

## **Pediatric radiology**

## Suspected Acute Appendicitis in Children: MRI Appearances, Alternative Diagnoses, and Lessons Learned

All Day Location: PD Community, Learning Center

### Awards

#### Certificate of Merit

### Participants

Jessica R. Leschied, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

Jonathan R. Dillman, MD, Ann Arbor, MI (*Abstract Co-Author*) Research support, Bracco Group; Research support, Siemens AG

Peter J. Strouse, MD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose

Ethan A. Smith, MD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose

Samir Gadepalli, MD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose

Nicole S. Sroufe, MD, MPH, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

Outline a rapid, non-contrast MRI protocol to identify causes of right lower quadrant pain in pediatric patients in the emergent setting

Identify MRI features of acute non-complicated appendicitis

Identify the MRI features of complications of appendicitis

Recognize the MRI appearances of various clinical mimics of acute appendicitis

### TABLE OF CONTENTS/OUTLINE

Epidemiology of acute appendicitis in the US

Brief review of literature and current imaging algorithm for acute presentation of abdominal pain in children

Outline a rapid, non-contrast MRI appendicitis protocol

Case-based approach to identifying MR features of acute appendicitis

Highlight MR appearance of complications of acute appendicitis

Demonstrate MR appearance of clinical mimics of acute appendicitis

## Management and Follow-Up of Pediatric Hepatic Tumors

All Day Location: PD Community, Learning Center

### Participants

Christopher T. Watterson, MD, W Hollywood, CA (*Presenter*) Nothing to Disclose  
Allen Ardestani, MD, PhD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose  
Snehalkumar Patel, MD, PhD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose  
Katherine M. Haker, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

To discuss the radiologic appearance and delineating factors of the hepatic tumors commonly encountered in pediatric patients. To review the etiology, management, and follow-up considerations of these lesions. To discuss the staging of hepatoblastoma. To describe the differences between transplant criteria in adults and pediatrics.

### TABLE OF CONTENTS/OUTLINE

Benign Tumors: Hemangiomas Hemangioendothelioma Mesenchymal Hamartomas Hepatic Adenoma FNH Malignant Primary:  
Hepatoblastoma: Associated with Beckwith-Wiedemann Syndrome, FAP Hepatocellular Carcinoma Secondary: Wilms' Tumor  
Neuroblastoma Rhabdomyosarcoma Rhabdoid Lymphoma/Leukemia Adrenal cortical carcinoma

## Treatment Planning and MRI Guided Sclerotherapy in Pediatric Patients with Lymphatic Malformations

All Day Location: PD Community, Learning Center

### Participants

Sasan Partovi, MD, Cleveland, OH (*Presenter*) Nothing to Disclose

Lorena Lourhance M. Vidal, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose

Nicholas Bhojwani, MD, Nashville, TN (*Abstract Co-Author*) Nothing to Disclose

Dean A. Nakamoto, MD, Beachwood, OH (*Abstract Co-Author*) Research Grant, Galil Medical Ltd; Research agreement, Toshiba Corporation

Kristine Blackham, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose

Indravadan J. Patel, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1. To understand the classification of lymphatic malformations based on MRI appearance. 2. To discuss the advantages of real-time MRI guided sclerotherapy treatment of lymphatic malformations in the pediatric patient population. 3. To become familiar with the different steps of real-time MRI guided sclerotherapy treatment of lymphatic malformations including lesion localization, needle placement visualization, depiction of sclerotherapy injection process by using a mixture with Gadolinium based contrast agents. 4. To appreciate potential complications of the procedure and their appropriate treatment

### TABLE OF CONTENTS/OUTLINE

1. Characterization and differentiation of different types of lymphatic malformations based on appearance in MRI. 2. Advantages of real-time MRI guided sclerotherapy treatment in the pediatric population including increased safety and lack of radiation exposure. 3. Real-time MRI guided treatment of lymphatic malformations including technical aspects of the applied sequences for: Lesion localization, Needle placement, Sclerotherapy-Gadolinium mixture injection process, Assessment of treatment success. 4. Associated complications including frequency and treatment approach. 5. Post-procedure follow-up imaging protocols using MRI

## The Role of Ultrasonography on Congenital Malformations Evaluation of the Umbilical-portal-hepatic Venous System

All Day Location: PD Community, Learning Center

### Participants

Bruna B. Bastos, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose  
Diego P. Rodrigues, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Mauricio Yamanari, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Yoshino T. Sameshima, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Miguel J. Francisco Neto, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Marcelo B. Funari, MD, Ribeirao Pires, Brazil (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1. This paper describes the evolution of three cases of congenital malformations of the umbilical-portal-hepatic venous system diagnosed by ultrasonography in the perinatal period, that illustrate the following malformations: a) persistent vitelline vein complicated with portal vein thrombosis; b) congenital intrahepatic portosystemic shunt; and c) hepatic arteriovenous malformation. 2. The hepatic venous system begins its formation around the fifth gestational week. The terminal part of the inferior vena cava, hepatic veins, and the portal veins is derived from the umbilical and vitelline veins. Malformations and anomalies arising during the development of this venous network are rare and highly varied, and may result in several pathologies. 3. The Doppler ultrasonography is the most important tool for congenital malformations evaluation of the umbilical-portal-hepatic venous system diagnosis.

### TABLE OF CONTENTS/OUTLINE

Introduction. Embriology of the umbilical-portal-hepatic venous system. Ultrasonographic anatomy of the umbilical-portal-hepatic venous system. Persistent vitelline vein complicated with portal vein thrombosis demonstrating early opening of collateral circulation. Congenital portosystemic shunt: intrahepatic and extrahepatic. Hepatic arteriovenous malformation. Conclusion. References.

## Cloud Based Interactive Training Tool to Improve Diagnostic Skills in Pediatric Musculoskeletal Imaging

All Day Location: PD Community, Learning Center

### Participants

Roland S. Talanow, MD, PhD, South Lake Tahoe, NV (*Presenter*) President, InnoMed LLC;  
Shannon L. Tocchio, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

This web platform, along with continuing updates, will provide a 1) realistic environment and 2) important resource for residents and radiologists to improve their diagnostic skillset in pediatric MSK imaging.

### TABLE OF CONTENTS/OUTLINE

A. Anatomy This program provides a collection of MSK cases showing significant anatomical structures that need to be recognized by the user. B. Pathophysiology Provided is furthermore a case collection with frequent and infrequent pathologies in pediatric MSK imaging that need to be recognized by the user. C. Diagnostic Imaging In each module, the user goes through a set of cases and need to recognize (if) any pathology. This online program offers a modular approach through musculoskeletal imaging, based on modalities and body regions. D. ROI Recognition An intelligent coordinate based algorithm saves the pathology location and the system calculates if the user pointed out the correct region of interest and recognized the pathology and compares to the 'gold standard' entered by the authors. E. Outcome (Results with Analytics) After each module, the system calculates the user results with the true results and provides detailed analytics about user performance and comparison with their peers. Exams can be done in a timed or untimed matter to prepare for the 'real life' of a busy Radiology practice.

## Standardization of the Head Ultrasonography for Usual and Unusual Applications

All Day Location: PD Community, Learning Center

### Participants

Marielli B. Dal Bo, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose  
Yoshino T. Sameshima, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Mauricio Yamanari, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Miguel J. Neto, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Marcelo B. Funari, MD, Ribeirao Pires, Brazil (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1.The first experiments with cerebral ultrasound in neonates date back to 1950s when the A mode studies were conducted. Since then it has remained as a method of choice for the initial evaluation of the neonate brain. 2.This work aims to emphasize the importance of standardized documentation of head ultrasonography (HUS), showing the main levels of sonographic slices and demonstrate the major injuries of premature newborns brain such as periventricular leukomalacia (PVL), germinal matrix hemorrhage (GMH), periventricular hemorrhagic infarction, and congenital CNS malformation as well as infection.3.Unusual applications of HUS will also be shown such as in tocotraumatism, craniostenosis, scalp disorders, analysis of aqueductal cerebrospinal fluid (ACSF) flow with color Doppler in grade IV germinal matrix hemorrhage, and guiding neuroendoscopic procedures.

### TABLE OF CONTENTS/OUTLINE

1.HUS standardized documentation, sonographic slices, positioning, acoustic windows. 2.Major brain injuries in premature newborns such as PVL and De Vries grading system. 3.GMH and Papile grading system. 4.Congenital CNS malformation and infection. 5.Unusual applications of HUS such as in tocotraumatism, craniostenosis, scalp disorders, analysis of ACSF flow with color Doppler, and guiding neuroendoscopic procedures.

## Ultrasonographic Features of Various Thyroid Diseases in Children and Adolescents

All Day Location: PD Community, Learning Center

### Participants

Jisun Hwang, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

Hyun-Sook Hong, MD, PhD, Bucheon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

Eun Hye Lee, MD, Bucheon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

Sun Hye Jung, Bucheon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

To learn about the normal development of the thyroid gland To be able to distinguish various diseases that can involve the thyroid health of children and adolescents. To recognize the imaging features of congenital thyroid disorders To review epidemiological features of imaging findings on various benign or malignant thyroid nodular lesions in children and adolescents To review diffuse thyroid disease

### TABLE OF CONTENTS/OUTLINE

1. Introduction2. Normal development of the thyroid gland3. Congenital hypothyroidism (dysgenesis, [aplasia, ectopy, and hypoplasia]; dyshormonogenesis; transient hypothyroidism; thyroglossal duct cysts)4. Thyroid nodules Benign thyroid nodules Malignant nodules5. Diffuse thyroid disease Grave's disease Hashimoto's thyroiditis Suppurative thyroiditis



## Cranial Ultrasound for the Diagnosis of Craniosynostosis: Avoiding Radiation Exposure in Young Children

All Day Location: PD Community, Learning Center

### Participants

Katya Rozovsky, MD, Jerusalem, Israel (*Abstract Co-Author*) Nothing to Disclose  
 Kristin Udjus-Teitelbaum, MD, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose  
 Nagwa M. Wilson, MD, PhD, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose  
 Nick Barrowman, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose  
 Natalia Simanovsky, MD, Jerusalem, Israel (*Abstract Co-Author*) Nothing to Disclose  
 Elka Miller, MD, Ottawa, ON (*Presenter*) Nothing to Disclose

### TEACHING POINTS

The purpose of this exhibition is: To discuss the advantages of cranial ultrasound (CUS) as a radiation-free and technically simple technique as a first-line tool for detection or exclusion of craniosynostosis, reducing the use of radiography in young children To illustrate CUS techniques for suture evaluation, thus improving reader skill and confidence in the confirmation or exclusion of synostosis using CUS To discuss the challenges inherent in metopic suture evaluation, where we found disagreement between CUS and cranial radiography in several cases; to provide imaging "tricks and tips" to improve diagnostic accuracy To present the next steps in imaging evaluation in cases where synostosis is diagnosed or cannot be ruled out on CUS

### TABLE OF CONTENTS/OUTLINE

CUS technique: how we do it Normal cranial sutures: appearance on CUS, correlation with cranial radiography Craniosynostosis: appearance on CUS, correlation with cranial radiography Sagittal suture Coronal suture Lambdoid suture Metopic suture CUS appearance of metopic suture Patent Normally closed Abnormally closed (synostosis) "True positive" and "false positive" cases of metopic synostosis, correlation with cranial radiography What to do next in cases where synostosis is diagnosed or cannot be ruled out on CUS?

## Sonographic Features of Newborns Umbilical Catheterization: Anatomical Catheter's Pathway, Positioning and its Complications

All Day Location: PD Community, Learning Center

### Participants

Bruna B. Bastos, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose  
Francisco D. Junior, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Mauricio Yamanari, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Yoshino T. Sameshima, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Miguel J. Francisco Neto, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Marcelo B. Funari, MD, Ribeirao Pires, Brazil (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1. This paper aims to illustrate the fundamental role of ultrasonography in the evaluation of umbilical catheter placement and the detection of its potential complications. 2. Ultrasonography is a widely available method, which can be performed at the bedside, and does not require iodinated contrast or ionized radiation. 3. Since the introduction of intravascular catheters and the use of umbilical vein to exchange transfusions in 1947, the arterial and venous umbilical catheter is routinely used in premature neonates. 4. The umbilical catheter reaches an acceptable position during the first attempt to insert in less than half of the cases. Considering that most of the complications are related to improper placement of the distal end of the catheter, we face a high risk of complications. 5. Umbilical catheters may be misspositioned in various vascular structures, including the left atrium, and extraluminal site; another common complication is portal vein thrombosis.

### TABLE OF CONTENTS/OUTLINE

Introduction. Ultrasonographic aspects of venous and arterial umbilical catheters anatomical pathways. Usual ultrasonographic appearance of umbilical catheters. Venous catheterization related complications. Arterial catheterization related complications. Conclusion. References.

## MR Imaging of CNS Inflammatory Demyelinating Disorders in Pediatrics

All Day Location: PD Community, Learning Center

### Participants

Ahmed Abdel Razek, MD, Mansoura, Egypt (*Presenter*) Nothing to Disclose

### TEACHING POINTS

1-To review basic background about pediatric CNS inflammatory demyelinating disorders (CIDD) 2- To illustrate update proposed classification and Revised McDonald multiple sclerosis criteria in children 3-To discuss typical and atypical imaging appearance of different causes of pediatric CIDD

### TABLE OF CONTENTS/OUTLINE

2-Review proposed 2012 International Pediatric Multiple Sclerosis Study Group (IPMSSG)3- Illustrate 2010 Revised McDonald multiple sclerosis criteria in children4-Different MR pulse sequences applied in children with CIDD5-MR imaging features of clinically isolated syndrome in the children6-MR imaging appearance and different locations of pediatric multiple sclerosis7-Imaging of pediatric neuromyelitis optica8-Imaging of acute disseminated encephalomyelitis and its variants9-Imaging findings used to differentiate pediatric CIDD from other simulating lesions10-Summary and future directions

## Pelvic Puzzlers: Uncommon Pediatric Pelvic Neoplasms with Radiologic, Clinical, and Pathologic Correlation

All Day Location: PD Community, Learning Center

### Awards

#### Certificate of Merit

### Participants

Sara Cohen, MD, Boston, MA (*Presenter*) Nothing to Disclose

Osman Yilmaz, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

Anastasia L. Hryhorczuk, MD, Brookline, MA (*Abstract Co-Author*) Nothing to Disclose

Donald A. Tracy, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

The purpose of this exhibit is to describe the clinical presentation, characteristic radiographic features, pathologic correlates and management for a selection of unusual neoplasms arising in the pelvis of children. Viewers of this exhibit will become familiar with rare tumors that may mimic other neoplasms and that are challenging to diagnose. Viewers will also explore the typical histopathologic features diagnostic of these entities.

### TABLE OF CONTENTS/OUTLINE

Cases include the following: 1. perivascular epithelioid cell tumor (PEC-oma) of the uterus, 2. presacral extragonadal yolk sac tumor, 3. inflammatory myofibroblastic tumor of small bowel, 4. low grade inverted papillary urothelial neoplasm, 5. granulosa cell tumor, 6. Castleman's disease, 7. dermatofibrosarcoma protuberans of the vulva, 8. bilateral ovarian lymphoma metastases

## Ultrasound Evaluation of Radiographically Occult Elbow Injuries in Children and Infants

All Day Location: PD Community, Learning Center

### Participants

Jessica R. Leschied, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose  
Ramon Sanchez, MD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose  
Lawrence R. Kuhns, MD, Plymouth, MI (*Abstract Co-Author*) Nothing to Disclose  
Qian Dong, MD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose  
Mark Riederer, MD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

By completion of this educational exhibit, the learner will be able to: Perform a sonographic evaluation of the pediatric elbow joint for the purposes of detecting traumatic injury Identify normal appearances of non-ossified epiphyses and normal anatomic relationships of the elbow joint Understand the indications for elbow sonography in the setting of clinically suspicious elbow injury Identify the sonographic appearance of common pediatric elbow injuries including supracondylar fracture, lateral condyle fracture, medial epicondyle avulsion fracture, fracture-dislocation, radial neck fracture, nursemaid's elbow and clinical fracture mimics such as osteomyelitis and septic arthritis

### TABLE OF CONTENTS/OUTLINE

Epidemiology of pediatric elbow fractures Anatomy of elbow joint Sonographic techniques for performing elbow ultrasound Case examples of elbow fracture/dislocations and role of ultrasound for specific injury patterns

## "Where do I Draw the Line?": A How-to Guide on Most Commonly Used Measurements in Pediatric Musculoskeletal Radiology

All Day Location: PD Community, Learning Center

### Participants

Eric J. Jordan, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

Andrew S. Phelps, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose

Johanna M. Chang, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose

John D. MacKenzie, MD, San Francisco, CA (*Abstract Co-Author*) Research Grant, General Electric Company

Jesse L. Courtier, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

Accurate measurements are key in the appropriate diagnosis and management in a number of common pediatric conditions. Inappropriate performance of these measurements can lead to missed diagnoses and inappropriate management. Through a series of case examples this exhibit will: 1. Provide radiologists with a review of common pediatric musculoskeletal conditions affecting the spine, elbow, knees, hips, and feet. 2. Allow viewers to test their knowledge with a quiz on the accurate performance of measurements in these conditions.

### TABLE OF CONTENTS/OUTLINE

Using an interactive quiz format, cases will be presented with emphasis on appropriate placement of measurement lines. Common pitfalls will be highlighted. A discussion of key points on the diagnosis and management will be made of entities including. Spine (trauma and alignment) C-spine (pseudo-subluxation vs abnormal) Scoliosis (cobb angle, coronal/sagittal imbalance Elbow (fall on outstretched hand) anterior humeral line (normal in young versus old) radiocapitellar alignment (considerations in <1yr olds) Hip alpha angle in US acetabular and center-edge angles Klein line in slipped capital femoral epiphysis Knee Mechanical vs Weightbearing Axis Foot Hindfoot alignment

## Pearls and Pitfalls in Imaging of Pediatric and Adolescent Breast Masses

All Day Location: PD Community, Learning Center

### Participants

Priya Krishnarao, MD, San Jose, CA (*Presenter*) Nothing to Disclose  
Patrick H. Do, MD, San Jose, CA (*Abstract Co-Author*) Nothing to Disclose  
Amrita K. Arneja, MD, Hicksville, NY (*Abstract Co-Author*) Nothing to Disclose  
Vanessa Starr, MD, San Jose, CA (*Abstract Co-Author*) Nothing to Disclose  
Long Trinh, MD, San Jose, CA (*Abstract Co-Author*) Nothing to Disclose  
Evan J. Zucker, MD, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

Review normal breast development Review developmental breast anomalies Review benign lesions of the pediatric breast Review malignant lesions of the pediatric breast

### TABLE OF CONTENTS/OUTLINE

Introduction Methods and Materials- Description of case selection from multiple institutions Overview of normal breast development Review of benign breast lesions such as breast cysts, mastitis, fibroadenomas, juvenile fibroadenomas, and juvenile papillomatosis Review of malignant breast lesions such as malignant phyllodes tumors, primary breast carcinoma, and metastatic disease

## Hips Don't Lie

All Day Location: PD Community, Learning Center

### Participants

Iman Khodarahmi, MD, PhD, Newark, NJ (*Presenter*) Nothing to Disclose

Christina Skoski, MD, Newark, NJ (*Abstract Co-Author*) Nothing to Disclose

Neha A. Kothari, MD, Warren, NJ (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

It is challenging for many to perform or interpret pediatric hip ultrasound, due to lack of familiarity with the anatomic orientation of the standard imaging planes. Upon completing this exhibit, the participant will become familiar with the scanning technique as well as standard views and maneuvers employed during performance of hip ultrasound. Cross-sectional imaging will be provided to help orient the viewer with respect to the normal anatomic planes. Viewers will learn how to identify the normal anatomic landmarks needed to perform biometric analysis, and also how to diagnose a normal, subluxed or dislocated hip with the aid of MR and CT correlation.

### TABLE OF CONTENTS/OUTLINE

Importance of hip ultrasound: Why perform the hip ultrasound? Indications: Who gets the hip ultrasound? Review of infant hip anatomy. Technique: How to perform a hip ultrasound? Tutorial: Standard imaging planes on ultrasound with biometric measurements. Correlation between normal pediatric hip Ultrasound, CT and MRI on coronal and transverse views. Correlation between abnormal pediatric hip Ultrasound, CT and MRI: Subluxed and dislocated hips.



## Pulmonary Air Leak Syndrome: Risk Factors and Imaging Findings

All Day Location: PD Community, Learning Center

### Participants

Cecilia Santos Monton, Salamanca, Spain (*Presenter*) Nothing to Disclose

Roberto Llorens Salvador, Valencia, Spain (*Abstract Co-Author*) Nothing to Disclose

Amparo Moreno Flores, MD, Valencia, Spain (*Abstract Co-Author*) Nothing to Disclose

Roberto Correa Soto, Salamanca, Spain (*Abstract Co-Author*) Nothing to Disclose

Maria Teresa Garzon Guiteria, Salamanca, Spain (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

Respiratory failure is one of the main causes of morbidity and mortality in the neonatal intensive care unit. Pulmonary air leak syndrome is a fairly common complication in newborns with mechanical ventilation. The teaching points of this exhibition are: -To define the pulmonary air leak syndrome and to know the different entities that are part of it. -To describe the radiological pattern of the different entities: Pulmonary interstitial emphysema, pneumothorax, pneumomediastinum, subcutaneous emphysema, pneumopericardium, pneumoperitoneum and massive air embolism. -To know the risk factor that increase the incidence of this entity.

### TABLE OF CONTENTS/OUTLINE

Introduction Definition of pulmonary air leak syndrome Pathogenesis of pulmonary air leak syndrome Risk factors Pulmonary interstitial emphysema: definition, diagnosis and imaging findings Pneumothorax: definition, clinical findings and radiological pattern Pneumomediastinum: risk factors, symptoms and imaging findings Subcutaneous emphysema: physical examination and radiological features Pneumopericardium: risk factors, diagnosis and treatment Pneumoperitoneum: imaging features Massive air embolism Conclusion

## Differential Diagnosis of Pediatric Non-renal Retroperitoneal Masses

All Day Location: PD Community, Learning Center

### Participants

Andrew Kim, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose

Ellen M. Chung, MD, Bethesda, MD (*Presenter*) Nothing to Disclose

### TEACHING POINTS

Primary pediatric non-renal retroperitoneal masses are uncommon and may be of neurogenic, germ cell, mesodermal, lymphoid, or non-neoplastic origin. Distinguishing imaging features may help to narrow the differential diagnosis. Neuroblastomas characteristically demonstrate calcifications, vessel engulfment, and a tendency to cross midline and invade neural foramina. Paragangliomas show distinct margins and intense peripheral enhancement. Peripheral nerve sheath tumors demonstrate fascicular or target appearance on T2-weighted images and the split fat sign on T1-weighted images. Malignant tumors show an edema-like zone and central cystic change. Mature teratomas contain calcifications, cysts, and fat. Rhabdomyosarcomas are bulky, heterogeneous masses with necrosis and local invasion. Inflammatory myofibroblastic tumors show non-specific appearances with characteristic chunky calcifications in a minority of cases. Retroperitoneal lymphomas present as non-enhancing homogenous masses abutting vessels. Lipoblastomas are well-circumscribed fat-containing lesions. Lymphatic malformations have macro- and microcystic components. The contents of the macrocysts do not enhance.

### TABLE OF CONTENTS/OUTLINE

List and classify primary pediatric retroperitoneal masses  
Imaging findings, pathologic correlation, and distinguishing features of each

## Imaging of Pediatric Skull Base: Variants, Developmental Abnormalities, Trauma, Infections, and Tumors

All Day Location: PD Community, Learning Center

### Participants

Haley R. Clark, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose  
 Julie C. Bulman, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose  
 Korgun Koral, MD, Dallas, TX (*Presenter*) Nothing to Disclose

### TEACHING POINTS

1. The appearance of pediatric skull base changes with age. 2. Recognizing normal developmental changes helps avoiding unnecessary imaging and intervention. 3. Pediatric skull base infection generally arises from the adjacent paranasal sinuses and mastoid air cells, however, its diagnosis may be difficult, as lack of normal aeration is not uncommon in children. 4. Primary pediatric skull base tumors are not common, however, tumors of the head and neck are encountered not uncommonly. Appropriate evaluation of skull base is of utmost important for definition of tumor extent and staging.

### TABLE OF CONTENTS/OUTLINE

CASE LIST  
 Developmental Spheno-occipital synchondrosis Arrested sphenoid sinus pneumatization Persistent craniopharyngeal canal  
 Transsphenoidal encephalocele Transthemoidal encephalocele Heterotopic neuroglial tissue Traumatic Fracture Penetrating trauma  
 Vascular injury Infection Skull base osteomyelitis and complications Neoplasia Benign Aneurysmal bone cyst Fibrous dysplasia  
 Ossifying fibroma Malignant Rhabdomyosarcoma, Langerhans Cell Histiocytosis Lymphoma Neuroblastoma Chordoma Chondrosarcoma  
 Chloroma (myeloid sarcoma)

## Arterial Spin Labeled Perfusion MRI before and after Acetazolamide Challenge in Children with Intracranial Arterial Stenosis: Our Experience

All Day Location: PD Community, Learning Center

### Participants

Ashishkumar K. Parikh, MD, Jacksonville, FL (*Presenter*) Nothing to Disclose

Chetan C. Shah, MBBS, Jacksonville, FL (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

Chronic intracranial arterial stenosis among children can lead to impairments in cerebrovascular reserve, which can greatly increase the risk of subsequent ischemic events. Identification of children with deficient cerebrovascular reserve is crucial as these patients can benefit from extracranial-intracranial (EC/IC) carotid artery bypass. We describe our experience with arterial spin labeled (ASL) perfusion MRI before and after an acetazolamide challenge in children with intracranial arterial stenosis and compare this method with 99mTc-HMPAO SPECT; the traditional gold standard for assessment of cerebrovascular reserve.

### TABLE OF CONTENTS/OUTLINE

This educational exhibit will be an illustrative review of several cases of chronic intracranial arterial stenosis that had assessment of cerebrovascular reserve via arterial spin labeled perfusion MR imaging before and after acetazolamide administration. The pre and post processing techniques, MR sequence parameters, clinical utility, and efficiency of arterial spin labeled perfusion MRI will be emphasized. Lastly, the pros and cons of ASL perfusion MRI will be compared with the gold standard, 99mTc-HMPAO SPECT.

## Clival and Intracranial Atypical Teratoid Rhabdoid Tumors: A Case Series and Review

All Day Location: PD Community, Learning Center

### Participants

Brittany K. Albers, MD, Jacksonville, FL (*Presenter*) Nothing to Disclose

Chetan C. Shah, MBBS, Jacksonville, FL (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

Atypical Teratoid Rhabdoid Tumor (ATRT) is a rare but highly aggressive intracranial neoplasm found almost exclusively in the pediatric population. 1) Multiple case series have examined imaging characteristics of ATRT, without identifying reliable and distinct imaging characteristics. We will review the classical and non-classical imaging findings of atypical teratoid rhabdoid tumor, a rare but highly aggressive pediatric neoplasm. Multiple cases will be presented to reinforce variable imaging findings, including size, location, and multiparametric MR imaging characteristics. 2) Review the demographics of atypical teratoid rhabdoid tumors, as it can help in narrowing the differential diagnosis. 3) Review the genetics of these atypical teratoid rhabdoid tumors, and review their common genetic origin with extra-cranial malignant rhabdoid tumors.

### TABLE OF CONTENTS/OUTLINE

Classic and non-classical MR imaging findings of atypical teratoid rhabdoid tumors (ATRT) Demographics of ATRT, specifically compared to medulloblastoma Case presentations: - Intra-axial, intraparenchymal ATRT - Intraventricular ATRT - Osseous ATRT: Clivus and Vertebrae - Malignant rhabdoid tumor of the kidney, metastasized to brain Tumor genetics: Emphasis on shared genetics with malignant rhabdoid tumors found outside of the CNS.

## Atypical Imaging Findings of Intracranial Cavernous Malformation in Children: A Pictorial Review

All Day Location: PD Community, Learning Center

### Participants

Alexandre Perez, MD, Valencia, Spain (*Presenter*) Nothing to Disclose

Pierre Lemerrier, Valencia, Spain (*Abstract Co-Author*) Nothing to Disclose

Carlos Leiva Salinas, MD, Charlottesville, VA (*Abstract Co-Author*) Nothing to Disclose

Silvia Paz Maya, MEd, Valencia, Spain (*Abstract Co-Author*) Nothing to Disclose

Francisco Menor, Valencia, Spain (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

To describe epidemiology, histopathology and typical imaging findings of cavernous malformations. To define and review the atypical imaging findings of cavernous malformations in pediatric patients To emphasize the inclusion of cavernous malformation in the differential diagnosis of a focal cerebral hemorrhagic mass, even if there is a tumor-like appearance.

### TABLE OF CONTENTS/OUTLINE

1. Introduction2. Epidemiology3. Histopathology4. Imaging findings of cavernous malformation - CT findings - MRI findings - Associations5. Atypical findings of cavernous malformations - Imaging appearance - Location - Size - Number6. Conclusions

## Clinical Applications of Susceptibility-Weighted Imaging in the Pediatric Brain

All Day Location: PD Community, Learning Center

### Participants

Emily Ambinder, MD, MSc, Baltimore, MD (*Presenter*) Nothing to Disclose

Andrea Poretti, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose

Thierry Huisman, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose

Thangamadhan Bosemani, MD, FRCR, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

To review the unique characteristics of susceptibility-weighted imaging (SWI). To present situations in which SWI can provide important information in pediatric neuroimaging. To describe potential pitfalls in SWI.

### TABLE OF CONTENTS/OUTLINE

Introduction  
SWI Technique  
Cases demonstrating applications in pediatric neuroimaging: Intracranial hemorrhage  
Traumatic brain injury  
Cerebral vascular malformations, Stroke  
Sinus venous thrombosis  
Hypoxic-ischemic injury  
Infections  
Tumors  
Neurodegenerative/metabolic disorders  
Potential pitfalls  
Hypoxemia  
Thick sections  
Aliasing  
Conclusion

## The Imaging of Takayasu's Arteritis in Children: A Pictorial Essay

All Day Location: PD Community, Learning Center

### Awards

#### Certificate of Merit

### Participants

Eu-Leong H. Teo, MBBS, Singapore, Singapore (*Presenter*) Nothing to Disclose

Ehab Shaban Mahmoud Hamouda, FRCR, Singapore, Singapore (*Abstract Co-Author*) Nothing to Disclose

Varanasi Krishna, MD, FRCR, Manama, Bahrain (*Abstract Co-Author*) Nothing to Disclose

Marielle V. Fortier, MD, Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

The purpose of this pictorial essay is to: Review the pathophysiology of Takayasu's Arteritis (TA). Educate the reader in the optimisation of imaging protocols to best demonstrate the findings of TA. Illustrate the imaging features of TA in children through the use of different imaging modalities Show how the features of TA change over time with treatment and how this is monitored through imaging.

### TABLE OF CONTENTS/OUTLINE

Takayasu's arteritis (TA) is a rare chronic granulomatous vasculitis involving the aorta and its major branches. Mononuclear infiltration of the arterial wall results in arterial media destruction leading to luminal stenosis, contour irregularity, dissection, aneurysmal dilatation and rarely, rupture of the involved arteries. This pictorial essay will illustrate the varied imaging findings of TA in children. A series of cases in the different stages and severity of disease will be shown highlighting the use of ultrasound, CT and MRI in the diagnosis and follow-up of these patients. Optimal imaging protocols and differential diagnoses will be discussed. After viewing this exhibit, the reader will be familiar with the imaging features of TA and the optimal imaging techniques that best demonstrate these features. This will facilitate early diagnosis and treatment with improved patient outcome.



## Ultra-low-dose Fetal Computed Tomography (ULDCT) with Model-based Iterative Reconstruction (MBIR): A Prospective Pilot Study

All Day Location: PD Community, Learning Center

### Participants

Rumi Imai, Setagaya, Japan (*Presenter*) Nothing to Disclose  
Osamu Miyazaki, MD, Setagaya, Japan (*Abstract Co-Author*) Nothing to Disclose  
Gen Nishimura, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose  
Keisuke Asano, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose  
Hiroshi Horiguchi, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose  
Shunsuke Nosaka, MD, Zama, Japan (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

To introduce MBIR for fetal CT - clarify the lower limit of tube current for ULDCT. To review the implementation of ULDCT for fetal skeletal dysplasias; assess the diagnostic ability of MBIR for the detection of pathognomonic findings. To estimate the fetal radiation dose of MBIR, and compare it to current protocol (CP) and other published data.

### TABLE OF CONTENTS/OUTLINE

Materials and Methods: measurement of standard deviation of CT number (there were 5 ROIs on 32 cm CTDI phantom at 10 different dose settings and 3 ROIs in amniotic fluid of the 5 cases; MBIR and ASIR respectively). Four-point Likert scale test of ULDCT (5 cases) including chondrodysplasia punctate(XLD type), Pfeiffer syndrome type 2, Achondroplasia (2 cases), Thanatophoric dysplasia. Estimation of fetal radiation doses was based on the absorbed uterine dose using computer software (CT-Expo). Summary: ULDCT can reduce 80% radiation dose without loss of image quality. Pathognomonic findings were observed even on ULDCT of CTDIvol (0.5 mGy). The CTDIvol of ULDCT is 20% of CP, only 5% of Japanese diagnostic reference level (DRL) in 2011. Estimated fetal dose was 0.7 mSv, and is slightly lower than the estimated mean fetal dose from pelvic radiography (1.1 mSv, ICRP 84) in the UK. From the view point of risk and benefit, radiation dose of ULDCT might be acceptable.

## 'Wood' You Find It?: Pearls and Pitfalls in Imaging of Common Radiolucent and "Can't Miss" Pediatric Foreign Bodies

All Day Location: PD Community, Learning Center

### Awards

#### Certificate of Merit

### Participants

Lindsay P. Busby, MD, MPH, San Francisco, CA (*Presenter*) Nothing to Disclose  
Andrew S. Phelps, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose  
Johanna M. Chang, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose  
John D. MacKenzie, MD, San Francisco, CA (*Abstract Co-Author*) Research Grant, General Electric Company  
Pierre-Alain Cohen, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose  
Jesse L. Courtier, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

Foreign bodies are commonly encountered in the pediatric population and can lead to significant morbidity and mortality. Familiarity with imaging appearance of commonly encountered foreign bodies in children as well as potential pitfalls is critical in appropriate management. The purpose of this exhibit is to: 1. Improve understanding of child development as it relates to foreign body ingestion and aspiration in children. 2. Explain common locations for ingested and aspirated foreign bodies. 3. Review imaging strategies for radiolucent foreign bodies including wood and aluminum. 4. Demonstrate imaging appearance of foreign bodies at high risk for complications including disk batteries and magnets.

### TABLE OF CONTENTS/OUTLINE

1. Introduction: Review pertinent child development and risk factors  
2. Radiolucent foreign bodies aspirated: imaging strategies  
3. Ingested: common locations  
4. Soft tissue foreign bodies: Imaging and management  
5. High risk foreign bodies disk batteries  
6. Complications

## Intrathoracic Huge Malignant Tumors in Children: Basic Knowledge and Tips for a Differential Diagnosis

All Day Location: PD Community, Learning Center

### Participants

Takahiro Sueoka, MD, Hiroshima, Japan (*Presenter*) Nothing to Disclose

Chihiro Tani, MD, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose

Yoko Kaichi, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose

Fuminari Tatsugami, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose

Makoto Iida, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose

Kazuo Awai, MD, Hiroshima, Japan (*Abstract Co-Author*) Research Grant, Toshiba Corporation; Research Grant, Hitachi, Ltd;

Research Grant, Bayer AG; Research Grant, DAIICHI SANKYO Group; Medical Advisor, DAIICHI SANKYO Group; Research Grant, Eisai

Co, Ltd; Research Grant, Nemoto-Kyourindo; ; ; ;

Yukiko Honda, MD, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

Intrathoracic malignant tumors in children arise from the chest wall, mediastinum, pleura, or lung parenchyma; when the tumor is huge, it can difficult to ascertain its origin. We present crucial imaging findings that help to identify the tumor origin. Subsequently a differential diagnosis can be reached based on the patient age, clinical findings, and imaging features.

### TABLE OF CONTENTS/OUTLINE

Clinical findings in children with intrathoracic malignant tumors Tips to identify the origin of intrathoracic malignant tumors in children Differential diagnosis of intrathoracic malignant tumors in children Representative cases - Tumors arising from the chest wall: Ewing sarcoma, rhabdomyosarcoma, malignant primitive neuroectodermal tumor, osteosarcoma of the rib -Tumors arising from the mediastinum: Malignant lymphoma, thymic infiltration from leukemia, malignant germ cell tumor, neuroblastoma -Tumors arising from the lung or pleura: Pulmonary and pleural rhabdomyosarcoma, pulmonary blastoma, metastatic lung- and pleural lesions

## Choledochal Cysts in a New Light: The Visser Classification

All Day Location: PD Community, Learning Center

### Participants

James Banks, MD, Miami, FL (*Presenter*) Nothing to Disclose  
Joseph M. Dalonzo, MD, Miami, FL (*Abstract Co-Author*) Nothing to Disclose  
Maria Bastos, MD, Miami, FL (*Abstract Co-Author*) Nothing to Disclose  
Gaurav M. Saigal, MBBS, Miami, FL (*Abstract Co-Author*) Nothing to Disclose  
Nguyen V. Nguyen, MD, Miami, FL (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

Understand the Todani classification and the need for revision  
Be able to group biliary ductal dilatation patterns by Visser's system  
Know the salient imaging findings that should be included in the report to improve management  
Provide appropriate recommendations for establishing the diagnosis and detecting complications

### TABLE OF CONTENTS/OUTLINE

General Discussion - Todani's system and its limitations - Visser's system - Imaging Recommendations - What to Report  
Choledochal Cysts - imaging characteristics - etiology, demographics, natural history, prognosis - treatment  
Choledochal Diverticulum - imaging characteristics - etiology, demographics, natural history, prognosis - treatment  
Choledochocoele - imaging characteristics - etiology, demographics, natural history, prognosis - treatment  
Caroli Disease - imaging characteristics - etiology, demographics, natural history, prognosis - treatment  
Pitfalls - mimicker conditions - trouble shooting techniques

## Foreign Bodies (FB) in the Pediatric Population: Radiologic Appearance, Common Anatomic Locations, and Clinical Implications

All Day Location: PD Community, Learning Center

### Participants

Jorge Delgado, Philadelphia, PA (*Presenter*) Nothing to Disclose

Maria Alejandra Bedoya Velez, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

Asef B. Khwaja, MD, Philadelphia, MO (*Abstract Co-Author*) Author, Reed Elsevier

Victor M. Ho-Fung, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

Nancy A. Chauvin, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

-Most common aspirated FB are radiolucent. Radiographic evaluation should include assessment of indirect findings such as air trapping or consolidation. Useful techniques include lateral decubitus chest imaging (<5 years old) and end-expiratory films (>5 years old).-Most common ingested FB are radiopaque. Management depends both on its location within the GI tract and risks associated with the type of FB.-Esophageal FB are usually located in the 3 anatomic areas of decreased esophageal diameter.-Button batteries located in the esophagus require emergent removal with attention to the 3Ns rule: The Narrow side of the battery is the Negative pole where Necrosis is more likely.-Ingestion of two-more magnets may cause pressure necrosis of the bowel with risk of perforation, enteroenteric fistula formation or obstruction.-Transperineal US is useful to depict vaginal FB. Signs include acoustic shadowing and slight indentation in the posterior wall of the bladder.

