu, Junpei Mukai, Yoshihiro Minosaki, Kikuko Oku
Kawaguchi Municipal Medical Center, Kawaguchi-City, Saitama (Japan)

Purpose-Objective. To describe imaging findings and a literature review of congenital herpes simplex virus type 2 (HSV-2) infection.

Material and methods. A female infant weighing 1076 g.was born at 28 weeks and 5 days of gestation by cesarean section. She presented an extensive epidermal exfoliation, chorioamniotis, and thrombocytopenia at birth. HSV-2 was confirmed immunologically from the epidermal vesicle. TORCH infection other than HSV was serologically negative. Transplacental HSV infection was established. She was treated by Acyclovir, and is 2 years and 9 months old presently. Antenatal course had been uncomplicated. There had been no previous maternal HSV infection.

Results. Initial radiography and ultrasonography demonstrated ventriculomegaly, periventricular calcification, cystic change of the brain, hepatosplenomegaly, hepatic calcification in the abdomen. In addition, CT on day 36 identified cystic encephalomalacia, microcephaly, microphthalmos, calcification of both globes, intracardiac and adrenal calcification.

Discussion and conclusions. Intrauterine HSV infection is rare, but can develop either ascending infection or, extremely rarely, transplacental spread. Transplacental HSV infection is potentially lethal. Neonatal HSV infection presents isolated meningoencephalitis, limited infection of skin, eye and mucous membranes and disseminated visceral infections (liver, adrenals, CNS, skin, larynx, trachea, lungs, esophagus and GI tracts). As multiple organs were involved, our case corresponded to disseminated HSV infection. Although findings are similar to congenital Cytomegalovirus or Toxoplasmosis infections, HSV should be included in differential diagnosis.

124

Assessment of the quality of portable X-ray examinations on a neonatal intensive care unit

Sylwia Niewiarowski [1], Shema Hameed[2], Afshin Alavi[2], May-Ai Seah[2], Joanna Danin[2]
[1] St Mary's Hospital, Imperial College Healthcare Nhs Trust, London (United Kingdom); [2] St Mary's Hospital, London (United Kingdon)

Purpose-Objective. Neonates are susceptible to radiation induced cancers. The European Commission has guidelines on "good radiographic technique" and "image quality criteria" for paediatric examinations in order to achieve dose optimization and reduce repeated exposures. Achieving high quality images can be challenging as neonates are small, vulnerable and often critically ill. As one of the largest neonatal units in London we retrospectively assessed the quality of our portable images.

Material and methods. Image quality was evaluated over a 6 month period by paediatric radiologists. Quality assessment criteria were developed from those advocated by the European Commission. We assessed for side markers, unnecessary artefacts, film size, adequacy of collimation, penetration, patient positioning and whether the correct examination was performed according to the clinical information. Targets were set since no regional or national targets are available.

Results. The overall diagnostic quality of the portable x-rays is acceptable. Improvements can be made in collimation, patient positioning and removal of unnecessary artefacts from the image field.

Discussion and conclusions. Despite the challenges encountered in the imaging of neonates, our study shows that the diagnostic quality of our portable x-rays is acceptable. However, dose optimization can be achieved by improvements to image quality through better collimation and multidisciplinary staff involvement. The latter helps ensure good patient positioning and removal of obscuring equipment. The overall result is a reduction in the incidence of repeated exposures.

125

Quantitative ultrasound of the peripheral skeleton in the newborn

Elena Basemann [1], Claus Dörfel [2], Axel Hübler [2], Martin Stenzel [1], Hans-Joachim Mentzel [1]
[1] Dept Pediatric Radiology, University Hospital, Jena (Germany); [2] Dept of Pediatrics, University Hospital Jena, Germany

Purpose-Objective. The purpose was to evaluate quantitative ultrasound (QUS) of the tibia in the newborn for the creation of locoregional reference data.
Material and methods. 223 newborns were included in this prospective study (107 female). Gestational age was 28+3 to 41+5 weeks; birth weight 3363±557 g. Some preterm infants were also sampled. QUS was performed in the first weeks of life using the Sunlight Omnisense 7000 P (BeamMed Ltd., Petah Tikva, Israel). Investigation was performed standardised on the left sided tibia; speed of sound (SOS) was measured. Anthropometric, neonatal, and maternal data were sampled. Statistical analysis was performed using SPSS 20.0 (IBM Corp.).
Results. There was a significant correlation between SOS and gestational age (r=0.2; p=0.004). Female newborns showed lower SOS than male (3022±93 m/s vs. 3060± 98 m/s; p=0.009). In preterm infants SOS was lower (2977±108 m/s vs. 3043±97 m/s; p=0.0024) than in term newborns. Eutrophic newborns showed lower SOS then hypotrophic newborns and higher SOS then hypertrophic newborns. Precision was 0.42%.
Discussion and conclusions. Our data suggest that QUS on the tibia is possible in newborn and also in preterm infants. There was a correlation between SOS and gestational age and gender. The gathered reference data can be used for an estimation of bone quality in newborns.

126

Congenital left atrial appendage aneurysm in a fetus: A rare prenatal diagnosis

Sara Savelli [1], Venturella Vangi [2], Lucia Pasquini [2], Marco Di Maurizio [1], Anna Perrone [1], Claudio Fonda[1]
[1] Meyer Children's Hospital, Firenze (Italy); [2] Careggi University Hospital, Firenze (Italy)

Purpose-Objective. Left atrial appendage aneurysms are rare entities in children. We report a case of a fetal diagnosis with review of the literature.
Material and methods. A 39 year-old woman with prenatal ultrasonographic diagnosis of cardiomegaly and echocardiographic evidence of a large intrapericardial cystic mass adjacent to the left ventricle was referred for fetal MRI at 33 weeks of gestation. An extracardiac intrapericardial cystic mass lying along the left heart border with blood-like signal intensity was detected. At followup echocardiography, communication between left atrium and pericardial cystic mass without doppler flow gradient was discovered, suggesting a giant intrapericardial aneurysm of the left atrium appendage.
Results. A well being asymptomatic male newborn was discarried at 40 weeks of gestation with a cesarian labour. A chest X-ray confirmed cardiomegaly with prominence of the upper left heart border. Echocardiography and color flow mapping showed a huge echo free space communicating with the left atrial appendage determining left ventricle compression without hemodynamic significance. On day-of-life 10, the patient was elected for surgical resection of the aneurysm and operative findings were consistent with the echocardiography findings. At 6 months' follow-up, the infant is thriving well.
Discussion and conclusions. Isolated aneurysm of the left atrial appendage is rare in pediatric population. But as the complications associated with this abnormality can be devastating, timely diagnosis is mandatory and surgical resection recommended even in asymptomatic cases.

Musculoskeletal

127

Erdheim-Chester disease in a 14-year old girl with Type 2 Diabetes mellitus and Pre-B cell acute lymphoblastic leukemia: A case with previously unreported radiological features

Eu Leong Harvey James Teo, Varanasi Venkata Rama Krishna, Kenneth Tou En Chang
Kk Women's And Children's Hospital, Singapore (Singapore)

Purpose-Objective. Erdheim-Chester disease (ECD) is a rare form of non-Langerhans Histiocytosis occurring mainly in adults and is extremely rare in children. The histopathologic hallmark is defined by a mononuclear infiltrate of foamy histiocytes and rare pathognomonic Touton giant cells with extensive fibrosis.
Material and methods. We report a case of a 14-year-old girl with pre-existing Type 2 Diabetes Mellitus (DM) controlled with metformin and pre-B cell Acute Lymphoblastic Leukemia (ALL) for which she completed one course of chemotherapy. She was in remission when she complained of bilateral knee pain and lumps in her forehead and dorsum of the right hand. Physical examination revealed a bony hard

lump over her forehead and a softer lump over the dorsum of the right hand.
Results. Radiographs and CT scan showed multiple lucencies distributed throughout the skeleton, with some lesions having ill-defined margins whilst others had well-defined margins. These findings are atypical for EDC which is characterized by bilateral symmetrical osteosclerosis of the diametaphyseal regions of long bones and infiltration in other organs. MRI showed these lesions to be isointense to muscle on T1- and T2-weighted imaging with slight enhancement post-gadolinium administration. The diagnosis was confirmed on biopsy of the lesions in her forehead, dorsum of the right hand and left fibula.
Discussion and conclusions. The association of EDC with DM and ALL has not been previously reported.