### TABLE OF CONTENTS/OUTLINE

IntroductionAspirated FB Epidemiology Characteristics Radiopaque vs. Radiolucent Indirect findings ManagementIngested FB Epidemiology Characteristics Coins Button batteries Characteristics associated with increased risk Management Magnets Management (1 vs. 2-more) Sharp FB Follow-upVaginal FB Epidemiology US signs

## Why Can't I Breathe? Congenital Nasal Cavity Narrowing in Newborns

All Day Location: PD Community, Learning Center

### Participants

Miren Zubizarreta, Donostia, Spain (*Presenter*) Nothing to Disclose

Diana Garcia Asensio, Donostia, Spain (*Abstract Co-Author*) Nothing to Disclose

Virginia Gomez, San Sebastian, Spain (*Abstract Co-Author*) Nothing to Disclose

Elena Inchausti, MBBS, Donostia, Spain (*Abstract Co-Author*) Nothing to Disclose

Monica Fernandez, Donostia, Spain (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

To describe different pathologies and their radiological findings that may cause a life-threatening acute upper airway obstruction in newborns. To emphasize in the importance of the radiological evaluation (performed with an accurate technique to avoid pitfalls) for the diagnosis and management of these pathologies.

### TABLE OF CONTENTS/OUTLINE

Newborns are obligate nasal breathers. When there is a nasal airway narrowing can lead to cyanosis and respiratory distress (especially while they are feeding) that could be life-threatening. There is a wide variety of etiology including choanal atresia (most common cause), pyriform aperture stenosis, dacryocystocele, rare tumors (such as glioma, encephalocele, teratoma...), craniofacial syndromes (one of the most common is the Pierre - Robin sequence). We will expose different cases, all of them from our hospital, with different image modalities (CT and MR) emphasizing in the classic signs to reach the diagnosis.

## Spectrum of Imaging Findings of Osteoid Osteoma and Differential Diagnosis

All Day Location: PD Community, Learning Center

### Awards

#### Certificate of Merit

### Participants

Yu Luo, MD, PhD, Nashville, TN (*Presenter*) Nothing to Disclose

Matthew R. Prater, MD, Nashville, TN (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

To review classic presentation and imaging findings of osteoid osteoma (OO) in long bones. To review spectrum of clinical presentation, imaging findings of OO and differential diagnosis in the spine, joints and small bones in the hand and feet. Nidus of OO in the spine may be difficult to identify. Findings of intra-articular OO could resemble inflammatory arthritis or malignancy, delaying diagnosis and effective treatment. Nidus of OO in small bones of the hands and feet could be obscured by other bony change, such as sclerosis. Familiarity with spectrum of clinical presentations, imaging findings and differential diagnosis and the study of choice (CT) is essential for early diagnosis and treatment of osteoid osteoma.

### TABLE OF CONTENTS/OUTLINE

1. Review clinical presentation and pathophysiology of osteoid osteoma (OO). 2. Discuss utility of radiographs, nuclear medicine, CT and MRI in the diagnosis of OO. 3. Case-based review of clinical presentation, imaging features of OO and differential diagnosis in: A: Long bones (OO vs eosinophilic granuloma, osteomyelitis, stress fracture, osteoblastoma). B: Joint (OO vs septic arthritis, inflammatory arthritis, leukemia). C: Spine (OO vs osteoblastoma, healing fracture, osteomyelitis). D: in hands and feet (OO vs healing fracture, osteomyelitis, BPOP). 4. Summary

## MRI of the the Temporomandibular Joint in Juvenile Idiopathic Arthritis: How to Do It and What to Look For

All Day Location: PD Community, Learning Center

### Awards

Cum Laude

### Participants

Maria Navallas, MD, Barcelona, Spain (*Presenter*) Nothing to Disclose

Emilio Inarejos Clemente, MD, Barcelona, Spain (*Abstract Co-Author*) Nothing to Disclose

Marcela De la Hoz Polo, MD, Tarragona, Spain (*Abstract Co-Author*) Nothing to Disclose

Lucia Riaza, Esplugues De Llobregat, Spain (*Abstract Co-Author*) Nothing to Disclose

Monica Rebollo, MD, Esplugues de Llobregat, Spain (*Abstract Co-Author*) Nothing to Disclose

Estibaliz Iglesias, 08950, Spain (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

Describe the MRI technique to evaluate the TMJ joint in patients with juvenile idiopathic arthritis. Describe the problems you may encounter and potential solutions. Define what parameters should be analyzed. Illustrate the main imaging findings.

### TABLE OF CONTENTS/OUTLINE

The term juvenile idiopathic arthritis encompasses a group of arthritis of unknown cause with onset before the age of 16 years that last for at least 6 weeks. The prevalence of temporomandibular joint involvement in published series ranges from 17% to 87%. Temporomandibular joint involvement is difficult to detect clinically, so imaging plays a key role in diagnosis and monitoring treatment. MRI is the technique of choice for the study of arthritis of the temporomandibular joint because it is the most sensitive technique for detecting acute synovitis and bone marrow edema. MR imaging findings with greater sensitivity and positive predictive value are acute inflammatory changes such as synovial thickening with enhancement after administration of paramagnetic contrast, marrow edema and joint effusion; and chronic changes such as bone erosions, morphology changes of the mandibular condyle and the temporal fossa, shortening of the ramus, etc.



## Jejunal Involvement in Pediatric Crohn's Disease: Imaging Features and Clinical Implications

All Day Location: PD Community, Learning Center

### Awards

#### Certificate of Merit

### Participants

Kaiming Wu, MD, Boston, MA (*Presenter*) Nothing to Disclose

Michael S. Gee, MD, PhD, Jamaica Plain, MA (*Abstract Co-Author*) Nothing to Disclose

Jess Kaplan, MD, Boston, MA (*Abstract Co-Author*) Consultant, Johnson & Johnson

Katherine Nimkin, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

Review of the multimodality imaging features of jejunal disease in pediatric Crohn's disease. Recognize the importance of documenting jejunal involvement as a prognostic indicator in children with Crohn's disease

### TABLE OF CONTENTS/OUTLINE

Introduction Discuss importance of detecting jejunal involvement with Crohn's disease as this region is not accessible endoscopically Discuss clinical features of jejunal disease in this setting, including greater risk of stricturing disease, association with multiple abdominal surgeries, and potential need for earlier and more aggressive medical therapy Show imaging features of normal jejunum Review of imaging studies including UGI/SBFT, CT enterography and MR enterography in children with surgically proven jejunal involvement with Crohn's disease Summarize the importance of these findings and emphasize the clinical implications of jejunal disease in pediatric Crohn's disease

## Calvarial Lesions in Children: A Systematic Approach Based on Clinical and Imaging Findings

All Day Location: PD Community, Learning Center

### Awards

#### Certificate of Merit

### Participants

Leonor G. Savarese, MD, Ribeirao Preto, Brazil (*Presenter*) Nothing to Disclose

Murilo B. Cintra, Ribeirao Preto, Brazil (*Abstract Co-Author*) Nothing to Disclose

Gustavo N. Simao, MD, PhD, Ribeirao Preto, Brazil (*Abstract Co-Author*) Nothing to Disclose

Marcello H. Nogueira-Barbosa, MD, PhD, Ribeirao Preto, Brazil (*Abstract Co-Author*) Nothing to Disclose

Angela D. Bellucci, MD, PhD, Ribeirao Preto, Brazil (*Abstract Co-Author*) Nothing to Disclose

Sara R. Teixeira, MD, PhD, Ribeirao Preto, Brazil (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1. To illustrate the most common calvarial lesions in children. 2. To show a systematic approach based on clinical history and imaging findings to help radiologists narrow down the definitive diagnosis.

### TABLE OF CONTENTS/OUTLINE

Head lumps in children may be discovered incidentally or in radiological examinations following symptomatic lesions. The variable nature of lesions may pose a diagnostic dilemma. In neonates and infants, congenital or benign lesions are more frequent, whereas in older children, neoplastic tumors and inflammatory lesions should be considered. From the imaging point of view, evaluation of the nature of the lesion (lytic or sclerotic, cystic or solid), calcification and involvement of the two skull tables usually allows the radiologist to state whether the lesion has benign or aggressive characteristics. We describe lesions of different etiologies, including normal variants, congenital, neoplastic, traumatic, inflammatory and miscellaneous. All the cases were confirmed either by biopsy or based on clinical history and follow-up. A systematic approach based on clinical history, age and radiological characteristics may assist the radiologist in establishing optimal diagnosis with significant therapeutic implications.

## Pitfalls and Practical Challenges in Imaging of the Pediatric Scrotum

All Day Location: PD Community, Learning Center

### Participants

Esther Hwang, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

Martin P. Edwards, MD, New York, NY (*Presenter*) Nothing to Disclose

Neil Lester, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

Henrietta Kotlus Rosenberg, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

List the various causes of scrotal abnormalities in the pediatric age range Describe the ultrasound appearance of pathological processes that affect the pediatric scrotum Recognize and understand how to avoid pitfalls when imaging the scrotum

### TABLE OF CONTENTS/OUTLINE

Common major pitfall of testicular sonography is improper probe technology High-frequency (12-5 MHz, 17-5 MHz, 9-4 MHz), "hockey stick," (17-5io) linear probe, curvilinear transducer and/or extended FOV Illustrate sonographic appearance and imaging pitfalls of each of the following scrotal pathological processes Cryptorchidism Hydrocele, Funicular hydrocele Acute Scrotal Pain i.Testicular torsion ii.Epididymitis with or without orchitis; pyocele, abscess iii.Torsion of testicular appendage Varicocele Pachyvaginalitis Microlithiasis Testicular masses i.Teratoma ii.Germ Cell Testicular Tumor: seminoma, emryonal carcinoma, teratoma, choriocarcinoma, mixed iii.Gonadal stromal tumor: Leydig cell, Sertoli cell iv.Adrenal rest v.Secondary Testicular Neoplasm: metastases Paratesticular mass i.Paratesticular tumor: embryonal rhabdomyosarcoma ii.Benign paratesticular tumors: spermatocoele, epididymal cyst Trauma i.Testicular hematoma ii.Testicular rupture Miscellaneous i.Venolymphatic malformation ii.Testicular Feminization 46 X,Y iii.Ovotestis 46 X,X

## Unusual Causes of Hepatic Dysfunction in Infants and Children; Recognizing the Underlying Vascular Etiology

All Day Location: PD Community, Learning Center

### Participants

Gopi Nayak, MD, New York, NY (*Presenter*) Nothing to Disclose

Terry L. Levin, MD, Mamaroneck, NY (*Abstract Co-Author*) Nothing to Disclose

Nadia Ovchinsky, Bronx, NY (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

The purpose of this exhibit is to describe unusual acquired and congenital hepatic vascular diseases. These cases present with nonspecific signs and symptoms and are often initially misdiagnosed. Teaching points: 1. Review the vascular anatomy of the liver and discuss its embryologic development. 2. Present uncommon acquired and congenital causes of hepatic vascular pathology. 3. Discuss the nonspecific signs and symptoms of these conditions that often lead to delay in diagnosis and management. 4. Identify key clinical and imaging features that may suggest the correct diagnosis.

### TABLE OF CONTENTS/OUTLINE

1. Vascular anatomy of the liver and embryogenesis with imaging of normal hepatic vascular anatomy using MRI, CT, and US, with emphasis on Doppler imaging. 2. Pictorial review of cases, including patient's initial diagnosis, time to accurate diagnosis, and associated clinical and imaging findings. 3. Discuss therapeutic options for each entity. 4. Cases: -Abernethy malformation (congenital portosystemic shunt) in a newborn. -Congenital hepatic artery to portal vein shunt in a newborn. -Budd Chiari syndrome in a young adult as a presentation of underlying JAK2 mutation. -Idiopathic portal hypertension in an older child. -Obliterative portal venopathy in a teenager.

## Advances in Pediatric Cardiac MR Imaging-Principles of New Techniques

All Day Location: PD Community, Learning Center

### Participants

Keyur Parekh, MD, Chicago, IL (*Presenter*) Grant, Siemens AG  
Michael Markl, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose  
Marina Doliner, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose  
Patrick Magrath, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose  
Kelly Jarvis, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose  
Cynthia K. Rigsby, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1. Technological developments in the field of cardiac MRI (CMR) are on rise and it is prudent to be aware of the clinical utility of these newer tools. 2. The role of CMR in pediatric patients is different from that in adults. 3. Newer sequences like T1 mapping, T2 mapping, 3D motion encoded phase-contrast MR and 4D flow imaging in CMR have drawn increased attention. Our exhibit will discuss basic principles, clinical applications and exemplify role of these tools in pediatric patients.

### TABLE OF CONTENTS/OUTLINE

1. Basic principles of newer techniques 2. MR physics of T1 and T2 mapping, three-directional (3D) motion encoded phase-contrast MR, four-dimensional (4D) flow MR 3. Role of T1 mapping in quantitative assessment of myocardial tissue in children and young adults 4. Clinical utility of T2 mapping to determine myocardial edema 5. 3D motion encoded phase-contrast MR to quantify myocardial wall motion of entire heart 6. Utility of 4D flow in Pediatric CMR to demonstrate complex blood flow patterns in congenital heart disease 7. Limitations 8. Conclusions

## MRI of Pediatric Bone Marrow: The Normal, the Abnormal, and the Exceptions

All Day Location: PD Community, Learning Center

### Awards

Cum Laude

### Participants

Brian Y. Chan, MD, Madison, WI (*Presenter*) Nothing to Disclose

Kara Gill, MD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose

Susan L. Rebsamen, MD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose

Jie C. Nguyen, MD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1 Understanding the normal progression of red to yellow marrow conversion in the growing skeleton is essential to pediatric radiology. 2 Although there is extensive overlap in the pattern of malignant marrow replacement, recognizing specific marrow patterns can help narrow the differential diagnosis. 3 Mimickers of abnormal marrow include normal variants and reactive marrow changes.

### TABLE OF CONTENTS/OUTLINE

1 Introduction 2 Stereotypic appearance of bone marrow throughout skeletal maturation 3 Examples of malignant marrow replacement 4 Mimickers of abnormal bone marrow signal 5 Conclusion The bone marrow is visible on all MRI studies and is the most variable portion of the exam, depending on stage of skeletal maturation. Normal maturation from hematopoietic (red) to fatty (yellow) marrow has a predictable pattern within the long bones and the spine. Malignant marrow replacement can be diffuse, focal, or patchy. A "flip-flop" pattern is suspicious for acute lymphoblastic leukemia. A focal pattern favors lymphoma or metastatic disease. Malignant marrow involvement should be differentiated from normal variants and focal reactive marrow signal from infection, injury, or treatment effects. Familiarity with the imaging characteristics of bone marrow can increase diagnostic accuracy and ensure timely and appropriate patient management.

## The Supraclavicular Space in the Pediatric Patient

All Day Location: PD Community, Learning Center

### Participants

Maria I. Martinez-Leon, MD, PhD, Malaga, Spain (*Presenter*) Nothing to Disclose

Laura Penuela Ruiz, Malaga, Spain (*Abstract Co-Author*) Nothing to Disclose

Maria Vidal, Malaga, Spain (*Abstract Co-Author*) Nothing to Disclose

Pascual Garcia Herrera Taillefer, Malaga, Spain (*Abstract Co-Author*) Nothing to Disclose

Ramon Ribes, Cordoba, Spain (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1. To describe the anatomy of the supraclavicular space (SS) as a crossroad of multiple structures. 2. To correlate the anatomical elements of the SS with their pathological counterparts.

### TABLE OF CONTENTS/OUTLINE

1. Anatomical structures in the pediatric SS. 2. Pathological entities in the pediatric SS. 3. Correlation between anatomical structures and lesions in the pediatric SS: \* Muscles: Fibromatosis Colli, Rhabdomyosarcoma, Hematoma... \* Veins: Low Flow Malformation, Malposition of Venous Accesses... \* Arteries: High Flow Malformation, Hemangioma... \* Lymphatics: Reactive adenopathies, Infectious adenopathies, Lymphoma, Neuroblastoma... \* Nerves: Obstetric Brachial Plexus Injury... \* Bones: Benign and Malignant Tumors, Fractures... \* Fat: Teratoma, Lipoma, Liposarcoma... 4. Summary.

## Imaging Spectrum of Non Vascular Pediatric Mediastinal Masses, Tumors and Tumore Mimics

All Day Location: PD Community, Learning Center



Discussions may include off-label uses.

### Participants

Hadeel M. Seif El Dein, MD, Cairo, Egypt (*Presenter*) Nothing to Disclose

Abdel Rahman M. Sayed, MD, Giza, Egypt (*Abstract Co-Author*) Nothing to Disclose

Rania Zakareya, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

to identify the most common non vascular mediastinal masses in pediatric age by their location and special imaging features.to learn about occasional un usual behaviourto identify rare tumor and tumors mimic masses

### TABLE OF CONTENTS/OUTLINE

1- classification of common pediatric non vascular masses according to their location.2- review of their special imaging features (CT and MRI).3-samples of unusual behavior3-samples of cases and mimics.4- samples of unusual neoplastic and non neoplastic masses.



## Prenatal and Neonatal Diagnosis of Congenital Chest Malformations - An 2015 Uptodate

All Day Location: PD Community, Learning Center

### Participants

Catia Esteves, MD, Porto, Portugal (*Presenter*) Nothing to Disclose

Francisco Rego Costa, MD, Porto, Portugal (*Abstract Co-Author*) Nothing to Disclose

Marcio Rodrigues, MD, Braga, Portugal (*Abstract Co-Author*) Nothing to Disclose

Daniela F. Pinto, Barcelos, Portugal (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

Review the embryologic development of fetal thorax. Recapitulate the most useful examinations in the diagnosis of congenital chest malformations (CCM) prenatally and postnatally. Illustrate the normal anatomy of fetal thorax with special emphasis on fetal magnetic resonance imaging (MRI) with discussion of protocols and technical requirements. Classify and describe current CCM classification with correlative case examples. Summarize essential findings that should be searched for and included in the radiologist report.

### TABLE OF CONTENTS/OUTLINE

Background of CCM and basic embryology of thorax. Evaluation of fetal thorax MRI - Protocol/technical requirements; - Advantages in early diagnosis. Imaging findings and differential diagnosis of the different subtypes of current CCM with emphasis in the most common lesions, potential mimics/pitfalls, possible associated syndromes. - Bronchopulmonary (eg.congenital cystic adenomatoid malformation,congenital lobar emphysema,bronchogenic cyst); - Vascular; - Combined (vascular/nonvascular) (eg.bronchopulmonary sequestration); - Other (eg. diaphragmatic hernia) Summary with essential findings in the radiologist report taking into account:presence/absence of systemic arterial supply, hydrops, mass effect on the mediastinum, percentage of ventilated lung, associated organ system anomalies.

## MRI Evaluation of Fetal Teratoma, A Spectrum of Findings

All Day Location: PD Community, Learning Center

### Participants

Sherelle L. Laifer-Narin, MD, Englewood, NJ (*Abstract Co-Author*) Nothing to Disclose

Sejal N. Patel, MD, New York, NY (*Presenter*) Nothing to Disclose

Maansi R. Parekh, MBBS, New York, NY (*Abstract Co-Author*) Nothing to Disclose

Stuart Bentley-Hibbert, MD, PhD, Valhalla, NY (*Abstract Co-Author*) Nothing to Disclose

Elizabeth M. Hecht, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

Jeffrey H. Newhouse, MD, Bronxville, NY (*Abstract Co-Author*) Research Consultant, PAREXEL International Corporation

### TEACHING POINTS

To review key anatomic, pathologic, and imaging characteristics of fetal teratomas. To review diagnosis, clinical management, ancillary findings, and ultimate outcome of patients with fetal teratomas.

### TABLE OF CONTENTS/OUTLINE

Background Most common fetal tumor Significant challenge to the patient and physician Diagnosis, counseling, obstetrical care  
Review of key anatomy and pathology Midline of the body, from brain to the sacrococcygeal region Spectrum of fetal teratoma cases presented Intracranial, oropharyngeal, intra-abdominal, sacrococcygeal, and a rare form of a parasitic twin Review of Fetal MR Imaging Technique 1.5 Tesla system utilizing: single shot fast spin echo T2, gradient echo, T1, and diffusion weighted sequences Review of detailed evaluation, precise anatomic location, and description Conclusions/Clinical Significance of Fetal MRI  
Extremely useful in the evaluation of fetuses presenting with a presumed neoplasm Evaluation of size, location, extent of a mass, airway patency, degree of hydrops, associated abnormalities, and assessing serial growth Invaluable in the management of high risk obstetric patients, guiding patient/fetal care, and an integral part of multidisciplinary approach for these very difficult cases

## Left Pulmonary Artery Sling? Appropriate Imaging Strategy for Better Management

All Day Location: PD Community, Learning Center

### Participants

Jiajun Xie, Guangzhou, China (*Presenter*) Nothing to Disclose

Hui Liu, MD, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose

Sachin S. Saboo, MD, FRCR, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose

Xiao-Mei Zhong, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose

Hai-Ying Luo, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose

Yu-Hsiang Juan, MD, Taoyuan, Taiwan (*Abstract Co-Author*) Nothing to Disclose

Suhny Abbara, MD, Dallas, TX (*Abstract Co-Author*) Author, Reed Elsevier; Editor, Reed Elsevier; Institutional research agreement, Koninklijke Philips NV; Institutional research agreement, Siemens AG

Chang Hong Liang, MD, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1. Classification, anatomic variations, and anomalies associated with Left Pulmonary Artery Sling (LPAS). 2. Clinical features and basic surgical procedures for LPAS. 3. Discuss an appropriate imaging strategy to identify the anatomic details and the severity of patient's condition for better pre-, intra- and postoperative assessment.

### TABLE OF CONTENTS/OUTLINE

1. Review the classification, anatomic variations, and anomalies associated with LPAS. 2. Clinical features of LPAS related to the consequences of tracheal and esophageal compression. 3. Illuminate the basic surgical procedures for LPAS. 4. Appropriate Imaging Strategy (pros and cons): A. preoperative assessment: a. Chest radiography b. Ultrasound c. MRI d. CT combined bronchoscopy makes a good preoperative imaging evaluation for the anomalies of vessels and trachea. B. intra-operative assessment: a. bronchoscopy; b. ultrasound C. postoperative assessment: ultrasound, CT, MRI. 5. Conclusion: Chest radiography, CT, CMR, bronchoscopy, and ultrasound [ss1] play a complementary role in pre-, intra- and postoperative assessment, respectively. [ss1] Do you mean TEE for ultrasound

### Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Suhny Abbara, MD - 2014 Honored Educator

## US for Necrotizing Enterocolitis - Fact or Fiction?

All Day Location: PD Community, Learning Center

### Participants

Monica Epelman, MD, Orlando, FL (*Presenter*) Nothing to Disclose

Alan Daneman, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose

Daniel J. Podberesky, MD, Orlando, FL (*Abstract Co-Author*) Author with royalties, Amirsys, Inc; Speakers Bureau, Toshiba Corporation; Travel support, General Electric Company; Travel support, Koninklijke Philips NV; Travel support, Siemens AG; Consultant, Guerbet SA

Lauren W. Averill, MD, Wilmington, DE (*Abstract Co-Author*) Nothing to Disclose

Kassa Darge, MD, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

The purpose of this exhibit is: 1. To summarize the terminology, epidemiology, and pathophysiology of necrotizing enterocolitis (NEC). 2. To discuss the role of ultrasound (US) in the diagnosis of NEC. 3. To illustrate the common sonographic findings of in NEC.

### TABLE OF CONTENTS/OUTLINE

- Pathophysiology of NEC- Clinical background.- Management of NEC.- Review of sonographic findings of NEC with sample cases: Echogenic bowel, increased or decreased perfusion, bowel wall thickening, bowel wall thinning, free fluid (simple or complex), intraperitoneal gas, intramural gas, portal venous gas, focal fluid collections- Mimics- Future directions and summary The major teaching points of this exhibit are:1- US can depict intraabdominal fluid, bowel wall thickness and bowel perfusion, all important factors in evaluation of NEC2- It is important to interpret bowel US in conjunction with radiographs in NEC3- Free gas and focal fluid collections are indicators of poor outcome4- Increased perfusion and anechoic free fluid are unsupportive findings for adverse outcome5- US findings may be useful in guiding management

## Pulmonary Tuberculosis Imaging Findings in Children

All Day Location: PD Community, Learning Center

### Participants

Jiajun Xie, Guangzhou, China (*Presenter*) Nothing to Disclose  
Hui Liu, MD, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose  
Sachin S. Saboo, MD, FRCR, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose  
Xiao-Mei Zhong, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose  
Hai-Ying Luo, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose  
Yu-Hsiang Juan, MD, Taoyuan, Taiwan (*Abstract Co-Author*) Nothing to Disclose  
Suhny Abbara, MD, Dallas, TX (*Abstract Co-Author*) Author, Reed Elsevier; Editor, Reed Elsevier; Institutional research agreement, Koninklijke Philips NV; Institutional research agreement, Siemens AG  
Devri L. Weakley, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose  
Chang Hong Liang, MD, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1. Overview of the epidemiology, pathogenesis, and diagnosis of tuberculosis (TB) in children. 2. Discuss current imaging utilization and updates in the evaluation of childhood pulmonary TB. 3. Imaging spectrum of childhood pulmonary TB and diagnostic clues for arriving at the diagnosis.

### TABLE OF CONTENTS/OUTLINE

1. Discuss epidemiology, pathogenesis and common types of TB in children. 2. Learn the role of different imaging modalities with emphasis on the chest radiography since it is most commonly used imaging tool with role of CT since it very helpful; gain insight into the increasing application of ultrasound and MRI its evaluation. 3. Case based review of pulmonary TB in children. Each case to be discussed as follows: key imaging pearls, diagnostic pitfalls, common mimics and differential diagnosis. 4. Review the role of imaging in management and follow-up of pulmonary TB in children.

### Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Suhny Abbara, MD - 2014 Honored Educator

## Musculoskeletal Ultrasound in Children: To the Hip and Beyond

All Day Location: PD Community, Learning Center

### Participants

Eu-Leong H. Teo, MBBS, Singapore, Singapore (*Presenter*) Nothing to Disclose

Varanasi Krishna, MD, FRCR, Manama, Bahrain (*Abstract Co-Author*) Nothing to Disclose

Ehab Shaban Mahmoud Hamouda, FRCR, Singapore, Singapore (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

After viewing this exhibit, the reader should be familiar with: 1. The advantages and disadvantages of ultrasound (US) in Pediatric Musculoskeletal Imaging. 2. How to make optimal use of US in conjunction with other modalities to provide critical information in a cost-effective and efficient manner. 3. The imaging features of a wide range of musculoskeletal cases in children where ultrasound (US) has made a significant impact on patient management.

### TABLE OF CONTENTS/OUTLINE

US is an ideal modality for imaging the Pediatric Musculoskeletal system because it is relatively inexpensive, does not expose the child to ionizing radiation, provides real-time imaging, can be repeated without sedation, is readily available and provides images with high spatial resolution. US is used to evaluate developmental hip dysplasia, neural tube defects, soft tissue masses, joint swelling, infections, lesions involving the chest and abdominal walls, bones, muscles and tendons. This pictorial essay will illustrate a wide range of cases where US has played an important role in the management of patients. Correlation with pathological specimens and intra-operative photographs will be shown where available. The reader will also learn how to make the best use of US, in conjunction with other modalities, to provide critical clinical information in a cost-effective and efficient manner.

## Liver MRI in Children: Concepts and Technique

All Day Location: PD Community, Learning Center



Discussions may include off-label uses.

### Participants

Govind B. Chavhan, MD, Toronto, ON (*Presenter*) Nothing to Disclose

Paul S. Babyn, MD, Saskatoon, SK (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1. MRI has remarkable ability to characterize tissues and lesions, and has become an integral part of diagnosis and management of hepatobiliary disease in children. 2. Understanding appropriate technique, sequences, and contrast media in performing pediatric liver MRI is important for high diagnostic yield.

### TABLE OF CONTENTS/OUTLINE

Introduction  
Anatomy and vascular supply of liver  
Technique: sedation, positioning, coil choice  
Sequences: routine sequences, In-and-out-of-phase imaging, dynamic imaging, diffusion weighted imaging  
Contrast media used for pediatric liver imaging  
Principles of interpretations and special considerations for common pediatric indications: - Focal liver lesions - Diffuse liver diseases - Portal hypertension  
Summary and Teaching points  
References

### Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Paul S. Babyn, MD - 2012 Honored Educator

**Pituitary Blastoma and DICER-1 Syndrome: Imaging and Recommendations for Management**

All Day Location: PD Community, Learning Center

**Participants**Aditi S. Hendi, MD, Philadelphia, PA (*Presenter*) Nothing to DiscloseKatrina Conard, MD, Wilmington, DE (*Abstract Co-Author*) Nothing to DiscloseAndrew Walters, MD, Wilmington, DE (*Abstract Co-Author*) Nothing to DiscloseVinay V. Kandula, MBBS, Wallingford, PA (*Abstract Co-Author*) Nothing to Disclose**TEACHING POINTS**

Pituitary blastoma is a rare tumor which occurs during infancy and in young children. It has been described to have an association with mutation of the DICER-1 gene, which has an integral role in cleavage of oncogene regulatory microRNAs, leading to DICER-1 syndrome. MRI characteristics of pituitary blastoma include a mixed cystic and solid T2/FLAIR hyperintense sellar/suprasellar tumor with hyperenhancement and restricted diffusion in the peripheral solid component. Pathology of pituitary blastoma demonstrates a mixture of Rathke epithelium as well as adenohypophyseal folliculostellate and secretory cells. DICER-1 mutation also predisposes to pleuropulmonary blastoma (PPB), and CT appearance of pleuropulmonary blastoma ranges from predominantly cystic to mostly solid lesions, corresponding with increasing degree of tumor aggressiveness. The purpose of this study is to give background on DICER-1 syndrome, outline imaging findings of pituitary blastoma and PPB as part of this syndrome, provide radiologic-pathologic correlation and discuss recommendations for management and further imaging.

**TABLE OF CONTENTS/OUTLINE**

Background on Pituitary Blastoma and DICER-1 Syndrome MRI T2W imaging including DWI MRI T1W and postcontrast imaging MRI Spectroscopy Radiologic-Pathologic correlation Pleuropulmonary blastoma CT appearance Management and Further Imaging



## Pediatric CT in the ER-pearls and Pitfalls for the Radiology Resident

All Day Location: PD Community, Learning Center



Discussions may include off-label uses.

### Participants

Gaurav M. Saigal, MBBS, Miami, FL (*Presenter*) Nothing to Disclose

Robert M. Quencer, MD, Miami, FL (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1. Present challenging cases of pediatric CT's in the ER.2. Highlight certain pearls and pitfalls which might be useful to the radiology resident when evaluating such cases.

### TABLE OF CONTENTS/OUTLINE

CategoriesA. Traumatic-Fractures and mimics such as normal/accessory sutures and wormian bones -Non Accidental Trauma - Benign Extraaxial Fluid spaces of infancy (BESS)B. Non Traumatic-Venous Sinus Thrombosis and mimics-neonates, acute renal failure (pseudo-delta sign) -Parenchyma-edema due to Hypoxic Ischemic encephalopathy, ADEM or Hemorrhage (non traumatic causes), cavernomas -Arachnoid cysts/granulation -Extra axial collections-subdural/epidural empyema

## **MRI of Thoracic Outlet Syndrome in Children**

All Day Location: PD Community, Learning Center

### **Awards**

**Cum Laude**

### **Participants**

Govind B. Chavhan, MD, Toronto, ON (*Presenter*) Nothing to Disclose

Vaishnavi Batmanabane, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose

Gregory Borschel, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose

### **TEACHING POINTS**

1. Thoracic outlet syndrome can be seen in older children and imaging plays important role in the diagnosis. 2. Because of ability to show bony, soft tissue, vascular and neural abnormalities MRI is most useful imaging modality for the diagnosis of thoracic outlet syndrome in children. 3. Dynamically induced vascular compression can be assessed using MRI because of availability of different sequences and contrast media.

### **TABLE OF CONTENTS/OUTLINE**

Introduction Anatomy of thoracic outlet Imaging methods MRI technique: Positioning, sequences, post-contrast imaging, imaging with abduction of arms. Our experience with MRI of thoracic outlet syndrome Illustration of its various causes in children: - Neural - Arterial - Venous Summary and Teaching points References

## Pediatric Benign Bone Tumors: What Does the Radiologist Need to Know?

All Day Location: PD Community, Learning Center

### Participants

Jignesh N. Shah, MD, Memphis, TN (*Presenter*) Nothing to Disclose

Harris L. Cohen, MD, Memphis, TN (*Abstract Co-Author*) Nothing to Disclose

Asim F. Choudhri, MD, Memphis, TN (*Abstract Co-Author*) Nothing to Disclose

Saurabh Gupta, MD, Milwaukee, WI (*Abstract Co-Author*) Nothing to Disclose

Stephen F. Miller, MD, Memphis, TN (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1. To review classification and pathogenesis of pediatric benign bone tumors 2. To discuss role of radiography and cross sectional imaging to diagnose and guide management 3. To review clinical and imaging features of systemic syndromes associated with benign bone tumors in children

### TABLE OF CONTENTS/OUTLINE

Discuss classification and pathogenesis of benign bone tumors which occur in pediatric age group. Review salient imaging features of various tumors including but not limited to simple bone cyst, aneurysmal bone cyst, osteoid osteoma, osteoblastoma, enchondroma, chondroblastoma, giant cell tumor, fibrous cortical defect, non-ossifying fibroma, osteochondroma, juxtacortical chondroma, chondromyxoid fibroma, eosinophilic granuloma, fibrous dysplasia, enchondroma, brown tumor in hyperparathyroidism. Discuss systemic syndromes associated with benign bone tumors, including Ollier's disease, Maffucci syndrome, diaphyseal aclasis, Jaffe Campanacci syndrome, McCune Albright syndrome. Discuss implications of imaging on management

## Gastrointestinal Posttransplantation Lymphoproliferative Disease (PTLD) in Pediatric Imaging - A Diagnosis to Remember

All Day Location: PD Community, Learning Center

### Participants

Hannes Platzgummer, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose

Ulrika Asenbaum, MD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose

Azadeh Hojreh, MD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose

Marius E. Mayerhoefer, MD, PhD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose

Jamila K. Williams, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose

Janina M. Patsch, MD, PhD, Vienna, Austria (*Presenter*) Nothing to Disclose

### TEACHING POINTS

Posttransplantation lymphoproliferative disease (PTLD) is a pathologic condition resulting from clonal proliferation of immune cells. It is considered a rare but serious complication of immunosuppressive therapy post solid organ transplantation. PTLD can occur in the adult and pediatric population affecting various organ systems including the gastrointestinal tract. Early diagnosis is crucial for the initiation of adequate oncologic treatment. The proposed educational exhibit will use a multi-modal imaging approach to review pediatric gastrointestinal PTLD in a case-based manner. Specifically, we will review imaging features of gastrointestinal PTLD in pediatric ultrasound, computed tomography (CT), magnetic resonance imaging (MRI) and hybrid imaging including PET-CT and PET-MR. Clinical presentation, current classification systems and differential diagnoses will also be addressed.

### TABLE OF CONTENTS/OUTLINE

Definition of PTLD Review of existing classifications Typical clinical presentation Case-based review of imaging findings in ultrasound, computed tomography (CT), magnetic resonance imaging (MRI) and hybrid imaging (including PET-CT and PET-MR) Differential diagnosis

## Pediatric Stroke: Little Folks Have Different Strokes

All Day Location: PD Community, Learning Center

### Participants

Mark T. Tierney, MD, Madison, WI (*Presenter*) Nothing to Disclose

Susan L. Rebsamen, MD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose

Howard A. Rowley, MD, Madison, WI (*Abstract Co-Author*) Research Consultant, Bracco Group; Research Consultant, Guerbet SA; Research Consultant, General Electric Company; Consultant, F. Hoffmann-La Roche Ltd; Consultant, W.L. Gore & Associates, Inc; Consultant, Lundbeck Group; ; ; ; ;

### TEACHING POINTS

•Understand that pediatric stroke patients will have unique presentations which are often much different from adults including seizures, headache, altered mental status, or personality changes which make the diagnosis of stroke difficult•Understand some of the more common underlying etiologies of stroke in young people, especially the emergence of underlying vasculopathy/vasculitic, thromboembolic, and metabolic etiologies for arterial ischemic stroke•Review several case examples demonstrating unique features of stroke in this age group, and factors complicating the development of a differential diagnosis•Examine the emergence of pediatric stroke centers and teams, and how they have positively affected stroke care in the pediatric age group

### TABLE OF CONTENTS/OUTLINE

Opening case example Demonstrate complex type of presentation Difficulty in development of a differential diagnosis Brief history of the clinical understanding of stroke Historical understanding Modern definitions Pediatric stroke presentation patterns Review types of pediatric non hemorrhagic stroke Arteriopathy model of stroke and several large and small vessel case examples Thromboembolic strokes Metabolic strokes Emergence of pediatric stroke centers

## Radiologic Approaches to the Diagnosis and Follow-up of Mid-Aortic Syndrome in Children

All Day Location: PD Community, Learning Center

### Participants

Irene M. Borzani, MD, Milan, Italy (*Presenter*) Nothing to Disclose  
Claudia Muzzupappa, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose  
Sara Maccagnoni, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose  
Patrizia Salice, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose  
Larry Burdick, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose  
Pietro R. Biondetti, MD, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

Middle aortic syndrome is a rare condition that involves narrowing of the abdominal aorta and its visceral branches. It can be acquired or congenital and can be seen in infants and children. The purpose of this exhibit is: 1) to review the causes and clinical aspects of patients with mid-aortic syndrome (MAS) 2) to describe and compare imaging techniques that help in the diagnosis and treatment planning, with particular attention to CT/MRI protocols to reduce ionizing radiation exposure 3) to discuss suggested treatments and follow-up examinations

### TABLE OF CONTENTS/OUTLINE

- Introduction- Clinical presentations of children and young adults with Mid-Aortic Syndrome- Discussion and illustration of sample cases highlighting radiological findings- Comparison of different imaging modalities (Ultrasound, Doppler, Cross-sectional imaging)- Review of CT and MR techniques in the diagnosis and follow-up of Mid-Aortic Syndrome- Summary

## Ultrasound and MRI Pitfalls in Evaluating Hemophilic Arthropathy

All Day Location: PD Community, Learning Center

### Participants

Magdy M. Soliman, MBBCh, FRCR, Toronto, ON (*Presenter*) Nothing to Disclose  
 Paulo Eduardo Daruge Grando, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose  
 Sergio S. Dertkigil, MD, Campinas, Brazil (*Abstract Co-Author*) Nothing to Disclose  
 Ying-Jia Li, Bijing, China (*Abstract Co-Author*) Nothing to Disclose  
 Fang Zhou, MD, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose  
 Andrea S. Doria, MD, Toronto, ON (*Abstract Co-Author*) Consultant, Bayer AG; Consultant, Novo Nordisk AS; Consultant, Baxter International Inc  
 Eloy d. Fernandes, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose  
 Jose R. Negrao, MD, San Diego, CA (*Abstract Co-Author*) Nothing to Disclose  
 Ningning Zhang, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose  
 Ai hua Huo, Beijing, China (*Abstract Co-Author*) Nothing to Disclose  
 Emerson T. Sakuma, MD, Campinas, Brazil (*Abstract Co-Author*) Nothing to Disclose  
 Sonia de Aguiar Vilela Mitraud, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1.To summarize the current level of knowledge regarding the utilization of MRI and US for assessing hemophilic arthropathy.2.To recognize the limitations of each imaging modality.3.To discuss conditions and underlying causes of mismatched imaging scores for target joints (knees, ankles and elbows).4. To raise awareness on US and MRI pitfalls of soft tissue (effusion/ hemarthrosis, synovial hypertrophy, hemosiderin) and osteochondral (erosions, subchondral cysts, cartilage loss)in hemophilic joints.5. To point out areas for future research aiming at increase the diagnostic accuracy of each modality.

### TABLE OF CONTENTS/OUTLINE

Pathophysiology of Hemophilic ArthropathyScoring of hemophilic arthropathy by Ultrasound and MRILimitations of Ultrasound:  
 Inability of penetration of US beam in certain areas of joints. Technical factors Level of operator training Difficulty on interpretations of imagesUS pitfalls in evaluation of hemophilic arthropathy (using MRI as the reference standard)Limitations of MRI:  
 Over-estimation of hemosiderin deposition on gradient echo images (due to susceptibility artifacts). Underestimation of synovial hypertrophy.Areas of future research: Pixel quantification of synovial vascularity by color Doppler US. Volumetric quantification of hemosiderin, fluid and synovium on 3D-US.

## Pediatric Non-Neoplastic Hepatobiliary Disorders-Radiological Approach and Differential Diagnosis

All Day Location: PD Community, Learning Center

### Participants

Dhanashree Rajderkar, MD, Gainesville, FL (*Presenter*) Nothing to Disclose

Leslie E. Hirsig, MD, Gainesville, FL (*Abstract Co-Author*) Nothing to Disclose

Robert L. Dubuisson, MD, Archer, FL (*Abstract Co-Author*) Nothing to Disclose

Jonathan L. Williams, MD, MBA, Gainesville, FL (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1. Discuss non-neoplastic pediatric hepatobiliary disorders. 2. Study the role of imaging in the diagnosis and evaluation of these conditions. 3. Discuss imaging based differential diagnosis.

### TABLE OF CONTENTS/OUTLINE

Hepatobiliary disorders have a wide age of presentation starting from the fetal/neonatal age to the teenage population. Antenatal diagnosis is possible in certain congenital disorders like the choledochal cysts. There is an extensive list of the hepatobiliary disorders in the pediatric population, a few of them have overlapping pathology with the adults. Recognizing typical imaging manifestations is essential for timely diagnosis and prevention of complications. Imaging plays a critical role in patient management. In this exhibit, we discuss multimodality imaging findings and differential diagnosis of the complete spectrum of the hepatobiliary disorders in the pediatric population. Increased awareness of such entities will contribute to proper patient care. Outline: Introduction. Discussion: An approach to categorize the hepatobiliary disorders in various groups and discuss subsequent radiological management. Discuss the multimodality approach to diagnose the complications of these disorders.



## Antenatal and Postnatal Hydronephrosis: Etiology, Update on New Classification and Management

All Day Location: PD Community, Learning Center

### Participants

Manjiri K. Dighe, MD, Seattle, WA (*Presenter*) Research Grant, General Electric Company

Mariam Moshiri, MD, Seattle, WA (*Abstract Co-Author*) Consultant, Reed Elsevier; Author, Reed Elsevier

Theodore J. Dubinsky, MD, Seattle, WA (*Abstract Co-Author*) Stockholder Global Cancer Technology

### TEACHING POINTS

1. Antenatal hydronephrosis can result from a variety of reasons and careful description and evaluation is necessary to decide on the prenatal and postnatal management. This exhibit will review the various causes of antenatal and postnatal hydronephrosis with illustrative cases. 2. Variable terminology is used for the description of the urinary dilatation including hydronephrosis, pyelectasis and pelviectasis. In order to standardize the description and management, a multidisciplinary consensus conference proposed the Urinary Tract Dilatation classification. This exhibit will review the classification and the recommendations proposed for follow up.

### TABLE OF CONTENTS/OUTLINE

1. Description of the development of the urinary system 2. Normal anatomy of the fetal urinary system and appearance on ultrasound and MRI 3. Postnatal anatomy of the urinary system and appearance on various modalities 4. Etiology and illustrative cases of antenatal hydronephrosis with postnatal correlation 5. Description of the new Urinary Tract Dilatation (UTD) Classification 6. Management and follow up options in antenatal and postnatal UTD.

### Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Mariam Moshiri, MD - 2013 Honored Educator

Mariam Moshiri, MD - 2015 Honored Educator

Theodore J. Dubinsky, MD - 2012 Honored Educator

Theodore J. Dubinsky, MD - 2013 Honored Educator

## Breathe Easy: A Systemic Approach to Radiologic Evaluation of Pediatric Unilateral Hyperlucent Lung

All Day Location: PD Community, Learning Center

### Participants

James R. Hogan, MD, Morristown, NJ (*Presenter*) Nothing to Disclose

Robyn C. Murphy, MD, Randolph, NJ (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

Unilateral hyperlucent lung is a common finding on pediatric chest x-ray, and often warrants further radiologic evaluation for underlying pathology. Etiologies of pediatric hyperlucent lung are broad and include pathology of the chest wall, lung parenchyma, airways or pulmonary vasculature. Decubitus views are helpful at a key branch point in the diagnostic decision tree for ruling out emergent causes of pediatric unilateral hyperlucent lung. In rare cases, a pulmonary abnormality may result in a hyperexpanded and hyperlucent contralateral lung.

### TABLE OF CONTENTS/OUTLINE

Introduction Key differences between adult and pediatric chest x-rays Detailed radiologic and clinical review of etiologies for pediatric unilateral hyperlucent lung focusing on pertinent chest x-ray and CT findings, to include the following entities: Mechanical/idiopathic Endobronchial obstruction Pneumothorax Bulla Infectious/inflammatory Pneumonia Asthma Swyer-James syndrome Congenital Congenital pulmonary airway malformation Congenital lobar emphysema Scimitar syndrome Vascular ring/sling Poland syndrome Conclusion

## Congenital Variations of the Uterus and Reproductive Tract

All Day Location: PD Community, Learning Center

### Awards

Cum Laude

### Participants

Paul A. DiCamillo, MD, PhD, Cleveland, OH (*Presenter*) Nothing to Disclose

Michael B. Shvarts, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose

Raj M. Paspulati, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose

Pauravi S. Vasavada, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

\*) To review the etiology and presentation of congenital uterine and reproductive tract abnormalities\*) To explore a series of congenital uterine abnormality cases\*) To understand the role of imaging in patient management

### TABLE OF CONTENTS/OUTLINE

\*) Classification of congenital uterine anomalies, and classification controversies\*) Review imaging findings in uterine and associated anomalies, including the following Agenesis Lateral fusion defects Septate/arcuate uterus Unicornate uterus Bicornate uterus Uterine didelphys Verticle fusion defects\*) Consider presenting symptoms and possible complications, including recurrent pregnancy loss\*) Summarize role and limitations of imaging

## Imaging of Non-traumatic Disorders of the Pediatric Cervical Spine: A Pictorial Review

All Day Location: PD Community, Learning Center

### Awards

#### Certificate of Merit

### Participants

Diana P. Rodriguez, MD, Cincinnati, OH (*Presenter*) Nothing to Disclose

Robert M. Kurtz, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

Michelle Silvera, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1. To describe and illustrate the imaging findings in nontraumatic disorders affecting the pediatric cervical spine. 2. To review the utility and indications of the different imaging modalities in the evaluation of nontraumatic disorders of the pediatric cervical spine.

### TABLE OF CONTENTS/OUTLINE

1. Brief review of key anatomic imaging findings of the normal pediatric cervical spine on plain radiography, CT and MR. 2. Imaging evaluation of the nontraumatic pediatric cervical spine: utility and indications of imaging modalities 3. Nontraumatic disorders of the pediatric cervical spine: a. Congenital b. Musculoskeletal c. Infectious d. Inflammatory e. Neoplastic

## **Pediatric Demyelinating Disease and Mimics**

All Day Location: PD Community, Learning Center

### **Participants**

Paul N. Chen, MD, Boston, MA (*Presenter*) Nothing to Disclose

Sanjay P. Prabhu, MBBS, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

### **TEACHING POINTS**

1. Review of major demyelinating disease in pediatrics including multiple sclerosis, ADEM, NMO, and transverse myelitis. 2. Recognize important mimics within the brain including tumefactive lesions mimicking neoplasm and vasculitis mimicking demyelination. 3. Recognize important mimics within the spine including spinal cord infarcts and neoplasms mimicking demyelination.

### **TABLE OF CONTENTS/OUTLINE**

1. Overview of myelin and normal myelination. 2. Review of demyelinating disease with a focus on pediatrics. Will go through clinical presentation, epidemiology, diagnostic criteria, and imaging findings of MS, ADEM, NMO, and transverse myelitis. Several case examples will also be shown. 3. Using a case based approach mimics will be shown for the brain and then spine. Some examples of cases include: tumefactive lesions, vasculitis, Lyme disease, spinal cord infarct, spinal cord neoplasm, and spinal cord AVM.

## Adolescent Scoliosis: Important Radiologic Parameters for the Surgeon

All Day Location: PD Community, Learning Center

### Participants

Jeffrey D. Stevens, MD, Temple, TX (*Presenter*) Nothing to Disclose

Krista L. Birkemeier, MD, Temple, TX (*Abstract Co-Author*) Nothing to Disclose

Ricardo D. Garza-Gongora, MD, Temple, TX (*Abstract Co-Author*) Nothing to Disclose

Casey J. Schmitz, MD, Temple, TX (*Abstract Co-Author*) Nothing to Disclose

Linda M. Parman, MD, Temple, TX (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

Summarize the types of adolescent scoliosis. Detail radiographic curve measurements and spinopelvic parameters important for surgical consideration. Discuss the various management protocols and surgical classification systems, most notably the Lenke Classification.

### TABLE OF CONTENTS/OUTLINE

Scoliosis is defined as the abnormal lateral curvature of the spine with Cobb angle 10° or more. Most cases of scoliosis in the adolescent are idiopathic (termed primary scoliosis). Other secondary causes of scoliosis include developmental, congenital, neuromuscular, and tumor-associated. At the basis of the scoliosis evaluation is the determination of degree of angulation in the coronal plane (using the Cobb angle); however, in order to comprehensively evaluate the scoliotic spine, it is also important to understand the various curve types, degree of rotation, as well as the concept of coronal and sagittal imbalance, each of which will be discussed further in detail. The most widely used system to classify and guide surgical treatment for adolescent idiopathic scoliosis (AIS) is the Lenke Classification System. One of the main purposes of the Lenke System is to determine which vertebral levels are to be included in the vertebral fusion. As not all scoliosis requires surgical management, other treatment options will also be discussed.

## Imaging of Biliary Ductal Pathology in the Pediatric Patient: A Road Map

All Day Location: PD Community, Learning Center

### Participants

Raju Sharma, MD, New Delhi, India (*Presenter*) Nothing to Disclose  
Devasenathipathy Kandasamy, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose  
Manisha Jana, MD, FRCR, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose  
Ankur Goyal, MBBS, MD, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose  
Vireshwar Bhatnagar, MD, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose  
Arun K. Gupta, MBBS, MD, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

To present the imaging spectrum of biliary pathology in the pediatric population Discuss the differential diagnosis of these entities  
Highlight the multi-modality approach

### TABLE OF CONTENTS/OUTLINE

1. Embryology of the biliary system  
2. Imaging algorithm using sonography, MRCP, HIDA scan and intra-operative cholangiogram  
3. Congenital biliary ductal Pathology  
Congenital variations  
Biliary atresia: types, sonographic and MRI features, distinction from neonatal hepatitis  
Choledochal cyst: Classification Illustrate all types with examples Association with anomalous pancreato-biliary junction Complications  
4. Infectious  
AIDS cholangiopathy  
Parasite: Ascaris in CBD  
Hydatid Cyst with biliary communication  
Tuberculosis  
Cryptococcosis  
5. Neoplastic: Biliary Rhabdomyosarcoma  
6. Miscellaneous  
Portal Biliopathy: sonographic and MRCP appearance, impact of shunt surgery on biliary abnormality  
Langerhan cell histiocytosis  
Sclerosing cholangitis

## The Person Behind the Name: Eponyms in Pediatric Radiology

All Day Location: PD Community, Learning Center

### Participants

Eralda Mema, MD, New York, NY (*Presenter*) Nothing to Disclose  
Carrie B. Ruzal-Shapiro, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose  
Gerald G. Behr, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose  
Susie S. Chen, MD, Fort Lee, NJ (*Abstract Co-Author*) Nothing to Disclose  
Daniel S. Chow, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose  
Rama S. Ayyala, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

Medical eponyms are common in day-to-day medical practice. They are used to communicate complex medical conditions while commemorating the contributions of an individual to that particular disease. There are numerous eponyms encountered in Pediatric Radiology. Knowledge of the most commonly encountered eponyms is important for the radiologist in order to minimize potential confusion during reporting and when interacting with referring clinicians. Furthermore, learning about the individual behind the name offers us an opportunity to learn about the history of our predecessors and gives us insight into our own medical culture. The purpose of this exhibit is to define commonly used eponyms in Pediatric Radiology by describing the pathology, reviewing radiographic image findings, and presenting a brief history of the person behind the name.

### TABLE OF CONTENTS/OUTLINE

1. Definition of common pediatric pathologies:- Nervous system- Chest - Abdomen- Musculoskeletal system- Genetic syndromes2. Brief history of the individual after which the condition was named. 3. Relevant radiographic images pertaining to each described condition and a brief overview of radiologic findings.4. Review quiz.



## Brain MRI Findings after Cardiac Surgery in Newborns, Our Experience

All Day Location: PD Community, Learning Center

### Participants

Diego A. Garrido, MD, Madrid, Spain (*Presenter*) Nothing to Disclose  
Alberto Alvarez Muelas, MD, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose  
Cristina Utrilla, MD, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose  
Amelia Fernandez Zubillaga, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose  
Arantxa Royo Orejas, MD, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose  
Nuria Lopez, MD, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose  
Amaya Palacios, MD, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose  
Alvaro M. Morales Vargas, MD, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose  
Gonzalo Garzon Moll, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

Congenital cardiac defects occur in 8-10/1000 live births. About half of these patients will require surgical treatment during the first year of life, and the most common complications of this surgery involve the central nervous system. Neuroradiologists should be aware of these, sometimes subtle, findings because they affect these patients' outcome.

### TABLE OF CONTENTS/OUTLINE

We reviewed the brain MRI images of 42 infants (from 0 to 6 months old) that were examined after having undergone cardiac surgery in our institution between the years 2013-2014. IMAGING PROTOCOL: T1, T2, DWI and T2\* sequences. The aim was to document the rate of neurological complications visible in MRI in these patients. 22 patients exhibited intracranial bleeding (most of them, minimal hemosiderin deposits in T2 gradient echo sequences), 8 patients had hypoxic-ischemic findings, and 9 patients had other findings (benign enlargement of the subarachnoid space, cortical retraction, indirect signs of infection). Four of the patients showed more than one type of findings (stroke + bleeding, bleeding + retraction). The brain MRI was normal in 7 cases. The goal of this exhibit is to describe the most common findings in brain MRI in newborns after cardiac surgery.

## Strategies to Decrease Sedation in Pediatric MRI

All Day Location: PD Community, Learning Center

### Awards

#### Certificate of Merit

### Participants

Camilo Jaimes Cobos, MD, Boston, MA (*Presenter*) Nothing to Disclose

Sabah Servaes, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

M. Dylan Tisdall, Charlestown, MA (*Abstract Co-Author*) Nothing to Disclose

Michael S. Gee, MD, PhD, Jamaica Plain, MA (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1.Utilization of MRI in children has increased as a result of technological advances and growing awareness of potential effects of radiation. Infants and young children often require sedation for MRI which carries risks and slows workflow. Alternative strategies can be used to facilitate imaging of awake children. 2.Behavioral techniques, child life specialists, and audiovisual systems decrease anxiety and increase compliance. 3.Tailoring the protocols to specific questions and using fast sequences may obviate the need for sedatives.4.Parallel imaging, phased array coils, and sequences with non-Cartesian k-space filling, can increase the diagnostic quality of the exam. 5.The synergistic use of retrospective and prospective motion correction techniques will play a central role in pediatric MRI in the future.

### TABLE OF CONTENTS/OUTLINE

1.Summarize risks of sedation and the effect on workflow. 2.Describe the role of child life specialists, play therapy, and practice MRI, in decreasing sedation. 3.Review the types of motion, how they relate to MRI artifacts, and how to reduce them. 4.Discuss strategies to decrease scan time, with emphasis on single-shot acquisitions and parallel imaging. 5.Discuss the advantages of using non-Cartesian k-space acquisition, such as PROPELLER. 6. Illustrate retrospective and prospective strategies for motion correction.

## Ureteral Anomalies for Radiology Residents: Embryology Really Matters!

All Day Location: PD Community, Learning Center

### Participants

Kevin O'Brien, MD, Chicago, IL (*Presenter*) Nothing to Disclose

Kate A. Feinstein, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1) The ureteral bud is the key to unlocking the imaging findings of duplicated ureters, UPJ obstruction, MCDK and complications of these anomalies. 2) Position of the ureteral bud on the mesonephric duct decides the location and morphology of the ureteral orifice. 3) Timing of the arrival of the ureteral bud at the metanephric blastema determines the location of renal parenchyma, as well as parenchymal quality and quantity, which is directly related to the type of urine produced.

### TABLE OF CONTENTS/OUTLINE

Introduction Clinical and radiological significance of congenital ureteral anomalies Embryology of normal ureteral bud and metanephric blastema Disturbances in the ureteral budding Incorporation of the metanephros into the bladder and the Weigert-Meyer rule Imaging findings and complications of ureteral duplication (complete and partial), VUR, ectopic ureter, ureterocele, and UPJ obstruction of lower pole ureter Dual embryologic origin, ureteral bud and metanephric blastema Imaging findings and complications of UPJ obstruction and MCDK Summary of teaching points Quiz cases

## **Fetal Airway Obstruction: Embriology, Radiology and Clinical Spectrum of High Air Way Obstruction and Their Role for a Better Management Planning**

All Day Location: PD Community, Learning Center

### **Awards**

#### **Certificate of Merit**

### **Participants**

Marianna A. Palmejani, MD, Balsamo, Brazil (*Presenter*) Nothing to Disclose  
Mariana R. Rodero, MD, Sao Jose Do Rio Preto, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Fernanda D. Braojos Braga, MD, Sao Jose Do Rio Preto, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Ulysses S. Torres, MD, Sao Jose Do Rio Preto, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Antonio S. Souza, MD, Sao Jose Rio Preto, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Pedro Daltro, MD, Rio De Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Heron Werner, MD, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose

### **TEACHING POINTS**

This education exhibit aims to: 1. Provide a concise overview of the normal development and embryology of the fetal high airway.2. Disruption causes of laryngeal lumen recanalization.3. Illustrate and discuss the main prenatal MRI findings of these anomalies based in a review of the literature and in a serie of cases to facilitate the diagnostic approach by radiologists

### **TABLE OF CONTENTS/OUTLINE**

- Embriology of the high airway development.- Relationship between the embriology and the causes of high airway obstruction.- Pictorial review of imaging findings: Fetal MRI and necropsy sample cases.- Topics for radiologysts suspicion and allert for correct diagnosis, allowing early planning management by the multidisciplinary team.

## Imaging Foreign Bodies in Children: What the Surgeon Needs to Know

All Day Location: PD Community, Learning Center

### Participants

Kathryn Darras, MD, Vancouver, BC (*Presenter*) Nothing to Disclose

Alexandra Roston, West Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose

Candace Haddock, Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose

Lila Yewchuk, Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

To understand the classification of foreign bodies in children including aspirated, ingested, and embedded foreign bodies. To present an imaging algorithm for the work up of a child with a suspected ingested foreign body. To review the clinical presentation, imaging findings, and management of ingested foreign bodies. To highlight pitfalls of imaging foreign bodies in children, including mimics.

### TABLE OF CONTENTS/OUTLINE

Introduction  
Classification of foreign bodies: (1) Aspirated (2) Ingested (3) Embedded  
Imaging recommendations for suspected foreign bodies including radiography, ultrasound, CT and MRI  
Indications and contraindications  
Recommended follow up imaging when a foreign body is identified  
Pediatric anatomic considerations using original illustrations  
Upper and lower airway  
Upper and lower gastrointestinal tract  
Ingested foreign bodies  
Clinical presentation, imaging findings, management, and complications (all examples will be from our institution) including radiography and CT  
Findings that are potentially life-threatening  
What the surgeon needs to know  
Pearls and pitfalls for interpretation of radiography when a foreign body is suspected  
Mimics of pediatric foreign bodies including tumours, Commonly missed "blind spots"  
Summary

## **Congenital Fetal Infections: Obstetric Ultrasound and Fetal Magnetic Resonance Imaging Findings in CMV and Toxoplasmosis**

All Day Location: PD Community, Learning Center

### **Participants**

Bianca Guedes Ribeiro, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose  
Heron Werner, MD, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Tatiana M. Fazecas, MD, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Renata A. Nogueira, MD, Rio De Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Taisa D. Gasparetto, MD, PhD, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Pedro Daltro, MD, Rio De Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose

### **TEACHING POINTS**

Congenital infections involving the brain are caused by relatively few agents, but toxoplasmosis and CMV infections are relatively frequent around the world. Ultrasound remains the method of choice to the fetal evaluation of congenital infection and should be complemented by magnetic resonance (MR) imaging for a better evaluation of lesions extent. Although not definitive proof, periventricular echogenicity with or without periventricular pseudocysts, intraventricular synechiae, and brain calcifications are highly indicative of congenital CMV infection. Toxoplasmosis usually manifests with more severe ventriculomegaly and nodular echogenic foci instead of punctate or en plaque calcifications characteristic of CMV.

## Urinary Tract Obstruction: Prenatal and Postnatal Diagnostic Investigation

All Day Location: PD Community, Learning Center

### Participants

Taisa D. Gasparetto, MD, PhD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

Pedro Daltro, MD, Rio De Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose

Bianca Guedes Ribeiro, MD, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose

Heron Werner, MD, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

Urinary tract obstruction can occur at any point in the urinary tract, from the kidneys to the urethral meatus. Prenatal diagnosis with obstetric ultrasound and fetal MRI is of fundamental importance to the proper management of these cases. Postnatal diagnosis must follow a proper algorithm in order to preserve function and reduce morbidity, including ultrasonography, voiding cystourethrography, renal urogram, magnetic resonance urography, renal scintigraphy.

### TABLE OF CONTENTS/OUTLINE

- Prenatal diagnosis of urinary tract obstructions including lower and upper tract obstructions.- Signs of obstruction in the routine obstetric ultrasonography.- Use of fetal MR imaging in the assessment of complex pathologies.- Illustration of the imaging algorithm used to investigate pediatric urinary tract obstruction.- Use of high-resolution ultrasonography in the evaluation of renal parenchyma in cases of hydronephrosis.- MR urography in the evaluation of difficult postnatal cases.

## Pancreatic Problems in the Pediatric Population

All Day Location: PD Community, Learning Center



Discussions may include off-label uses.

### Participants

Saad Ranginwala, MD, Cincinnati, OH (*Presenter*) Nothing to Disclose

Harsha V. Nalluri, MD, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose

Jonathan R. Dillman, MD, Ann Arbor, MI (*Abstract Co-Author*) Research support, Bracco Group; Research support, Siemens AG

Mahati N. Reddy, MD, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose

Suraj Serai, PhD, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose

Sadhna Verma, MD, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1. Provide an overview of the common pancreatic abnormalities which may be encountered. 2. Discuss pancreatic abnormalities which are specific to the pediatric population and describe their key imaging findings. 2. Show examples of congenital / syndromic abnormalities involving the pancreas which are likely to present in childhood.

### TABLE OF CONTENTS/OUTLINE

Benign Masses: dermoid cyst, true pancreatic cyst, lymphangioma, splenule  
Malignant Masses: metastasis, solid and pseudo papillary neoplasm, pancreatoblastoma  
Findings related to Systemic or Genetic Disease: Cystic Fibrosis, Diamond-Shwachman syndrome, Von Hippel Lindau syndrome, MEN Type 1, Hemochromatosis, Tuberous Sclerosis  
Mimics of Tumor: focal pancreatitis, ectopic pancreas, pancreatic pseudocyst, Hyperinsulinemic hypoglycemia of infancy

### Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Sadhna Verma, MD - 2013 Honored Educator



## State of the Art Multi-modal MR Assessment of Vein of Galen Malformations and Its Role in Therapeutic Decision Making

All Day Location: PD Community, Learning Center



Discussions may include off-label uses.

### Participants

Reade A. De Leacy, MBBS, New York, NY (*Presenter*) Nothing to Disclose

Idoia Corcuera-Solano, New York, NY (*Abstract Co-Author*) Nothing to Disclose

Lawrence N. Tanenbaum, MD, New York, NY (*Abstract Co-Author*) Speaker, General Electric Compnny; Speaker, Bracco Group; Speaker, Bayer AG; Speaker, Siemens AG; Speaker, Guerbet SA

Alejandro Berenstein, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

Vein of Galen malformations are uncommon but serious congenital malformation of the cerebral vasculature with high associated morbidity and mortality. At present catheter directed angiography is used to determine the presence and severity of any arterio-venous shunting. This technique carries a not insignificant risk of both minor and major complication. Combined MRI and MRA techniques have the potential to change the way these children are followed, reducing the necessity of catheter angiograms. We present an efficient and thorough, multi-modal method for garnering the critical information necessary for treatment planning and surveillance imaging. This exhibit is aimed at educating the radiologist about the clinical manifestations of this condition, the options, indications and timing of therapy and the radiologic manifestations of the disease both before and after treatment to cure. It also highlights novel mri techniques which can be extrapolated to other vascular lesions, which will aid patient safety and imaging efficiency.

### TABLE OF CONTENTS/OUTLINE

1. Pathogenesis and embryology
2. Clinical presentation and indications for treatment
3. Imaging protocols, relevant imaging findings for the diagnostician and neuroendovascular specialist and how this affects decision making
4. Treatment options and techniques
5. Case examples from birth to cure

## Dos and Don'ts in Common and Uncommon Musculoskeletal Infections in Children

All Day Location: PD Community, Learning Center

### Participants

Maria C. Ageitos Casais, MD, Santiago de Compostela, Spain (*Abstract Co-Author*) Nothing to Disclose  
Maria V. Trujillo Ariza, MD, Villagarcía de Arosa, Spain (*Abstract Co-Author*) Nothing to Disclose  
Anxo Martinez De Alegria, MD, Santiago de Compostela, Spain (*Presenter*) Nothing to Disclose  
Mercedes Linares Paz, MD, Santiago Compostela, Spain (*Abstract Co-Author*) Nothing to Disclose  
Pablo Caro, MD, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose  
Sandra Baleato Gonzalez, MD, PhD, Santiago, Spain (*Abstract Co-Author*) Nothing to Disclose  
Amadeo Arango, MD, Santiago de Compostela, Spain (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

- To illustrate the radiologic features of pediatric musculoskeletal infections in different imaging techniques and depict potential complications- To review and classify each disease according to etiopathogenesis and localization. - To propose a reasonable imaging protocol explaining the usefulness of every imaging technique at each stage of disease avoiding unnecessary ionizing radiation.- To explain the different treatment options and how radiologists can affect in the patient management.

### TABLE OF CONTENTS/OUTLINE

A. Classification and structured review of each entity according to:- Localization (subcutaneous, muscular, osseous, and combined involvement), Epidemiology, and Mechanism of infection (hematogenous, contiguous or direct spread)- Key features and differential diagnosis - Medical and surgical therapies: what radiologists need to look for and communicate to clinicians.B. Imaging algorithm with the ALARA principles in mind: Dos and Don'ts.C. Take home points

## Imaging in Head and Neck Rhabdomyosarcoma: How Can a Radiologist Contribute in Effective Management?

All Day Location: PD Community, Learning Center

### Participants

Nikshita A. Jain, MBBS, Mumbai, India (*Presenter*) Nothing to Disclose  
Seema A. Kembhavi, MD, DMRD, Mumbai, India (*Abstract Co-Author*) Nothing to Disclose  
Supreet Arya, MD, Mumbai, India (*Abstract Co-Author*) Nothing to Disclose  
Somesh Singh, MBBS, Mumbai, India (*Abstract Co-Author*) Nothing to Disclose  
Sureshkumar G, MBBS, Mumbai, India (*Abstract Co-Author*) Nothing to Disclose  
Santhosh K. GeethaVirupakshappa, MD, MBBS, Mumbai, India (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

Characteristic imaging features of rhabdomyosarcoma Identify the top differential diagnoses and their classical imaging features To learn about clinical management of these tumors - so that relevant information is reported on imaging

### TABLE OF CONTENTS/OUTLINE

Introduction Incidence and epidemiology Survival 2. Diagnosis Common locations : orbits, para-meningeal (middle ear, nasal cavity, paranasal sinuses, nasopharynx, and infratemporal fossa), others Characteristic imaging features on CT and MRI 3. Differential diagnosis and their imaging characteristics Neuroblastoma Nasopharyngeal carcinoma Juvenile nasopharyngeal angiofibroma Haematolymphoid malignancy 4. Clinical management Histopathology - ERMS, ARMS Staging and risk stratification Treatment modalities - how imaging can help in choosing the right treatment option

## Eponyms in Pediatric Oncology Imaging

All Day Location: PD Community, Learning Center

### Participants

Douglas M. Choo, MD, Halifax, NS (*Presenter*) Nothing to Disclose  
Pierre Schmit, MD, Halifax, NS (*Abstract Co-Author*) Nothing to Disclose  
Bruce Crooks, MD, Halifax, NS (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

This educational exhibit will explore eponyms in pediatric oncology imaging and hopefully, through consolidation, improve memorization of the diseases. Every medical image comes from our institution. For each pediatric oncology eponym, there are 3 teaching points: 1. Imaging features 2. Key Disease facts 3. Biographical information of the individual(s) for whom the eponym was named

### TABLE OF CONTENTS/OUTLINE

1. Introduction (w/quiz question).2. Pediatric Eponyms (with the above 3 teaching points for each): Bourneville's disease (Tuberous sclerosis) - Désiré Magloire Bourneville Burkitt's lymphoma - Denis Parsons Burkitt Codman triangle - Ernest Amory Codman Ewing sarcoma - James Stephen Ewing Gorlin Goltz syndrome - Robert James Gorlin and Robert William Goltz Hodgkin disease - Thomas Hodgkin Kaposi sarcoma - Moriz Kohn Kaposi Kasabach Merritt Syndrome - Haig Haigouni Kasabach and Katharine Krom Merritt Langerhans cell histiocytosis - Paul Langerhans Li-Fraumeni syndrome - Frederick Pei Li and Joseph F. Fraumeni, Jr Maffucci syndrome - Angelo Maria Maffucci Ollier Disease - Louis Xavier Édouard Léopold Ollier Proteus syndrome (Wiedemann syndrome) - Proteus and Hans-Rudolf Wiedemann Von Hippel Lindau syndrome - Eugen von Hippel and Arvid Lindau Wilms Tumor - Max Wilms.3. Conclusion (w/quiz answers from introduction).

## Masses of the Nose, Nasal Cavity and Nasopharynx in Children

All Day Location: PD Community, Learning Center

### Participants

Diana P. Rodriguez, MD, Cincinnati, OH (*Presenter*) Nothing to Disclose

Emily S. Orscheln, MD, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose

Bernadette L. Koch, MD, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1. Review the CT and MR imaging characteristics of masses of the nose, nasal cavity and nasopharynx in children. 2. Illustrate the utility and indications of imaging techniques in the evaluation of pediatric nasal masses.

### TABLE OF CONTENTS/OUTLINE

Lesions may arise from the nasal ala or other soft tissues of the nose, including the nasal mucosa, nasal septum, and nasal bones. In addition, lesions may arise from the nasopharynx and adjacent structures and extend into the nose. Etiology of these lesions includes congenital disorders, inflammatory or infectious diseases, and benign and malignant tumors. Imaging is essential in many cases to characterize the mass lesion and to determine the exact location and extension of the lesion for further clinical management.

ED012-SU

## Pediatric Sunday Case of the Day

Sunday, Nov. 29 8:00AM - 11:59PM Location: Case of Day, Learning Center

PD

AMA PRA Category 1 Credit™: .50

### Participants

Ting Y. Tao, MD, PhD, Saint Louis, MO (*Presenter*) Nothing to Disclose

Asef B. Khwaja, MD, Philadelphia, MO (*Abstract Co-Author*) Author, Reed Elsevier

Elizabeth F. Sheybani, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose

Shannon Farmakis, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose

Luke L. Linscott, MD, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose

Joan K. Zawin, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1) Recognize the importance of a multimodality approach in imaging pediatric patients. 2) Form appropriate differential diagnoses based on clinical information and imaging findings. 3) Recognize the clinical implications of diagnoses.

**Pediatric Series: Neuro**

Sunday, Nov. 29 10:45AM - 12:15PM Location: S100AB



AMA PRA Category 1 Credits™: 3.25  
ARRT Category A+ Credits: 4.00

**Participants**

Robert C. McKinstry III, MD, PhD, Saint Louis, MO (*Moderator*) Travel support, Siemens AG Speaker, Siemens AG  
Thierry Huisman, MD, Baltimore, MD (*Moderator*) Nothing to Disclose

**Sub-Events****VSPD11-01 Malformations of Cortical Development**

Sunday, Nov. 29 10:45AM - 11:05AM Location: S100AB

**Participants**

Robert C. McKinstry III, MD, PhD, Saint Louis, MO, (mckinstryb@mir.wustl.edu) (*Presenter*) Travel support, Siemens AG Speaker, Siemens AG

**LEARNING OBJECTIVES**

A radiologist attending this session will learn 1) The stages of cortical development. 2) The malformations associated with abnormal neuronal proliferation and/or apoptosis. 3) The malformations associated with abnormal neuronal migration. 4) Learn the malformations associated with abnormal postmigrational development

**ABSTRACT**

This presentation will review the stages of normal cerebral cortical development. Malformations of cortical development will be organized according to abnormal development at each stage: proliferation/apoptosis, migration, and postmigrational organization. Tubulinopathies (e.g., polymicrogyria) and defects in the mTOR pathway (e.g., Tuberous Sclerosis) will illustrate emerging knowledge tying genotype to endophenotype.

**Active Handout:** Robert C. McKinstry

<http://abstract.rsna.org/uploads/2015/15002018/VSPD11-01.pdf>

**VSPD11-02 Comparison of Three Diffusion Models for Differentiating Low- and High-Grade Pediatric Brain Tumors**

Sunday, Nov. 29 11:05AM - 11:15AM Location: S100AB

**Participants**

Muge Karaman, PhD, Chicago, IL (*Presenter*) Nothing to Disclose  
Yi Sui, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose  
He Wang, PhD, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose  
Frederick C. Damen, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose  
Yu Hua Li, MD, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose  
Xiaohong J. Zhou, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To evaluate the performance of monoexponential, biexponential, and continuous time random walk (CTRW) diffusion models for differentiating low-grade (LG) and high-grade (HG) pediatric brain tumors.

**METHOD AND MATERIALS**

With IRB approval, 54 children (4 months to 13 years old) with brain tumors were enrolled in the study and underwent MRI scans at 3T. The imaging protocol included pre-/post-contrast T1, T2, FLAIR, and diffusion-weighted imaging with 12 b-values (0 to 4000 s/mm<sup>2</sup>). The parameters of the mono-exponential (apparent diffusion coefficient, D), biexponential (fast and slow diffusion coefficients, D<sub>f</sub> and D<sub>s</sub>; fast diffusion fraction, f) and CTRW (diffusion coefficient, D<sub>m</sub>; fractional powers of the waiting time and jump length, α and β) models were estimated from the diffusion data. Surgical biopsy or surgery was performed to determine the tumor grade histopathologically according to the WHO guidelines, resulting in 24 patients with LG and 30 with HG tumors. The mean values of all parameters over the tumor ROIs were compared between the two groups using a Mann-Whitney-Wilcoxon U-test. A k-means clustering algorithm was employed to differentiate LG and HG tumors based on the biexponential or CTRW parameters, followed by a comparison using histopathology as a reference.

**RESULTS**

Significant differences between the two tumor groups (LG vs. HG) were observed in the parameters of any of the three models with p-values < 0.001 (D: 0.90±0.34 vs. 0.56±0.17 in monoexponential; D<sub>f</sub>: 2.6±1.1 vs. 1.8±0.5, D<sub>s</sub>: 0.58±0.1 vs. 0.31±0.1, f: 0.73±0.11 vs. 0.59±0.09 in biexponential; D<sub>m</sub>: 1.5±0.5 vs. 0.75±0.2, α: 0.95±0.04 vs. 0.90±0.03, β: 0.92±0.07 vs. 0.81±0.06 in CTRW, with D's in units of μm<sup>2</sup>/ms). The combination of CTRW parameters produced better accuracy (85% vs. 79%), sensitivity (87% vs. 83%), and specificity (83% vs. 75%) than the combination of biexponential parameters for identifying tumor grades. Both models outperformed the monoexponential model in accuracy (75%) and specificity (54%).