128

Sonographic features of juvenile xanthogranuloma
Oscar Navarro, Gino Somers
The Hospital For Sick Children, Toronto (Canada)

Purpose-Objective. Juvenile xanthogranuloma is an uncommon non-Langerhans cell histiocytosis. The purpose of this exhibit is to illustrate the sonographic features of juvenile xanthogranuloma, which are not well documented in the literature.
Material and methods. Review of sonographic, clinical and pathologic features of dermal/subcutaneous juvenile xanthogranuloma in two young infants.
Results. Case 1: 10-week-old girl presented with rapid growth of congenital, non-tender, erythematous, rounded lesion of 3 cm in the trunk. Ultrasound showed a well-outlined solid lesion involving the dermis and subcutaneous tissues. The lesion had two well-demarcated components, one that is more superficial and relatively more hyperechoic and more vascularized than the deeper component. Excisional biopsy showed that the lesion is formed by a sheet-like growth of histiocytic cells in keeping with juvenile xanthogranuloma. More fibrosis and more vertically oriented vessels were noted in the superficial component of the lesion. Case 2: 3-month-old girl presented with a well-defined 1.5 cm rounded lesion in the left upper arm, non-tender, with a central yellow hue and violaceous rim. The clinical diagnosis was of juvenile xanthogranuloma. Sonographic features were similar to Case 1. Clinical follow-up in 6 months showed decrease in size of the lesion.
Discussion and conclusions. Juvenile xanthogranuloma presented with a characteristic sonographic appearance. The degree of fibrosis and the orientation of the vessels in the superficial component of the lesion may account for some of the sonographic features.

129

MRI of adolescents sports injuries
Goran Djuricic [1], Bojan Vucinic[1], Milan Apostolovic[2], Tatjana Knezevic[1], Goran Vukomanovic[1]
[1] University Children's Hospital Belgrade, Belgrade (Serbia); [2] Institute For Orthopaedic Surgery "Banjica", Faculty Of Medicine University Of Belgrade, Belgrade (Serbia)

Purpose-Objective. Adolescents are at a special risk for musculoskeletal injuries because most sports are not adapted to children's age specific motor skills. This study analyzes the epidemiology, gender distribution, age and type of injury during sport activities, which can help diagnose and treat injuries.
Material and methods. The study includes 351 patients [238 boys (67.8%) and 113 girls (32.2%)] between the age of 13 and 19, injured in 14 different sports. All patients were examined clinically at the University's Children Hospital (Belgrade, Serbia) regarding range of motion, pain, stability and swelling. The clinical examination was followed by a radiographic evaluation and accompanied by MRI in the case of unclear findings.
Results. Injuries were predominant in males who also had a lower age mean than the girls (12.8 compared to 13.7 years). Leading injury mechanisms were falls on level surfaces (47.8%) with most frequent sports injuries seen in soccer (35%), followed by basketball (18%) and volleyball (11%). 36% of patients had knee problems, 52% had injuries of lower extremity, while 37% of upper extremity. MRI findings consisted primarily of hematoma (33%), cartilage (18%) and 11% of all injuries were ligament tears
Discussion and conclusions. Males participating in sports may be at greater risk of injury as they tend to play more aggressive sports and at an earlier age. This information may help to prevent, diagnose and treat sports injuries among teens.

130 Withdrawn

131

Early MRI in the management of scaphoid fractures in children
Aikaterini Kanavaki, Amira Dhouib, Laura Merlini, Mehrak Anooshiravani, *Sylviane Hanquinet*
Geneva's University Hospital, Geneva (Switzerland)

Purpose-Objective. Scaphoid fractures are the most common carpal bones fractures in children. The place

of MRI in the diagnosis of these fractures has been recognized for adults but not for children. The aim of our study is to show the role of MRI in the early diagnosis and management of scaphoid fractures in the pediatric population.

Material and methods. We reviewed the wrist x-rays and MRIs of 45 children (7 to 15 years old) with clinical suspicion of scaphoid fracture. MRIs were performed in a 1,5T machine and our protocol included coronal T1, coronal STIR, axial T2 and 3D TRUFI sequences.

Results. MRI findings were compared to initial radiographs. In 9 cases both xray and MRI were positive for fracture. From the 33 children with an initial negative xray the MRI was positive in 15 of them. Three children had a suspicion of scaphoid fracture on xray, not proved on MRI. Treatment was readapted when MRI was positive for scaphoid or other fractures whereas the period of immobilization was shorten in cases of a negative MRI.

Discussion and conclusions. Clinical and radiological diagnosis of scaphoid fractures in children is difficult probably because the bone is partly cartilaginous. Early MRI permits detection and exclusion of scaphoid fractures in children leading to a more adapted treatment and management of this injury. MRI avoids repeated control xrays of non-existent fractures.

132

Pictorial overview of the plain film appearances of normal variants and common artefacts seen on skeletal surveys performed in children with suspected child abuse

Alan Quigley, Samuel Stafrace
Royal Aberdeen Children's Hospital, Aberdeen, Scotland (United Kingdom)

Purpose-Objective. In this poster we aim to demonstrate a spectrum of normal plain film appearances, variants and artefacts in paediatric patients who have had skeletal surveys performed where child abuse was suspected.

Material and methods. All patients over the past 3 years where non-accidental injury was suspected had their skeletal survey plain film imaging reviewed retrospectively and such findings identified.

Results. Normal variants identified included physiological periosteal reaction, metaphyseal variants (step-offs, beaks and spurs), nutrient vessels and spinal variants (including pseudosubluxation, intersegmental clefts, neurocentral synchrondroses). Artefacts seen included skin folds, artefact from hair and artefacts related to cannulation.

Discussion and conclusions. There are several normal anatomical variants that may simulate an abnormality associated with non-accidental injury. Also, there are various artefacts that may be confused for traumatic injury. These radiological appearances are demonstrated to allow radiologists to avoid the misinterpretation of normal variants or artefacts for underlying injury.

133

Elbow muscle strength and ultrasonografic findings in young baseball pitchers: preliminary results

Rutkauskas Saulius [1] Algidas Basevicius[1], Sigitas Kamandulis[2], Mantas Mickevicius[2], Vytautas Streckis[2]
[1] Lithuanian University Of Health Sciences, Kaunas (Lithuania); [3] Lithuanian Sports University, Kaunas (Lithuania)

Purpose-Objective. To assess the correlation between elbow muscle strength (EMS), elbow joint instability (EJI) and ulnar collateral ligament (UCL) thickness in young baseball players.

Material and methods. A total of 10 pitchers were included in the study. All were right-handed. Maximal isometric torque of the extensor and flexor muscles of the elbow was measured using a Biodex dynamometer (Multi joint system 3). A standardized protocol of 300° per second was adopted. The measurement value was a Newton meter (Nm) . Each participant underwent elbow ultrasonography with 12-MHz linear array transducer using a GE ultrasound machine (Logiq 7). Measurements of UCL and dynamic scanning of MEJS with valgus stress were performed. Spearman rank correlation coefficient and Mann–Whitney test were used with MedCalc.

Results. The mean age of participants was 11.4±0.8 years. The mean pitching time was 3.1±1.8 years. EJI at rest was 1.5±0.04 mm in the throwing arm and 1.4±0.03 mm in the non-throwing arm (P=0.43), after stress – 2.1±0.6 mm and 1.7±0.04 mm, respectively (P=0.09). The EMS of the right side flexion was 19.1±5.5 Nm, extension – 28.3±5.0 Nm, left side flexion – 20.2±3.9 Nm, extension – 26.0±6.1 Nm. A strong correlation between the right side UCL and EMS was found (rho 0.77, p=0.009); other correlations were not statistically significant.