**CONCLUSION**

The CTRW diffusion model performed the best in determining pediatric brain tumor malignancy when compared with the monoexponential and biexponential models.

## CLINICAL RELEVANCE/APPLICATION

The CTRW diffusion model can provide quantitative imaging markers to improve diagnosis of pediatric brain tumors.

### VSPD11-03 Evaluation of Pediatric Intracranial Tumors with Intravoxel Incoherent Motion MR Imaging

Sunday, Nov. 29 11:15AM - 11:25AM Location: S100AB

#### Participants

Kazufumi Kikuchi, MD, Fukuoka, Japan (*Presenter*) Nothing to Disclose  
Akio Hiwatashi, MD, Fukuoka, Japan (*Abstract Co-Author*) Nothing to Disclose  
Osamu Togao, MD, PhD, Fukuoka, Japan (*Abstract Co-Author*) Nothing to Disclose  
Koji Yamashita, MD, PhD, Fukuoka, Japan (*Abstract Co-Author*) Nothing to Disclose  
Tomoyuki Okuaki, RT, Chuo-Ku, Japan (*Abstract Co-Author*) Employee, Koninklijke Philips NV  
Hiroshi Honda, MD, Fukuoka, Japan (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Intravoxel incoherent motion (IVIM) is a non-invasive MR imaging technique to measure microcirculation and diffusivity simultaneously. The purpose of this study was to evaluate the utility of perfusion fraction (f) and diffusion coefficient (D) derived from IVIM to characterize pediatric intracranial tumors.

#### METHOD AND MATERIALS

This retrospective study included 16 children (M: F = 9: 7; age range 2 month-19 year-old, median 5 year). There were 6 high-grade tumors (HGTs; 3 anaplastic ependymoma, 1 glioblastoma, 1 medulloblastoma, and 1 atypical teratoid/rhabdoid tumor), 9 low-grade tumors (LGTs; 4 pilocytic astrocytoma, 2 craniopharyngioma, 1 diffuse astrocytoma, 1 choroid plexus papilloma, and 1 subependymoma) and 1 germinoma. IVIM imaging was obtained using single-shot SE-EPI sequence with 13 b-factors (0, 10, 20, 30, 50, 80, 100, 200, 300, 400, 600, 800, 1000 s/mm<sup>2</sup>). Other parameters of IVIM were as follows: TR/TE = 2500/70 ms, FA = 90, FOV = 230 x 230 mm<sup>2</sup>, matrix = 128 x 126, slice thickness = 5 mm, slices = 11, average = 1. The signal equation:  $S = S_0 \cdot [(1-f) \exp(-bD) + f \exp(-bD^*)]$  was fitted to obtain f pixel-by-pixel. The f and D were measured in the three hot spot regions-of-interest in a tumor in each map. Histopathologic vascular density was measured in three microscopic fields (x200) of the most intense vascularization on CD-31-immunostained histopathologic specimens. Statistical analysis was performed with the Pearson correlation coefficient and receiver operating characteristic (ROC). A p value less than .05 was considered significant.

#### RESULTS

The f-value (4.2-27.1%) significantly correlated ( $r = 0.72$ ,  $P = 0.0018$ ) with vascular density (0.60-13.4%). The f of HGTs ( $19.1 \pm 4.6\%$ ) was significantly higher than LGTs ( $7.7 \pm 4.0\%$ ;  $P = 0.0047$ ). The D of HGTs ( $0.93 \pm 0.34 \times 10^{-3} \text{ mm}^2/\text{s}$ ) was significantly lower than LGTs ( $1.70 \pm 0.34 \times 10^{-3} \text{ mm}^2/\text{s}$ ;  $P = 0.0032$ ). ROC analysis showed high Az values with f (0.94) and D (0.96) without a statistically significant difference ( $P = 0.74$ ).

#### CONCLUSION

The f-value derived from IVIM significantly correlated with vascular density of pediatric brain tumors. Both f and D parameters could discriminate HGTs from LGTs.

## CLINICAL RELEVANCE/APPLICATION

Using IVIM, we could simultaneously evaluate flow and diffusivity in pediatric brain tumors. The f-value derived from IVIM significantly correlated with vascular density. Both f and D could discriminate HGTs from LGTs.

### VSPD11-04 rADC and Location Differ between Posterior Fossa Pilocytic Astrocytomas with and without Gangliocytic Differentiation

Sunday, Nov. 29 11:25AM - 11:35AM Location: S100AB

#### Participants

Julie Harreld, MD, Memphis, TN (*Presenter*) Nothing to Disclose  
Scott N. Hwang, MD, PhD, Memphis, TN (*Abstract Co-Author*) Nothing to Disclose  
Ibrahim Qaddoumi, MD, Memphis, TN (*Abstract Co-Author*) Nothing to Disclose  
David W. Ellison, MD, PhD, Memphis, TN (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Pediatric gangliogliomas (GG) are rare ( $\leq 4\%$  of pediatric brain tumors), and only  $\sim 5\%$  of gangliogliomas occur in the posterior fossa. A recently defined GG variant, histopathologically resembling pilocytic astrocytoma but with focal gangliocytic differentiation (PA-GG) that can be overlooked, can be mistaken for the common pilocytic astrocytoma (PA). We investigated whether MRI features could differentiate posterior fossa PA-G from PA.

#### METHOD AND MATERIALS

Pre-operative MRIs (and CTs where available) of 42 children (3mo-15 years, mean  $7.11 \pm 3.8$  years; 57% male; 8 PA-GG, 34 PA) were evaluated by two neuroradiologists blinded to pathologic diagnosis for tumor location and gross morphology; presence of hemorrhage or calcification; circumscription; degree of enhancement, edema, and %cyst/necrosis; and minimum rADC (compared to thalamus). Data for PA-GG and PA were compared.

#### RESULTS

Location differed significantly between PAs and PA-Gs (Pearson ChiSquare,  $p = 0.0194$ ); 16/34 PAs, but no PA-GGs, were centered in the cerebellar hemisphere. All PA-GGs predominantly involved midline structures (vermis, medulla, midbrain), compared to 13 of 34 PAs. Minimum rADC was significantly lower in PA-GGs (mean  $0.95 \pm 0.21$ ; 95%CI 0.73, 1.17) than in PAs (mean  $2.01 \pm 0.38$ ; 95%CI 1.86, 2.16) ( $p < 0.0001$ ). 24/34 PAs and 1/8 PA-GGs had "cyst+nodule" morphology, 7/34 PAs and 4/8 PA-GGs had evidence of hemorrhage, with no statistically significant difference between these or the remaining evaluated features.

#### CONCLUSION



Minimum rADC and location appear to differ significantly between posterior fossa PAs with or without gangliocytic differentiation.

#### CLINICAL RELEVANCE/APPLICATION

For differentiation between posterior fossa PAs with and without gangliocytic differentiation, location and minimum rADC may be a useful adjunct to histopathologic diagnosis, which is subject to sampling error.

#### VSPD11-05 Systematic Comparison of MR Imaging Findings in Pediatric Ependymoblastoma with Ependymoma and CNS-PNET NOS

Sunday, Nov. 29 11:35AM - 11:45AM Location: S100AB

##### Participants

Johannes Nowak, MD, Wurzburg, Germany (*Presenter*) Nothing to Disclose  
Carolin Seidel, Wurzburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Torsten Pietsch, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose  
Balint Alkonyi, Wurzburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Taylor Laura Fuss, Charlestown, MA (*Abstract Co-Author*) Nothing to Disclose  
Carsten Friedrich, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Katja von Hoff, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Stefan Rutkowski, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Monika Warmuth-Metz, Wurzburg, Germany (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Ependymoblastoma (EBL), ependymoma (EP), and primitive neuroectodermal tumors of the central nervous system (CNS-PNET NOS = not otherwise specified) are pediatric brain tumors that can be differentiated by histopathology in the clinical setting. Recently, we first described specific MRI features of EBL. In this study, we compare standardized MRI characteristics of EBL with EP and CNS-PNET NOS in a series comprising of 22 patients in each group.

#### METHOD AND MATERIALS

We systematically analyzed the initial cranial MRI scans at diagnosis according to 25 standardized criteria, and paired comparison was performed for EBL and EP, as well as for EBL and CNS-PNET NOS. All 66 cases of this multi-center study were centrally reviewed regarding histopathology, MR imaging and multimodal therapy.

#### RESULTS

We found differences between EBL and EP regarding age at diagnosis, MR signal intensity, tumor margin and surrounding edema, presence and size of cysts, and contrast enhancement pattern. Although MRI appearance of EBL shares many features with CNS-PNET NOS, we revealed significant differences in terms of age at diagnosis, tumor volume and localization, tumor margins, edema, and contrast enhancement.

#### CONCLUSION

We systematically analyze and compare MRI characteristics of pediatric EBL with EP and CNS-PNET NOS in a series of 22 centrally reviewed cases of each group. A definite differentiation of these entities with MRI seems to be difficult; however, we identify particular imaging features that might help distinguishing these histologically distinct tumor types.

#### CLINICAL RELEVANCE/APPLICATION

This is the first study that systematically compares multiple parameters of MR imaging in pediatric EBL with findings in EP and CNS-PNET NOS. Since EBL is very rare, our data provides important information that might help differentiating EBL from other pediatric brain tumor entities in the clinical setting.

#### VSPD11-06 Quantitative Approach to the Posterior Cranial Fossa and Cranio-cervical Junction in Asymptomatic Children with Achondroplasia

Sunday, Nov. 29 11:45AM - 11:55AM Location: S100AB

##### Participants

Rosalinda Calandrelli, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose  
Marco Panfili, MD, Rome, Italy (*Presenter*) Nothing to Disclose  
Gabriella D'Apolito, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose  
Giuseppe M. Di Lella, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose  
Cesare Colosimo, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Achondroplasia, the best-known form of congenital dwarfism, is caused by a disturbance of endochondral bone formation. We proposed a MRI-based quantitative morpho-volumetric approach to the posterior cranial fossa and cranio-cervical junction to understand posterior cranial fossa changes responsible of ventriculomegaly and life-threatening medullary compression.

#### METHOD AND MATERIALS

We analyzed brain MRI of 12 children with a diagnosis of achondroplasia (mean age  $39 \pm 16$  months) and no surgical treatment. 3DFSPGR T1weighted images were used for 1) evaluation of the posterior fossa synchondroses; 2) volumetric analysis of the posterior fossa (posterior cranial fossa volume=PCFV, posterior cranial fossa brain volume=PCFBV, PCFV/PCFBV ratio, hemispheres/cerebellar volume=Ce.V, cerebellar vermis volume=Ve.V, brainstem volume, CSF spaces volume, IV ventricle volume); 3) morphometric analysis of the posterior fossa (clivus, supraocciput, exocciput lengths, tonsillar herniation, tentorial angle) and cranio-cervical junction (A-P and LL diameters of the foramen magnum); 4) measurements of foramen magnum and jugular foramina areas; 5) volumetric analysis of supratentorial ventricles. These patients were compared with age-matched control group.

#### RESULTS

All patients showed synostosis of speno-occipital synchondroses while six patients showed synostosis of anterior and posterior

intra-occipital synchondroses, cervical myelopathy without swelling cord. Compared to control group, clivus and exocciput lengths, L-L and A-P diameters of the foramen magnum, foramen magnum area and jugular foramina area were significantly reduced; supraocciput length, tentorial angle, PCFV, PCFBV, CeV, Ve, brainstem volume and supratentorial ventricular system volume were significantly increased ( $p < 0.05$ ) while PCFV/PCFBV ratio, the subarachnoid spaces volume of the PCF and IV ventricle volume were not significant ( $p > 0.05$ ).

## CONCLUSION

The quantitative approach to the posterior fossa and cranio-cervical junction modifications shows a complex relationship among the maldevelopment of the posterior cranial fossa, the foramen magnum stenosis, the development of ventriculomegaly and medullary compression.

## CLINICAL RELEVANCE/APPLICATION

Posterior cranial fossa changes and foramen magnum stenosis should be evaluated together to the status of synchondroses in order to plan the prophylactic cervicomedullary decompression.

## VSPD11-07 Congenital Spine Anomalies: Diagnosis and Classification

Sunday, Nov. 29 11:55AM - 12:15PM Location: S100AB

### Participants

Erin S. Schwartz, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

## LEARNING OBJECTIVES

- 1) Understand the embryologic derangements behind the more common congenital spinal anomalies encountered in clinical practice.
- 2) Be able to apply a clinical-radiological classification to facilitate the interpretation of imaging studies of patients with spinal dysraphism.

## ABSTRACT

Encouraging imaging studies on patients with congenital spinal anomalies can be intimidating for radiologists, particularly when pediatric imaging and/or neuroimaging are not a large part of your practice. A clinical-radiological classification system developed by Tortori-Donati, et al (Neuroradiology, 2000), remains a valuable approach to correctly diagnosing these children, largely dividing entities into open or closed spinal dysraphism based on the absence or presence of overlying skin, respectively. Closed spinal dysraphism is further subdivided into those lesions that present with a subcutaneous mass versus those that do not. Lesions without a subcutaneous mass can be further subdivided into simple and complex, and may be associated with other cutaneous stigmata such as hemangioma, skin dimple, and/or focal hairy patch.

## Pediatric Sunday Poster Discussions

Sunday, Nov. 29 12:30PM - 1:00PM Location: PD Community, Learning Center

PD

AMA PRA Category 1 Credit™: .50

### Participants

Rajesh Krishnamurthy, MD, Bellaire, TX (*Moderator*) Research support, Koninklijke Philips NV; Research support, Toshiba Corporation

### Sub-Events

#### PD201-SD- Obese Children fMRI Brain Connections for Food Odor Stimuli SUA2

Station #2

### Awards

#### RSNA Country Presents Travel Award

### Participants

Pilar Dies-Suarez, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose  
 Silvia Hidalgo-Tobon, PhD, Mexico City, Mexico (*Abstract Co-Author*) Nothing to Disclose  
 Benito De Celis IV, Puebla, Mexico (*Abstract Co-Author*) Nothing to Disclose  
 Eduardo Barragan, Mexico, Mexico (*Abstract Co-Author*) Nothing to Disclose  
 Porfirio Ibanez, MD, Mexico City, Mexico (*Abstract Co-Author*) Nothing to Disclose  
 Manuel Obregon, MD, Mexico City, Mexico (*Abstract Co-Author*) Nothing to Disclose  
 Castro eduardo, mexico, Mexico (*Abstract Co-Author*) Nothing to Disclose  
 samuel flores, mexico, Mexico (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Obesity is a precursor of health problems, In Mexico this condition affects more than 70% of the population It is known that odor/smell is one of the principal cues for the appearance and control of appetite To fight obesity it is crucial to understand the brain mechanisms of this stimulus There is no information on the changes in connectivity between brain regions for this age group. In this work we studied the different brain fMRI activations and connections between normal weighted (NW) and obese (OB) infants for different types of food odors.

### METHOD AND MATERIALS

30 volunteers infants 8.4±2 15 males/15 females were studied Two cohorts of 15 subjects each were obtained from the sample one with BMI between 19 and 24 kg/m<sup>2</sup> (NW) and the other with BMI over 30 kg/m<sup>2</sup> (OB) Volunteers received 3 odor cues One was pleasant and represented caloric foods(chocolate) the second was healthy and presented low calorie foods(onion) the third was a neutral odor not associated with food(diluted acetone) We used a 1.5 T Philips Intera Achieva scanner using 35 coronal slices covering the whole of the brain were acquired with a Fast-Echo-EPI sequence over a period of 13.9 minutes TR=3s TE=50 ms 64x64 matrix with a 3.6 x 3.6 mm inplane resolution and 4 mm slice thickness Data was analyzed with SPM8 software Results for both analysis were corrected for multiple comparisons (FWE p<0.05) and data was presented overlaid on template images

### RESULTS

All food smells presented larger activations in cerebellum for NW volunteers probably corresponded to the pleasure regulation function of this area The cingulate gyrus was much more active for OB infants when presented with food smells This response was possibly related to the emotional processing or the memory functions of this area These two findings clearly indicated different mechanisms of interpretation of these stimuli between

### CONCLUSION

Clear differences in fMRI and connectivity between the OB and NW groups were found, pointing at a very different processing of odor cues in infants.

### CLINICAL RELEVANCE/APPLICATION

if we know where there is a failure in connectivity in obese patients maybe we can influence this area trying to avoid the problem of obesity development before it appears to the emotional processing or the memory functions of this area. These two findings clearly indicated different mechanisms of interpretation of these stimuli between

#### PD202-SD- The Diagnostic Potential of Diffusion-weighted Imaging and Conventional MRI in the Localization of SUA3 Non-palpable Undescended Testes

Station #3

### Participants

Sally Emad-Eldin, MD, Cairo, Egypt (*Presenter*) Nothing to Disclose

### PURPOSE

Our aim was to assess the diagnostic utility of combined Diffusion-weighted imaging and conventional MRI, including Fat suppression T2 sequence in the identification and localization of non-palpable testes.

### METHOD AND MATERIALS

This study was approved by the hospital ethical committee. The parents of the children were sufficiently informed of the purpose of our study and they all given consent. This prospective study included 37 consecutive patients, with 44 non palpable undescended

testis (unilateral in 30 cases and bilateral in 7 cases). They ranged in age from 2 to 18 years, mean=7.52 ± 5.91). MRI examinations were done using 1.5 T machine. T1, T2 WI, fat-suppressed T2WI and DWI at b value of 50, 400 and 800 s/mm<sup>2</sup> were performed in all patients. The results of MRI were confirmed by laparoscopic findings. The mean duration between MRI and surgery was about 1 month ± 2 weeks. The results of MRI were considered positive when when a testis was identified before the operation and finally diagnosed by surgeon.

## RESULTS

According to the laparoscopic findings, the final diagnoses of the location of undescended testes were: intra-canalicular (n=19, 43.18%), low intra-abdominal (n=5, 11.36%), high intra-abdominal (n=5, 11.36%). Vanishing or absent testes were detected in 15 cases (34%). The combined diffusion and conventional MRI were capable of locating all intra-canalicular testes (19/19) as well as low intra-abdominal testes (5/5). However, it was less efficient in locating high intra-abdominal testes (3/5). We found that the combination of DWI and conventional MRI was the most sensitive and the most accurate technique with diagnostic accuracy of 95.45%, sensitivity of 93%, specificity of 100 % respectively. We used the combined conventional MRI and DWI to detect the viability of testes before laparoscopy. Two cases were diagnosed by MRI as a testicular nubbin which were treated by orchiectomy.

## CONCLUSION

Based on our findings, we suggest that a combination of DWI and conventional MRI, including Fat-suppression T2WI sequence is the most accurate mean of detecting and localizing non-palpable undescended testes. In addition, it is helpful in detection of testicular viability or atrophy properly before the operation.

## CLINICAL RELEVANCE/APPLICATION

Combined Diffusion and conventional MRI, including fat suppression T2WI can be used for preoperative localization of non palpable UDT and to detect its viability.

## PD203-SD- Fetal Magnetic Resonance Imaging (MRI) versus 3D-Ultasonography (3D-US) in Assessment of Fetal Lung Volumes in Cases at Risk of Pulmonary Hypoplasia

SUA4

Station #4

Participants

Mariam R. Louis, MD, Cairo, Egypt (*Presenter*) Nothing to Disclose

## PURPOSE

To analyze the correlation and agreement between 3D-US and MRI in measuring fetal lung volumes in cases at risk of developing pulmonary hypoplasia (PH).

## METHOD AND MATERIALS

38 fetuses at high risk of developing lung hypoplasia either due to extra-thoracic causes like renal anomalies causing oligohydramnios and skeletal dysplasias with narrow chest (22cases) or due to intra-thoracic causes like congenital cystic adenomatoid malformation (CCAM) and congenital diaphragmatic hernia (CDH) (16cases) were involved in a cross sectional study . 3D volume data sets of the fetal lungs were acquired using a commercially available ultrasound system, total lung volumes were calculated using the virtual organ computer-aided analysis (VOCAL) method. MRI obtained a fast T2 weighted images of fetal chest in axial, coronal and sagittal planes, with assessment of signal intensity of fetal lungs as well as lung volumetry. Comparison between mean lung volumes was performed using unpaired t test. Agreement between the 3D-US and MRI methods was done using Cohen kappa test. Finally sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic accuracy were calculated for 3D-US and for MRI.

## RESULTS

Good agreement was detected between the two methods (Kappa = 0.715, p = 0.001). The measured lung volumes by 3D-US were smaller than those measured by MRI (p >0.05, non-significant). MRI showed greater specificity, positive predictive value and diagnostic accuracy (100%each) than 3D-US (68.75, 78.26 and 82.86% respectively).

## CONCLUSION

There is a good concordance between 3D-US and MRI in measuring lung volumes and in assessment of pulmonary hypoplasia . MRI can be used complementary to US in borderline cases of pulmonary hypoplasia and in difficult diagnostic situations due to complicated lesions or due to technical problems as in cases of severe oligohydramnios or improper fetal position. In addition it provides images with much better tissue contrast thus confirm the US diagnosis and can add or change diagnosis in few cases .

## CLINICAL RELEVANCE/APPLICATION

3DUS and fetal MRI have the ability to diagnose pulmonary hypoplasia , however MRI is more accurate in borderline cases hence; it could be used as a complementary method to US in inconclusive cases .

## PD204-SD- Quantitative Analysis of the Facial Nerve on Contrast-enhanced 3-dimensional FLAIR: Diagnosis of Pediatric Bell Palsy

SUA5

Station #5

Participants

Sun Kyoung You, MD, Daejeon, Korea, Republic Of (*Presenter*) Nothing to Disclose

Jin Hee Seo, MD, Daejeon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

In Ho Lee, MD, Daejeon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To propose the quantitative analysis of facial nerve on CE 3D FLAIR-VISTA for the diagnosis of Bell palsy in pediatric patients.

## METHOD AND MATERIALS

Twenty six patients with acute facial nerve palsy ( M:F = 13:13, mean age = 8.78±5.39, age range, 1-17 years, Right:Left =

13:13) were underwent temporal MRI, from April through December 2014. The unaffected side were considered normal group (palsy group(Group1): normal group(Group2)=26:26). Signal intensity (SI) of five segments (canalicular, labyrinthine, geniculate ganglion, tympanic, and mastoid) of the facial nerve on the CE 3D FLAIR image was measured by drawing round ROI. The SI of each segments were measured three times and mean value was used for analysis. MR imaging index (summation of SI in the five segments/100) of each side and Relative SI index (RSI; summation of SI in the five segments of right side facial nerve/summation of left side) of each patient were calculated. Visual assessment (VA) was obtained by reviewer and reviewer classified the CE 3D FLAIR images as normal, right facial neuritis, or left facial neuritis. MR imaging index and RSI were compared with VS. For statistical analysis, we used SPSS software (V18.0) and Medcalc for Windows (V11.2.1).

## RESULTS

Intra-class correlation coefficients of reviewer for each segments were 0.96. The SI of canalicular segment and MR imaging index of palsy group were greater than that of normal group. (Group 1, 791.3±496.3; Group 2, 448.0±157.7 ; P=0.02, Group 1, 21.6±6.5 ; Group 2, 17.5±5.1; p=0.037, respectively). In seven of the eight that are classified as normal by the VA, the results of the RSI is matched with the direction of the lesion. The sensitivities, specificities, and accuracies were 100%, 76.9%, and 88.4%, respectively, for RSI, and 65.3%, 100%, and 82.6%, respectively, for VA. The sensitivity of RSI was greater than VA, but specificity of VA was greater than RSI (sensitivity, p=0.043; specificity, p=0.047).

## CONCLUSION

Quantitative analysis of facial nerve should be considered for clinical use to improve diagnosis of Bell palsy in pediatric patients.

## CLINICAL RELEVANCE/APPLICATION

Quantitative analysis of facial nerve is recommended when the affected site is unclear by visual assessment of MRI.

### PD111-ED- SUA6 Cross Sectional Imaging Features of Primary Pediatric Skull Lesions: What the Radiologist Should Know

Station #6

#### Awards Identified for RadioGraphics

##### Participants

Alex C. Wu, MD, Cleveland, OH (*Presenter*) Nothing to Disclose  
Ellen Park, MD, MS, Chagrin Falls, OH (*Abstract Co-Author*) Nothing to Disclose  
Neil Vachhani, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose  
S. Pinar Karakas, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose  
Unni K. Udayasankar, MD, FRCR, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

Primary skull lesions are rare in children, could present as clinically apparent masses or incidentally detected lesions on imaging studies. Pediatric skull lesions encompass a wide spectrum of imaging appearance and differential diagnosis including developmental and acquired pathologies. The role of cross-sectional imaging studies, specifically MRI is to characterize the lesion, delineate intracranial involvement, and evaluate for any associated developmental anomalies. Imaging could provide crucial clues to management options and has prognostic value in certain cases.

## TABLE OF CONTENTS/OUTLINE

Discuss relevant anatomy and normal cross sectional imaging appearance of the calvarium in infants and children. Discuss palpable lesions versus incidentally detected abnormalities on imaging studies. Explain the role of cross sectional imaging studies in lesion identification and potential management implications. Discuss characteristic imaging features and differentiate pathologies based on imaging appearances. Emphasize on 'touch me not' lesions. Provide extensive illustrative case studies of MRI and CT findings of a wide spectrum of skull lesions from a tertiary care pediatric hospital including the following categories: Congenital/developmental, post-traumatic, infectious/inflammatory, neoplastic, vascular, and post surgical.

### PD166-ED- SUA7 Sonography of the Infant Spine: What You Need to Know

Station #7

##### Participants

Hing Y. Eng, MD, New York, NY (*Presenter*) Nothing to Disclose  
Anmol G. Bansal, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose  
Henrietta Kotlus Rosenberg, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1. To review the embryological development and normal anatomy of the infant spine, including normal variants and how aberrations in embryological development can lead to various spinal anomalies. 2. To discuss the indications and technical aspects of performing sonography of the infant in order to achieve optimal evaluation of spinal abnormalities. 3. To review the clinical and sonographic characteristics of congenital and developmental infant spine anomalies with a pictorial review of representative images in each category, including diagnostic pitfalls. 4. To discuss what to include in the sonography report. 5. To review when follow up imaging is needed.

## TABLE OF CONTENTS/OUTLINE

Overview of embryological developmental pathway of the spine. Normal anatomy of the infant spine, including normal variants. Embryological developmental aberrations that can lead to spinal anomalies, including time and stage of development of defects. Indications and sonographic techniques for performing infant spine sonography: what to do and what not to do. Clinical and sonographic features of congenital and developmental infant spine abnormalities with representative images of each type of anomaly. Diagnostic pitfalls and how to avoid them. The Report: what to tell the pediatrician. The Next Step: Indications for follow up sonography and/or MRI. Summary.

## Pediatric Sunday Poster Discussions

Sunday, Nov. 29 1:00PM - 1:30PM Location: PD Community, Learning Center

PD

AMA PRA Category 1 Credit™: .50

### Participants

Rajesh Krishnamurthy, MD, Houston, TX (*Moderator*) Research support, Koninklijke Philips NV; Research support, Toshiba Corporation

### Sub-Events

#### PD205-SD- SUB1 Infarction Characteristics after Encephaloduroarteriosynangiosis in Young Moyamoya Patients

Station #1

### Participants

Hyun Gi Kim, MD, PhD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

Seung-Koo Lee, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Young patients with Moyamoya disease can exhibit cerebral infarction at the time of postoperative period. The aim of this study was to evaluate the characteristics of infarction after encephaloduroarteriosynangiosis (EDAS).

### METHOD AND MATERIALS

We retrospectively reviewed the pre- and postoperative MRIs of Moyamoya patients younger than 18 years who underwent EDAS from January 2013 to February 2015. Pre- and postoperative infarction patterns were evaluated using T2WI and DWI, respectively. The infarction patterns were categorized into watershed, territorial, or mixed. The shape (gyral, punctate, or other) and side (right or left) of infarctions were evaluated. The postoperative infarction dates were recorded to see the interval and relationship between the date and stage (first or second) of the operations.

### RESULTS

One hundred and four EDAS were performed in 63 patients (mean age: 8.3 years). Preoperative infarctions were found in 17 patients. Preoperative infarction pattern was watershed in 10 (58.8%), territorial in 4 (23.5%), and mixed in 3 (17.6%) patients. There were 17 postoperative infarctions in 11 patients. The mean interval between postoperative infarction and EDAS was 13.2 days (range: 0-40 days). Postoperative infarction occurred after the first stage EDAS in 11 (64.7%) and second stage EDAS in 6 (35.3%) cases. Postoperative infarction pattern was territorial in 8 (47.1%), watershed in 8 (47.1%), and mixed in 1 (5.9%) case. Gyral (12/17, 70.6%) was the most common shape of infarction. The postoperative infarction sides were concordant with the sides of the operations in 7 cases and were discordant in 6 cases.

### CONCLUSION

Acute infarction after EDAS is often territorial and occur at the opposite side of the first stage operation.

### CLINICAL RELEVANCE/APPLICATION

Post-EDAS infarction pattern on DWI in young Moyamoya patients has not been studied before. Knowing the frequent pattern and the side of acute infarction after EDAS will help understanding the pathophysiology of the postoperative infarction which will lead to an adequate postoperative management.

#### PD206-SD- SUB2 Abbaent Temporal Variability of Thalamocortical Functional Connectivity in Children Suffered from Primary Nocturnal Enuresis, A Resting-state FMRI Study

Station #2

### Participants

Xiaoxue Ge, MD, Shenyang, China (*Presenter*) Nothing to Disclose

Na Chang, Shenyang, China (*Abstract Co-Author*) Nothing to Disclose

Bing Yu, MD, Shenyang, China (*Abstract Co-Author*) Nothing to Disclose

Qiyong Guo, MD, Shenyang, China (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To assess abnormal temporal variations in resting-state thalamocortical functional connectivity in children suffered from primary nocturnal enuresis (PNE) using sliding window correlation analysis.

### METHOD AND MATERIALS

Nineteen PNE children (M/F 11:8, 9.0 to 11.8 years, with a median age of 10.3 years) and 18 healthy controls (M/F 10:8, 8.8 to 11.5 years, with a median age of 9.8 years) participated in this study after providing informed consent. FMRI data were collected on a 3 Tesla MR scanner using a three-dimensional (3D)-PRESTO (principle of echo shifting with a train of observations) pulse sequence (total acquisition time per volume was 1s) and postprocessed with the DynamicBC software package. To assess the stationarity of thalamocortical connectivity, we used a sliding window analysis to compute the running correlation coefficients of thalamocortical connectivity as a function of time, the coefficient of variation (CV, standard deviation/average) and amplitude of fluctuation (AF, the square root of the power spectrum) of these sliding window correlation coefficients were calculated and compared between PNE children and controls.

### RESULTS



Compared with controls, the CVs of sliding window correlation coefficients in PNE children were higher in bilateral inferior frontal gyrus, left precuneus and lower in left medial prefrontal cortex (MPFC), bilateral anterior cingulate cortex (ACC), however, the AFs were higher in bilateral parahippocampal gyrus, bilateral inferior frontal gyrus and lower in right middle temporal gyrus, right inferior temporal, post Cingulum (PCC), bilateral medial prefrontal cortex (MPFC) (P < 0.05, FDR corrected).

## CONCLUSION

Abnormal temporal variability of thalamocortical functional connectivity in default mode network (DMN), inferior frontal gyrus, precuneus, parahippocampal gyrus and ACC may be associated with onset and progression of PNE in children.

## CLINICAL RELEVANCE/APPLICATION

Abnormalities in temporal variability of thalamocortical functional connectivity in default mode network (DMN), inferior frontal gyrus, precuneus, parahippocampal gyrus and ACC may be associated with onset and progression of PNE.

## PD207-SD-SUB3 The Neuroimaging Findings of Joubert Syndrome with the C5ORF42 Gene Mutation Do Not Show the Classic Molar Tooth Sign

Station #3

### Participants

Mikako Enokizono, MD, Yokohama, Japan (*Presenter*) Nothing to Disclose  
Noriko Aida, MD, Yokohama, Japan (*Abstract Co-Author*) Nothing to Disclose  
Yuta Fujii, Yokohama, Japan (*Abstract Co-Author*) Nothing to Disclose  
Kumiko Nozawa, Saitama, Japan (*Abstract Co-Author*) Nothing to Disclose  
Tomohide Goto, Yokohama, Japan (*Abstract Co-Author*) Nothing to Disclose  
Hitoshi Osaka, Shimotsuke, Japan (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Vermian hypoplasia (VH) and molar tooth sign (MTS) are the neuroimaging hallmarks of Joubert syndrome (JBTS). JBTS is a genetically heterogeneous condition for which 22 genes have been described to date. The spectrum of neuroimaging findings in JBTS is much wider, however, few studies demonstrated neuroimaging-genotype correlation. The purpose of this study is to describe neuroimaging pattern in patients with JBTS17 caused by mutation in the C5ORF42 gene on chromosome 5p13.

## METHOD AND MATERIALS

2 pediatric neuroradiologists retrospectively analyzed clinical MR images in 11 children (aged 7 days to 12 years) with clinical features meeting JBTS diagnostic criteria. 9 patients had undergone mutation analysis. Mutation in the C5ORF42 gene had been found in 5 patients, the AHI1 gene in 2, and the TMEM67 gene in 1. Imaging analysis of the infratentorial structures included qualitative assessment of the superior cerebellar peduncles (SCP), the cerebellar vermis and hemispheres, the fourth ventricle, the posterior fossa, and the brainstem on 3D T1- and T2-weighted images. The supratentorial evaluation included hippocampal malrotation, midline defects, cephaloceles, ventriculomegaly, and migrational disorders. Additionally, we assessed the absence of decussation of the SCP on diffusion tensor images (DTI). The patients were divided to 2 groups; JBTS17 (n=5) and patients other than JBTS17 (n=6).

## RESULTS

The width of the SCP in non JBTS17 group was obviously thickened in 6 patients, however, in JBTS17, minimally thickened in 2, normal in 3. The length of the SCP in non JBTS17 was obviously elongated in 4, minimally elongated in 2, in JBTS17, minimally elongated in 1, normal in 4. The IF in non JBTS17 was obviously deepened in 4, minimally deepened in 2, while, in JBTS17, minimally deepened in 2, normal in 3. VH in non JBTS17 was marked in 3, moderate in 3, whereas mild in 5 JBTS17. The flocculonodular lobe in non JBTS17 was not evident in 4, evident in 2, but evident in 5 JBTS17. Supratentorial findings were found in 3 in non JBTS17, not found in JBTS17. In all patients (not available in 1 patient), DTI showed the absence of decussation of the SCP.

## CONCLUSION

In patients with JBTS17, the neuroimaging findings are distinctly milder than those in non JBTS17 and do not show the classic MTS but the absence of decussation of the SCP on DTI.

## CLINICAL RELEVANCE/APPLICATION

Radiologists should know the wide spectrum of neuroimaging findings of JBTS.

## PD208-SD-SUB4 Increased Fetal Lung T2 Signal is not Due to Increasing Surfactant Concentration: An in Vitro T2 Mapping Analysis

Station #4

### Participants

Theodore J. Dubinsky, MD, Seattle, WA (*Presenter*) Stockholder Global Cancer Technology  
Mariam Moshiri, MD, Seattle, WA (*Abstract Co-Author*) Consultant, Reed Elsevier; Author, Reed Elsevier  
Gregory J. Wilson, PhD, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose  
Jeffrey H. Maki, MD, PhD, Seattle, WA (*Abstract Co-Author*) Research support, Bracco Group; Speakers Bureau, Lantheus Medical Imaging, Inc;  
Kristina A. Waldorf, MD, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Purpose: Many institutions around the world have demonstrated that fetal lungs increase in T2 signal with increasing gestational age. It would be extremely valuable to have a noninvasive imaging means of assessing fetal lung maturity to predict potential pulmonary hypoplasia. The mechanism for this signal increase has been postulated to be due to the increased surfactant within the fetal lungs. We performed an in vitro T2 mapping experiment on serially diluted surfactant mixtures to determine if the signal does indeed increase with increasing surfactant, and is therefore the mechanism for increasing T2 signal on fetal MR images.

## METHOD AND MATERIALS

Material and Methods: Serial dilutions of Surfactant (AbbVie Pharmaceuticals, Chicago, IL), of 1:2, 1:4, 1:16 and 1:64 in plasmolyte (Baxter Healthcare, Old Toongabbie, NSW Australia) as well as undiluted and plasmolyte only solutions were placed into 5mm OD NMR sample tubes. Water relaxation rate constants ( $R_2 = 1/T_2$ ) for the 6 in vitro samples were measured on a 3T whole body scanner (Achieva TX, Philips Healthcare, the Netherlands) using a small extremity coil. Quantitative  $R_2$  mapping using a single-slice turbo spin echo sequence with 32 echoes spaced 20 ms apart, FOV 200x152 mm<sup>2</sup>, slice thickness 3 mm, in-plane resolution 1.0x1.0 mm<sup>2</sup>, TR 2 s. Average region-of-interest signal intensity from even-numbered echoes were fitted to a mono-exponential decay using off-line curve-fitting software (Matlab, Natick, MA).

## RESULTS

Results: Our results indicated that T2 decreases with increasing surfactant concentration. That would correspond to decreasing signal, i.e. darker T2w images for higher concentrations of surfactant.

## CONCLUSION

Conclusion: T2 elongates with increasing concentration of surfactant in solution. This is the opposite effect of what is seen in fetal lungs during gestation, and therefore not the etiology of the increased fetal lung signal that has been reported.

## CLINICAL RELEVANCE/APPLICATION

Clinical Relevance: The ability to noninvasively predict fetal lung maturity would be of great value to obstetricians for delivery planning when complex fetal or maternal disease is present. Proof that surfactant which is increasing in the fetal lungs in the third trimester is not the reason for increased fetal lung T2 signal is useful for directing further research into the etiology of this observation as a means of noninvasively evaluating fetal lungs is sought.

## Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Theodore J. Dubinsky, MD - 2012 Honored Educator  
Theodore J. Dubinsky, MD - 2013 Honored Educator  
Mariam Moshiri, MD - 2013 Honored Educator  
Mariam Moshiri, MD - 2015 Honored Educator

## PD209-SD- SUB5 Pediatric Neuroimaging in the ED for Trauma - A Retrospective Review Based on the ACR Appropriateness Criteria

Station #5

## Participants

Sevith Rao, BA, Houston, TX (*Presenter*) Nothing to Disclose  
Sishir Rao, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Anand M. Prabhakar, MD, Somerville, MA (*Abstract Co-Author*) Nothing to Disclose  
H. Benjamin Harvey, MD, JD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

CT and MRI can detect important and potentially treatable complications of pediatric head trauma, but should largely be reserved for moderate and severe mechanisms of injury. This study assessed the prevalence of appropriate neuroimaging based on the ACR Appropriateness Criteria (ACR AC) among pediatric patients who presented status post trauma to a level 1 emergency department (ED).

## METHOD AND MATERIALS

A retrospective review of ED records was performed for patients under 18 years of age who received a head CT or head MRI for the clinical indication of "head trauma" in 2014. The clinical history and patient symptoms were compared to the ACR AC with the indication deemed appropriate based on a rating of 5 or higher. Additionally, patients were analyzed by age, gender, presentation, imaging, follow-up, treatment, and outcomes.

## RESULTS

There were 40 patients imaged with CT alone, 27 with MRI alone, and 3 patients with both CT and MRI (overall 38% F, 62% M). There was a statistically significant difference in average age of patients imaged with CT alone (12 years  $\pm$  6 years) versus MRI alone (5 years  $\pm$  7) ( $p < .01$ ). The majority of all subgroups were appropriately imaged based on the ACR Appropriateness Criteria: 33/40 (83%) for CT alone, 22/27 (81%) for MRI alone, and 2/3 (66%) for imaged with both CT and MRI. Appropriate reasons for neuroimaging included high energy mechanism of injury, decreased GCS ( $\leq 13$ ), suspected skull base fracture, or non-accidental trauma. Of patients imaged with CT alone, 12 (30%) had no follow-up in our system, and of those with follow-up, 21 (75%) returned to baseline with conservative management. Of patients imaged with MRI alone, 6 (22%) did not have follow-up, and of those with follow-up 21 (100%) of patients returned to baseline with conservative management.

## CONCLUSION

Most pediatric patients in our level 1 ED who underwent neuroimaging for trauma did so based on appropriate ACR guidelines and had resolution of their symptoms with conservative management. The minority of patients not imaged appropriately per the ACR AC represent a potential target of future quality improvement efforts.

## CLINICAL RELEVANCE/APPLICATION

Appropriate utilization of pediatric neuroimaging in the post traumatic setting has important cost, quality and radiation safety implications.

## PD118-ED- Participants



## **SUB6      A Practical Approach to Pediatric Scrotal Disorders on Ultrasonography (US): What Radiologists Should Know?**

Station #6

Bianca Guedes Ribeiro, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose  
Pedro Daltro, MD, Rio De Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Tatiana M. Fazecas, MD, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Renata A. Nogueira, MD, Rio De Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Alessandra Anaissi, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Claudia R. Penna, MD, Rio De Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Taisa D. Gasparetto, MD, PhD, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Leise Rodrigues, Rio De Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Geraldo Juca, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose  
Heron Werner, MD, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose

### **TEACHING POINTS**

A variety of conditions involving the testicles may have similar clinical manifestations. Acute scrotal disorders, cryptorchidism and scrotal masses are the three typical clinical manifestations in children and the ultrasound (US) provides distinguish these conditions and their different degrees. A frequent request for pediatric scrotal examination is the nonpalpable testes and the evaluation may include the inguinal and abdominal sonograms. The acute scrotal pain can be caused by torsion of the spermatic cord, torsion of appendages or orchitis-epididymitis. Scrotal masses are categorized on intratesticular or extratesticular. Germ tumors are pediatric common testes tumors of whom the most common is the yolk sac tumor, followed by the teratoma, Leydig cell and Sertoli cell tumors.

### **TABLE OF CONTENTS/OUTLINE**

1-Anatomy 2-Scanning US protocol in children 3-Clinical manifestations and imaging of pediatric scrotal disorders: 3.1 Nonpalpable testis: - Incompletely descended; - Ectopic. 3.2 Acute scrotal disorders: - Torsion of the spermatic cord; - hydatid torsion; - epididymitis-orchitis. 3.3 Scrotal masses: - Intratesticular (germ cells tumors, sex cord-stromal tumors, endodermal sinus tumor, metastasis from neuroblastoma) - Extratesticular (spermatic cord cyst, spermatic cord and scrotal neurofibroma, leukemia, inguinal hernia, giant chronic hydrocele) 4-Discussion

## **PD174-ED- SUB7      Pediatric Kidney Transplant Biopsy: The 'Core' Essentials**

Station #7

### **Awards**

#### **Certificate of Merit**

#### **Participants**

Saveen Ahuja, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose  
Marsha M. Lee, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose  
Andrew S. Phelps, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose  
Johanna M. Chang, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose  
John D. MacKenzie, MD, San Francisco, CA (*Abstract Co-Author*) Research Grant, General Electric Company  
Jesse L. Courtier, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

### **TEACHING POINTS**

Ultrasound-guided biopsy of pediatric kidney transplants can be technically challenging and while complication rates are overall low, these can arise and may result in significant morbidity and mortality. The purpose of this educational exhibit is to: Identify indications for and contraindications to kidney transplant biopsy in children Review the procedure and techniques for kidney transplant biopsy (including intraperitoneal transplants) Review common immediate post-procedure complications and management options

### **TABLE OF CONTENTS/OUTLINE**

Using original images and figures from our institution, this exhibit will review important concepts in ultrasound-guided renal transplant biopsy including: Introduction: -Background on renal transplantation in children Institutional approaches - Indications/contraindications to transplant biopsy Technique Pre-biopsy imaging (pearls on what to look for) Positioning and approach (techniques on difficult biopsies) Equipment checklist Biopsy performance/ultrasound image optimization frame rate optimization use of crossbeam Determination of sample adequacy Complications and management Hematoma A-V fistula Pseudoaneurysm

**Pediatric Series: Fetal/Neonatal**

Sunday, Nov. 29 2:00PM - 3:30PM Location: S102AB

GU

OB

MR

PD

AMA PRA Category 1 Credits™: 3.25  
ARRT Category A+ Credits: 4.00

**Participants**Daniela Prayer, MD, Vienna, Austria (*Moderator*) Nothing to DiscloseAmy R. Mehollin-Ray, MD, Houston, TX, (armeholl@texaschildrens.org) (*Moderator*) Nothing to Disclose**Sub-Events****RC113-01 Fetal MRI of Genitourinary Tract Abnormalities**

Sunday, Nov. 29 2:00PM - 2:20PM Location: S102AB

**Participants**Ann M. Johnson, MD, Philadelphia, PA, (johnsona@email.chop.edu) (*Presenter*) Nothing to Disclose**LEARNING OBJECTIVES**

1) Learn basic fetal MRI techniques and relevant embryology. 2) Understand what fetal MRI can add in evaluation of genitourinary (GU) abnormalities. 3) Become familiar with patterns of fetal GU abnormalities with an emphasis on complex lesions affecting multiple organ systems, such as cloacal malformation spectrum and exstrophy. 4) The purpose of the course is to understand the potential role of fetal MRI in the evaluation of fetal genitourinary tract abnormalities. There will be an emphasis on complex lesions affecting multiple organ systems, such as cloacal malformation spectrum and exstrophy.

**RC113-02 Novel Nanoparticle Gd Contrast Agent Does Not Penetrate the Placental Barrier**

Sunday, Nov. 29 2:20PM - 2:30PM Location: S102AB

**Participants**Anil N. Shetty, PhD, Houston, TX (*Presenter*) Nothing to DiscloseKetan B. Ghaghada, PhD, Houston, TX (*Abstract Co-Author*) Nothing to DiscloseRobia Pautler, PhD, Houston, TX (*Abstract Co-Author*) Nothing to DiscloseWesley Lee, MD, Houston, TX (*Abstract Co-Author*) Research support, General Electric Company Research support, Koninklijke

Philips NV Research support, Siemens AG Research support, Samsung Electronics Co Ltd

Haijun Gao, PhD, Houston, TX (*Abstract Co-Author*) Nothing to DiscloseChandra Yallampalli, DVM, PhD, Houston, TX (*Abstract Co-Author*) Nothing to DiscloseDavid Rendon, PhD, Houston, TX (*Abstract Co-Author*) Nothing to DiscloseAnanth Annapragada, PhD, Houston, TX (*Abstract Co-Author*) Stockholder, Marval Pharma Ltd Stockholder, Alzeca Biosciences LLC

Stockholder, Sensulin LLC Stockholder, Abbott Laboratories Stockholder, Johnson &amp; Johnson

**PURPOSE**

Gd contrast agent usage in placental imaging is generally contraindicated, for concerns related to fetal contrast agent exposure. We therefore developed a novel liposomal Gd nanoparticle contrast agent for T1-MRI, retaining the Gd on the maternal side, thus shielding the fetus from potential toxicities. In this study, we tested this agent in placental imaging in a mouse model, and measured its transplacental permeability.

**METHOD AND MATERIALS**

Female C57BL/6 mice, pregnant at gestational age E16.5±1 days, were imaged by T1-MRI on a 9.4T small animal MRI (Bruker Instruments) using a conventional contrast agent (Multihance, a meglumine salt of Gd-BOPTA chelate) (13 mice) and using the novel nanoparticle Gd agent (9 mice). DCE-MRI was conducted using consecutive 3D-SPGRE sequences at a constant flip angle of 16°, TE/TR=1.93ms/6ms, FOV = 3x3x2.5cm, matrix = 128x128x16. Each image was converted to a T1 map, and the contrast agent concentration on a pixel-by-pixel basis, estimated from the known relaxivity. After imaging, the mice were sacrificed and the Gd content of the placenta and fetus measured using ICP-AES.

**RESULTS**

Image and data shown below are representative of each cohort. The placentae are rather small (2mmx3mm) but are still clearly defined, and obviously not invasive into the uterine wall. Signal intensities in the placental and fetal ROI's, indicative of Gd concentration in each compartment, clearly show that the conventional Gd chelate agent penetrates the placental barrier and enters the fetus. The nanoparticle agent however, does not do so, indicated by zero signal in the fetal compartment throughout the duration of this experiment. The ICP-AES study confirmed the imaging study results, with no detectable Gd in the fetal compartment. A separate study in human placentae using an ex vivo perfused placenta preparation, also confirmed these results.

**CONCLUSION**

The nanoparticle contrast agent does not penetrate the placental barrier in a mouse model. The data are consistent with separate tests on a perfused human placenta model.

**CLINICAL RELEVANCE/APPLICATION**

The incidence of placenta accreta has increased 8-fold in the last 30 years, and improved methods for placental imaging are sorely needed. Nanoparticle Gd contrast agents described in this work could be useful for placental imaging, while maintaining fetal safety.

**RC113-03 Normal and Abnormal Development of the Cerebellar Vermis - A Quantitative Fetal MRI Study**

#### Participants

Gregor Kaspran, MD, Vienna, Austria (*Presenter*) Nothing to Disclose  
Gregor Dovjak, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose  
Peter C. Brugger, MD, PhD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose  
Gerlinde Gruber, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose  
Georg Langs, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose  
Michael Weber, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose  
Ernst Schwartz, MSc, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose  
Dieter Bettelheim, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose  
Daniela Prayer, MD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Postnatal neurodevelopmental outcome of fetuses with hindbrain malformations is dependent on normal growth and development of the cerebellar vermis. This comparative in vivo and post mortem fetal MRI study aims to quantitatively assess the relative dimensions of respective vermian lobules between 18 to 32 gestational weeks (GW) in normal and pathological conditions.

#### METHOD AND MATERIALS

75 fetuses (18-32 GW, mean 25.7GW) with normal brain development and 20 fetuses with different types of hindbrain malformations were scanned prenatally (1.5T, T2-TSE, voxel size 0.72/0.72/4.4mm - 1.0/1.0/4.4mm) and seven fetuses (16-30GW, mean 21.9GW, 3T, CISS sequence, resolution: 0.33/0.33/0.33mm) scanned within 24 hours postmortem were selected for postprocessing. A T2-weighted midline sagittal slice was identified and 2D vermian segmentation was performed using ITK snap (Figure).

#### RESULTS

The mean proportional size of 7/9 discriminable vermian lobules did not differ between in vivo and post mortem measurements. The relative size of the following lobules increased during gestation (Pearson,  $p < 0.05$ ): Culmen ( $r^2 = .460$ ) and Declive/Folium/Tuber ( $r^2 = .453$ ). The proportions of Lingula ( $r^2 = -.439$ ), Centrum ( $r^2 = -.554$ ), Pyramis ( $r^2 = -.303$ ) and Nodulus ( $r^2 = .491$ ) decreased with gestational age. The relative size of the Uvula did not show age specific changes ( $p = .201$ ). Certain types of hindbrain malformations showed common patterns of cerebellar lobular hypoplasia.

#### CONCLUSION

Fetal vermian lobulation can be accurately assessed by MRI between 18 and 32GW in normal and pathological conditions in vivo. Growth of specific vermian lobules is nonuniform during the second and third trimester. Distinct patterns of vermian lobular hypoplasia can be described antenatally.

#### CLINICAL RELEVANCE/APPLICATION

Knowledge about the distinct growth patterns of specific vermian lobules is helpful in the prognostic classification of fetal hindbrain malformations.

#### RC113-04 MRI-US Fusion Imaging in Real-Time Virtual Sonography for the Evaluation of Fetal Anomalies: Preliminary Stud

Sunday, Nov. 29 2:40PM - 2:50PM Location: S102AB

#### Participants

Silvia Bernardo, MD, Rome, Italy (*Presenter*) Nothing to Disclose  
Valeria Vinci, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose  
Matteo Saldari, MD, PhD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose  
Antonella Giancotti, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose  
Carlo Catalano, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose  
Lucia Manganaro, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose  
Camilla Aliberti, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Magnetic resonance imaging (MRI) and ultrasound (US) scanning complement each other in the screening and diagnosis of fetal anomalies. Real-time virtual sonography (RVS) is a new technique that uses magnetic navigation and computer software for the synchronized display of real-time US and multiplanar reconstruction MRI images. The purpose of this study was to evaluate the feasibility and ability of RVS to assess the main pathologies in fetuses with suspected US anomalies.

#### METHOD AND MATERIALS

This study was conducted over a two-month period march-april 2015 in 30 patients referred for a morphological fetal US-based evaluation. Patients undergone Fetal MRI at 1.5 T for fetal anomalies were offered fusion imaging (Hitachi HI Vision Ascendus). The MRI image dataset acquired at the time of the examination was loaded into the fusion system and displayed together with the US image on the same monitor. Both sets of images were then manually synchronized and image were registered using multiple planes MR imaging. The ability of this combined image (RVS imaging) to assess the main anatomical sites and fetal anomalies was evaluated and compared with standard B-Mode US and MRI images previously acquired.

#### RESULTS

In all cases RVS was technically possible, with a 100% match between MR images and US images. Data registration, matching and fusion imaging were performed in less than 15-20 minutes. On a total of 30 fetuses, 20 were for the encephalic district and 10 for the body (8 thoraco- abdominal; 2 heart). In all cases RVS was technically possible, with a 100% match between MR images and US images. In 10 cases of body abnormalities, fusion imaging helped the diagnosis in 20%. In the 10/20 cases of encephalic pathology, fusion imaging improved the diagnosis; in the other 10 cases MRI was superior to US even using the RVS.

#### CONCLUSION

The present work is a preliminary study on the feasibility and practical use of a Fetal MRI-US real-time fusion imaging. Thanks to

informations from both US and MRI, fusion imaging allows better identification of the different fetal pathologies and could improve the performance of ultrasound examination.

#### CLINICAL RELEVANCE/APPLICATION

Fusion imaging is feasible for the assessment of fetal abnormalities. Because it combines information from both US and MRI techniques, fusion imaging allows better identification of the different fetal pathologies.

#### **RC113-05 Predictive Value of the MRI-based Ratio of Fetal Lung Volume to Fetal Body Volume in Congenital Diaphragmatic Hernia in Comparison to the MR Fetal Lung Volume and the Sonographic Lung-to-Head Ratio**

Sunday, Nov. 29 2:50PM - 3:00PM Location: S102AB

##### Participants

Claudia Hagelstein, MD, Mannheim, Germany (*Presenter*) Nothing to Disclose  
Silke von Mittelstaedt, Mannheim, Germany (*Abstract Co-Author*) Nothing to Disclose  
Meike Weidner, Mannheim, Germany (*Abstract Co-Author*) Nothing to Disclose  
Christel Weiss, Mannheim, Germany (*Abstract Co-Author*) Nothing to Disclose  
Regine Schaffelder, MD, Mannheim, Germany (*Abstract Co-Author*) Nothing to Disclose  
Thomas Schaible, Mannheim, Germany (*Abstract Co-Author*) Nothing to Disclose  
Stefan O. Schoenberg, MD, PhD, Mannheim, Germany (*Abstract Co-Author*) Institutional research agreement, Siemens AG  
Wolfgang Neff, MD, PhD, Alzey, Germany (*Abstract Co-Author*) Nothing to Disclose

##### PURPOSE

To evaluate prognostic accuracy of the MRI-based ratio of fetal lung volume to fetal body volume (MR-FLV/FBV) in fetuses with congenital diaphragmatic hernia (CDH) and to compare it to established prognostic parameters (the observed-to-expected MR fetal lung volume [o/e-MR-FLV] and the US-based observed-to-expected lung-to-head ratio [o/e-LHR]) with regard to survival, extracorporeal membrane oxygenation (ECMO) requirement and development of a chronic lung disease (CLD).

##### METHOD AND MATERIALS

Fetal MRI was performed in 132 patients with isolated CDH (mean gestational age  $32.8 \pm 3.8$  weeks) to measure FLV and FLV/FBV. Sonographic assessment of the LHR was performed within three days before or after fetal MRI. To obtain parameters that were independent from gestational age, the o/e-MR-FLV and the o/e-LHR were calculated based on normal controls, whereas calculation of the MR-FLV/FBV is independent from normal controls.

##### RESULTS

91% of the neonates survived, 37% needed ECMO therapy and 45% developed a CLD. All prenatal parameters revealed an excellent correlation with patients' clinical outcome. MR-FLV/FBV, o/e-MR-FLV and o/e-LHR were significantly higher in survivors ( $p$  always  $<0.0001$ ). Patients with ECMO requirement and patients with CLD showed a significantly lower MR-FLV/FBV, o/e-MR-FLV or o/e-LHR ( $p$  always  $<0.0001$ ). Prognostic accuracy regarding survival was quite similar for the three parameters (AUC MR-FLV/FBV : 0.830, AUC o/e-MR-FLV : 0.868, AUC o/e-LHR : 0.845). Regarding ECMO requirement (AUC MR-FLV/FBV : 0.844, AUC o/e-MR-FLV : 0.843, AUC o/e-LHR : 0.736) and development of CLD (AUC MR-FLV/FBV : 0.778, AUC o/e-MR-FLV : 0.795, AUC o/e-LHR : 0.738) the MR-FLV/FBV and o/e-MR-FLV showed a slightly better prognostic accuracy compared to the o/e-LHR.

##### CONCLUSION

In CDH, assessment of pulmonary hypoplasia based on the MR-FLV/FBV, the o/e-MR-FLV or the o/e-LHR is quite similar in predicting survival. Regarding ECMO requirement and development of CLD, the o/e MR-FLV and the MR-FLV/FBV showed a slightly better prognostic accuracy compared to the US-based o/e-LHR. Compared to other prognostic parameters, MR-FLV/FBV has the advantage of being independent from the reference to a normal control group.

#### CLINICAL RELEVANCE/APPLICATION

In CDH, MRI-based MR-FLV/FBV and o/e-MR-FLV as well as US-based o/e-LHR are excellent and almost equivalent parameters to predict survival, ECMO-requirement and development of CLD.

#### **RC113-06 Correlation between Fetal and Postmortem Magnetic Resonance Imaging and Conventional Autopsy in the Detection of Fetal Abnormalities**

Sunday, Nov. 29 3:00PM - 3:10PM Location: S102AB

##### Participants

Matteo Saldari, MD, PhD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose  
Silvia Bernardo, MD, Rome, Italy (*Presenter*) Nothing to Disclose  
Carlo Catalano, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose  
Valeria Vinci, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose  
Lucia Manganaro, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose

##### PURPOSE

To compare Fetal and postmortem MRI and conventional autopsic findings in cases of major pathological abnormalities.

##### METHOD AND MATERIALS

In this prospective study we enrolled 128 fetuses with identified US findings of severe fetal malformations, with local research ethics committee approval. Among these, we performed 94 whole body Fetal MRI on 94 fetuses using a 1.5 T MR scanner and of these, only 89 women underwent termination of pregnancy because of the fetal abnormalities. Of the 89 patients, 80 (90%) consented to postmortem MRI alone; 59 (66%) women consented to both postmortem MRI and conventional autopsy and formed our study group. Following delivery, fetuses were stored in refrigerated compartments prior to MR imaging and autopsy. Also for the post-mortem imaging evaluation we acquired whole body MR imaging using a 1.5 T MR scanner. MR images were reviewed by a team of two radiologists blinded to the autopsic data. Pathologists who performed conventional autopsy were blinded to the MR data; autopsic data were considered the gold standard.

## RESULTS

Final autptic diagnoses were: polycystic kidney disease (n=15), diaphragmatic hernia (n=10), lissencephaly (n=4), type-2 Arnold-Chiari malformation (n=6), Dandy-Walker syndrome (n=13), cloacal malformation (n=1), anencephaly (n=1), holoprosencephaly (n=4), rhombencephalosynapsis (n=2), Walker-Warburg syndrome (n=2), schizencephaly (n=1).MRI-autopsy provided additional information in 10/59 (17%) compared to fetal MRI.In 6 cases (10%) conventional autopsy provided superior diagnostic information compared to MRI-autopsy. On the other hand, in 7 cases (12%) the disruption of the anatomy during autptic dissection of the fetal body couldn't allow a correct identification of the pathology.

## CONCLUSION

MR autopsy is accepted by nearly all mothers while conventional autopsy is accepted by about two-thirds of mothers, it provides similar information compared to conventional autopsy in case of fetal malformations and it allows the evaluation of the pathology in case of tissue disruption during the autptic evaluation.

## CLINICAL RELEVANCE/APPLICATION

Fetal MRI can add significant additional information and may be use to guide conventional autopsy

### RC113-07 Imaging of Ambiguous Genitalia

Sunday, Nov. 29 3:10PM - 3:30PM Location: S102AB

#### Participants

Jeanne S. Chow, MD, Boston, MA (*Presenter*) Nothing to Disclose

## LEARNING OBJECTIVES

1) The purpose of this course is to understand the important role of the radiologists in infants with ambiguous genitalia. Imaging techniques as well as important imaging findings will be detailed.

## ABSTRACT

RC124

## Pediatric MR: Normal or Not?

Sunday, Nov. 29 2:00PM - 3:30PM Location: N228

**GI** **MK** **NR** **MR** **PD**

AMA PRA Category 1 Credits™: 1.50  
ARRT Category A+ Credits: 1.50

### Participants

Geetika Khanna, MD, MS, Iowa City, IA (*Moderator*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Differentiate normal and abnormal signal intensity patterns of abdominal structures in children. 2) Recognize normal developmental variants that can simulate abdominal pathology.

### ABSTRACT

#### Sub-Events

#### RC124A Musculoskeletal MR

### Participants

Nancy A. Chauvin, MD, Philadelphia, PA, (chauvinn@email.chop.edu) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Describe the MR appearance of normal marrow conversion in the developing skeleton. 2) Identify common pediatric marrow pitfalls that might be mistaken for pathology. 3) Describe the MR appearance of common bone marrow abnormalities in children.

#### RC124B Brain and Spine

### Participants

Tina Y. Poussaint, MD, Boston, MA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Assess MR features associated with normal brain and spine development and maturation. 2) Identify abnormal MR imaging features associated with specific brain diseases and disorders of development in childhood.

### ABSTRACT

In pediatric neuroradiology, magnetic resonance imaging is used to assess central nervous system (CNS) disease in the infant, child, and teenager. This requires 1) an understanding of normal brain development and maturation from gestation through adolescence; 2) a technical mastery of the neuroimaging techniques that are used in evaluating brain diseases of childhood; and 3) an overall grasp of the imaging features of numerous brain pathologies, both acquired and congenital. This lecture will focus on the common MR imaging features of the normal pediatric brain and spine and will compare and contrast with MR imaging features in specific brain diseases and disorders of development.

#### RC124C Abdominal MR

### Participants

Geetika Khanna, MD, MS, Iowa City, IA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Differentiate normal and abnormal signal intensity patterns of abdominal structures in children. 2) Recognize normal developmental variants that can simulate abdominal pathology.

ED012-MO

## Pediatric Monday Case of the Day

Monday, Nov. 30 7:00AM - 11:59PM Location: Case of Day, Learning Center

PD

AMA PRA Category 1 Credit™: .50

### Participants

Ting Y. Tao, MD, PhD, Saint Louis, MO (*Presenter*) Nothing to Disclose  
Asef B. Khwaja, MD, Philadelphia, MO (*Abstract Co-Author*) Author, Reed Elsevier  
Elizabeth F. Sheybani, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose  
Shannon Farmakis, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose  
Luke L. Linscott, MD, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose  
Joan K. Zawin, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1) Recognize the importance of a multimodality approach in imaging pediatric patients. 2) Form appropriate differential diagnoses based on clinical information and imaging findings. 3) Recognize the clinical implications of diagnoses.



**Pediatric Series: MSK**

Monday, Nov. 30 8:30AM - 12:00PM Location: N230



ARRT Category A+ Credits: 3.50

AMA PRA Category 1 Credits™: 3.25

**Participants**

Andrea S. Doria, MD, Toronto, ON (*Moderator*) Consultant, Bayer AG; Consultant, Novo Nordisk AS; Consultant, Baxter International Inc

Tal Laor, MD, Cincinnati, OH (*Moderator*) Nothing to Disclose

Siddharth P. Jadhav, MD, Houston, TX (*Moderator*) Nothing to Disclose

Sarah D. Bixby, MD, Boston, MA (*Moderator*) Nothing to Disclose

**Sub-Events****RC213-01 Magnetic Resonance Imaging of Children with Juvenile Idiopathic Arthritis**

Monday, Nov. 30 8:30AM - 8:50AM Location: N230

**Participants**

Tal Laor, MD, Cincinnati, OH (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

1) To review the nomenclature and criteria for the diagnosis of juvenile idiopathic arthritis (JIA) in children. 2) To recognize the sites in children commonly affected by JIA. 3) To illustrate the spectrum of abnormalities identified with magnetic resonance imaging in children with JIA.

**ABSTRACT****RC213-02 Predictive Value of Magnetic Resonance Imaging in Clinically Inactive Juvenile Idiopathic Arthritis?**

Monday, Nov. 30 8:50AM - 9:00AM Location: N230

**Participants**

Charlotte M. Nusman, MSc, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose

Robert Hemke, MD, PhD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose

Cristina Lavini, DPhil, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose

Dieneke Schonenberg-Meinema, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose

Marion Van Rossum, MD, PhD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose

Koert M. Dolman, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose

Merlijn van den Berg, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose

Taco Kuijpers, MD, PhD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose

Mario Maas, MD, PhD, Utrecht, Netherlands (*Abstract Co-Author*) Nothing to Disclose

Mirkamal A. Tolend, BSc, Toronto, ON (*Presenter*) Nothing to Disclose

**PURPOSE**

The value of subclinical synovitis on magnetic resonance imaging (MRI) in clinically inactive patients with juvenile idiopathic arthritis (JIA) is yet to be unraveled. This study was performed to determine whether (dynamic) contrast-enhanced MRI parameters of a previously affected target joint in patients with clinically inactive JIA can predict a flare of joint inflammation during 2-year follow-up.

**METHOD AND MATERIALS**

Thirty-two JIA patients with clinically inactive disease at the time of MRI of the knee were prospectively included. Dynamic contrast-enhanced (DCE) MRI provided both descriptive measures and time-intensity-curve shapes, representing functional properties of the synovium. Conventional MRI outcome measures included validated scores for synovial hypertrophy, bone marrow edema, cartilage lesions and bone erosions. During a 2-year period the patients were examined at regular time points and clinical flares were registered.

**RESULTS**

MRI analysis revealed synovial hypertrophy in 13 (39.4%) of the clinically inactive patients. Twelve patients (37.5%) had at least one flare during 2-year clinical follow-up. Median time-to-flare was 0.68 years (IQR 0.18-1.97) and 50% of the flaring patients did so within the first 6 months (Figure 1). Persistently inactive and flaring patients differed significantly in the maximum enhancement of the DCE-MRI ( $p < 0.05$ ), whereas no difference was found between these two groups in any of the baseline scores of conventional MRI.

**CONCLUSION**

Our prospective clinical follow-up study indicates that the assessment of 'maximum enhancement' upon DCE-MRI may be able to predict a clinical flare within 2 years in inactive JIA patients. In the future, functional imaging biomarkers, such as DCE-MRI can be combined with serum markers or gene profiling data, leading to the construction of a predictive model to more precisely decide about treatment strategies in any individual patient.

**CLINICAL RELEVANCE/APPLICATION**

The presence of a relatively high maximum enhancement on dynamic contrast-enhanced MRI of the knee in clinically inactive patients with juvenile idiopathic arthritis indicates a risk of flaring.



## RC213-03 Periosteal Entrapment in Salter-Harris Injuries: Too Much on the Plate

Monday, Nov. 30 9:00AM - 9:10AM Location: N230

### Participants

Peter H. Van Geertruyden, MD, Fort Belvoir, VA (*Abstract Co-Author*) Nothing to Disclose  
William B. Morrison, MD, Philadelphia, PA (*Presenter*) Consultant, General Electric Company Consultant, AprioMed AB Patent agreement, AprioMed AB Consultant, Zimmer Holdings, Inc  
Adam C. Zoga, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose  
Timothy G. Sanders, MD, Keswick, VA (*Abstract Co-Author*) Nothing to Disclose  
Jana M. Crain, MD, Atherton, CA (*Abstract Co-Author*) Nothing to Disclose  
Brendan T. Doherty, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To present a series of Salter-Harris injuries with periosteal entrapment, to better understand incidence and distribution, appearance and potential complications with regard to healing.

### METHOD AND MATERIALS

Two musculoskeletal radiologists retrospectively reviewed 142 MRI exams with Salter-Harris injuries from 2007 to present for the presence of periosteal entrapment. Evaluation included Salter-Harris grade, location, presence of periosteal entrapment, and degree of entrapment measured in distance extending within the physis. Available follow-up imaging findings and clinical evaluations were recorded.

### RESULTS

Of 144 Salter-Harris injuries on MRI, 59 cases were type I injuries, 48 cases were type 2 injuries, 20 cases were type 3 injuries, 14 cases were type 3 injuries, and 3 cases were type 5 injuries. The most common location for type I injuries was the distal fibula. The most common location for type 2 injuries was the distal radius. Type 3 and 4 Salter-Harris injuries showed no particular location preference. Of the 144 cases, 96 cases were in boys and 48 in girls. Average age of boys was 13 years, 9 months. The average age for girls was 12 years, 4 months.

### CONCLUSION

Periosteal entrapment is observed in 7% of Salter-Harris injuries by MRI; entrapment is an under-reported phenomenon in current literature. In our series periosteal entrapment occurred most commonly at the distal tibia and fibula. Continued follow-up will reveal whether premature physeal arrest/growth disturbance is associated with periosteal entrapment.

### CLINICAL RELEVANCE/APPLICATION

To make aware the frequency and potential implications of periosteal entrapment in Salter Harris fractures.

## RC213-04 Plastic Bowing Fractures of the Pediatric Forearm: Evaluation of a Novel Computer Aided Method for Detection

Monday, Nov. 30 9:10AM - 9:20AM Location: N230

### Participants

Uygar Teomete, MD, Miami Beach, FL (*Presenter*) Nothing to Disclose  
Yuwei Zhou, Coral Gables, FL (*Abstract Co-Author*) Nothing to Disclose  
Ozgur Dandin, MD, Bursa, Turkey (*Abstract Co-Author*) Nothing to Disclose  
Weizhao Zhao, Coral Gables, FL (*Abstract Co-Author*) Nothing to Disclose  
Taner Dandinoglu, Bursa, Turkey (*Abstract Co-Author*) Nothing to Disclose  
Onur Osman, PhD, Istanbul, Turkey (*Abstract Co-Author*) Nothing to Disclose  
Ulas Bagci, PhD, MSc, Orlando, FL (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

(1) To develop a computer aided diagnosis (CAD) system for detection of plastic bowing fractures of the pediatric forearm and (2) to compare its feasibility with respect to the radiologists' interpretation.

### METHOD AND MATERIALS

Following IRB approval, we retrospectively analyzed the forearm radiographs of the patients presenting to the pediatric emergency room following trauma. We included a total of 55 pediatric patients from all age groups. We used morphological operations to extract the forearm diaphyseal features. In geometry, the radius of curvature,  $R$ , is a measure of the radius of the circular arc which best approximates the curve at that point. Along with the border of the bone, at every point, the more "bending" of the curve, the smaller of the radius of curvature; the "flatter" of the curve, the bigger of the radius of curvature. Average of  $R$  increases with increased bowing level. Curvature of the radial and ulnar diaphyses were calculated for the normal patients with normal interpretation and for the patients with plastic bowing fracture. Leave one out cross validation scheme was used for avoiding bias in our evaluations. Results were compared with the radiologist's interpretation. t-test was used to determine statistical significance level.

### RESULTS

Curvature values were obtained from our CAD method in the training step. With a sensitivity of 80% in detecting plastic bowing fractures, we recorded 92% specificity. When compared to radiologists' conventional readings, we did not find significant differences between the proposed method and the radiologists' reading using t-test ( $p > 0.05$ ).

### CONCLUSION

The proposed automated computer aided detection method can be used as a second opinion to aid the radiologist's decision making by highlighting the suspicious regions for plastic bowing fracture. To best of our knowledge, this is the first attempt towards automatizing quantitative evaluation of pediatric buckle fractures from radiographs.

## CLINICAL RELEVANCE/APPLICATION

Our CAD method is fast, effective and reliable. It can be used as a standalone application or as a plugin to the PACS viewer in a radiology workstation. Its use as a second opinion may obviate the need to obtain additional radiographs of the contralateral forearm for comparison, preventing unnecessary radiation exposure to the child.

### RC213-05 Growth Recovery Lines are More Common in Infants at High- vs. Low-risk for Abuse

Monday, Nov. 30 9:20AM - 9:30AM Location: N230

#### Participants

Matthew A. Zapala, MD, PhD, Boston, MA (*Presenter*) Nothing to Disclose  
Andy Tsai, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Paul K. Kleinman, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Growth recovery lines (GRLs), AKA growth arrest, Harris, and Parks lines are transverse radiodense metaphyseal bands believed to be due to a temporary arrest of enchondral ossification-caused by local or systemic insults such as intermittent illness and malnutrition. The purpose of this study was to determine if GRLs are more common in infants at high- vs. low-risk for abuse.

#### METHOD AND MATERIALS

The reports of initial high detail ACR compliant skeletal surveys done at a large pediatric hospital between 1999 and 2013 were reviewed, along with the relevant clinical records. Infants were considered at low-risk for abuse if they had a skull fracture without significant intracranial injury (ICI) on CT, a history of a fall and the determination of Child Protection Team (CPT)/social work assessment. High risk infants had significant ICI, retinal hemorrhages, skeletal injuries (other than skull fractures) and the determination of risk by CPT/social work assessment. There were 53 low-risk infants (age range, 0.4-12 months; mean, 4.7 months) and 21 high-risk infants (range, 0.8-9.1; mean, 4.2). Using a 4 point Likert scale, a pediatric radiology attending and fellow independently evaluated the frontal radiographs of the lower extremities from the skeletal surveys for the presence of at least one GRL involving the distal femurs/tibias. The data were pooled and differences between the two groups were calculated.

#### RESULTS

Intra- and inter-reader agreement was very good (Cohen's kappa inter-reader = 0.77 and intra-reader = 0.82 and 0.84). The relative prevalence of GRLs in the low-risk groups was 38% (SD 8%, reader 1 = 17/53, reader 2 = 23/53) vs. 71% (SD 7%, reader 1 = 16/21, reader 2 = 14/21) in the high-risk group ( $p < 0.001$ , odds ratio 4.1, 95% CI 1.8 to 9.8).

#### CONCLUSION

GRLs are encountered at a significantly higher rate in infants at high- vs. low-risk for abuse. This difference may reflect the response of enchondral ossification to intermittent stresses associated with abusive events. However, since healing classic metaphyseal lesions may appear as radiodense transverse metaphyseal bands, some of the apparent GRLs in the high-risk group may reflect the residua of inflicted metaphyseal injury.

## CLINICAL RELEVANCE/APPLICATION

GRLs may carry special significance when encountered in infants with suspected abuse. The possibility that some apparent GRLs may in-fact reflect healing occult metaphyseal injuries deserves further study.

### RC213-06 Definition of a Scoring System for Assessment of Skeletal Age Using MRI of Hand and Wrist in Healthy Males and Females Children: Gender Differences

Monday, Nov. 30 9:30AM - 9:40AM Location: N230

#### Participants

Milvia Martino, MS, Rome, Italy (*Presenter*) Nothing to Disclose  
Rosa Maria Ammendola, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose  
Ernesto Tomei, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose  
Sofia Battisti, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose  
Richard C. Semelka, MD, Chapel Hill, NC (*Abstract Co-Author*) Research support, Siemens AG.; Consultant, Guerbet SA.  
Iacopo Carbone, MD, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose  
Carlo Catalano, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Magnetic Resonance Imaging (MRI) of hand and wrist is a radiation free tool used to create a gender specific scoring system method for the skeletal age (SA) estimation in the healthy pediatric population.

#### METHOD AND MATERIALS

96 healthy young male (chronological age (CA) 1y6mo to 19y) and 108 females (CA range 4y to 19y) were enrolled. 9 bones of the wrist and hand have been analyzed at different stages of the skeletal maturation detecting different pattern of growth among tubular and carpal bones based on several anatomic features of the cartilaginous and osseous component. Two operators first in consensus and after 6 months blinded from CA established a MRI scoring system. Correlation between CA and MRI bone age estimation was determined with Pearson coefficient ( $R^2$ ). Spearman's correlation coefficient ( $r$ ) was used to analyze each carpal and tubular bones stages development.

#### RESULTS

A significant linear correlation ( $R^2$ ) between MRI bone age estimation and CA was demonstrated in males ( $R^2 = 0.976$ , A operators in consensus,  $R^2 = 0.978$  B first operator in the double-blind,  $R^2 = 0.977$  C second operator in double-blind) and females ( $R^2 = 0.9694$ , operators in consensus,  $R^2 = 0.9751$  B first operator double-blind,  $R^2 = 0.9710$  C second operator in double-blind). Radius and Ulna showed a stronger correlation with the skeletal age in both males and (Radius  $r = 0.96$ ; Ulna  $r = 0.963$ ,  $p < 0.0001$ ) females (Radius  $r = 0.975$ , Ulna  $r = 0.963720$   $p < 0.05000$ ). A good linear correlation was observed (males  $R^2 = 0.96$ ; females  $R^2 = 0.9472$ ) between the sum of scoring system assigned for each subject and the CA in years. The growth curve resulting from the correlation

between CA and SA shows in males 2 peaks than 3 observed in females and related to the growth spurt in the pubertal age following by phases of deceleration.