Discussion and conclusions. Elbow muscle strength is not associated with joint instability, however, correlates with the thickness of the medial ulnar ligament in the throwing arm.

134

Gorham's disease: radiography and MRI findings of a case

Emrah Ozcan, Veysel Akgun, Murat Kocaoglu, Mutlu Saglam

Gulhane Military Medical School, Department Of Radiology, Ankara (Turkey)

Purpose-Objective. Gorham-Strout syndrome, also known as Gorham's massive osteolysis, is a rare disease with multiple osteolytic lesions due to vascular proliferation. Its etiology is not well known and clinical presentation is variable in most of the cases. In this report, we aimed to present plain films and MRI findings of Gorham-Strout disease.
Material and methods. 10-year-old boy with inguinal mass was examined with abdominal US and MRI. Because of the vertebral body cysts on MRI skeletal survey was also obtained.
Results. On x-rays, we detected multiple well-circumscribed osteolytic lesions within medullar bone of femur, sacrum, lumbar spine and pelvis. No prominent cortical thickening or periosteal reaction was determined. In MRI, the lesions were hypointense in T1 and hyperintense on T2 weighted images. There was a little contrast enhancement in late phase after paramagnetic gadolinium injection. We also found cystic mass lesions in spleen and iliac fossa.
Discussion and conclusions. Gorham's disease is a very rare disease characterized with osteolytic lesions. Although, radiography can show these osteolytic lesions, soft tissue lesions can be demonstrated on MRI.

135

Osteogenesis imperfecta & non-accidental injury in the neonate: where do we stand?

Joy Barber, Samantha Negus
St George's Hospital, London (United Kingdom)

Purpose-Objective. Through reading this poster, the reader will: - Review the clinical, pathological and radiological features of osteogenesis imperfecta (OI) - Be aware of techniques that can be used to assist in differentiating OI from NAI - Understand positions supported in the literature regarding differentiating OI from NAI in children, and ongoing controversies.
Material and methods. Here we review the literature on OI, and fractures presenting in children where the differential includes OI and NAI.
Results. OI is a complex disease, most often caused by mutations in the COL1A1 and COL1A2 genes resulting in type 1 collagen of inadequate quantity or quality for normal bone formation. Fractures due to mild type III and type IVA disease can be difficult to differentiate from NAI. OI is much less common than NAI, and in the neonatal age group the possibility of fracture due to birth trauma or other metabolic bone disorders also needs to be considered. Clinical history, subtleties in fracture patterns and laboratory testing can all contribute to differentiating NAI from OI, however there are ongoing controversies and systematic studies comparing NAI and OI in neonates are scarce.
Discussion and conclusions. Various factors can assist in differentiating OI from NAI. Radiologists need to be aware of fracture patterns that have been reported as more likely due to NAI than OI, and the limitations of the evidence surrounding this.

136

Neonatal hip dysplasia: normal values for alpha angle and femoral head coverage should include age, sex and laterality variations

Alastair Graham Wilkinson, Sally Wilkinson
Royal Hospital For Sick Children, Edinburgh (United Kingdom)

Purpose-Objective. Background: Normal values for quantitative assessment of neonatal hip dysplasia on ultrasound examination may lack detail which could be useful in treatment decisions. Aim: To clarify normal values of alpha angle (αA) and percentage femoral head cover (PHC) and investigate variations with age, sex and laterality.
Material and methods. 3224 hips in 1612 babies of mean age 11.9 weeks referred to a treatment centre for ultrasound to determine need for treatment between 2007 and 2012. Measurements of αA and PHC were performed by a single operator and recorded prospectively.
Results. Both αA and PHC increased rapidly from age 1 week to age 6 weeks (mean 2.2° in αA and 2% in PHC per week) with much slower increase thereafter. There are differences according to sex with αA being approximately 5° less in females and also in laterality with the αA in the left hip being 5° less than the right. Normal values for right hip in males are approximately 10° greater than for left hip in females. FHC shows a similar variation with sex and laterality, although less marked variation with laterality in males.
Discussion and conclusions. Normal values vary considerably with age, sex and laterality and this variation should be taken into account when treatment decisions are being made.

137

Neonatal hip dysplasia: effect of treatment on alpha angle and femoral head coverage

Alastair Graham Wilkinson, Sally Wilkinson
Royal Hospital For Sick Children, Edinburgh (United Kingdom)

Purpose-Objective. Background: Published data on how splintage affects quantitative measurement of hip maturity is sparse. Aim: To document the effect of treatment on alpha

angle (αA) and percentage femoral head cover (PHC) to allow the effectiveness of treatment to be assessed.
Material and methods. 269 babies aged between 1 and 29 weeks (mean 4.4 weeks) at first visit treated over a period of 5 years formed the study population. Measurement of αA and PHC were performed by a single operator and recorded prospectively for each visit at monthly intervals. Hips having alpha angle of more than 50° at the start of the treatment were excluded leaving 156 hips in the analysis.
Results. αA increased by a mean of 5.3, 5.0 and 3.7° per week during the first month of treatment in babies aged 1–6 weeks, .6–10 weeks and >10 weeks respectively and by 2.3, 1.8 and 2.1° per week in the second month. Increase in αA during treatment is faster than the normal (untreated) increase in αA with age. PHC in these age groups increased rapidly in the first month of treatment by 6.9, 6.5 and 6.7% per week and 2.4, 1.2 and 0.8% per week in the second.
Discussion and conclusions. The more rapid improvement in both parameters in younger babies indicates that treatment should be started earlier than the 12 weeks often recommended.

138

So you think you know about rickets?
Joy Barber, Alex Weller, Tom Watson, Alistair Calder[2]
[1] St George's Hospital, London (United Kingdom); [2] Great Ormond Street Hospital, London (United Kingdom)

Purpose-Objective. By the end of this poster, the reader will be able to:

- describe the physiological basis of rickets;
- derive from the physiology the basis for radiographic features of rickets;
- describe the presentations and complications of rickets.

Material and methods. Here we review vitamin D and calcium metabolism which underscores understanding of the different aetiologies of rickets and the basis of characteristic histopathological and radiological features.
Results. Rickets is a disorder of growing bone due to diminished calcium-phosphate product in extracellular fluid. The key role of the active metabolite of Vitamin D is in intestinal transport of calcium. Vitamin D deficiency can thus cause low serum calcium, and resulting secondary hyperparathyroidism causes increased renal phosphate wasting. At the growth plate, low calcium-phosphate product causes delayed apoptosis of hypertrophied chondrocytes and their disordered accumulation produces the radiological appearance of widened growth plates, metaphyseal irregularity, flaring and cupping.
Hereditary forms include hypophosphatemic rickets, Vitamin D dependent rickets type 1 (failure of 1-alpha hydroxylation of Vitamin D) and type 2 (end organ resistance). Complications of rickets include bone deformities, growth retardation and muscle weakness. Low trauma fractures occur but are rare, and usually do not occur in the absence of florid rachitic changes.
Discussion and conclusions. The reader may revise and update their understanding of the pathophysiology, radiological presentation and complications of the various forms of rickets.

139

Review of causes of hip pain in children
Nidhi Jain, Julian Chakraverty, Moni Sah, Sridhar Kamath, *Alison Evans*
University Hospital Of Wales, Cardiff (United Kingdom)
Purpose-Objective. To review and discuss causes of hip pain in a child and familiarise with their radiological features.
Material and methods. Literature review and illustration of radiological findings.
Results. Variety of cases ranging from traumatic, infective, inflammatory, neurological, developmental, metabolic and neoplastic causes are discussed systematically.
Discussion and conclusions. Pain in the hip of a child can be a diagnostic challenge partly because of the barriers to communication and partly because the pain could be referred pain from knee, spine (discitis), abdomen (appendicitis) or pelvis (psoas abscess) etc. A thorough history with a detailed clinical examination including a neurological assessment and laboratory tests help narrow down the differential diagnosis. Imaging plays an important role in clinching the diagnosis. Conventional radiography is the initial imaging tool of choice and often the only imaging modality required. Ultrasound is the second most common investigation, it's real time and guides any intervention such as aspiration. Cross Sectional Imaging and Bone Scintigraphy is used for problem solving or to demonstrate the extent or stage of the disease.
We discuss a surgical sieve approach to differential diagnosis. We discuss the various pathologies ranging from common things like Trauma and Acute transient Synovitis to the commonly thought of culprits like SUFE, Perthes, DDH to other causes like metabolic, malignant and inflammatory with their clinical features and imaging characteristics and illustrate with images from our experience.

Education/Miscellaneous

140

SMA-related pseudomass as a form of reverberation artifact in a 10 year old boy

Natalia Kokhanovsky, Abdel-Rauf Zeina, Nadir Reindorp, Alicia Nachtigal
Department Of Radiology, Hillel Yaffe Medical Center, Hadera, Haifa (Israel)

Purpose-Objective. Artifacts are encountered routinely in clinical ultrasonography practice. If misinterpreted as such, ultrasound artifacts can lead to serious misdiagnosis. The ability to recognize and eliminate potentially correctable ultrasound artifacts is of great importance to image quality improvement and optimal patient care.
Material and methods. We describe a case of a 10 year old boy with acute abdominal pain. Abdominal sonography was performed, which showed a hyperechoic intraluminal mass in the abdominal aorta between the origin of the superior mesenteric artery (SMA) and the ostia of the renal arteries. A computed tomographic aortogram was performed, which ruled out an aortic intraluminal filling defect.
Results. This aortic mass eventually proved to be an artifact, probably due to acoustic reverberation, not a thrombus. We present the ultrasonographic and computed tomographic findings and provide relevant discussion thereof.
Discussion and conclusions. The incidence of an aortic thrombus or an intravascular mass in children is extremely rare. An echogenic focus within the lumen of the abdominal aorta just distal to the origin of the SMA should always raise the suspicion of an SMA-related pseudomass as a form of reverberation artifact. This artifact is generated when the transducer, SMA and aorta are in alignment. Therefore, the aorta should be scanned with and without the SMA, to confirm whether the lesion disappears and can thus be interpreted as a reverberation artifact from the SMA.

141

The diversity of the Meckel's diverticulum

Eu Leong Harvey James Teo
Kk Women's And Children's Hospital, Singapore (Singapore)

Purpose-Objective. The Meckels diverticulum (MD) is a vestigial remnant of the omphalomesenteric duct. Patients present with abdominal pain, bloatedness and per-rectal bleeding due to gastrointestinal haemorrhage, obstruction due to volvulus, intussusception and adhesions; diverticulitis, umbilical abnormalities, and rarely neoplasm. MD is usually difficult to diagnose pre-operatively. The learning objectives of this educational poster are: 1. To discuss the imaging techniques that will enable the Radiologist to diagnose MD pre-operatively. 2. To illustrate the diverse imaging appearances of Meckel's diverticulum and to correlate these with pathological specimens where available.
Material and methods. All cases of Meckel's diverticulum seen in a tertiary referral Children's hospital over a 8-year period were compiled. This exhibit will highlight the varied clinical scenarios, the imaging modalities used for diagnosis and the differential diagnoses considered.
Results. The Tc 99 m-pertechnate radioisotope study, ultrasound and CT were the most useful in diagnosing MD and for surgical planning. Plain radiography and small bowel barium procedures had no significant roles. The diverse imaging appearances of MD on the different imaging modalities will be shown.
Discussion and conclusions. This exhibit will highlight the diverse clinical presentations MD as well as illustrate the appearance of MD on different imaging modalities. After reviewing this exhibit, the reader will be familiar with the optimal imaging techniques that will help him make the diagnosis pre-operatively and the diverse imaging appearances of Meckel's diverticulum.

142

Radiologic appearances of big abnormal masses (BAMs) and weird abnormal masses (WAMs) in pediatric patients

Mary Mallon, Jacqueline Urbine, Eric N. Faerber
St. Christopher's Hospital For Children, Philadelphia, Pa (United States)

Purpose-Objective. A retrospective pictorial review of pediatric body masses that initially presented as diagnostic conundrums in pediatric patients is assembled here.
Material and methods. A retrospective review of patients aged 0–21 years with neoplastic processes that had been imaged at our urban pediatric tertiary care facility from 2005 to the present was performed. A multi-modality review of these cases is presented with pathologic and surgical correlation.
Results. The retrospective review yielded many masses that presented either in an uncommon way or at an unusually large size. Examples include: lipoblastoma of the colonic mesentery; epithelioid hemangioma of the right common carotid artery; embryonal sarcoma of the liver; metastatic papillary thyroid cancer; giant cell tumor of the tendon sheath in the hindfoot; aggressive fibromatosis of the sternocleidomastoid muscle; epidermoid inclusion cyst occupying the mid-lumbar spinal canal.
Discussion and conclusions. This review of uncommon body masses will allow radiologists to refresh their

knowledge of rare entities – BAMs and WAMs – in the pediatric population.

143

Langerhans cell histiocytosis in children: imaging findings

Cecilia Lanza, Andrea Giovagnoni, Caterina Gambini, Lucia Amici, Valeria Bolli
Azienda Ospedaliero-Universitaria Ospedali Riuniti, Ancona (Italy)

Purpose-Objective. The radiologic presentations of Langerhans Cell Histiocytosis (LCH) are variable and range from a lytic skeletal lesion that may mimic infection as well as benign and malignant tumors, to widespread disease with organ dysfunction. The purpose is to present the radiologic features of LCH based on our experience and to review the literature.
Material and methods. The radiologic images and medical records were reviewed in 9 children (4 male, 5 female aged 1.1 to 10.5 years, mean 4.3 year) with biopsy proving LCH. All patients underwent radiography limited to the area(s) of involvement, 6 underwent Magnetic Resonance (MR) and 7 nuclear bone scanning, while computed tomography (CT) was performed in 8 patients. Follow-up imaging studies were performed in 8 patients.
Results. Four patients presented with localized disease and five with multifocal disease. Two patients developed diabetes insipidus. Three patients had organ dysfunction. The radiologic findings were largely due to destructive bone lesions. Isolated soft-tissue masses, interstitial lung disease, and central nervous system abnormalities were also seen. In the follow-up 25% showed improvement in their lesions, 12.5% developed new lesions, and 75% had good outcomes.
Discussion and conclusions. LCH is usually a self-limited disease with varied clinical and radiologic presentation. The prognosis is generally poor in children with organ dysfunction. In the absence of organ dysfunction, children with either localized or multifocal LCH have an excellent prognosis.

144

Referrals and injury patterns in paediatric trauma : experiences from major trauma centre

Susan Cheng Shelmerdine, Rhianydd E. Williams, Kavita Lutchmeesingh, Rosemary Allan, S. Negus
St George's Hospital, London (United Kingdom)

Purpose-Objective. Major trauma is a significant cause of death in the paediatric population . At our institution national trauma guidelines have resulted in rapid access to CT imaging to rule out life-threatening injuries. This study aims to quantify the most common modes of trauma and injury patterns in our patient population on CT imaging.
Material and methods. A retrospective review was conducted of all paediatric trauma CT examinations between April 2010 and August 2012. Indications for CT and patterns of injury were analysed. Where available, electronic patient records were reviewed to analyse resultant hospital admission times and surgical interventions.
Results. A total of 209 CT scans were performed of which the most common referral indications included involvement in a road traffic accident (87.42%) and fall from a height (63.30%). 103 (49%) scans demonstrated major injuries and 76 (36%) demonstrated minor injuries. The major injuries identified on CT included 51 (24%) head, 19 (9%) chest, 19 (9%) abdominal/pelvic and 15 (7%) limb injuries. Of a total of 182 patient records that were available for analysis, 154 (85%) patients were admitted to hospital with 43 (24%) requiring surgery. 4 (2%) patients died during their admission. The average inpatient stay was 5 days (range 1–45 days).
Discussion and conclusions. Paediatric trauma may result in major injuries with inpatient hospital admission and resultant surgery. Imaging is crucial in determining such injuries.