## CONCLUSION

The score system for MRI bone age estimation can be potentially used as a clinical tool to evaluate skeletal development. Males and females have patterns of maturation corresponding to a different clinical speed of growth. The MRI score system shows specific anatomical details characterizing the pubertal age when between the sexes there is a gap of about 2 years.

## CLINICAL RELEVANCE/APPLICATION

Bone age estimation is performed in pediatric patients with growth failure and advanced or delayed puberty maturation mainly covering the clinical areas of endocrine, skeletal and metabolic diseases.

### RC213-07 Pediatric Elbow MR

Monday, Nov. 30 9:40AM - 10:00AM Location: N230

#### Participants

John D. MacKenzie, MD, San Francisco, CA (*Presenter*) Research Grant, General Electric Company

#### LEARNING OBJECTIVES

1) Review developmental anatomy of the pediatric elbow as depicted by MRI. 2) Review technical imaging considerations when imaging the pediatric elbow with MRI. 3) Review unique lesions that occur at the pediatric elbow as depicted by MRI.

#### ABSTRACT

MRI presents an unique view into the detection and characterization of pediatric elbow pathology. Developmental changes at the pediatric elbow have a characteristic and predictable anatomy and it is important for the radiologist to understand the normal developmental appearance and separate this from pathology. Technical imaging considerations for high resolution MRI will be reviewed. Common pathologies unique to the pediatric elbow will be discussed and placed into context with their appearance on MRI.

### RC213-08 Imaging of Slipped Capital Femoral Epiphysis: From Early Diagnosis to Late Sequelae

Monday, Nov. 30 10:20AM - 10:40AM Location: N230

#### Participants

Delma Y. Jarrett, MD, Boston, MA, (delma.jarrett@childrens.harvard.edu) (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

1) Recognize imaging findings of SCFE using radiographs, MR, CT, and US. 2) Understand surgical management and normal post-operative appearance of SCFE. 3) Recognize imaging findings of immediate and delayed post-operative complications of SCFE.

### RC213-09 Absence of Rickets in Infants with Fatal Abusive Head Trauma and Classic Metaphyseal Lesions

Monday, Nov. 30 10:40AM - 10:50AM Location: N230

#### Participants

Jeannette M. Perez-Rossello, MD, Boston, MA (*Presenter*) Nothing to Disclose  
Anna McDonald, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Andrew E. Rosenberg, MD, Miami, FL (*Abstract Co-Author*) Nothing to Disclose  
Andy Tsai, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Paul K. Kleinman, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To determine if rickets is present in infant homicides with classic metaphyseal lesions (CMLs) and other skeletal injuries.

#### METHOD AND MATERIALS

This study was exempt from the institutional human subjects board review because the infants were all deceased. An archival review (1984-2012) was performed of the radiologic and histopathologic findings of 46 consecutive infant fatalities referred from the state Medical Examiner's Office for the evaluation of possible child abuse. Thirty infants with distal femoral histologic material were identified. Additional inclusion criteria were: 1) The medical examiner determined that the infant had sustained a head injury and that the manner of death was a homicide; 2) At least one CML was evident on skeletal survey; 3) CMLs were confirmed at autopsy; and 4) Non-CML fractures were also present. Nine infants (mean age 3.9 months, range: 1-9 months) were identified. Two pediatric radiologists independently reviewed the skeletal surveys for rachitic changes at the wrists and knees. A bone and soft tissue pathologist reviewed the distal femoral histologic sections for rickets.

#### RESULTS

There were no radiographic or pathologic features of rickets in the cohort.

#### CONCLUSION

Our findings provide no support for the view that the CML is due to rickets. Rather, they strengthen a robust literature that states that the CML is a traumatic injury commonly encountered in physically abused infants.

## CLINICAL RELEVANCE/APPLICATION

This work confirms the traditional view that the classic metaphyseal lesion is a fracture encountered in abused infants rather than a manifestation of rickets. The classic metaphyseal lesion is a characteristic fracture in child abuse and should be reported as such.

### RC213-10 Can Coronal STIR be Used as Screening for Acute Non-traumatic Hip Pain in Children?

#### Participants

Monica M. Forbes-Amrhein, MD, PhD, Zionsville, IN (*Presenter*) Nothing to Disclose

Matthew R. Wanner, MD, Zionsville, IN (*Abstract Co-Author*) Nothing to Disclose

Trenton D. Roth, MD, Indianapolis, IN (*Abstract Co-Author*) Institutional research support, Siemens AG; Institutional research support, Koninklijke Philips NV

Megan B. Marine, MD, Carmel, IN (*Abstract Co-Author*) Nothing to Disclose

Boaz Karmazyn, MD, Indianapolis, IN (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To evaluate if coronal STIR can be used as a screening test for acute non-traumatic hip pain in children

#### METHOD AND MATERIALS

A 4 year (2008-2012) retrospective analysis was performed of pediatric (age < 18 years) pelvic MRI studies. Only patients with the following indications were accepted; acute hip pain, limping, or refusal to bear weight. Exclusion criteria included known trauma, known pelvic pathology, and follow-up studies. Each study was anonymized. The coronal STIR series and later the full MRI studies, including all series, were reviewed in a randomized order independently by a pediatric radiologist (rad1) and a musculoskeletal radiologist (rad2). The full MRI study was considered the gold standard. Analysis of the interobserver variability on the negative and positive studies of the STIR only series was reported using Kappa statistics, and overall percentage agreement.

#### RESULTS

A total of 127 studies were included. 103 (83%) studies were positive by both radiologists. The most common pathologies that were identified by rad1 and rad2 were: hip effusion (63% and 57%), osteomyelitis (58% and 59%) and myositis (37% and 38%). 46% and 54% patients had more than one pathology. Using the full MR as the gold standard, the STIR-only series yields a sensitivity and specificity of 94% and 83% (rad1) and 94% and 67% (rad2). In 42% and 54% of the 97 true positive STIR-only studies, inconsistencies were found on the full MR scans, the most common of which were missed osteomyelitis (20% and 21% by rad1 and rad2) and myositis (7% and 13% by rad1 and rad2). The readers agreed on 111 (87.4%) coronal STIRs (95 abnormal; 16 normal), Kappa statistic is moderate, 0.59.

#### CONCLUSION

Coronal STIR of the pelvis has high sensitivity (94%) with good interobserver agreement in detecting pathology in children with acute hip pain. However, the study should be supervised by a radiologist and, when positive, a full MR study should be performed as it may change findings in 42% to 54% of cases.

#### CLINICAL RELEVANCE/APPLICATION

Coronal STIR MR can be used as a screening for evaluation of acute non traumatic hip pain in children. However, when positive, a full MR study should be performed as it can alter the findings in about half of the cases.

#### RC213-11 Utility of Post Intervention Hip Spica MRI, Retrospective Evaluation of Experience at a Large Children's Hospital

Monday, Nov. 30 11:00AM - 11:10AM Location: N230

#### Participants

Siddharth P. Jadhav, MD, Houston, TX (*Presenter*) Nothing to Disclose

Farahnaz Golriz, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

Wei Zhang, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

Vinitha Shenava, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

J. H. Kan, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

The objective of this study is to evaluate utility of post intervention hip spica MRI and to determine if there are pre-intervention predictors of failed reduction and need for reintervention. We also evaluate rates of reintervention after closed and open reduction.

#### METHOD AND MATERIALS

All patients who had hip spica MRI at our institution from 2008 to 2014 were retrospectively identified. This included 42 hips in 29 patients. Data was retrospectively reviewed including age at intervention, acetabular angle, degree of lateral and superoinferior displacement of the femoral head, intervention performed, MRI findings and need for reintervention. Wilcoxon scores were calculated and Wilcoxon two sample tests were performed to find correlation between age, acetabular angle, degree of lateral displacement and degree of superoinferior displacement and the need for re-intervention

#### RESULTS

Mean age at time of intervention was 20.1 months (range 4.7 to 63.8). Mean acetabular angle was 37.5 degrees (range 20-52). Mean lateral displacement was 11.2 mm (range 3-20mm) and mean superoinferior displacement was 5.7 mm (range 0-19mm). There was no correlation between age (P value=0.12), acetabular angle (P value=0.46), degree of lateral displacement (P value=0.82) and degree of superoinferior displacement (P value=0.54) and the need for re-intervention. Out of 19 hips that underwent closed reduction, 8 (42%) needed reintervention. Out of 23 hips that underwent open reduction, 1 (4%) needed reintervention but this could have been determined on the fluoroscopic images alone. Variables leading to a 42% rate of re-intervention in children who undergo closed reduction may be operator dependent or be related to extra-articular causes such as femoral version and biomechanical muscle imbalance.

#### CONCLUSION

Hip spica MRI is useful in determining need for reintervention after closed hip reduction. Value of MRI after open reduction is not clear since only 1 patient (4%) in our study needed reintervention after open reduction. This needs further evaluation. There is no correlation between age and pre-intervention imaging findings and the need for reintervention.

## CLINICAL RELEVANCE/APPLICATION

Post intervention hip spica MRI is useful in determining need for reintervention after closed hip reduction but its role after open reduction is questionable.

### RC213-12 Isolated Posteromedial Subtalar Coalitions: Incidence and Associated Morphologic Alterations of the Sustentaculum Tali

Monday, Nov. 30 11:10AM - 11:20AM Location: N230

#### Participants

Sarah D. Bixby, MD, Boston, MA (*Presenter*) Nothing to Disclose  
Delma Y. Jarrett, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Patrick Johnston, MSc, Cambridge, MA (*Abstract Co-Author*) Employee, Ora, Inc  
Susan Mahan, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Paul K. Kleinman, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To determine the prevalence and morphologic alterations of subtalar coalitions which lie entirely posterior to the middle facet (MF), AKA "posteromedial subtalar (PMST) coalition."

#### METHOD AND MATERIALS

After obtaining IRB approval, radiology records from 2004-2012 were reviewed to identify CT studies of patients with confirmed subtalar coalition. 97 subjects (48 male, 49 female, mean age 13.73 years) with subtalar coalition were identified. Electronic medical records were reviewed and symptoms of foot or ankle pain were confirmed in all subjects. In 41 (42%) subjects the coalition was bilateral. CT images of 138 subtalar coalitions were reviewed to determine site of coalition. In those patients with isolated PMST coalitions, multiplanar reformatted images along the long axis of the sustentaculum tali (ST) were generated, from which the antero-posterior dimensions of the ST and MF were measured. A posterior sustentaculum (PS) measurement was then calculated defining the posterior extension of the ST beyond the middle facet ( $PS = ST - MF$ ). Ratios of the MF to the PS measurements were calculated. 33 patients undergoing CT for triplane ankle fracture (21 male, 12 female, mean age 13.70 years) served as controls. Measurement were performed independently by two readers, and intra- and inter-reader reliability was estimated via a component of variance model.

#### RESULTS

97 of the 138 coalitions (70.2%) affected the MF and 2 (1.4%) involved the posterior facet. There were 39 (28.2%) isolated PMST coalitions identified in 33 patients (18 male, 15 female, mean age 14.07 years). The mean AP measurement of the MF and PS in the patients with PMST coalition were 12.70 mm and 15.90 mm, respectively, compared to 16.50 mm and 6.36 mm in the control population ( $p < 0.001$ ). The ratio of the MF to PS was 0.80 for PMST coalition patients versus 2.6 for controls ( $p < 0.001$ ).

#### CONCLUSION

In our cohort, 1/4 of all subtalar coalitions were of the PMST variety associated with an intact, but significantly shorter MF, and longer ST. This observation may aid in accurate diagnosis and provide insights into the morphogenesis of this relatively common disorder

## CLINICAL RELEVANCE/APPLICATION

The presence of a "normal" middle facet at imaging may lead to missed isolated PMST coalitions; the morphology of the ST and MF provide helpful imaging clues to the diagnosis.

### RC213-13 A Retrospective Study to Evaluate the Effect Recent Changes to NICE Guidelines Will Have on Imaging of the Paediatric Cervical Spine in Blunt Trauma in the UK

Monday, Nov. 30 11:20AM - 11:30AM Location: N230

#### Participants

Joseph Davies, MBBS, MRCS, London, United Kingdom (*Presenter*) Nothing to Disclose  
Sammy Anwuzia, BSC, MSc, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose  
Jane Evanson, MD, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose  
Susan Cross, MBChB, FRCR, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Paediatric cervical spine (c-spine) injury is a rare but devastating event. Imaging, particularly Computed Tomography (CT) is the investigation of choice to exclude injury. CT is however associated with increased thyroid radiation dose and risk of developing malignancy vs plain radiographs. Insufficient paediatric c-spine trauma data exists to produce robust imaging guidelines. There have been recent changes to NICE UK guidelines relating to evaluation of paediatric (<10 years) c-spine injury in trauma. We set out to investigate effects these changes have on the use of Computed Tomography (CT) in the investigation of c-spine injury

#### METHOD AND MATERIALS

5 year retrospective study of c-spine imaging in patients <10 years presenting to a level 1 trauma centre following blunt trauma. Data was collected relating to trauma mechanism, clinical presentation, radiologic evaluations and injury type. Patients with incomplete data were excluded. Criteria for c-spine CT in NICE head injury guideline 56 (CG 56) (GCS <8, inadequate plain radiographs, strong suspicion despite normal plain radiographs) and NICE head injury guideline 176 (CG176) (GCS <13, intubated, focal neurology, polytrauma, suspicion despite normal radiographs) were retrospectively applied to all cases with complete data to determine the proportion of patients requiring c-spine evaluation with CT.

#### RESULTS

278 patients underwent c-spine imaging and 217 had complete data. 80 patients met the criteria for a CT of the c-spine under CG 56, 4 of which had a significant c-spine injury. 1 patient with c-spine injury and a presenting GCS of 14 did not meet CG 56. 206 patients met the criteria for a CT under CG 176, 5 of which had a significant injury. Overall, there was one patient who presented



with significant c-spine injury who did not meet CG 56 guidelines, but falls under CG 176 criteria.

## CONCLUSION

CG 176 is more inclusive and if followed will result in higher proportion of paediatric blunt trauma cases being eligible for a c-spine CT without an initial plain radiograph series. Increased paediatric thyroid radiation exposure will result.

## CLINICAL RELEVANCE/APPLICATION

New guidelines are more sensitive for selecting c-spine injury, specificity is lower and results in potentially unnecessary thyroid irradiation. Further study is required to develop more robust paediatric trauma imaging guidelines.

### RC213-14 Three-Point Dixon Technique for Fat Quantification and for Identifying Wasting Progression Rate of Pelvic and Thigh Muscles in Duchenne Muscular Dystrophy

Monday, Nov. 30 11:30AM - 11:40AM Location: N230

#### Participants

Jing Du, MD, Beijing, China (*Presenter*) Nothing to Disclose  
Jiangxi Xiao, Beijing, China (*Abstract Co-Author*) Nothing to Disclose  
Xiaoying Wang, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose  
Ying Zhu, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose  
Fei Y. Li, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Three-point Dixon technique was applied to quantify fat fraction (FF) and identify the annual rate of disease progression of leg muscles in Duchenne muscular dystrophy (DMD).

## METHOD AND MATERIALS

This prospective study was approved by the Ethical Committee. Ninety boys with genetically and/or pathologically confirmed DMD were recruited. Imaging was performed with a 3-T unit by using a 32 channel phased-array coil. A quantitative water-fat separation method (IDEAL-Quant) was used. Imaging parameters were as follows: TR=6.3ms, TE=1ms, 6 echoes, bandwidth=111.11 kHz, FOV=32-40cm, slice thickness=7mm, matrix=160x160, flip angle= 3°, covering from the iliac crest to the knee, total imaging time=1min3sec. Images were processed on ADW4.6 workstation and FF of each muscle was calculated. The region of interest (ROI) was manually placed by tracing the outline of the individual muscle on the section level of the muscle belly. 18 muscles on each side were analyzed. Spearman correlation test was used to evaluate the correlation between age and FF. Linear correlation was used to show the relationship between age and FF.

## RESULTS

90 DMD boys aged 2-13 (mean 5.8 years) were enrolled. The gluteus maximus was the most severely infiltrated (mean FF 28.82%±19.96%), followed by the adductor magnus (mean FF 23.13%±22.47%). The least affected muscle was the obturator externus (mean FF 3.67%±1.13%). Positive correlation was obtained between FF value and age for all the muscles with correlation coefficient varied from 0.28 to 0.76. Significant correlation was seen in the gluteus maximus muscle ( $r=0.68$ ), adductor magnus ( $r=0.74$ ), and the quadratus femoris ( $r=0.74\sim0.76$ ). The muscle wasting progression can be calculated as  $(A + B \times \text{age})$ . A stands for a constant and B stands for annual progression rate varied from 0.3% to 6.1% for different muscles.

## CONCLUSION

IDEAL-Quant method can be used to quantitatively assess leg muscle fatty infiltration and identify muscle wasting progression in DMD patients.

## CLINICAL RELEVANCE/APPLICATION

IDEAL-Quant method can be used to quantitatively assess leg muscle fat infiltration in DMD. This method should be used to monitor disease severity and follow-up.

### RC213-15 Sports Injuries of the Pediatric Knee

Monday, Nov. 30 11:40AM - 12:00PM Location: N230

#### Participants

Jennifer Stimec, MD, Toronto, ON (*Presenter*) Nothing to Disclose

**Imaging Evaluation of Post-Radiation Therapy Normal Tissue Effects**

Monday, Nov. 30 8:30AM - 10:00AM Location: S403A



AMA PRA Category 1 Credits™: 1.50  
ARRT Category A+ Credits: 1.50

**Participants**

Gregory Videtic, MD, FRCPC, Cleveland, OH, (videtig@ccf.org) (*Moderator*) Nothing to Disclose

**Sub-Events****RC220A Post-radiation Therapy Lung Imaging****Participants**

Gregory Videtic, MD, FRCPC, Cleveland, OH, (videtig@ccf.org) (*Presenter*) Nothing to Disclose  
Michelle S. Ginsberg, MD, New York, NY (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

1) To review short term and long term changes following radiation therapy. Post SBRT changes will also be reviewed which can differ from more traditional conformal radiotherapy changes. 2) To distinguishing evolving post RT changes from recurrence which is critical in the follow up of these patients. Use of PET/CT in these cases will be discussed.

**ABSTRACT****RC220B Post-radiation Therapy Pediatric Body Imaging****Participants**

Ralph P. Ermoian, MD, Seattle, WA, (ralphpe@uw.edu) (*Presenter*) Nothing to Disclose  
R. Paul Guilleman, MD, Houston, TX (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Attendees will be able to list at least one common late body imaging finding associated with radiation treatment for Ewing sarcoma, Hodgkin lymphoma, Wilms tumor and transplant conditioning with total body irradiation. 2) Attendees will be able describe the relationship between dose and target volume in discussing late imaging findings on the musculoskeletal, hepatic and gastrointestinal systems.

**ABSTRACT**

With the improvement of outcomes of treatment for pediatric cancers, the number of long-term survivors continues to rapidly grow. Although the use of radiation therapy has generally declined over recent decades, it continues to play an essential role in treatment of many children with Wilms tumor, Ewing sarcoma, rhabdomyosarcoma, or Hodgkin lymphoma and some patients undergoing bone marrow transplant for leukemia. Though cured of their disease, long-term survivors often experience late-effects from radiation therapy with accompanying findings on body imaging. The session will describe late effects on multiple organ systems including musculoskeletal, gastrointestinal, and pulmonary, and relate the imaging findings to radiation techniques including dose and radiation fields.

**RC220C Post-radiation Therapy Liver Imaging****Participants**

Michael I. Lock, MD, FRCPC, London, ON, (michael.lock@lhsc.on.ca) (*Presenter*) Research Consultant, Accuray Incorporated; Speaker, AbbVie Inc  
Ashkan A. Malayeri, MD, Bethesda, MD, (ashkan.malayeri@nih.gov) (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Discuss the current literature on radiological liver changes induced by radiation. 2) Describe the incidence and long-term morphology/natural history of these changes. 3) Apply practical concepts that distinguish recurrence from normal changes in a growing subject area where evidence is just emerging.

**ABSTRACT**

Primary and secondary liver cancer is becoming a larger proportion of the radiology case load due to increasing incidence and the introduction of new treatment techniques. In particular, new radiotherapy techniques like stereotactic body radiotherapy (SBRT) are being applied routinely for hepatic lesions. However, SBRT induces changes that are difficult to distinguish from local recurrence. Many changes manifest over time and knowledge of the natural history of radiation changes is important. Some changes are transient and others are predictive of critical clinical outcomes. Radiologists are being pressured to provide clinical input as their opinions often result in significant changes in management. These management changes include high risk and expensive treatments. Therefore, we review the literature and provide practical case examples to assist radiologists in a) identifying normal changes b) determining the appropriate investigations with multidisciplinary input c) selecting appropriate predictive parameters for clinically important endpoints such as recurrence.

**ISP: Radiation Oncology (Pediatric Tumors, Lymphoma and Sarcoma)**

Monday, Nov. 30 10:30AM - 12:00PM Location: S104A



AMA PRA Category 1 Credits™: 1.50  
 ARRT Category A+ Credit: .50

**Participants**

Ralph P. Ermoian, MD, Seattle, WA (*Moderator*) Nothing to Disclose  
 David B. Mansur, MD, Cleveland, OH (*Moderator*) Nothing to Disclose

**Sub-Events****SSC11-01 Radiation Oncology Keynote Speaker: Perspectives in Lymphoma**

Monday, Nov. 30 10:30AM - 10:40AM Location: S104A

**Participants**

Martin Colman, MD, Houston, TX (*Presenter*) Nothing to Disclose

**SSC11-02 A Comparison Between VMAT, IMRT and GAP Techniques on the Meduloblastoma Approach: Different Technologies Aiming Better Patient Care**

Monday, Nov. 30 10:40AM - 10:50AM Location: S104A

**Participants**

Daniel Przybysz, MD, RIO DE JANEIRO, Brazil (*Presenter*) Nothing to Disclose  
 Felipe Erlich, rio de janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose  
 Maira Fabiana Neves, rio de janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose  
 Carlos Manoel Manoel Mendonca de Araujo, MD, rio de janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose  
 Celia Maria Paes Viegas, MD, rio de janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose  
 Denise Magalhaes, MD, rio de janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose

**ABSTRACT**

**Purpose/Objective(s):** To compare and analyze different types of treatment delivery (VMAT, IMRT and conventional 3D with GAP) to Meduloblastoma patients, intending to maximize disease's site proper dose without compromising noble structures that usually share boundaries with the tumor. **Materials/Methods:** 12 patients (age range 2-45 years old, mean 14 years) with biopsy proven diagnose of Meduloblastoma were assigned to Radiation Therapy with three different treatment techniques (VMAT, IMRT and conventional 3D with GAP) and planned to be treated with 36 Gy @ 20 fractions. The following organs at risk (OAR) were delineated: optic chiasm, optic nerves, lens, retinas, jaw, kidneys and vertebrae. All OAR's doses were optimized on IMRT and VMAT to be as low as possible, respecting the Quantec tolerance doses guidelines. PTV was set to be an outer margin of 5mm from CTV. We here used Varian's planning system Eclipse to delineate and establish treatment properties, along with the linear accelerator Trilogy (equipped with MLC Millennium 120) to deliver treatment. 6 MV photon energy was the standard for all patients. Conventional 3D technique used two fields on the spinal cord area, separated by a 1cm gap and two cranial fields with angulated collimator. Pencil Beam Convolution was the algorithm used. Sliding window technique was used for IMRT, where 3 fields were used on each superior and inferior site of the spinal cord. VMAT plans used a 359,8° arc. Collimator rotated to a 5° angle (355°). Standard doses were set up to treat 98% of PTV volume with 100% of the prescribed dose. We also used a heterogeneity index for all cases. **Results:** Data showed that 3D conventional technique and VMAT had a lower mean monitor unity (MU), meeting the recent literature published. 3D technique showed the highest homogeneity index, bringing a higher dose gradient variation to our patient. Mean dose values were in general lower for the VMAT technique. IMRT showed to be the safest treatment on delivery high doses without damaging vertebrae, lungs and/or the heart. Although, no significant difference was observed among patient's breasts regarding doses delivered. **Conclusion:** High technology treatment options have shown to be significantly important on the matter of delivering the correct dose to tumor area, preserving with a considerable safe margin noble tissues. New and upcoming techniques such as VMAT and IMRT should be strongly recommended in order to treat Meduloblastoma, having in mind that this disease has a great incidence in children and young adults - where aiming for the right target could mean better quality of life, overall survival and less toxicities.

**SSC11-04 Proton Therapy for Pediatric Hodgkin Lymphoma**

Monday, Nov. 30 11:00AM - 11:10AM Location: S104A

**Participants**

Justin Wray, MD, Gainesville, FL (*Presenter*) Nothing to Disclose  
 Bradford Hoppe, MD, Jacksonville Beach, FL (*Abstract Co-Author*) Nothing to Disclose

**ABSTRACT**

**Purpose/Objective(s):** The Children's Oncology Group upcoming protocol, AHOD1331, for pediatric high-risk Hodgkin lymphoma (HL) allows the use of proton therapy (PT). PT reduces the radiation dose to organs at risk, which should translate into fewer long term-side effects, yet minimal data exist on the use of PT in HL. The purpose of this study is to determine whether PT is an effective and safe treatment for pediatric HL. Herein, we present our institutional experience treating pediatric HL with PT. **Materials/Methods:** Between 2010 and 2014, 17 patients ages 18 years and younger were treated with PT for HL and enrolled on a prospective institutional review board-approved outcomes tracking protocol. Age distribution was as follows: 6-8 years, 3 patients (18%); 12-15 years, 5 patients (29%), and 16-18 years, 9 patients (53%). Nine patients (53%) were male and 8 (47%) were female. Stage distribution was as follows: stage I, 0 patients; stage II, 4 patients (23%); stage III, 7 patients (41%); stage IV, 3 patients (18%); and relapsed, 3 patients (18%). Thirteen (76%) had bulky mediastinal disease (X). The median axial bulky disease was 9 cm and the median cranio-caudal bulky disease was 13 cm. Eleven patients (65%) had high-risk disease (stages IIBX, IIIB, IVA, or B). All patients were evaluated using the Childhood Hodgkin International Prognostic Score (CHIPS) class 0-4. The CHIPS score



distribution consisted of 3 (18%) class 0, 4 (23%) class 1, 6 (35%) class 2, 3 (18%) class 3, and 1 (6%) class 4 patients. Total PT dose was a median of 21 Gy (RBE) (range, 15-36 Gy[RBE]), including 7 patients (41%) treated with a sequential boost. Of 14 de-novo patients, we obtained 11 PET and 12 CT images after 2 or 3 cycles of chemotherapy (mid-point). Seven patients (64%) had a partial response (PR) and 3 (36%) had a complete response (CR) on PET. Nine (75%) had a PR and 3 (25%) had CR on CT. Two of 3 (67%) recurrent patients achieved a PR on CT and PET and 1 patient achieved a CR before stem cell transplantation. Median follow-up for the cohort was 24 months (range, 4-52 months). Results: The 2-year overall survival rate was 93% and the progression-free survival rate was 80%. Three high risk patients recurred: 1 with an isolated in-field cervical lymph node and 2 recurred both in field and out of field. All recurrences were discovered within 5 months from completing PT. One patient with stage IVBx, CHIPS 4 died of a recurrence 7 months after treatment. The 2 other patients had stage IIBx and stage IVA disease, and both had mid-treatment PET-positive disease. No PT-related grade 3 or higher acute or late complications were observed according to CTCAEv4. Conclusion: Our results indicate that PT for pediatric HL is safe and effective in our generally unfavorable cohort of patients. In future studies, considerations will include increasing doses for patients with PET-positive disease at the midpoint of chemotherapy.

#### **SSC11-05 Risk Factors and Patterns of Lymph Node Involvement in Gastric Large B Cell Lymphoma: Implications for Target Definition**

Monday, Nov. 30 11:10AM - 11:20AM Location: S104A

Participants  
ximei zhang, Oak Brook, IL (*Presenter*) Nothing to Disclose

#### **ABSTRACT**

Purpose/Objective(s): To identify the appropriate radiation field in primary gastric diffuse large B-cell lymphoma (PG-DLBCL). Materials/Methods: The clinical and pathological findings of 48 PG-DLBCL patients treated with total gastrectomy and D2 lymphadenectomy were retrospectively analyzed. In addition, factors associated with lymph node involvement were also analyzed. Results: There were 26 patients with stage I disease, 14 patients with stage II and 8 patients with stage IIE disease. Lymph node involvement was identified in 37.5% of the whole series. Primary location, as well as the depth of invasion was significantly associated with lymph node involvement. The rate was rather low when gastric antrum was involved whereas when the whole stomach was involved, the rate could be as high as nearly 70%. The rate increased with the depth of invasion into stomach. Tumors invading into mucosa and submucosa, serosa and adjacent organs had a lymph node involvement rate of 0, 55.6% and 70%, respectively. When tumor was limited to the deep muscularis, the involved lymph nodes were all perigastric nodes. For tumors invaded upon muscularis, the involved lymph nodes were regional nodes. With a median follow up of 35 months, eight patients had developed progressive disease or a relapse, however, none of the patients who underwent adjuvant radiotherapy had disease progression or relapse. Conclusion: The radiation field for patients with PG-DLBCL is largely dependent on the primary location and depth of invasion. Large series as well as longer follow up are needed to further demonstrate the appropriateness of radiation volumes for PG-DLBCL.

#### **SSC11-06 Hypofractionated Radiation Therapy in the Evolving Paradigm of Treating Nasal-Type Extranodal Natural Killer/T-CELL Lymphoma**

Monday, Nov. 30 11:20AM - 11:30AM Location: S104A

Participants  
Amandeep Taggar, Oak Brook, IL (*Presenter*) Nothing to Disclose  
Douglas Stewart, MD, FRCPC, Calgary, AB (*Abstract Co-Author*) Nothing to Disclose  
Theresa Trotter, Calgary, AB (*Abstract Co-Author*) Nothing to Disclose  
Alexander G. Balogh, MD, MSc, London, ON (*Abstract Co-Author*) Nothing to Disclose

#### **ABSTRACT**

Purpose/Objective(s): Extranodal natural killer/T-cell lymphoma (ENKTL) is a rare and lethal malignancy with no consensus on its optimal management. External beam radiation (RT) is often used in its treatment with dosages of 45-50 Gy in 1.8-2.0Gy fractions delivered over 5 weeks. At our institution, a RT dose of 30 Gy in 3 Gy fractions over 2 weeks was introduced in 2006. Adjuvant therapies and autologous stem cell transplant (ASCT) were later introduced. It was hypothesized that this hypofractionated regimen would offer similar outcomes to the standard regimen, while shortening the duration of RT, because patients were progressing while on or shortly after the 5-week regimen. We look to describe our results by reporting on disease/treatment characteristics and survival outcomes in a cohort of patients treated in the era of 45-50 Gy and then with 30 Gy. Materials/Methods: The clinical records of patients presenting with ENKTL at our tertiary institution between 1999 and 2013 were retrospectively reviewed. Demographics, vital statistics, tumour characteristics and treatment parameters were extracted from the medical records. Results were examined using SPSSv.22 for both the descriptive analysis and survival. Non-parametric approaches including the Mann-Whitney U test was used to compare differences in outcomes between both groups. Results: The records of n=19 with nasal-type ENKTL were identified. Median age was 58.7 years. Median follow-up was 10.8 months (range(R): 4.4-43.9 months). Stage at presentation: 14 - stage I/II, 2 - stage IV and 3 - stage unknown. The observed median survival was 10.8 months. 2 year overall survival was 36%. N=17 received RT; n=10 received 30Gy in 10 fractions, n=1 received 35 Gy in 20 fractions and n=6 received 45 Gy in 25 fractions (of which 2 patients did not complete due to disease progression, and received 41.4 Gy in 25 and 36 Gy in 18 fractions). Among those patients who died, median time to death (MTD) was 7.2 months (R:5.4-29.8 months) for patients receiving the 30 Gy regimen versus 1.5 months (R:0.4-6.9 months) for those receiving standard dose-fractionation (p=0.05). In total, 12 patients received chemotherapy and 4 out of 12 subsequently received ASCT. All patients who proceeded to ASCT were treated with hypofractionated regimen. All patients who treated with RT plus ASCT are alive at a median follow-up of 42.4 months. N=7 of those receiving adjuvant chemotherapy relapsed, of which 2 had "in-field" recurrences. Median time to relapse was 12.4 months (R:6.5-19.4m) from diagnosis and 8.9 months (R:5.4-16.8 m) from the date RT. Conclusion: Patients treated in the post 2006 era of our hypofractionated regimen with 30Gy/10 fractions had improved OS outcomes compared to traditional dose fractionations. There remains a role for dose escalation to minimize in-field recurrences and more effective systemic agents to further delay relapses.

#### **SSC11-07 Prospective Absorbed Dose Based Combined Treatment Planning and Therapy Using 153Sm-EDTMP Radiopharmaceutical with External Beam Radiation Therapy in Metastatic Osteosarcoma Patients**

Monday, Nov. 30 11:30AM - 11:40AM Location: S104A

Participants

Robert Hobbs, Baltimore, MD (*Presenter*) Nothing to Disclose

Anders Josefsson, PhD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose

## ABSTRACT

**Purpose/Objective(s):** Metastatic osteosarcoma is a cancer of adolescents and young adults that has a very low survival rate. We present results and describe a methodology related to an ongoing trial designed to boost the radiation dose to lesions in cases where external beam radiation therapy (XRT) is limited by normal organ toxicity. We combine radiopharmaceutical therapy (RPT) using <sup>153</sup>Sm-EDTMP, an FDA approved bone seeking calcium mimetic with XRT, and provide a treatment plan that incorporates the dose from both modalities. **Materials/Methods:** Three patients have been treated thus far under this protocol. The patients first underwent stem cell harvesting, then received a 1 mCi/kg pre-therapeutic dose of <sup>153</sup>Sm-EDTMP and were imaged at 4, 24 and 48 h p.i. The in-house RPT treatment planning system, 3D-RD, was used to establish the maximum safe administered activity based on normal tissues absorbed dose (AD) constraints derived from RPT and the projected XRT treatment plan. One week after the pre-dose, a therapeutic dose, determined from the pre-therapeutic dosimetry and ranging from 10 - 15 mCi/kg of <sup>153</sup>Sm-EDTMP was administered, and the patients imaged at 4, 24 and 48 h p.i. The images were reconstructed with an iterative algorithm including count-rate saturation corrections. AD-maps and DVHs were generated using 3D-RD for the RPT part of the treatment. These were entered into the XRT treatment planning system, which was used to create a renewed combined RPT/XRT treatment plan that incorporated the real Sm-153 dose deposition. **Results:** Results for three patients will be shown. As an example for a pelvic tumor in patient 2: the AD delivered to the tumor by RPT was 25.5 Gy. The XRT plan was created based on the RPT plan and another 51.3 Gy was delivered to the tumor by XRT, resulting in a total tumor AD of 76.8 Gy. The AD to adjacent spinal cord from the combined treatments was 30.9 Gy, lower than the maximum tolerable AD of 52 Gy; the threshold dose of 75 Gy would not have been possible with XRT alone. **Conclusion:** The treatment planning protocol combining RPT and XRT for metastatic osteosarcoma in pediatric patients showed potential to treat a highly aggressive disease, while limiting the AD to normal organs to below potentially toxic thresholds.

## SSC11-08 Evaluation of the Response to Intratumor Implantation of Nanoparticles Activated by External Beam Radiation Therapy in Sarcoma by DCE-US and MRI: Radiologic-Pathology Correlation

Monday, Nov. 30 11:40AM - 11:50AM Location: S104A

### Participants

Samy Ammari, Villejuif, France (*Abstract Co-Author*) Nothing to Disclose

Laurent Dercle, MD, Villejuif, France (*Presenter*) Nothing to Disclose

Thierry Debaere, Villejuif, France (*Abstract Co-Author*) Consultant, Terumo Corporation; Speaker, Terumo Corporation; Consultant, Guerbet SA; Speaker, Guerbet SA; Consultant, General Electric Company; Speaker, General Electric Company; Proctor, Galil Medical Ltd

Sylvie Bonvalot, MD, Villejuif, France (*Abstract Co-Author*) Nothing to Disclose

Jean-Charles Soria, Villejuif, France (*Abstract Co-Author*) Nothing to Disclose

Nathalie B. Lassau, MD, PhD, Villejuif, France (*Abstract Co-Author*) Speaker, Toshiba Corporation; Speaker, Bracco Group; Speaker, Novartis AG; Speaker, Pfizer Inc; Speaker, F. Hoffmann-La Roche Ltd

### PURPOSE

Nanoparticles activated by external beam radiation therapy (EBR) are new drugs tested in phase 1 trial in patients with soft tissue sarcoma of the extremity and trunk wall. Using current thresholds, there is a poor agreement between RECIST1.1 and the response to treatment. We aimed to determine the predictive value of biomarkers measured on MRI and Dynamic contrast-enhanced ultrasound (DCE-US).

### METHOD AND MATERIALS

14 patients with a histological diagnosis of sarcoma received an injection of nanoparticles in a phase I study with NBTXR3. Once implanted in the tumor, they were activated by EBR (Day 2 until day 37). DCE-US and MRI (T1, T2, gadolinium) were performed at baseline and prior to the surgery (realized at 5 weeks). Biomarkers tested on MRI were: RECIST, WHO, Volumetric approach. Biomarkers tested on DCE-US were: Area Under Curve (AUC, quantitative) and DCE (Contrast enhancement in %, qualitative). A new biomarker: the percentage of tumor volume with increased T2-weighted signal (iT2%) or cystic on DCE-US was evaluated: Percentage of Cystic Volume (CV%). The reference standard for pathological response was based on the parameter of tumor cell viability expressed as a percentage of viable cells (PVC) in the global cell mass in the post-operative surgical specimen. Furthermore, the percentage of necrosis was evaluated. A  $p < .05$  was considered as statistically significant.

### RESULTS

At baseline 14MRI and only 12 DCE-US were analyzed. The estimation of the tumor volume by US ( $r=.85$ ) and MRI ( $r=.75$ ) was significantly correlated with the pathology specimen. CV% was significantly correlated with the PVC ( $r=.57$ ) and the percentage of necrosis ( $r=.65$ ). RECIST and the relative variation of volume were correlated with the PVC:  $r=.63$  and  $.57$ . The other biomarkers were not significantly correlated with the percentage of VC or of necrosis within the tumor volume.