145

Radiographic appearance of uncommon devices in the paediatric abdomen

Arlen Urquia [1], Owen Arthurs[2], Tom Watson[2], Susie Goodwin[2]
[1] Hospital Universitario De Burgos, Burgos (Spain); [2] Great Ormond Street Hospital, London (United Kingdom)

Purpose-Objective. To recognise the appearance of unusual implants or devices on abdominal radiographs in children, to illustrate their correct placement and to identify their most common complications.
Material and methods. We retrospectively reviewed our hospital radiology database for non-vascular devices or implants which were imaged by plain abdominal radiography. We categorised these into different system areas: e.g. cardiac, gastrointestinal and neurological. We excluded commoner vascular catheters as they have been reviewed extensively elsewhere.
Results. We identified several unusual devices, including abdominal pacemaker and defibrillators, intrathecal pumps and nerve stimulators, and gastrointestinal devices. We outline the appearance, distinguishing features, purpose and common complications of each device.
Discussion and conclusions. As medical care becomes more complex, children with implanted abdominal devices

will become more frequently encountered. We hope that by illustrating more unusual devices and their common complications, we can increase overall reporter awareness and reduce interpretation errors.

146

Beyond congenital diaphragmatic hernia: a case report

Irene Maria Borzani, Lorena Canazza, Alessandra Carnevali, Maurizio Torricelli, Pietro Biondetti
Fondazione Irccs Ca' Granda - Ospedale Maggiore Policlinico, Milan (Italy)

Purpose-Objective. Fetal US and MRI usually detect CDH in the prenatal period, but sometimes mild diaphragmatic defect may be lost and can be life threatening in the first days of life.
Material and methods. We present clinical, surgical and imaging findings of a newborn with postnatal diagnosis of right sided CDH associated with midgut malrotation, annular pancreas and tracheal bronchus.
Results. A 1 day old infant was referred to our NICU with rapidly worsening respiratory distress as main clinical manifestation. He didn't have any reported fetal abnormality and delivery was unremarkable. Babygram performed at our hospital showed cranial dislocation of the right diaphragm and liver, consistent with right CDH and abnormal abdominal gas distribution. US confirmed the defect of the right diaphragm and CT scan of thorax and abdomen showed midgut malrotation in association with annular pancreas. In addition, lung CT images demonstrated the presence of a right tracheal bronchus.
Discussion and conclusions. Multimodality imaging approach along with clinical and surgical cooperation is fundamental for diagnosis and for surgical planning and timing. Intraoperative findings confirmed right-sided antero-medial CDH with malrotation and Ladd's bands and duodenal stenosis due to annular pancreas.

147

New method for eye-lens radiation exposure reduction during pediatric head CT based on automatic exposure control

Shuji Abe [1], Makoto Shimada[2], Shouji Tani[2], Masanori Nishikawa[2], Koichi Yabunaka[3], Masayoshi Mizuta[4], Hidetoshi Yatake[5], Toshizo Katsuda[6], Shigeru Sanada[7]
[1] Department Of Radiology, Osaka Medical Center And Research Institute For Maternal And Child Health, Izumi (Japan); [2] Osaka Medical Center And Research Institute For Maternal And Child Health, Izumi (Japan); [3] Katsuragi Hospital, Kishiwada (Japan); [4] University Hospital, Kyoto Prefectural University Of Medicine, Kyoto (Japan); [5] Kaizuka City Hospital, Kaizuka (Japan); [6] National Cerebral And Cardiovascular Center, Suita (Japan); [7] School Of Health Sciences, College Of Medical, Pharmaceutical And Health Sci-Ences,Kanazawa University, Kanazawa (Japan)

Purpose-Objective. It is important to reduce radiation exposure of eye-lens during pediatric head CT. We devised a new method to reduce exposure of eye-lens based on the dose of automatic exposure control (AEC).
Material and methods. Absorbent was placed in a region from the supraorbital margin to the parietal during positioning scan to determine the AEC dose, and the dose distribution was changed to increase the difference in the amount of radiation absorption between orbit and parietal side. Part of the absorber set the AEC to daily reference dose; consequently, the eye-lens became relatively low. Following the scan the absorbent was removed. The absorbent comprised a multi-element conjugated sheet. The relationship between absorbent thickness and radiation dose, presence/absence of artifacts, and image quality was analyzed using a head phantom. Absorbent was also used for clinical purposes, such as follow-up observation of hydrocephalus, to examine the influence of changes in radiation doses on diagnosis by analyzing image interpretation.
Results. Phantom analysis revealed that the use of absorbent during the positioning scan appropriately changed the AEC dose. The radiation dose of the eye-lens was reduced by 58% with absorbent containing lead of 0.25 mmPb. Artifacts were not observed. Clinical evaluation revealed that no influence of changes in radiation doses on the diagnosis was observed in any case.
Discussion and conclusions. This method may effectively reduce radiation exposure of eye-lens without influencing the diagnosis.

148

Feeding tubes in the paediatric population- how, when and why

Ramdas Senasi [1], Ashok Raghavan[1], Derek Roebuck[2]
[1] Sheffield Children's Hospital, Sheffield (United Kingdom); [2] Great Ormond Street Children's Hospital, London (United Kingdom)

Purpose-Objective. Feeding tubes provide necessary calories and nutrient for children who are unable to ingest anything orally. Also called an enteral feeding, this type of feeding may be the only method of consuming food for some children, either as a temporary or as a permanent measure. Objectives 1. Indications for feeding tubes 2. Types of feeding tubes 3. Advantages 4. Disadvantages 5. Technique

Material and methods. Advantages 1. The ability to provide additional food and calories. 2. Less time spent giving feedings. 3. Feedings can be done at night when child is asleep. 4. Does not interfere with daily activities. 5. Less chance of child spitting up. 6. Less chance of tube coming out. 7. Tube is easy to replace. Disadvantages 1. Risk of Infection 2. Leak and malpositioning 3. Irritation 4. Malfunction
Results. Indications 1. Prematurity 2. Neurological conditions 3. Trauma 4. Post-operative 5. Metabolic disorders 6. Gastrointestinal diseases 7. Failure to thrive 8. Severe refusal to eat 9. Abnormalities of the anatomy and physiology of the gastrointestinal tract 10. Cancer Types of Feeding Tubes 1. Nasogastric feeding 2. Nasoduodenal feeding 3. Nasojejunal feeding 4. Jejunostomy feeding 5. Gastrostomy feeding Access and where the tip of the tube is placed will depend on clinical indication and length of time tube is needed.
Discussion and conclusions. Types of tubes and brief description of technique will be presented in particular nasojejunal, gastrostomy and jenunostomy feeding tubes.

149

Out of hours paediatric ultrasound service evaluation
Ramdas Senasi, Elizabeth Rogan, Andrew Yesudian, David Hughes
Sheffield Children's Hospital, Sheffield (United Kingdom)
Purpose-Objective. 1. Were clinical investigation correctly documented? 2. Were there any discrepancies in ultrasound findings by the radiology trainees necessitating a repeat scan the next day?
Material and methods. We looked at 319 on call scans performed between October 2010 and October 2012. We filtered scans performed by radiology trainees and assessed radiology trainee identification on scan images and availability of provisional reports. We also assessed the diagnostic image quality and discrepancies between the provisional report and the official report issued by supervising consultant the following day.
Results. There were a small proportion of scans where there was no trainee identification. In some cases, a provisional report was not available. There were also a number of scans where there were not enough images and a few minor diagnostic discrepancies. This made it difficult for the supervising consultant to make an adequate assessment and the patient requiring a repeat scan.
Discussion and conclusions. Implementations will include clearly visible signs to remind trainees to properly document trainee identification so that any discrepancy can be traced back for reflective practice. Trainees will also be re-educated with regards to the differences of paediatric ultrasound imaging as opposed to adult ultrasound as pathologies differ. High quality diagnostic imaging is also essential as the supervising consultant would have to issue a formal report based on somebody else's scan and to prevent a repeat scan.