### CONCLUSION

The response to a treatment with nanoparticles activated by EBR lead to the apparition of a cystic portion within the overall tumor volume (CV%) that may be evaluated non-invasively by either MRI or US. and is a good predictor of the percentage of tumor necrosis and of viable cells. Changes in volume (US and MRI) are correlated with the PVC and it suggests that an adaptation of thresholds might be necessary.

### CLINICAL RELEVANCE/APPLICATION

Nanoparticles activated by EBR are new drugs and RECIST1.1 is not a good predictor of the response to treatment. New biomarkers are needed.

## SSC11-09 Outcomes of Adjuvant Radiation Therapy for Retroperitoneal Soft Tissue Sarcoma

Monday, Nov. 30 11:50AM - 12:00PM Location: S104A

### Participants

Eric D. Miller, MD, PhD, Columbus, OH (*Presenter*) Nothing to Disclose

Nicole Andonian, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose

Xiaokui Mo, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose  
Karl Haglund, MD, PhD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose  
John C. Grecula, MD, Columbus, OH (*Abstract Co-Author*) Research Grant, Teva Pharmaceutical Industries Ltd; Research Grant, Soligenix, Inc;  
Douglas D. Martin, MD, Portsmouth, VA (*Abstract Co-Author*) Nothing to Disclose  
Meng X. Welliver, MD, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To evaluate outcomes of patients treated with adjuvant radiation therapy (RT) for retroperitoneal soft tissue sarcomas (RP STS) at our institution.

## METHOD AND MATERIALS

The medical records of 34 consecutive patients with RP STS treated definitively between 1998-2013 were reviewed. Survival analyses were conducted using the Kaplan-Meier method and subsets of patients were compared using the log rank test.

## RESULTS

Eighteen men and 16 women were included with a median age of 56 years (range 30-80). The most common histologies were liposarcoma (53%) and leiomyosarcoma (21%). The majority of patients had tumors >10 cm in size (53%). 26% of patients were stage III and 38% of patients were high grade. 21% of patients were treated for recurrent disease and 18% were treated for persistent disease after initial non-oncologic resection. All patients underwent resection and received RT as part of their treatment. 68% of patients had positive or close (<2 mm margins). 76% of patients completed external beam radiation therapy (EBRT). 62% of patients had RT delivered post-operatively with a median total dose of 45 Gy (range 39.5-54) and 38% of patients had pre-operative RT with a median total dose of 45 Gy (range 45-55). Intraoperative radiation therapy (IORT) was delivered in 82% of patients with 8 patients treated with IORT alone without EBRT. The median IORT dose was 12.5 Gy (range 10-15). At a median follow-up of 48 months (range 3-172), the 5-year LC, DFS, and OS rates were 62%, 50%, and 67%, respectively. 47% of patients ultimately failed with 35% failing locally, 15% failing distantly, and 3% failing both locally and distantly. RT timing delivered either pre- or post-operatively did not impact LC ( $p=0.68$ ), DFS ( $p=0.65$ ), or OS ( $p=0.46$ ). Patients with recurrent disease had reduced LC ( $p<0.0001$ ) and DFS ( $p<0.0001$ ) but no effect on OS ( $p=0.48$ ) was observed. There were no adverse effects on LC ( $p=0.23$ ), DFS ( $p=0.10$ ), or OS ( $p=0.27$ ) in patients who were treated after initial non-oncologic resection as long as they received definitive treatment afterwards.

## CONCLUSION

Patients with RP STS are most likely to fail locally. Based on our data, pre- vs. post-operative radiation and treatment following initial non-oncologic resection had no impact on outcomes. However, patients with recurrent disease were more likely to have a local or distant failure.

## CLINICAL RELEVANCE/APPLICATION

Patients with RP STS fail locally with worse outcomes for recurrent disease.

## Pediatric Monday Poster Discussions

Monday, Nov. 30 12:15PM - 12:45PM Location: PD Community, Learning Center

PD

AMA PRA Category 1 Credit™: .50

### Participants

Daniel J. Ashton, MD, Houston, TX (*Moderator*) Nothing to Disclose

### Sub-Events

#### PD210-SD- Shunt Series: Does it Change the Clinical Management in a Cost Effective Way MOA1

Station #1

### Participants

Katie S. Traylor, DO, Newark, DE (*Presenter*) Nothing to Disclose

Yakup Akyol, MD, Wilmington, DE (*Abstract Co-Author*) Nothing to Disclose

Arabinda K. Choudhary, MBBS, Wilmington, DE (*Abstract Co-Author*) Stockholder, General Electric Company;

Vinay V. Kandula, MBBS, Wallingford, PA (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To determine whether patient shunt status can be determined with MRI without the utilization of a shunt series and have the same clinical impact.

### METHOD AND MATERIALS

We retrospectively reviewed the medical record, shunt series radiographs and brain MRI imaging of 132 patients (mean age 8.6 ) with suspected ventriculoperitoneal shunt malfunction from January 2012 through May 2014 to determine if surgical shunt revision was performed. Shunt malfunction was defined as the performance of a shunt revision within 1 week of radiologic evaluation.

### RESULTS

A total of 132 patients had brain MRI imaging and 40 had corresponding shunt series radiographs. Fast MRI revealed ventriculomegaly in 9 patients whereas the corresponding shunt series only demonstrated an abnormality in 3 of these patients. 8 of these patients had the end result of a shunt revision which resulted in an improvement in the patients symptoms. Additionally, there were three patients that had normal fast MRI scans, however, the corresponding shunt series demonstrated an abnormality. After physical examination was completed by the neurosurgeon, it was felt that these shunt series abnormalities were not clinically significant to warrant a shunt revision.

### CONCLUSION

This study demonstrates that in the pediatric population with ventriculoperitoneal shunts and acute mental status change, the initial screening tool can be with MRI rather than with a shunt series or CT. This not only serves to decrease the radiation exposure to the child, it also dramatically decreases the cost.

### CLINICAL RELEVANCE/APPLICATION

Pediatric patients with ventriculoperitoneal shunts tend to have multiple imaging studies throughout the life of their shunt. This not only increases their overall radiation exposure throughout their young life, it also adds a substantial cost to healthcare dollars. This study demonstrates that when such a child is being assessed for shunt failure for the cause of their acute symptoms, a fast MRI can be completed initially to assess the lateral ventricles. If the lateral ventricles are non-enlarged, the patient's symptoms are likely not related to the shunt and other clinical causes can be sought. If the lateral ventricles are enlarged and felt to be the cause of the patient's symptoms, the patient's shunt can either be revised or the settings changed. Utilizing fast MRI yields no radiation exposure and cuts down on unnecessary imaging studies to cut costs.

#### PD211-SD- Functional MRI in Blind Children with Auditive Stimulus MOA2

Station #2

### Participants

Pilar Dies-Suarez, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose

Silvia Hidalgo-Tobon, PhD, Mexico City, Mexico (*Abstract Co-Author*) Nothing to Disclose

Benito De Celis IV, Puebla, Mexico (*Abstract Co-Author*) Nothing to Disclose

Eduardo Barragan, Mexico, Mexico (*Abstract Co-Author*) Nothing to Disclose

Porfirio Ibanez, MD, Mexico City, Mexico (*Abstract Co-Author*) Nothing to Disclose

Manuel Obregon, MD, Mexico City, Mexico (*Abstract Co-Author*) Nothing to Disclose

Rafael D. Maya, Mexico, Mexico (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

The objective of this study was to assess the differences in brain recruitment and connectivity when interpreting melodic and non-melodic music in a control and blind pediatric population

### METHOD AND MATERIALS

26 pediatric subjects were recruited for this study. N=13 were blind children and n=13 were controls with ages (average±standard deviation) of 12 ± 3 and 11.5 ± 2.5 respectively two sequences were run a T1weighted gradient echo sequence (anatomic) This sequence used 35 axial slices which covered the whole brain of pediatric volunteers including their cerebellum After an fMRI-BOLD sequence followed Data was acquired with a T2 gradient echo sequence MR parameters were TR= 3000 ms, TE= 35 ms, flip angle=

80°, matrix=64x64, in-plane resolution= 3.6x3.6 mmxmm, thickness=4 mm and NE=1. A total of 255 volumes per fMRI-BOLD experiment were acquired. Also every stimulation protocol started with white noise period which was not considered for image analysis later on.

## RESULTS

1-.Section obtained BOLD-fMRI volumes for the four different contrasts 2-.showed results of a connectivity study on the same contrasts. These calculations were based on correlations between ROI's. In general Blind and Controls showed similar connectivity when comparing music vs noise pointing towards similar interpretation processes between both groups. This trend was not followed in the Blind vs Control comparisons for music or noise in which large differences appeared. First an anterior prefrontal cortex connection to primary somatosensory (blind) and to the superior temporal (controls) appear as a strong correlation for music and noise interpretation (Network1) for both contrasts.

## CONCLUSION

In BOLD study the cerebellum played a big role in sound interpretation for both groups. Frontal lobe activations were strongly associated with music while temporal activations were found almost for all the sound stimuli. Regions of activation in the frontal and temporal lobes changed with the group and kind of stimuli applied. Blind volunteers seemed to have right hemisphere predominance contrasting with the left prominence in controls. For the connectivity study different networks of brain areas were involved in the musical or the noise interpretation depending on the kind of group studied.

## CLINICAL RELEVANCE/APPLICATION

Identified the differences in brain mechanism between control and blind pediatric population when interpreting melodic and non-melodic music.

### PD213-SD- The Use of Postmortem Computed Tomography (PMCT) in Assessing Pediatric Deaths MOA4

Station #4

#### Participants

Mary P. Harty, MD, Wilmington, DE (*Abstract Co-Author*) Nothing to Disclose  
Sharon W. Gould, MD, Wilmington, DE (*Presenter*) Nothing to Disclose  
Howard T. Harcke, MD, Dover AFB, DE (*Abstract Co-Author*) Nothing to Disclose  
Adrienne Sekula-Perlman, MD, Wilmington, DE (*Abstract Co-Author*) Nothing to Disclose  
Portia Kreiger, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose  
Arabinda K. Choudhary, MBBS, Wilmington, DE (*Abstract Co-Author*) Stockholder, General Electric Company;

## PURPOSE

Use of CT and MRI imaging in death investigation is increasing because it potentially provides useful non-invasive diagnostic information. We present the development process, operation and case experience of our hospital-based program.

## METHOD AND MATERIALS

Our institution has introduced the study of pediatric deaths using PMCT. Permission for PMCT is linked to the hospital autopsy request and may be permitted without agreeing to conventional autopsy. Medical Examiner (ME) cases require no parental permission. The protocol for whole-body imaging was selected to maximize resolution. The entire body and head are imaged helically in the transverse plane using 0.6 mm contiguous slices to produce isotropic voxels for optimal coronal and sagittal 2D and 3D reformats. A smaller FOV is used for the head. PMCT images are correlated with antemortem studies and/or autopsy when available.

## RESULTS

The State ME has utilized our hospital's services for pediatric cases they feel can benefit from PMCT before autopsy. Most ME cases are unexplained deaths where there is concern for non-accidental injury. Fetal and ICU death cases have also been imaged. Case studies to date have confirmed that interpretation of PMCT requires appreciation for the decomposition process. Findings described in adults are also observed in pediatric cases: for example, loss of gray-white differentiation, intravascular air, and hemoconcentration. Cases where PMCT identified a healing skull fracture not visible at autopsy guided focused histologic study that confirmed fracture presence. Fetal examinations have shown PMCT findings that can be used to determine live birth vs stillbirth. Cardiovascular and organ pathology have correlated with autopsy in cases of death from natural causes. PMCT can assess placement of devices used in medical therapy.

## CONCLUSION

PMCT correlation with autopsy has showed imaging is a valuable adjunct to the conventional autopsy and can provide information that impacts the determination of cause and manner of death. A PMCT program can be instituted with appropriate imaging protocols and the assistance and cooperation of the ME and hospital Pathology Department.

## CLINICAL RELEVANCE/APPLICATION

Postmortem imaging can provide useful information to clinicians and pathologists studying pediatric deaths.

### PD121-ED- Tips and Tricks to Evaluate the Urethra Through Serial Voidingurosonography (VUS): Making it Easy MOA6

Station #6

#### Awards

##### Certificate of Merit

#### Participants

Carmina Duran, MD, Sabadell, Spain (*Abstract Co-Author*) Nothing to Disclose  
Viviana P. Beltran Salazar, MD, Sabadell, Spain (*Presenter*) Nothing to Disclose  
Luis Riera Soler, MD, Sabadell, Spain (*Abstract Co-Author*) Nothing to Disclose  
Cesar Martin Martinez, MD, Sabadell, Spain (*Abstract Co-Author*) Nothing to Disclose  
Diego Preciado, MD, Sabadell, Spain (*Abstract Co-Author*) Nothing to Disclose  
Beatriz Consola, MD, Sabadell, Spain (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

- To provide tips and tricks for obtaining a voiding study of the urethra with high image quality in nearly 100% of patients. - To reaffirm the ease of observing the morphology and function of the urethra by urosonography.

## TABLE OF CONTENTS/OUTLINE

Several authors have demonstrated that the urethra can be studied through transperineal and/or transpelvic windows. In our 10 years' experience, we have obtained a correct morphological study of the urethra in 98 of VUS performed in infants and children, i.e. in a higher percentage than in voiding cystourethrography (the gold standard), which is 93% in some series. Here we detail the procedure, emphasizing key issues that may improve the results: Procedure before the test. Requirements for the technique. - Material. - Personnel. Carrying out the test. Imaging procedure. Image acquisition. Cases where we were unable to see the urethra. Pathologies.

## PD010-EB- Acquired Cystic and Cavitory Lung Diseases in Children MOA

Hardcopy Backboard

### Participants

Jin Seong Lee, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose  
Hee Mang Yoon, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Ahyoung Jung, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Young Ah Cho, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Chong Hyun Yoon, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

The purpose of this exhibit is:1. To describe the variable disease of acquired cystic and cavitory lung lesions. 2. To review the radiologic findings of acquired cystic and cavitory lung lesions in pediatric patients.3. To discuss the differential point between the acquired cystic and cavitory lung lesions

## TABLE OF CONTENTS/OUTLINE

IntroductionInfectious disease - bacterial infections: tuberculosis, septic emboli, pneumatocele - fungal infections: aspergillosis, mucormycosis, - Viral infections: CMV - Parasitic infection: ParagonimiasisNeoplastic conditions - PPB - LCH - metastasisMiscellaneous - LAM, LIP, Wegener's granulomatosis, Down syndrome - Bronchiectasis - Pulmonary interstitial emphysema - Bullae, blebsSummary and Conclusion



## Pediatric Monday Poster Discussions

Monday, Nov. 30 12:45PM - 1:15PM Location: PD Community, Learning Center

**PD**

AMA PRA Category 1 Credit™: .50

**FDA**

Discussions may include off-label uses.

### Participants

Daniel J. Ashton, MD, Houston, TX (*Moderator*) Nothing to Disclose

### Sub-Events

#### PD219-SD- Whole Brain Volumetric MRI Analysis of Extremely Low Gestational Age Newborns MOB5

Station #5

### Participants

Khalid Alshamrani, MSc, Boston, MA (*Presenter*) Nothing to Disclose

Zhou Qingde, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

Osamu Sakai, MD, PhD, Boston, MA (*Abstract Co-Author*) Speaker, Bracco Group; Speaker, Eisai Co, Ltd; Consultant, Guerbet SA

Alexander M. Norbash, MD, Boston, MA (*Abstract Co-Author*) Co-founder, Boston Imaging Core Laboratories, LLC;

Mufeed Mahd, PhD, Lowell, MA (*Abstract Co-Author*) Nothing to Disclose

Hernan Jara, PhD, Belmont, MA (*Abstract Co-Author*) Patent holder, qMRI algorithms Research Grant, General Electric Company  
Royalties, World Scientific Publishing Co

### PURPOSE

Preterm birth can lead to long-term brain structural and functional detrimental outcomes. In this study, quantitative magnetic resonance imaging (qMRI) was used to explore the basic volumetry differences of extremely low gestational age newborns (ELGAN) relative to full-term birth children at the ages of 9 to 11 years.

### METHOD AND MATERIALS

MRI data was obtained from 163 ELGAN study participants (males = 71, females = 92), using dual echo fast spin echo (DE-FSE) sequence with the following parameters: effective echo time TE<sub>1eff</sub> = 6.3-10ms, TE<sub>2eff</sub> = 100-107ms, repetition time ~ 11000ms. Children were MRI scanned at twelve ELGAN participating sites: all scanners were 3T from the three major manufacturers, except one 1.5T (GE). The total brain volume (whole gray matter (GM) + whole white matter (WM)), and cerebrospinal fluid (CSF) volume were calculated, also histograms (approximately modeled as a normal distribution) were generated using a semi-automated computer algorithm (Mathcad). Additionally, brain volumes of age-matched term children (control subjects) was obtained from the NIH published MRI data of normal brain development (Cerebral Cortex May 25, 2011, table 4) as a weighted mean between male and female.

### RESULTS

Histogram of total brain volume is shown in Fig. 1. ELGAN subjects demonstrated wide distribution (red curve), compared to control (dotted curve), dispersion of volume values was also observed ( $\sigma = 185$ ). The overall mean total/regional brain volumes between groups and gender are shown in Table. 1. In comparison to control subjects, the total brain mean volume of the ELGAN subjects was approximately the same, whereas an increased volume was found for GM. Significant decrease in WM volume was observed for the ELGAN participants. Outlier CSF volume values was noticed mostly in ELGAN male subjects. Most male subjects showed larger brain volume than female.

### CONCLUSION

Extremely preterm birth has a great impact in the volumetry of brain tissues. The significant reduction in WM volume may serve as explanation for the observed neurodevelopmental difficulties due to premature birth.

### CLINICAL RELEVANCE/APPLICATION

Volumetric MRI brain measurements of extremely low gestational age newborns are used to investigate the neurodevelopmental deficits and the associated cognitive changes subsequent to preterm birth.

### Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Osamu Sakai, MD, PhD - 2013 Honored Educator

Osamu Sakai, MD, PhD - 2014 Honored Educator

Osamu Sakai, MD, PhD - 2015 Honored Educator

Hernan Jara, PhD - 2014 Honored Educator

#### PD123-ED- Developing a Radiogenomics Program: Promises and Difficulties MOB6

Station #6

### Participants

Matthew R. Plunk, MD, Cincinnati, OH (*Presenter*) Nothing to Disclose

Andrew T. Trout, MD, Cincinnati, OH (*Abstract Co-Author*) Advisory Board, Koninklijke Philips NV

Alex Towbin, MD, Cincinnati, OH (*Abstract Co-Author*) Author, Reed Elsevier; Consultant, Reed Elsevier; Shareholder, Merge Healthcare Incorporated; Consultant, Guerbet SA; Grant, Guerbet SA

#### TEACHING POINTS

Radiogenomics is a growing area of research that seeks to correlate the radiologic appearance of tumors with gene expression. The goals of this exhibit are: Review the background and fundamental concepts of radiogenomics Discuss the elements of a radiogenomics program Share our institution's initial experiences, particularly, challenges we have faced and how we have addressed them

#### TABLE OF CONTENTS/OUTLINE

Radiogenomics: Concept review Introduction to the central ideas of radiogenomics and review of literature Establishing a radiogenomics program Selection of malignancy Role of radiology Identifying relevant imaging features Developing framework for data collection Role of collaborators Creating system to obtain and store tissue Determination of appropriate genetic analysis Radiogenomics challenges Integrating studies with varying protocols including outside exams Clearly defining and refining imaging features for consistent application Addressing and measuring lesion heterogeneity Correlation with tissue sampling Developing statistical expertise to address the enormous volumes of data generated

#### Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Alex Towbin, MD - 2014 Honored Educator

#### PD003-EB- MOB Pediatric Non Odontogenic Tumors of the Maxillo-facial Skeleton: What the Radiologist Needs to Know

Hardcopy Backboard

#### Awards

##### Magna Cum Laude

##### Identified for RadioGraphics

#### Participants

Salvatore Stefanelli, MD, Geneva, Switzerland (*Presenter*) Nothing to Disclose  
Laura Merlini, MD, Geneva, Switzerland (*Abstract Co-Author*) Nothing to Disclose  
Anne-Laure Rougemont, MD, Geneva, Switzerland (*Abstract Co-Author*) Nothing to Disclose  
Angeliki Ailianou, MD, Geneva, Switzerland (*Abstract Co-Author*) Nothing to Disclose  
Paolo Scolozzi, MD, Geneva, Switzerland (*Abstract Co-Author*) Nothing to Disclose  
Andrej Terzic, Geneva, Switzerland (*Abstract Co-Author*) Nothing to Disclose  
Minerva Becker, MD, PhD, Geneva, Switzerland (*Abstract Co-Author*) Nothing to Disclose

#### TEACHING POINTS

1. To provide a comprehensive approach for the evaluation of children with non-odontogenic maxillo-facial tumors. 2. To understand key imaging features of benign and malignant lesions based on radiologic-pathologic correlation. 3. To illustrate the importance of multimodality imaging for treatment planning. 4. To understand potential pitfalls of image interpretation.

#### TABLE OF CONTENTS/OUTLINE

Pediatric tumors of the maxillo-facial skeleton are rare. Non-odontogenic jaw tumors comprise osteogenic, chondrogenic, fibrogenic, vascular and hematopoietic lesions. The current exhibit is based on the retrospective analysis of a series of 40 children seen in our hospital during the past 15 years. Imaging findings were correlated with clinical presentation, physical findings, histology and outcomes in all patients. The most common benign lesions included fibrous dysplasia, Langerhans histiocytosis, osteoma, myofibroblastic and desmoid tumors. The most common malignant tumors were rhabdomyosarcoma, Ewing sarcoma, intraosseous lymphoma and neuroblastoma. We illustrate typical findings and discuss the added value of multimodality imaging with CT, DWI MRI and PET CT. We provide radiologic-pathologic correlation for the understanding of characteristic features, and address pitfalls of image interpretation. I



SSE20

## ISP: Pediatrics (Neuroradiology)

Monday, Nov. 30 3:00PM - 4:00PM Location: S102AB



AMA PRA Category 1 Credit™: 1.00  
ARRT Category A+ Credit: 1.00

### Participants

Ashok Panigrahy, MD, Pittsburgh, PA (*Moderator*) Nothing to Disclose  
Susan Palasis, MD, Atlanta, GA (*Moderator*) Nothing to Disclose

### Sub-Events

#### SSE20-01 Pediatrics Keynote Speaker: Studying the Pediatric Connectome

Monday, Nov. 30 3:00PM - 3:10PM Location: S102AB

### Participants

Michael J. Paldino, MD, Houston, TX (*Presenter*) Nothing to Disclose

#### SSE20-02 Post-treatment Diffusion Tensor Imaging to Evaluate Response to Total Body Hypothermia in Neonates with Hypoxic-ischemic Encephalopathy

Monday, Nov. 30 3:10PM - 3:20PM Location: S102AB

### Participants

Laura Scarcioia, MD, Massafra, Italy (*Presenter*) Nothing to Disclose  
Carlo Cosimo Quattrocchi, MD, PhD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose  
Thomas Joseph Re, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Stefania Galassi, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose  
Lorenzo Figa Talamanca, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose  
Antonio Napolitano, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose  
Giuseppe Calbi, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose  
Bruno Bernardi, MD, Bologna, Italy (*Abstract Co-Author*) Nothing to Disclose  
Bruno Beomonte Zobel, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose  
Daniela Longo, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

to test the efficacy of ADC and FA for the evaluation of treatment response in newborns with moderate and severe hypoxic-ischemic encephalopathy (HIE) treated with total-body hypothermia.

### METHOD AND MATERIALS

27 newborns with clinical criteria of moderate-severe HIE (17 treated with total body therapeutic hypothermia, 10 nontreated) and 10 healthy neonates were studied with MR imaging and DTI. Ten treated neonates and healthy neonates underwent a follow-up brain MRI and DTI at 6 months of life. All data were acquired on a 3-T Skyra (Siemens, Erlangen, Germany). Conventional MRI imaging included: axial T1 TSE (slice thickness = 2 mm, TR=550 ms, TE 6,7 ms, matrix size = 416x512), sagittal T1 TIRM (slice thickness = 3 mm, TR=2690 ms, TE 8,5 ms, matrix size = 256x256), axial and coronal T2 TSE (slice thickness = 2 mm, TR=10320 ms, TE 122 ms, matrix size= 348x384). DTI acquisition was performed by a single-shot echo-planar sequence, one volume not diffusion-weighted (b0), and bipolar diffusion gradients (b = 800 s/mm<sup>2</sup>) applied in 30 directions. On ADC and FA maps, basal ganglia and thalamus ROIs were designed. Preprocessing of the raw DTI data was performed using FSL software. Diffusion toolkit along with TrackVis (trackvis.org) were used to reconstruct and visualize tractography pathways respectively.

### RESULTS

Conventional MR imaging was normal in 11 (65%) treated neonates and in 3 (30%) nontreated neonates. All treated neonates presented lower FA values in all tracks, in BG and in Thalamus ROI (p<0.01) comparing to healthy newborns but higher FA values (p<10<sup>-5</sup>) comparing to nontreated neonates. ADC values were higher in BG and in all white matter fibers (p<10<sup>-4</sup>) comparing to nontreated neonates. At 6 months follow-up MR, the treated neonates FA and ADC values were closer to normal.

### CONCLUSION

FA and ADC may more accurately reflect true microstructure characteristics of brain immediately after therapeutic hypothermia and at 6-months follow-up than does conventional MRI. DTI data for nontreated neonates at 6 months would be required to confirm our results.

### CLINICAL RELEVANCE/APPLICATION

As DTI metrics reflect a different aspect of brain microstructure than conventional MRI, they may provide a more accurate tool for diagnosing and following neonates with poor neurodevelopment due to HIE.

#### SSE20-03 Increased Gray Matter Volume of Emotional Circuits in Children without Direct Parental Care

Monday, Nov. 30 3:20PM - 3:30PM Location: S102AB

### Participants

Yuan Xiao, Chengdu, China (*Presenter*) Nothing to Disclose  
Lili Yang, Wenzhou, China (*Abstract Co-Author*) Nothing to Disclose  
Zhihan Yan, Wenzhou, China (*Abstract Co-Author*) Nothing to Disclose  
Yuchuan Fu, Wenzhou, China (*Abstract Co-Author*) Nothing to Disclose

Meimei Du, Wenzhou, China (*Abstract Co-Author*) Nothing to Disclose  
Su Lui, MD, Chendu, China (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

With the economic boom, hundreds of millions of laborers are migrating away from their children to pursue a better job. This international parental migration has resulted in millions of left-behind children (LBC) and has raised widespread concern. However, it is still unclear where and how the brain is affected in these children who lack parental care. Therefore, we aimed to explore the gray matter volume alteration in LBC in relative to those with parental care.

## METHOD AND MATERIALS

This study was IRB approved and written informed consent was obtained from guardians. Thirty-eight LBC (age=9.6±1.8yrs, 21boys) and 30 comparison children (age=10.0±1.95yrs, 19boys) were included and performed a 3.0T MR scan. The LBC is defined as children who living with the absence of both of their biological parents for a period over six months. Image preprocessing and statistical analyses were performed with optimized voxel-based morphometry in SPM8. IQ of all participants was measured to quantify cognitive function.

## RESULTS

Compared to controls, LBC showed significantly greater gray matter volume in bilateral fusiform gyri, bilateral parahippocampus, right superior parietal lobe, right thalamus, right superior occipital gyrus, left cuneus, right superior temporal gyrus, right superior medial frontal gyrus, left postcentral gyrus, left middle occipital gyrus and left putamen ( $p<0.05$ , FDR corrected). The mean value of IQ scores in LBC was not significantly different from that in controls. Furthermore, gray matter volume in bilateral parahypocampus gyri in LBC was negatively correlated with IQ score ( $p<0.05$ ).

## CONCLUSION

This study provided the first empirical evidence of larger gray matter volumes, especially in emotional circuits in LBC than children living with their parents, suggesting the parental care affects the brain development. Since the larger gray matter volume may reflect insufficient pruning and mature of brain, the negative correlation between the gray matter volume and IQ scores suggest that growing without parental care may delay the development of brain.

## CLINICAL RELEVANCE/APPLICATION

To our knowledge, this study provides the first empirical evidence of larger gray matter volumes in emotional circuits in LBC, suggesting that parental care affects brain development. From a public health perspective, the study highlighted the importance of parental care in children and indicated early intervention and stimulation are needed to LBC.

## SSE20-04 Age-dependent Signal Density of Diffusion Kurtosis Imaging (DKI) of Healthy Volunteers' Brains at Left-right Hemispheric Level Analyses

Monday, Nov. 30 3:30PM - 3:40PM Location: S102AB

### Participants

Mamiko Koshiba, PhD, Iruma-gun, Japan (*Presenter*) Nothing to Disclose  
Takako Aoki, PhD, Iruma-Gun, Japan (*Abstract Co-Author*) Nothing to Disclose  
Hayato Sakurai, MD, Moroyama, Japan (*Abstract Co-Author*) Nothing to Disclose  
Tsuyoshi Sasaki, RT, Moroyama, Japan (*Abstract Co-Author*) Nothing to Disclose  
Tomokazu Araki, RT, Moroyama, Japan (*Abstract Co-Author*) Nothing to Disclose  
Hiroko Kakei, Moroyama, Japan (*Abstract Co-Author*) Nothing to Disclose  
Naomi Hotta, Moroyama, Japan (*Abstract Co-Author*) Nothing to Disclose  
Yuuki Minamikawa, Moroyama, Japan (*Abstract Co-Author*) Nothing to Disclose  
Mamoru Niitsu, MD, Saitama, Japan (*Abstract Co-Author*) Nothing to Disclose  
Tetsuya Kunikata, Iruma-Gun, Japan (*Abstract Co-Author*) Nothing to Disclose  
Hideo Yamanouchi, Iruma-Gun, Japan (*Abstract Co-Author*) Nothing to Disclose

### Background

For approaches to DKI application in neuropsychiatrics without any risky sedation, the lower resolution data of an infant's smaller brain raise a question whether 122significantly useful or not. As the preliminary evaluation, we are attempting to examine macroscopic DKI quantitative analyses in the data of our own medical staff volunteers if the linear regression would be visualized as previously reported age-dependency (2014).

### Discussion

In the scatter diagrams with DKI signal density as a dependent variable and age as an explanatory variable, age-dependent increasing of DKI density was generally revealed repeatedly in both left and right hemispheres in the 2nd to 4th slices (e.g. square correlation coefficient ( $R^2$ ) = 0.52) but not in either cerebellums ( $R^2$  = 0.069) or eye balls ( $R^2$  = 0.023) imaged in the 1st slice.

### Conclusion

DKI hemispheric density quantification in adult was preliminarily confirmed as a practical simple approach to diagnose neuronal development. This macroscopic comprehension using DKI is expected possibly contributable to Neuropsychiatrics by MRI without sedation under lower resolution.

## SSE20-05 Repeatability of Graph-Theoretical Metrics Derived from Resting-State fMRI in Pediatric Patients with Epilepsy

Monday, Nov. 30 3:40PM - 3:50PM Location: S102AB

### Participants

Michael J. Paldino, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Wei Zhang, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Zili David Chu, PhD, Houston, TX (*Presenter*) Nothing to Disclose

## PURPOSE

To measure the test-retest repeatability of metrics that quantify network architecture in the brain derived from resting-state fMRI in a cohort of pediatric epilepsy patients.

## METHOD AND MATERIALS

This IRB approved study identified patients with: 1. epilepsy; 2. brain MRI at 3 Tesla; 3. two identical resting state fMRI acquisitions performed in the same examination. Resting-state time series were co-registered to a T1-weighted structural image. Network nodes were defined by subdivision of whole brain gray matter into 400 (coarse parcellation) or 800 (fine parcellation) volumes of interest. The strength of an edge (connection) between two nodes was defined as the absolute value of the correlation between their BOLD time series. For each weighted connection matrix, correlation coefficients were thresholded over a range of values (0.7 to 0.98). The following topological properties were calculated for each graph: clustering coefficient, transitivity, modularity, characteristic path length, smallworldness, and global efficiency. A potential difference between observations was assessed using the Wilcoxon signed-rank test. For each parameter, we calculated: 1. Mean coefficient of variation (CoV). 2. Pearson Coefficient; 3. ICC; 4. Repeatability coefficient; 5. Ninety-five percent confidence limits (95%CL) for change.

## RESULTS

12 patients were included (4-21 yrs). There was no significant difference between observations for any metric. Maximal test-retest estimates for each metric are presented in Table 1. ICC for modularity, transitivity and clustering was consistent across thresholds (Fig 1). By contrast, ICC for characteristic path length, smallworldness and global efficiency peaked over a narrow range of threshold. Modularity, path length and smallworldness were the most repeatable measures.

## CONCLUSION

These findings demonstrate the test-retest repeatability of network metrics in a cohort of pediatric epilepsy patients. Change in an individual patient greater than the repeatability coefficient or 95%CL for change is unlikely to be related to intrinsic variability of the method.

## CLINICAL RELEVANCE/APPLICATION

NA

## SSE20-06 Identifying Medicated-naïve Boys with ADHD using Cortical Thickness via a Multivariate Pattern Analysis

Monday, Nov. 30 3:50PM - 4:00PM Location: S102AB

### Participants

Qi Liu, Chengdu, China (*Presenter*) Nothing to Disclose  
Lizhou Chen, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose  
Ming Zhou, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose  
Xinyu Hu, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose  
Ying Chen, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose  
Lanting Guo, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose  
Qiyong Gong, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose  
Xiaoqi Huang, MD, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Despite previous studies have reported structural and functional deficits in Attention-deficit/hyperactivity disorder (ADHD) children, it's still a challenge to translate the neuroanatomic abnormalities to clinical practice. Studies focus on adults with ADHD had shown the potential clinical value of support vector machine (SVM) in distinguishing patients with ADHD from healthy controls individually, but no study has explored its usage in unmedicated children with ADHD. As ADHD has a higher prevalence in males, our study sought to use cortical thickness (CT) to distinguish the medicated-naïve school-age ADHD boys from healthy controls via SVM.

## METHOD AND MATERIALS

Forty drug-naïve ADHD boys (mean age: 10.1) and 40 healthy controls (mean age: 10.2) were recruited. The T1-weighted images were obtained by 3T MRI with SPGR sequence. The whole-brain analysis between two groups was performed via the Qdec surface-based group analysis tool in Freesurfer for CT with age as covariate (corrected by FDR  $p < 0.05$ ). We used PROBID software to investigate the diagnosis potential of CT of each hemisphere separately based on SVM using leave-one-out cross-validation approach. Then we examined their combined discriminative power for both hemisphere ( $p < 0.001$ ). We also drew Receiver Operating Characteristic (ROC) curves to assess the diagnosis accuracy power.

## RESULTS

Compared to healthy group, ADHD boys showed significant reduction in cortical thickness of bilateral orbitofrontal, insula and lingual, right anterior and posterior cingulate, prefrontal, temporal and parietal cortex (Figure A), and left CT demonstrated obviously more significance in classification (sensitivity 80%, specificity 85%, accuracy 82.5%,  $P \leq 0.001$ , ROC area 0.841) (Figure B). The combined CT of both hemispheres didn't provide better result than left CT alone.

## CONCLUSION

Our study demonstrated deficits in cortical thickness provides best solution for classification of medicated-naïve ADHD boys with healthy controls. The fact that left hemisphere is more useful in classification showed the lateralization in brain neural pathology of ADHD.

## CLINICAL RELEVANCE/APPLICATION

Classification approach based on cortical thickness may be a useful technique to distinguish the ADHD individuals from healthy controls.

## Pediatric Tuesday Case of the Day

Tuesday, Dec. 1 7:00AM - 11:59PM Location: Case of Day, Learning Center

PD

AMA PRA Category 1 Credit™: .50

### Participants

Ting Y. Tao, MD, PhD, Saint Louis, MO (*Presenter*) Nothing to Disclose  
Asef B. Khwaja, MD, Philadelphia, MO (*Abstract Co-Author*) Author, Reed Elsevier  
Elizabeth F. Sheybani, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose  
Shannon Farmakis, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose  
Luke L. Linscott, MD, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose  
Joan K. Zawin, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1) Recognize the importance of a multimodality approach in imaging pediatric patients. 2) Form appropriate differential diagnoses based on clinical information and imaging findings. 3) Recognize the clinical implications of diagnoses.

**Pediatric Series: CV/Chest**

Tuesday, Dec. 1 8:30AM - 12:00PM Location: E353A

CH

VA

CT

MR

PD

AMA PRA Category 1 Credits™: 3.25  
ARRT Category A+ Credits: 3.50

FDA

 Discussions may include off-label uses.
**Participants**

Shreyas S. Vasanawala, MD, PhD, Palo Alto, CA (*Moderator*) Research collaboration, General Electric Company; Consultant, Arterys; Research Grant, Bayer AG;  
Lorna Browne, MD, FRCR, Denver, CO (*Moderator*) Nothing to Disclose  
Rajesh Krishnamurthy, MD, Houston, TX (*Moderator*) Research support, Koninklijke Philips NV; Research support, Toshiba Corporation  
R. Paul Guilleman, MD, Houston, TX (*Moderator*) Nothing to Disclose

**Sub-Events****RC313-01 Imaging of Aortopathies**

Tuesday, Dec. 1 8:30AM - 8:50AM Location: E353A

**Participants**

Cynthia K. Rigsby, MD, Chicago, IL, (crigsby@luriechildrens.org) (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Define aortopathy. 2) Describe the imaging features of common aortopathies. 3) Show potential complications associated with aortopathies.

**RC313-02 4D flow MRI Based Volumetric Aortic Peak Velocity Quantification: Efficiency, Observer Variability and Comparison to 2D Phase Contrast MRI**

Tuesday, Dec. 1 8:50AM - 9:00AM Location: E353A

**Participants**

Michael Rose, Chicago, IL (*Presenter*) Nothing to Disclose  
Kelly Jarvis, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose  
Varun Chowdhary, MD, BS, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose  
Alex Barker, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose  
Bradley D. Allen, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose  
Joshua D. Robinson, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose  
Michael Markl, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose  
Susanne Schnell, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose  
Cynthia K. Rigsby, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

Standard methods for measuring peak blood flow velocity include Doppler echocardiography and 2D CINE phase contrast (PC) MRI. Due to their reliance on single-direction velocity encoding and regional flow analysis (2D planes) both methods can underestimate peak velocities, especially in cases of complex flow jets as commonly seen in patients with abnormal aortic valves. The aim of this study was to test the feasibility and efficiency of a new method for volumetric peak velocity quantification of aortic peak systolic blood flow velocities in a cohort of pediatric BAV patients using 4D flow MRI and velocity maximum intensity projections (MIPs).