150

Vallecular cyst complicated by infection: case report and review of the literature
Maria Sidiropoulou, Emmanouil Zaikos, Vasiliki Georgopoulou, Thomas Nimas, Tania Chrysopoulou, Anthoula Morichovitou, Nikolaos Barmpas, Eirini Kazantzidou, Efthymia Zafeiriadou
Department Of Computed Tomography, 1St Department Of Radiology, "Hippokrateio"General Hospital, Thessaloniki (Greece)

Purpose-Objective. Vallecular cyst (VC) is a rare but potentially dangerous cause of stridor in neonates and infants. When seen in older children, VC is usually asymptomatic or there are only subtle symptoms. Here we describe the imaging findings of a rare and interesting case of VC in a 14-year-old boy and present relevant literature review.
Material and methods. A 14-year-old boy presented with dyspnea, progressive difficulty in swallowing of 4 days duration and coughing. There was no history of change in voice, earache or neck swelling. His vital signs and general condition were stable. Indirect laryngoscopy revealed a smooth non pulsatile mass occupying the base of the tongue. The vallecula, larynx and hypopharynx were not visible.
Results. Lateral neck X-ray revealed a smooth, soft-tissue lesion in the epiglottic area. Computed Tomography (CT) demonstrated a 3 cm×2.9 cm midline, unilocular cystic mass extending from the tongue base to the level of the pyriform sinuses. The cyst arised from the right vallecula deforming the epiglottis. CT findings were indicative of an infected VC. Surgical treatment included aspiration and excision of the VC. Histologically, the cyst contained respiratory epithelium with mucous glands, with an external lining of squamous epithelium, and contained inflammatory fluid.
Discussion and conclusions. In our case, the infected VC caused severe airway obstruction, which is rare in older children and may require emergent tracheostomy.

151

Pitfalls in pediatric radiology: a pictorial essay

Dawn Engelkemier, George Taylor
Children's Hospital Boston, Boston, Ma (United States)

Purpose-Objective. This exhibit will illustrate common diagnostic errors in pediatric radiology, discuss their causes, and suggest strategies for improvement.
Material and methods. Over 142,000 cases were reviewed and imaging examples of the major types of clinically significant errors were selected. Cases were evaluated to identify contributing factors and methods for reducing future occurrences.
Results. Cognitive errors result from knowledge deficits and thinking errors. Dismissing a synovial sarcoma as a benign cyst demonstrates the danger of premature closure. Failure to use interpretation tools such as windowing, ineffective review of patient history, and misinterpretation or over-interpretation of findings also contribute. Several visual phenomena influence perceptual errors. Missing multiple rib fractures on an MRI of a shoulder mass exemplifies "visual isolation." Identifying a fracture but missing a dislocation illustrates "satisfaction of search." Visual distractors also facilitate errors. Marked physical deformity may be a factor in both perceptual and cognitive errors. System type errors are related to technical or organizational flaws. For example, liver lesions may be missed on CT due to image noise.
Discussion and conclusions. Awareness of the types of errors and factors contributing to them may reduce mistakes. Clinical context, prior images, technical study parameters, and patient anatomy must be considered to minimize error. Visual checklists may be helpful, especially when multiple findings are present. Considering alternative diagnoses and discussion with the clinician is beneficial when findings remain unclear.

152

Learning preference of postgraduate medical trainees in the teaching of practical neonatal US

Patricia Bister-Set[1], Jacqueline Hughes [1], Dirk Bister[2], Claire Smith[1], Anna Curley[1]
[1] Addenbrookes University Hospital, Cambridge (United Kingdom); [2] Guy's University Hospital, London (UK)

Purpose-Objective. E-learning is increasingly used to enhance learning delivery in Medical education. There is much research in demonstrating the 'no significant difference' between e-learning intervention and traditional intervention (Cook and McDonald 2008). How valid is e-learning in teaching practical tasks? The purpose of this qualitative study is to assess learning preference in the teaching of neonatal US.
Material and methods. Thirteen postgraduate trainees in neonatology and radiology with no experience in neonatal US were taught in three different formats: Power Point Learning (PPL) traditional lecture, Video Based Learning (VBL) self- directed e-learning and Hands on Clinical Learning (HCL). The cohort was asked to fill in a questionnaire about their learning preferences; which consisted of five sections: three sections focused on each teaching method; the fourth section focused on their personal experience and the fifth was open to encourage unrestricted feedback.
Results. All formats provided adequate amount of learning information PPL 10/13, VBL 9/10 and HCL 10/13 rated the amount as "just right". The most clinical relevant information was provided by HCL. Majority of trainees preferred learning in the following order: clinical, VBL and PPT, with the PPT format being the least preferred. Voices of the outliers were informative.
Discussion and conclusions. In teaching of practical skills hands on clinical sessions are preferred by trainees. The voices of the outliers are informative in the supplementary use of e-learning.

153

The role of ultrasound and Doppler in evaluation of Takayasu's arteritis: a case report

Damjana Ključevšek [1] Anton Kenig[1], Tomaž Ključevšek[2], Gašper Markelj[1], Mojca Tomažič[1], Martin Thaler[1]
[1] University Clinical Centre Ljubljana, Children's Hospital, Ljubljana (Slovenia); [2] University Clinical Centre, Institute For Radiology, Ljubljana (Slovenia)

Purpose-Objective. Takayasu arteritis is a rare, systemic, inflammatory large-vessel vasculitis of the aorta and its major branches of unknown etiology. The role of US and Doppler in evaluation and follow-up of arteritis is presented.
Material and methods. A 14-year-old handball player came to the hospital due to spontaneous unspecific pain in lower back, abdomen, joints (shoulder). Fatigue lasted for 6 months. No fever, rash, or signs of arthritis. She had elevated SR, CRP, Tr, IgG, alternate complement pathway, mild anemia. Inflammatory bowel disease was suspected. US of the neck was performed because of enlarged lymph nodes. Thickened wall of carotis arteries and stenosis of left

subclavia artery was found. MRA of the whole body showed thickened wall and hyperintensive signal in different parts of aorta and its major branches, and stenosis of some vessels, including subtotal stenosis of celiacal trunk, which was confirmed by Doppler examination.
Results. Diagnosis of arteritis was suspected on the base of US and Doppler examination. Effects of therapy were followed-up primarily by US.
Discussion and conclusions. Aorta and its major branches should be evaluated by US in every child with unspecific abdominal pain, fatigue, or arthralgias. US findings should be the basis for further imaging modalities. MRA is the method of choice for evaluation of arteritis. US with Doppler can be a useful tool for evaluation of therapy in children with vasculitis.

154

Nephrogenic Systemic Fibrosis – Do you know the risk, and what to do to mitigate it?
Joy Barber, Alex Weller
St George's Hospital, London (United Kingdom)

Purpose-Objective. After reading this poster, the reader will: - Know what nephrogenic systemic fibrosis (NSF) is, and what risk it poses to patients; - Have reviewed current guidelines on gadolinium; - Understand the impact of non-adherence to the guidelines.
Material and methods. We present a review of gadolinium and NSF, and steps which should be taken in order to reduce the risk to patients.
Results. NSF is a potentially fatal condition associated with administration of gadolinium-based contrast agents (GBCAs) to patients with renal impairment. Approximately 400 cases of NSF have been reported worldwide, 10 paediatric. In renally impaired patients undergoing high dose studies, the rate of NSF has been reported as high as 22%. The ESUR guidelines (produced 2007, updated 2012) advise that higher risk GBCAs are contraindicated in neonates and patients with severe renal impairment, and should be used with caution in children under 1 year of age only at low dose. Since the implementation of guidelines in 2007 the incidence of NSF has reduced, with no further cases in children. However, a 2010 survey of radiology departments in the UK demonstrated variation in knowledge of, and compliance with guidelines on gadolinium and NSF—potentially leaving patients at risk.
Discussion and conclusions. NSF is a potentially fatal condition associated with gadolinium, the risk of which can be minimised through consistent implementation of the guidelines described here.

155

Ultrasound of the floor of the mouth in children
Kaseem Ajilogba
Royal Hospital For Sick Children, Edinburgh (United Kingdom)

Purpose-Objective. To illustrate the role of ultrasound in the assessment of the floor of the mouth in children and demonstrate the normal compartmental anatomy.
Material and methods. A 2 year retrospective review of ultrasound examinations of the neck in our institution was carried out and the routine demonstration of normal anatomic structures are demonstrated.
Results. Teaching points: Identify the fascial compartments and constituent structures of the floor of the mouth; demonstrate the typical ultrasound appearances of these structures
Discussion and conclusions. Ultrasound is a "child friendly", non-ionising imaging modality with excellent spatial resolution, that is not expensive and is readily available. It's use may obviate the need for more expensive cross sectional CT and/or MR imaging. It should be the initial modality for the assessment of the floor of the mouth.

156

Klippel-Trenaunay, Klippel-Trenaunay-Weber and Parkes Weber Syndromes. Should we still use these eponyms?
Cristian Garcia, Alejandro Zavala, Florencia De Barbieri, Claudio Berrios, Rodrigo Parra
Pontificia Universidad Catolica, Santiago (Chile)

Purpose-Objective. To discuss the actual usefulness of using the eponyms Klippel, Trenaunay and Parkes Weber in the diagnosis of some complex vascular anomalies in children.
Material and methods. In 1900, Klippel and Trenaunay reported a patient with hemihypertrophy of one extremity and hemangiomatous skin lesions (Klippel-Trenaunay Syndrome). In 1907, Parkes Weber described three cases with dermal nevi, hemihypertrophy and varices (Klippel-Trenaunay-Weber Syndrome) and in 1918 he added the additional component of AV fistula (Parkes Weber Syndrome). In 1982, Mulliken and Glowacki proposed the currently used classification for vascular anomalies and included these Syndromes within the group of vascular malformations.
Results. In the Vascular Anomaly Group of our Institution, we receive children with vascular anomalies from all over the country and we have found that many patients come

with the diagnosis of one of these Syndromes, but they do not represent what was originally described and are really part of a wide spectrum of complex vascular anomalies. In order to illustrate this, we show a case of a 5-year-old boy with clinical diagnosis of Klippel-Trenaunay Syndrome, who presented with an extensive mixed capillary-venous-lymphatic vascular malformation of lower extremities, pulmonary hypertension and bladder, rectal,lung, splenic and adrenal involvement.

Discussion and conclusions. The original eponyms of Klippel, Trenaunay or Parkes Weber might be confusing. We propose to name these complex vascular malformations according to their clinical and radiological presentation.

157

Imaging of pediatric head and neck infections: multimodality approach

Georgios Manganas, Evangelia Manopoulou, Christina Meleti, Spyros Yarmenitis, Georgia Papaioannou
Department Of Pediatric Radiology, Mitera Maternity And Chlildren's Hospital, Athens (Greece)

Purpose-Objective. To demonstrate the imaging spectrum of head and neck infections in children and infants.

Material and methods. Multimodality imaging (US, CT, MRI) in neonates and children with head and neck infection was performed in our institution during the past 4 years.

Results. The initial imaging approach included ultrasound in most of the cases. However, in the clinical suspicion of deep cervical and craniofacial lesions cross-sectional imaging and mainly MRI was applied. The additional value of cross-sectional imaging in the precise anatomic localization of these lesions, together with the detection of associated complications and possible underlying congenital anomalies is presented.

Discussion and conclusions. There is a great variety in the presentation and the appearances of pediatric head and neck infections which makes the multimodality imaging approach invaluable.

158

Low-cost medical image segmentation system including quad-buffered stereoscopic 3D visualization for teaching purposes

Reinhard Kaufmann, Erich Sorantin, Alexander Kolli
Medical University Graz, Department Of Radiology, Graz (Austria)

Purpose-Objective. 3D reconstructions can be generated from Computed Tomography (CT) or Magnetic Resonance Imaging (MRI) sequences. The main goal of this work presents a low cost, open source based system for interactive 3D display of medical cross sectionals in order to enhance and augment medical student educations.

Material and methods. CT series from representative cases were exported from the hospitals information system and the open source software package "ImageJ" (http://rsbweb.nih.gov/ij/) was used for segmentation of various organ systems followed by triangulation in order to computed displayable meshes. For optimal display those meshes were further post-processed with "MeshLab" (http://meshlab.sourceforge.net/). After modification and enhancement of ImageJ's "3D Viewer" Plugin the software could be used for quad-buffered 3D stereoscopic display based on a NVIDIA Quadro graphics card, active shutter glasses and a 3D Beamer (BENQ.....). All components are standard hardware.

Results. A set of three pediatric representative cases (normal anatomy, bronchopulmonary foregut malformation, pulmonary metastasis) was generated and could be displayed interactively in 3D stereo.

Discussion and conclusions. A low cost system for 3D stereo display based on standard hardware components and modified open source software could be generated—thus enabling a new tool for medical student education.

159

Incidental abnormalities of the vena cava inferior identified on CT and MRI in children

Natalia Barmpaliou [1], Eva Kvanta [2]
[1] Karolinska University Hospital, Astrid Lindgren Children's Hospital, Pediatric Radiology Dept., Stockholm (Sweden); [2] Karolinska University Hospital, Astrid Lindgren Children's Hospital, Stockholm (Sweden)

Purpose-Objective. To present three cases with anomalies of the vena cava found incidentally on pediatric MRI and CT scans together with a short literature review of anatomical variants of the inferior vena cava (IVC) and their possible importance for future vascular interventions or surgery.

Material and methods. Three children were investigated in our department for different reasons. Case 1: A 13-year old girl with repaired tetralogy of Fallot, (MRI). Case 2: A two-week-old baby with jaundice and growing abdominal size, (CT). Case 3: A five-year-old girl with unexplained high blood-pressure and a family history of hypertension, (CT and MRI).
Results. The following incidental abnormalities were found: Case 1: A double IVC infrarenally. Anomalous intrahepatic course of IVC, crossing ventrally through the liver and emptying together with the liver veins ventrally to the right atrium. Case 2: Azygous continuation of IVC (in addition to polysplenia syndrome and biliary atresia). Case 3: Absence of IVC. A left sided tortuous vessel was found, starting at the level of L5, continuing cranially and emptying into the azygous vein. Intrahepatic venovenous shunts were also found.
Discussion and conclusions. As shown by these cases there is a wide spectrum of congenital anomalies involving the IVC. It is important to identify and report these incidental abnormalities of the IVC. Some IVC anomalies, particularly the azygous continuation, have been associated with congenital heart disease and have importance for therapeutic decisions including interventions.

160

To err is human – common resident diagnostic errors in pediatric emergency radiography

Marc Jordaan, Michele Walters, George Taylor
Boston Children's Hospital, Boston (United States)

Purpose-Objective. The purpose of this exhibit is to highlight the most common diagnostic errors made by residents in the interpretation of pediatric emergency radiography. We focus on entities unique to pediatrics that most frequently elude the resident in early training.
Material and methods. We conducted a retrospective review of diagnostic errors made by on-call radiology residents interpreting emergency room radiographs in a major pediatric referral hospital over a two year period. Trainees had little or no prior experience in pediatric radiology. Preliminary trainee interpretations were compared with final attending interpretations, and discrepancies were tabulated. This exhibit discusses our results, and presents a pictorial review of the five most common diagnostic errors identified with a brief discussion of each.
Results. Certain entities are frequently misinterpreted by residents new to pediatric imaging when evaluating radiographs from the emergency department. These include buckle fractures, fractures of the digits, elbow fractures, pneumonia, and croup.
Discussion and conclusions. Resident knowledge of the most common diagnostic errors in pediatric emergency radiography may serve to limit misinterpretation and avoid inappropriate or delayed clinical management. We have recently instituted an educational conference highlighting common errors at the start of each resident rotation in our department. Our hope is that early familiarity with entities that are uniquely pediatric and sometimes challenging to recognize will help new residents avoid common pitfalls in the interpretation of pediatric emergency radiography.

161

Paediatric thyroid masses

Caron Parsons [1], Heather Stirling[1], Claire Miller[2], Emma Helm[1]
[1] University Hospital Coventry & Warwickshire, Coventry (United States); [2] Birmingham Children's Hospital, Birmingham (United Kingdom)

Purpose-Objective. 1) To assess the referral pattern and demographics of thyroid masses in a paediatric population at a large secondary care centre. 2) To summarise the clinical and radiological characteristics of thyroid pathology in children. 3) To emphasise the role of imaging in management of thyroid disease.
Material and methods. The study group was obtained by analysing the reports from all neck, thyroid, parotid and submandibular gland ultrasounds performed on all patients aged 16 years or less over a 7 year period.
Results. 500 children were scanned in total. The majority (n =218, 43.6%) showed lymphadenopathy. A total of 39 (7.8%) patients had thyroid pathology including 11 with nodules. 5 patients underwent surgical resection of nodules (2 hyperplastic nodules, 2 benign adenomas, 1 parathyroid adenoma and 1 papillary carcinoma). Other common diagnoses were diffuse goitres (1%) and absent/ectopic thyroid (1%). Less common diagnoses included Graves' disease and thyroiditis (0.6%).
Discussion and conclusions. We present the range of thyroid conditions presenting in a general paediatric population and their characteristic imaging appearances. All patients had at least one ultrasound and many were

managed with ultrasound follow-up alone. Cross-sectional imaging and nuclear medicine scans were very infrequently performed. Characteristic ultrasound findings together with US FNA and clinical correlation were the mainstay of patient management, allowing a confident diagnosis in most cases.

162

Fusion and subtraction post-processing in body-MRI

Tom Watson, Oystein Olsen
Great Ormond Street Hospital For Children Nhs Foundation Trust, London (United Kingdom)

Purpose-Objective. Advanced, often free, imaging software has made MRI post-processing techniques available. We demonstrate the use of fusion and subtraction techniques for body imaging, suggest scanning parameters and discuss limitations.
Material and methods. An educational review demonstrating the use of image fusion and subtraction. Techniques including synchronization of respiratory gating and the use of anti-cholinergic agents to reduce peristalsis are considered.
Results. Image fusion is effective for localisation of areas of restricted diffusion often seen in active bowel inflammation and in highly cellular tumours. Fusion seems valuable in dynamic MRI fluoroscopic studies increasing delineation of complex bowel anatomy and pathology such as fistulous tracts. Image subtraction pre/post contrast enhancement eases the demonstration of areas of active inflammation (e.g. bowel wall, synovium) and delineation of viable areas of a tumour. The use of hyocine is suggested for reducing the distorting effect of bowel peristalsis among sequences to be fused. If respiratory gating is necessary, the same phase (usually end-expiration) is recommended.
Discussion and conclusions. Image fusion and subtraction have the potential to ease reading and enhance the diagnostic potential in body-MRI. With increased availability of advanced imaging software, they are likely to become part of the radiologists' standard toolkit.

163

Imaging complications of solid organ and bone marrow transplantation

Tom Watson, David Hatch, Helen Spencer, Persis Amrolia, Paul Veys, Oystein Olsen, Catherine Owens
Great Ormond Street Hospital For Children Nhs Foundation Trust, London (United Kingdom)

Purpose-Objective. Retrospective pictorial review of imaging from a large series of solid organ and bone marrow transplantation.
Material and methods. We present the imaging of sequelae encountered over a 10 year period in a large international centre performing 60 solid organ (renal, cardiac+/−lung and lung), and 80 bone marrow transplants (BMT) per year. We illustrate and demonstrate techniques to improve and optimize detection of complications.
Results. Imaging contributed significantly to the diagnosis of opportunistic infections including CMV and fungal infection, Ebstein Barr Virus (EBV) related post-transplant lymphoproliferative disease (PTLD) and soft tissue tumours (leiomyomas). Lung complications of T cell sequestration diffuse alveolar haemorrhage/damage and constrictive obliterative bronchiolitis (host versus graft and graft versus host disease) are not uncommon. We also demonstrate the efficacy of post-processing techniques in optimizing detection of these complications, including high resolution US with frequency/dynamic range optimization and the role of maximum and minimum intensity projections (MIP and miniP) and volume rendering techniques with CT.
Discussion and conclusions. Imaging plays a crucial role in the complex analysis of the post transplantation patient. Our large case series review will illustrate a cross section of commonly encountered complications. We will suggest tips and tricks to optimize imaging techniques for maximum diagnostic yield.

164

Rare and unusual pediatric conditions are always present

Savas Deftereos, Aikaterini Zazaliari, Eugenia Vranou, Panos Prassopoulos
Democritus University Of Thrace, Alexandroupolis (Greece)

Purpose-Objective. To emphasize not particularly frequent pathologies of the pediatric age group. To review and describe these entities and their Ultrasound (US), CT and MRI imaging findings.

Material and methods. Our department pediatric cases of last 5 years were reviewed and the more infrequent or not so frequent pathologies were presented. From a "pool" with more than two thousand and five hundred small patients of all pediatric age groups fifteen children were appreciated as having not so usual conditions (0.67%, 17/2524). To estimate a case as rare, a rate up to 9% of references from the literature was used.
Results. All systems were studied involving unusual conditions. In 35.29% (6/17) congenital syndrome was documented (trisomy 13, Silver-Russell) and in the remaining population metabolic conditions (more often maternal) such as urinary bladder lithiasis, not classified, e.g. ectopic thymus, congenital cavernous hemangioma of scull vault, urethral atresia combined with underdeveloped lungs and last but not least gun shooting (children against children).
Discussion and conclusions. Rare pathologic entities in pediatric every day practice must not be absent from our diagnostic thinking. Pediatric Radiologists must be familiar with imaging findings of rare or unusual pathologies "from head to toe".

Functional Imaging

165

Functional assessment of the placenta with multiparametric MRI at 4.7T on a murine model of placental insufficiency

Marianne Alison [1,2], Gwennhael Autret [1], Daniel Balvay [1], Gihad Chalouhi [1], Thibault Quibel [1], Benjamin Deloison[1], Laurent Salomon [1], Charles André Cuenod [1,3], Olivier Clement [1,3], Guy Sebag [2], Nathalie Siauve [1,3]

[1] Inserm UMR 970, Paris (France); [2] Hôpital Robert Debré, Paris (France); [3] Hôpital Européen Georges Pompidou, Paris (France)

Purpose-Objective. Placental insufficiency caused by deficient vascularization is common during pregnancy and can lead to severe materno-fetal complications such as intrauterine growth restriction or preeclampsia. Its diagnosis remains difficult and delayed. New functional MRI tools are in development and could be useful to increase the accuracy of this diagnosis. The objective was to develop multi-parametric MRI to assess placental function at 4.7T, on a murine model of decreased placental perfusion.
Material and methods. Diffusion-weighted imaging (DWI) with intravoxel incoherent motion (IVIM) analysis and dynamic contrast enhanced MRI (DCE) with single-compartment analysis were developed and evaluated on a controlled rat model. Decreased placental perfusion was achieved by ligation of the left uterine vascular pedicle of the bicornuate uterus on the 17th embryonic day. Placental perfusion remained normal in the right uterine horn. Mixed regression analysis was used to compare placental parameters between the 2 horns.
Results. For DWI, 73 placentas were examined, 23 from the ligated horn ($n=10$ rats). For DCE, 53 placentas were analysed, 11 from the ligated horn ($n=12$ rats). In the placentas with reduced perfusion, the apparent diffusion coefficient (ADC), the perfusion fraction (f) obtained with DWI and the placental blood flow (F) obtained with DCE were significantly decreased ($p<0.01$).
Discussion and conclusions. DWI with IVIM analysis and DCE-MRI appear as promising and complementary techniques to assess placental microcirculation.

AUTHOR INDEX