**METHOD AND MATERIALS**

51 pediatric BAV patients (age =  $14 \pm 5$ , range = 3-24 years, 18 female) underwent aortic 4D flow MRI (1.5T Aera, Siemens, Germany). After pre-processing (velocity anti-aliasing, phase offset correction) and 3D segmentation of the aorta, velocity MIPs were generated to determine peak velocities in the ascending aorta, arch, and descending aorta by two independent observers. 4D flow derived peak velocities were compared to results from 2D CINE PCMRI from the same study for 36 BAV patients.

**RESULTS**

4D flow peak systolic velocities were significantly higher than 2D CINE PC MRI ( $2.02 \pm 0.72$  m/s vs  $1.72 \pm 0.81$  m/s,  $p = 0.0001$ , Wilcoxon signed-rank test). Bland-Altman analysis of peak velocity assessment showed excellent inter-observer variability (mean difference =  $-0.005$  m/s, limits of agreement =  $\pm 0.192$  m/s) with low average inter-observer error 2.0 %. The estimated time for 4D flow MRI pre-processing and segmentation was 20 min. Average analysis time (calculation of velocity MIP, ROI analysis) was  $92 \pm 49$  s.

**CONCLUSION**

4D flow MRI in combination with 3D segmentation of the aorta and velocity MIP analysis can be used to determine aortic peak systolic velocity with high efficiency and low observer variability. The full volumetric coverage and 3-directional velocity of 4D flow MRI fully captures complex aortic flow patterns and is thus better suited to identify the highest velocity in an entire aortic segment compared to 2D CINE PC MRI, which underestimated peak velocities in our BAV cohort by 15%.

**CLINICAL RELEVANCE/APPLICATION**

In patients with aortic valve disease such as bicuspid aortic valve (BAV), the severity of valve disease is characterized using peak blood velocity to estimate the peak transvalvular pressure gradient (via the simplified Bernoulli equation).

**RC313-03 Accuracy of Ventricular Septal Defect Measurements by High Pitch Computed Tomography Angiography of the Thorax in Pediatric Patients Younger Than One Year Compared to Echocardiographic and Intraoperative Measurements**

Tuesday, Dec. 1 9:00AM - 9:10AM Location: E353A

**Participants**

Matthias S. May, Erlangen, Germany (*Presenter*) Speakers Bureau, Siemens AG  
David Nau, Erlangen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Oliver Rempel, MD, Erlangen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Matthias Hammon, MD, Erlangen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Michael Uder, MD, Erlangen, Germany (*Abstract Co-Author*) Speakers Bureau, Bracco Group; Speakers Bureau, Siemens AG; Research Grant, Siemens AG;  
Michael M. Lell, MD, Erlangen, Germany (*Abstract Co-Author*) Research Grant, Siemens AG; Speakers Bureau, Siemens AG; Research Grant, Bayer AG ; Speakers Bureau, Bayer AG; Research Consultant, Bracco Group; ;  
Wolfgang Wust, MD, Erlangen, Germany (*Abstract Co-Author*) Speakers Bureau, Siemens AG

**PURPOSE**

Preoperative assessment of VSDs is routinely performed by echocardiography. However, it seems to be challenging to obtain precise and reproducible findings, due to the limited angulations that are available. Additional preoperative evaluation by Computed Tomography (CT) has become reasonable in the recent years for complex congenital heart disease and allow for assessment of the size of VSDs in a static and isovolumetric dataset. Our aim was to evaluate the accuracy of size measurement of congenital ventricular septal defects (VSD) using High Pitch Computed Tomography Angiography of the thorax compared to echocardiography and intraoperative findings in children with congenital heart disease below 1 year.

**METHOD AND MATERIALS**

Angiography of the chest was performed using a second and third generation Dual-Source CT in 54 patients (median age 7 days, range 1-348 days) with a high-pitch protocol ( $p=3.2-3.4$ ) at low tube voltages (70-80 kV). The margins of the VSDs were angulated by Multiplanar Reformations and Minimum Intensity Projection (MinIP) was used to overcome partial volume effects. The results were compared to the measurements from echocardiography and intraoperative measurements served as reference.

**RESULTS**

Mean deviation of the CT-measurements compared to the intraoperative findings was not statistically significant ( $3.5 \pm 3.0$  mm,  $p=0.21$ ), while the mean difference compared to echocardiography was significantly higher ( $7.4 \pm 4.8$  mm,  $p<0.01$ ). The VSDs can be classified into four different types by CT. With the exception of apical septal defects the size of the defects seems not to correlate with a specific location. Median radiation dose was as low as 0.37 mSv (range 0.12 - 2.00 mSv).

**CONCLUSION**

High Pitch Computed Tomography Angiography of the thorax provides precise measurements of VSDs in pediatric patients with congenital heart disease younger than one year.

**CLINICAL RELEVANCE/APPLICATION**

Preoperative High Pitch Computed Tomography Angiography of the thorax, besides the advantages in imaging of the coronaries and great intrathoracic vessels, provides precise measurements of VSDs at reasonable low radiation dose.

**RC313-04 Image Quality and Accuracy of a Prototype Self-Navigated 3D Whole-heart Sequence for the Assessment of Coronary Artery Anomalies in a Pediatric Patient Population**

Tuesday, Dec. 1 9:10AM - 9:20AM Location: E353A

**Participants**

Giuseppe Muscogiuri, MD, Charleston, SC (*Presenter*) Nothing to Disclose  
Akos Varga-Szemes, MD, PhD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose  
Carlo N. De Cecco, MD, PhD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose  
Pal Suranyi, MD, PhD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose  
Julian L. Wichmann, MD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose  
U. Joseph Schoepf, MD, Charleston, SC (*Abstract Co-Author*) Research Grant, Bracco Group; Research Grant, Bayer AG; Research Grant, General Electric Company; Research Grant, Siemens AG; Research support, Bayer AG; ;  
Paola Maria Cannao, MD, San Donato Milanese, Italy (*Abstract Co-Author*) Nothing to Disclose  
Stefanie Mangold, MD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose  
Davide Piccini, Lausanne, Switzerland (*Abstract Co-Author*) Employee, Siemens AG  
Wolfgang Rehwald, Erlangen, Germany (*Abstract Co-Author*) Employee, Siemens AG  
Anthony M. Hlavacek, MD, Charleston, SC (*Abstract Co-Author*) Investigator, Siemens AG Research Grant, Siemens AG  
Arni C. Nutting, MD, Charleston, SC (*Abstract Co-Author*) Research Grant, Siemens AG

**PURPOSE**

The aim of this study was to assess the feasibility, image quality, and diagnostic performance of a prototype non-contrast enhanced self-navigated 3D (SN3D) whole-heart MRA acquisition in comparison with coronary CT angiography (cCTA) for delineating the coronary artery origin and proximal course in pediatric patients with suspected coronary artery anomalies.

**METHOD AND MATERIALS**

Seven patients (13 $\pm$ 3 years) with suspected coronary artery anomalies underwent a reference standard cCTA (SOMATOM Flash, Siemens Healthcare, Forchheim, Germany) and a research non-contrast cardiac MRA (MAGNETOM Avanto 1.5T, Siemens Healthcare, Erlangen, Germany) for the assessment of the origin and proximal course of the coronary arteries. The steady-state free precession based SN3D MRA was performed using the following parameters: TR/TE 3.1/1.5ms, flip angle 115°, FOV 220mm, voxel size: 1.1mm<sup>3</sup>, and 12064 radial views distributed over 377 heartbeats. Subjective image quality of the SN3D MRA and cCTA was evaluated using a 4-grade scale (1, nondiagnostic; 2, sufficient; 3, good; 4, excellent). Visualization of the left main, left anterior descending (LAD), circumflex (LCX) and right coronary arteries (RCA), as well as the time of acquisition and signal to noise



ratio (SNR), were assessed. Wilcoxon test was used to compare subjective image quality between cCTA and MRA.

## RESULTS

The acquisition time of the SN3D MRA was  $5.9 \pm 1.4$  min with an average heart rate of 81 bpm, while the mean SNR was  $27 \pm 9$ . MRA and cCTA image quality ratings were  $2.3 \pm 0.7$  and  $3.3 \pm 0.7$ , respectively ( $p > 0.05$ ). SN3D MRA allowed the visualization of the left main, the LAD and the RCA with good agreement to cCTA in all cases, but failed to visualize the LCX in a single case.

## CONCLUSION

In this preliminary study there was good agreement for the evaluation of coronary artery anatomy between SN3D MRA and cCTA. The novel radial SN3D sequence allows for the acquisition of an isotropic volume in a free-breathing fashion in about half the time as a standard respiratory-navigated coronary MRA, with an improved ease of use, without penalties in image quality, and without radiation exposure, contrast agent administration or the need for general anesthesia.

## CLINICAL RELEVANCE/APPLICATION

This non-contrast self-navigated MRA sequence provides relatively rapid, free-breathing radiation-free evaluation of anomalies of the coronary artery origin and proximal course in children.

### RC313-05 Contrast Material Injection via Fenestrated Catheters is Useful in Pediatric Patients with Congenital Heart Disease Undergoing CT Angiography

Tuesday, Dec. 1 9:20AM - 9:30AM Location: E353A

#### Participants

Takanori Masuda, Hiroshima, Japan (*Presenter*) Nothing to Disclose  
Yoshinori Funama, PhD, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose  
Masao Kiguchi, RT, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose  
Takayuki Oku, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose  
Naoyuki Imada, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose  
Kazuo Awai, MD, Hiroshima, Japan (*Abstract Co-Author*) Research Grant, Toshiba Corporation; Research Grant, Hitachi, Ltd; Research Grant, Bayer AG; Research Grant, DAIICHI SANKYO Group; Medical Advisor, DAIICHI SANKYO Group; Research Grant, Eisai Co, Ltd; Research Grant, Nemoto-Kyourindo; ; ; ;  
Tomoyasu Sato, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose  
Noritaka Noda, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

While 3D CT angiography (CTA) images are useful for evaluating the complex anatomy in patients with congenital heart disease, they require higher contrast enhancement to identify blood vessels and soft tissues. However, the thin pediatric vessel wall imposes an injection pressure limit and can result in poor CT enhancement. As the gauge of the fenestrated- is smaller than of the conventional nonfenestrated catheter, optimal enhancement can be achieved by controlling the injection pressure. We compared the injection rate, aortic enhancement, and injection pressure when intravenous contrast material was injected with fenestrated- and conventional non-fenestrated catheters.

## METHOD AND MATERIALS

We randomly divided 34 pediatric patients seen between December 2014 and March 2015 into two groups. Group A consisted of 18 children (age one week to 8 months, body weight  $3.6 \pm 1.2$  kg) and group B of 16 (age one week to 12 months, body weight  $3.3 \pm 0.9$  kg). In group A we delivered the contrast medium via a 22-gauge conventional non-fenestrated catheter and in group B we used a 24-gauge fenestrated catheter. Whole-heart helical CTA scans were performed on a 64-detector scanner (GE VCT, tube voltage 80 kVp, detector configuration  $64 \times 0.625$  mm, rotation time 0.4s/r, helical pitch 1.375, preset AEC noise index 12) and the injection rate, aortic enhancement, and injection pressure were compared in groups A and B.

## RESULTS

The mean injection rate and aortic enhancement were  $0.9 \pm 0.1$  ml/sec and  $468 \pm 45.0$  HU in group A and  $0.87 \pm 0.3$  ml/sec and  $444 \pm 63.5$  HU in group B. There was no significant difference in the injection rate and aortic enhancement ( $p = 0.34$ ,  $p = 0.38$ ). The maximum injection pressure was significantly lower in group B than group A ( $0.33$  vs.  $0.55$  kg/cm<sup>2</sup>,  $p < 0.05$ ).

## CONCLUSION

Use of the fenestrated catheter decreases the injection pressure limit while retaining the injection rate and aortic enhancement of conventional catheters.

## CLINICAL RELEVANCE/APPLICATION

With use of the fenestrated catheter, pediatric CT angiography obtains the optimal aortic enhancement by changing injection rate in safety.

### RC313-06 The Impact of Dual-source Parallelradiofrequency Transmission with Patient-adaptive Shimming on the 3.0 T Cardiac Magnetic Resonance in Children

Tuesday, Dec. 1 9:30AM - 9:40AM Location: E353A

#### Participants

Haipeng Wang, Jinan, China (*Abstract Co-Author*) Nothing to Disclose  
Cuiyan Wang, MD, PhD, Jinan, China (*Abstract Co-Author*) Nothing to Disclose  
Fei Gao, Jinan, China (*Abstract Co-Author*) Nothing to Disclose  
Bin Zhao, MD, Jinan, China (*Presenter*) Nothing to Disclose

## PURPOSE

To evaluate the effect of dual-source parallel RF transmission on the B1 homogeneity, the image quality (image contrast and off-resonance artifacts) in the cine b-SSFP sequence and the repeatability of left-ventricle cardiac function in 3.0T CMR of children.

## METHOD AND MATERIALS

The prospective intraindividual comparison study was approved by the institutional ethics committee and written informed consent was obtained. The 3.0T cardiac magnetic resonance (CMR) was performed in 30 chronic myocarditis children by using the dual-source radiofrequency (RF) transmission with patient-adaptive RF shimming. B1 homogeneity and image contrast with and without RF shimming were quantitatively evaluated and t-test was used for statistical significance. The off-resonance artifacts were evaluated independently by two readers. Statistical significance was assessed by the Mann-Whitney U test and inter-observer agreement by Cohen's kappa test. The inter-observer agreement of LV cardiac function with dual-source RF transmission was evaluated by Bland-Altman analysis and the intra-class correlation coefficient (ICC).

## RESULTS

Compared with single-source RF transmission, dual-source RF transmission with patient-adaptive RF shimming performed a higher mean percentage of flip angle (FA), lower coefficient of variation (CV) and higher image contrast in both free-breathe (NBH) and breathe-hold (BH) scanning (  $P < 0.05$  for all). The scores of off-resonance artifacts with patient-adaptive RF shimming were lower than that without RF shimming (  $P < 0.05$ ) and inter-observer agreement between two readers was good to very good (kappa values from 0.66 to 0.86). A high level inter-observer agreement for cardiac function with RF shimming was acquired both in NBH scanning (CV: 1.91%-11.84%; ICC, 0.83-0.98) and BH scanning (CV: 0.52%-4.44%; ICC, 0.98-0.99).

## CONCLUSION

Dual-source parallel RF transmission with patient-adaptive RF shimming could significantly improve the B1 homogeneity and image contrast, reduce the off-resonance artifacts in the b-SSFP cine image and show excellent reproducibility of cardiac function in the 3.0T CMR of children.

## CLINICAL RELEVANCE/APPLICATION

Dual-source parallel RF transmission could significantly improve the B1 homogeneity and image quality and is suitable for the 3.0T cardiac magnetic resonance in children.

### RC313-07 Estimation of Functional Lung Capacity and Correlation with the Results of Infant Pulmonary Function Test and Quantitative CT Assessment in Infants with Postinfectious Bronchiolitis Obliterans

Tuesday, Dec. 1 9:40AM - 9:50AM Location: E353A

#### Participants

Mi-Jung Lee, MD, PhD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose  
Yoon Hee Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Hyun Joo Shin, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Myung-Joon Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Myung Hyun Sohn, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To investigate the possibility for estimating functional lung capacity from ventilation inhomogeneity using infant pulmonary function test (iPFT) and quantitative CT assessment for air trapping in infants with postinfectious bronchiolitis obliterans (BO).

## METHOD AND MATERIALS

This prospective study included infants with clinically and radiologically proven BO since 2009. We performed iPFT in these patients and measured tidal volume (TV), functional residual capacity (FRC) and lung clearance index (LCI) by sulphur hexafluoride multiple breath washout using an ultrasonic flow meter. From chest CT, we calculated total lung volume (CT-TLV) and imaging functional lung volume (CT-FLV) which showed higher attenuation than the mean attenuation of the grossly normal and air trapping areas. We compared iPFT and CT parameters using Spearman correlation analysis.

## RESULTS

Thirteen infants (M:F = 11:2) were included in this study. The age was 3-17 months with the mean of  $10.4 \pm 4.5$  months. The mean body weight and height were  $9.4 \pm 1.7$  kg and  $75.9 \pm 8.0$  cm. The values of TV, FRC and LCI were  $82.0 \pm 19.9$  ml,  $184.1 \pm 49.1$  ml and  $8.2 \pm 1.3$ , respectively. For chest CT, the effective radiation dose was 0.2-1.8 mSv with the mean of  $1.0 \pm 0.5$  mSv. The values of normal lung attenuation and air trapping attenuation on CT were  $-571.3 \pm 63.1$  HU and  $-767.1 \pm 58.3$  HU. And the calculated CT-TLV and CT-FLV were  $268.8 \pm 90.9$  ml and  $202.9 \pm 70.4$  ml. In the correlation analysis, CT-TLV had a positive correlation with TV ( $\gamma = 0.602$ ,  $p = 0.029$ ) and FRC ( $\gamma = 0.731$ ,  $p = 0.005$ ). CT-FLV also showed a significant negative correlation with LCI ( $\gamma = -0.670$ ,  $p = 0.012$ ) which represented ventilation inhomogeneity.

## CONCLUSION

Both iPFT and chest CT can demonstrate ventilation inhomogeneity and estimate functional lung capacity in infants with postinfectious BO with good correlation. Both methods can be useful and complementary for evaluating in these patients.

## CLINICAL RELEVANCE/APPLICATION

Not only infant pulmonary function test but also quantitative chest CT assessment can demonstrate ventilation inhomogeneity and estimate functional lung capacity in infants who are not easy to evaluate lung function due to limited compliance.

### RC313-08 Coronary Artery Imaging in Children

Tuesday, Dec. 1 9:50AM - 10:10AM Location: E353A

#### Participants

Lorna Browne, MD, FRCR, Denver, CO (*Presenter*) Nothing to Disclose

## LEARNING OBJECTIVES

1) How to successively image the coronary arteries in children with both MR and CT. 2) How to interpret a range of coronary artery anomalies and pathologies.



## RC313-09 Dynamic Airway Imaging

Tuesday, Dec. 1 10:30AM - 10:50AM Location: E353A

### Participants

Rajesh Krishnamurthy, MD, Houston, TX (*Presenter*) Research support, Koninklijke Philips NV; Research support, Toshiba Corporation

### LEARNING OBJECTIVES

1) Discuss indications and protocols for dynamic airway imaging in children using CT and MRI, with emphasis on advantages offered by new generation CT scanners. 2) Learn appropriate use of common post-processing tools and measurement metrics for the pediatric airway that correlate well with bronchoscopy. 3) Understand imaging findings that distinguish between intrinsic and extrinsic airway pathology. 4) Review common applications for dynamic airway imaging, including tracheobronchomalacia, vascular mediated airway compromise, complete tracheal rings, mediastinal masses, and airway tumors.

### ABSTRACT

This talk will provide an overview of indications and protocols for dynamic airway imaging in children using CT and MRI, with emphasis on advantages offered by new generation CT scanners, and post-processing tools that allow derivation of metrics similar to bronchoscopy. We will review examples of intrinsic and extrinsic airway pathology in children, including tracheobronchomalacia, vascular mediated airway compromise, complete tracheal rings, mediastinal masses, and airway tumors.

## RC313-10 Comparison of a ROI-based and a Whole-lung Segmentation Based Approach for MR Lung Perfusion Quantification in Two-year Old Children after Congenital Diaphragmatic Hernia Repair

Tuesday, Dec. 1 10:50AM - 11:00AM Location: E353A

### Participants

Meike Weidner, Mannheim, Germany (*Presenter*) Nothing to Disclose

Verena Sommer, Mannheim, Germany (*Abstract Co-Author*) Nothing to Disclose

Frank G. Zoellner, Mannheim, Germany (*Abstract Co-Author*) Nothing to Disclose

Claudia Hagelstein, MD, Mannheim, Germany (*Abstract Co-Author*) Nothing to Disclose

Thomas Schaible, Mannheim, Germany (*Abstract Co-Author*) Nothing to Disclose

Stefan O. Schoenberg, MD, PhD, Mannheim, Germany (*Abstract Co-Author*) Institutional research agreement, Siemens AG

Wolfgang Neff, MD, PhD, Alzey, Germany (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

By the means of a region-of-interest (ROI) based approach it has been demonstrated that 2-year old children after congenital diaphragmatic hernia (CDH) repair show reduced MR lung perfusion values on the ipsilateral side. As ROI-based approaches only cover parts of the lung tissue, this study aimed to evaluate if results can be reproduced by segmentation of whole lung, whether there are differences between both approaches and as a consequence which technique should be applied.

### METHOD AND MATERIALS

DCE-MRI was performed in 30 children (24.3±1.8 month) after CDH repair using a 3D TWIST sequence (Siemens Healthcare, Germany). 0.05 mmol/kg body weight of contrast agent (Dotarem, Guerbet, France) were administered. Pulmonary blood flow (PBF) was calculated based on a pixel-by-pixel deconvolution approach. For ROI-based quantification, three circular ROIs (apical, middle and basal) per lung side were used both in the ventral and dorsal lung. Propagation of those circular ROIs through five adjacent slices generated 6 cylindrical ROIs in the ventral and dorsal lung respectively. For whole-lung analysis, the whole lung was contoured. In both techniques larger vessels were excluded from analysis (Fig. A).

### RESULTS

In the ROI-based approach, PBF was significantly reduced on the ipsilateral side (74.5±30.3 ml/100ml/min) in comparison to the contralateral side (113.1±40.4 ml/100ml/min;  $p<0.0001$ ). Also in the whole-lung based approach ipsilateral PBF was significantly lower (73.9±25.5 ml/100ml/min) than in the contralateral lung (102.3±31.8 ml/100ml/min;  $p<0.0001$ ). In the ipsilateral lungs, quantification results of the ROI-based and the whole-lung segmentation based approach were equal ( $p=0.50$ ). In the contralateral lungs, the ROI-based approach significantly overestimated PBF in comparison to the whole-lung approach by approximately 9.5% ( $p=0.0013$ ; Fig. B).

### CONCLUSION

MR lung perfusion in 2-year children after CDH is significantly reduced ipsilaterally, both when quantified by a ROI-based and a whole-lung based approach. In the contralateral lung, the ROI-based approach significantly overestimates perfusion results and therefore whole lung segmentation should be preferred.

### CLINICAL RELEVANCE/APPLICATION

With MR lung perfusion imaging, perfusion deficits after congenital diaphragmatic hernia can be depicted. Whole-lung segmentation for quantification is advisable, as a ROI-based approach can overestimate results.

## RC313-11 Functional Lung MRI for Non-invasive Monitoring of Regional Effects of Inhaled Hypertonic Saline in Children with Cystic Fibrosis

Tuesday, Dec. 1 11:00AM - 11:10AM Location: E353A

### Participants

Till F. Kairait, Hannover, Germany (*Presenter*) Nothing to Disclose

Julius Renne, MD, Hannover, Germany (*Abstract Co-Author*) Nothing to Disclose

Christian O. Schoenfeld, MD, Hannover, Germany (*Abstract Co-Author*) Nothing to Disclose

Andreas Voskrebenez, Hannover, Germany (*Abstract Co-Author*) Nothing to Disclose

Marcel Gutberlet, Dipl Phys, Hannover, Germany (*Abstract Co-Author*) Nothing to Disclose

Angela Schulz, Hannover, Germany (*Abstract Co-Author*) Nothing to Disclose

Gesine Hansen, Hannover, Germany (*Abstract Co-Author*) Nothing to Disclose

Tobias Welte, MD, Hannover, Germany (*Abstract Co-Author*) Nothing to Disclose  
Frank K. Wacker, MD, Hannover, Germany (*Abstract Co-Author*) Research Grant, Siemens AG Research Grant, Pro Medicus Limited  
Burkhard Tuemmler, Hannover, Germany (*Abstract Co-Author*) Nothing to Disclose  
Jens Vogel-Claussen, MD, Hannover, Germany (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Quantification of regional effects of inhaled hypertonic saline (7% NaCl) by functional lung MRI in adolescents with cystic fibrosis (CF).

## METHOD AND MATERIALS

The clinical effect of a single treatment with hypertonic saline inhalation in patients with CF is still under debate. 17 CF patients prospectively underwent two functional lung MRI scans and pulmonary function tests on the same day before and 1h after a single treatment of inhaled hypertonic saline (n=10, mean 15,2y, mean FEV1% 80±21) or without any treatment (n=7, mean 13,9y, mean FEV1% 80±20) at 1.5T. As a 2nd control group 12 healthy volunteers (mean 28,5y) were included. Assessed parameters for both cohorts were as follows: MRI-derived T1 relaxation measurements breathing room air (T1(21)) and 100% oxygen as well as the calculated oxygen transfer function (OTF), normalized fractional ventilation (FV) obtained by ventilation-weighted Fourier Decomposition MRI; pulmonary blood flow (PBF) obtained by dynamic contrast enhanced MRI, a morpho-functional CF-MRI score and the lung clearance index (LCI). After manual segmentation of each lobe mean and coefficient of variation (CoV) were calculated.

## RESULTS

Comparing the CF group to healthy controls, mean values of T1(21) (1176ms vs. 1246 ms,  $p < 0.01$ ) and FV (0.67 vs. 0.95,  $p < 0.001$ ) were significantly lower and the CoV significantly higher (CoV T1(21) 0.08 vs. 0.04; CoV FV 0.73 vs. 0.37,  $p < 0.001$  for all). In CF group receiving treatment, mean values in the whole lung of OTF (pre 13.1/post 12.7 10<sup>-4</sup>/s/%O<sub>2</sub>), FV (pre 0.69/post 0.76), PBF (pre 98/post 102ml/100 ml/min), LCI (pre 12.1/post 13.1) and the morpho-functional score (pre 15 / post 17) did not show a significant difference between pre and post treatment measurements ( $p > 0.05$ ). Also data on a lobar level in the treatment group as well as measurements in the CF-control group did not show any significant differences between the 2 MRI exams ( $p > 0.05$ ).

## CONCLUSION

Compared to healthy controls functional lung MRI detects significantly increased ventilation heterogeneity in CF patients. After a single treatment with inhalation of hypertonic saline (7% NaCl) neither functional lung MRI nor LCI detected a significant change in CF patients.

## CLINICAL RELEVANCE/APPLICATION

This study shows the feasibility of functional lung MRI, as a non-invasive, radiation-free tool for visualization and quantification of potential regional treatment effects in patients with CF.

## RC313-12 Comparison of Lung Ultrasound and Chest Radiography in Estimating Lung Edema after Surgery for Congenital Heart Disease in Children

Tuesday, Dec. 1 11:10AM - 11:20AM Location: E353A

### Participants

Laura Martelius, Helsinki, Finland (*Presenter*) Nothing to Disclose  
Anu Kaskinen, Helsinki, Finland (*Abstract Co-Author*) Nothing to Disclose  
Kirsi Lauerma, MD, Helsinki, Finland (*Abstract Co-Author*) Nothing to Disclose  
Paula Rautiainen, Helsinki, Finland (*Abstract Co-Author*) Nothing to Disclose  
Sture Andersson, Helsinki, Finland (*Abstract Co-Author*) Nothing to Disclose  
Olli Pitkanen, Helsinki, Finland (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Lung edema is a frequent complication after surgery for congenital heart disease in children. A readily available accurate measure for lung edema is lacking. Chest radiographs (CXR) are commonly used for this purpose. CXR, however, is inaccurate especially in intensive care when portable supine radiographs are used. In lung ultrasound (US) vertical artifacts known as B-lines have been shown to correlate with lung liquid. In adults with congestive heart disease B-lines in US correlates with lung edema scored from CXR. Our aim was to compare lung US and CXR in estimating lung edema in children after surgery for congenital heart disease.

## METHOD AND MATERIALS

Lung US was performed on 50 children 1-6 h postoperatively using a high-frequency linear transducer. Videoclips from three anterolateral intercostal spaces on both sides were stored. An observer blinded to the patient data and CXR scored the abundance of B-lines on each videoclip using a 5-step scale (0 = no artefact, 1 = B-lines in <25% of surface area, 2 = <50%, 3 = <75%, and 4 = >75%). The postoperative CXR were evaluated for lung edema at the right and left upper and lower lobes, the middle lobe and lingula using a 4-step scale (0 = normal lung, 1 = minimal opacity, 2 = opacity partially obscuring lung vessels, 3 = opacity totally obscuring lung vessels). For each patient a mean score for lung US (B-line score), and for CXR (CXR LE score) was calculated.

## RESULTS

There was a significant positive correlation between the B-line score and the CXR LE score ( $R = 0.65$ ,  $p < 0.001$ ).

## CONCLUSION

Lung US is a promising diagnostic tool in evaluation of postoperative lung edema in patients with congenital heart disease.

## CLINICAL RELEVANCE/APPLICATION

Lung US has great potential since the current methods for estimating lung edema are unsatisfactory (CXRs are nonspecific, invasive techniques are unreliable in patients with intracardiac shunts).

## RC313-13 Computerized Texture Analysis of Pulmonary Nodules in Pediatric Osteosarcoma Patients:

## Differentiation of Pulmonary Metastases from Non-metastatic Nodules

Tuesday, Dec. 1 11:20AM - 11:30AM Location: E353A

### Participants

Yeon Jin Cho, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose  
Young Hun Choi, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Yoo Jin Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Ji-Eun Park, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Hyun Suk Cho, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Sang Joon Park, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Jung-Eun Cheon, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Woo Sun Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
In-One Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To evaluate the value of computerized 3D texture analysis for differentiation of pulmonary metastases from non-metastatic lesions in pediatric osteosarcoma patients.

### METHOD AND MATERIALS

Our study comprised 42 pathologically confirmed pulmonary nodules in 16 children with osteosarcoma who had undergone preoperative CT scans between January 2009 and December 2014. Each pulmonary nodule was manually segmented and its computerized texture features were extracted by using an in-house software program. Multivariate logistic regression analysis was performed to investigate the differentiating factors of metastatic nodules from non-metastatic lesions. A subgroup analysis was performed to identify significant differentiating parameters in non-calcified pulmonary nodules. The ROC curve was created to evaluate the discriminating performance of established model.

### RESULTS

There were 24 metastatic pulmonary nodules and 18 non-metastatic pulmonary lesions. Pulmonary metastases and non-metastatic lesions exhibited significant differences in various histograms and volumetric parameters ( $P < .05$ ). Multivariate analysis revealed that higher mean Hounsfield units (HU) (adjusted odds ratio (OR), 1.02) and larger effective diameter (OR, 17.03) are significant differentiators ( $P < .05$ ). The subgroup analysis with non-calcified pulmonary nodules (13 metastases and 18 non-metastases) revealed significant differences between metastases and non-metastases in various parameters. Multivariate logistic regression analysis revealed that lower entropy (OR, 0.01) and larger effective diameter (OR, 38.92) are significant predictors of non-calcified pulmonary metastases ( $P < .05$ ). The established logistic regression model of subgroup showed excellent discriminating performance in ROC analysis (AUC, 0.927).

### CONCLUSION

Metastatic pulmonary nodules from osteosarcoma can be accurately differentiated from non-metastatic pulmonary lesions by using computerized texture analysis. High HU and larger effective diameter were the significant predictors for pulmonary metastases, while lower entropy and larger effective diameter were for non-calcified pulmonary metastases from non-metastatic lesions.

### CLINICAL RELEVANCE/APPLICATION

The computerized 3D texture analysis can accurately differentiate pulmonary metastases from non-metastatic pulmonary lesions in pediatric osteosarcoma patients.

## RC313-14 Extralobar pulmonary sequestration: initial CT findings predicting spontaneous regression in neonates

Tuesday, Dec. 1 11:30AM - 11:40AM Location: E353A

### Participants

Hee Mang Yoon, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose  
Jin Seong Lee, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Ahyoung Jung, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Young Ah Cho, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Chong Hyun Yoon, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

In general, it is accepted that extralobar pulmonary sequestration (EPS) may spontaneously regress. However, radiologic features associated with spontaneous regression of EPS have not been well documented. Therefore, we tried to find the CT features predicting spontaneous regression of EPS.

### METHOD AND MATERIALS

A total of 51 patients were included in our study with the following inclusion criteria: (a) antenatally diagnosed with EPS, (b) underwent a CT scan within 1 month after birth, and (c) had more than one follow-up CT without treatment. Spontaneous regression of EPS was determined by percent decrease of volume (PDV) and decrease in diameter of feeders. Volume of EPS and diameters of feeding systemic arteries (FSA) were evaluated on all 148 CT. For the enhancement degree of EPS, CT attenuation number of EPS and the back muscle were measured on initial CT and the ratio of EPS-to-back muscle was calculated. The PDV and the changes in diameter of FSA between initial and follow-up CT scans were calculated. Univariate and multivariate linear regression analysis were performed to assess factors related to PDV and decrease in diameter of FSA.

### RESULTS

PDV more than 50% ( $PDV \geq 50\%$ ) was noted in 20 patients (38.5%) within one year, in other 12 patients (23.1%) between one and two years, and in 6 patients after two years. The enhancement degree of EPS was significantly different between 38 patients with  $PDV \geq 50\%$  and 13 patients with  $PDV < 50\%$  ( $1.0 \pm 5.4$  vs  $2.1 \pm 1.1$ , respectively,  $p < 0.001$ ). Enhancement degree of EPS was the only significant factors predicting  $PDV \geq 50\%$  ( $B = -26.227$ ,  $p < 0.001$ ), and the decrease in diameter of FSA ( $B = -21.476$ ,  $p = 0.009$ ). In addition, PDV showed significant correlation with decrease in the diameter of the FSA ( $r = 0.602$ ,  $p < 0.001$ ).

## CONCLUSION

The volume of EPS had spontaneously decreased more than 50 % within 2 years without treatment in 63% of patients. The most important factor predicting spontaneous regression of the EPS was the enhancement degree on initial CT scan. Therefore, a significant volume regression and decrease in diameter of FSA can be expected without any treatment in a neonate with EPS showing hypoenhancement on initial CT scan.

## CLINICAL RELEVANCE/APPLICATION

The enhancement degree of EPS on initial CT scan is significantly associated with spontaneous regression of EPS during follow-up. Based on this result, we can more confidently predict spontaneous regression of EPS in neonates.

## RC313-15 Pediatric Chest Interventions

Tuesday, Dec. 1 11:40AM - 12:00PM Location: E353A

### Participants

Kamlesh U. Kukreja, MD, Bellaire, TX (*Presenter*) Nothing to Disclose

## LEARNING OBJECTIVES

1. Describe different types of chest interventions for children.

## Confluence of Diagnostic Radiology and Radiation Oncology in Management of Pediatric Malignancies

Tuesday, Dec. 1 8:30AM - 10:00AM Location: S403A



AMA PRA Category 1 Credits™: 1.50  
ARRT Category A+ Credits: 1.50

### Participants

Stephanie A. Terezakis, MD, Baltimore, MD (*Moderator*) Speaker, Elekta AB

### Sub-Events

#### RC320A Supratentorial CNS Tumors

### Participants

Stephanie M. Perkins, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose

Tina Y. Poussaint, MD, Boston, MA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Identify the common supratentorial brain tumors of childhood. 2) Evaluate the imaging features of supratentorial brain tumors.

### ABSTRACT

The most common type of solid tumor among children is the pediatric brain tumor, which is the second most frequent childhood malignancy after leukemia, and the leading cause of death from solid tumors in this population. Among children aged 0-19, the incidence rate for all primary brain and central nervous system tumors was roughly 5.3 per 100,000, with approximately 4350 cases of new cases of childhood primary malignant and non-malignant CNS tumors were expected to be diagnosed each year in the United States in 2013. Supratentorial tumors are most common in the first 2-3 years of life and in children older than 10 years, supratentorial and infratentorial are of equal frequency. This lecture will focus on the standard and advanced MR imaging features of the common supratentorial tumors of childhood affecting the cerebral hemispheres, suprasellar/sellar regions and pineal regions.

#### RC320B Infratentorial Central Nervous System Tumors

### Participants

David B. Mansur, MD, Cleveland, OH (*Presenter*) Nothing to Disclose

Thierry Huisman, MD, Baltimore, MD, (thuisma1@jhmi.edu) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Identify the types of diagnostic imaging most useful in the management of infratentorial CNS tumors. 2) Describe how proper diagnostic imaging aids in target delineation, staging, and treatment planning in posterior fossa CNS radiotherapy. 3) Define how conventional and advanced neuroimaging may characterize and differentiate brain neoplasms from treatment-related imaging findings following radiotherapy.

### ABSTRACT

The radiotherapeutic management of infratentorial CNS tumors requires close collaboration between neuroradiology and radiation oncology. This process begins with accurate initial tumor description and delineation in the pre-operative setting. Detection of drop metastases is another critical role for neuroimaging which can be done either preoperatively or post operatively. Post-operative imaging is essential to assist with determining extent of resection as well as defining radiotherapy treatment volumes. Finally, neuroimaging after radiotherapy can aid in determining benign radiation therapy changes from recurrent or progressive tumor.

#### RC320C Pediatric Sarcomas: MR Imaging

### Participants

Oren Cahlon, Princeton, NJ (*Presenter*) Investor, ProCure Treatment Centers, Inc

Laura M. Fayad, MD, Baltimore, MD (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Examine the roles MRI plays in the evaluation of pediatric sarcomas. 2) Assess the utility of various imaging sequences for the initial assessment and post-treatment follow-up of sarcomas. 3) Apply anatomic, functional and metabolic techniques for the identification of tumor extent and character.

### ABSTRACT

MRI plays a critical role in the assessment of pediatric musculoskeletal tumors, both osseous and soft tissue masses. Although such neoplasms may initially be evaluated on other modalities, such as sonography or radiography, the most salient role for MRI is in determining the extent of disease. MRI sequences also offer information for tumor detection, characterization, the assessment of treatment response and the distinction of post-operative scar from recurrence. With conventional MRI, excellent anatomic detail is obtained, but with the advent of non-contrast chemical shift imaging, diffusion weighted imaging and MR spectroscopy, functional and metabolic features of a neoplasm can be evaluated noninvasively. In this presentation, a comprehensive MRI approach to assessing pediatric musculoskeletal tumors will be reviewed, focusing on the roles of anatomic, functional and metabolic MRI sequences.

## Pediatric Tuesday Poster Discussions

Tuesday, Dec. 1 12:15PM - 12:45PM Location: PD Community, Learning Center

PD

AMA PRA Category 1 Credit™: .50

FDA

Discussions may include off-label uses.

### Participants

Daniel J. Ashton, MD, Houston, TX (*Moderator*) Nothing to Disclose

### Sub-Events

#### PD220-SD- TUA1 Experience from a Large Level 1 Trauma Centre: : Is CT Being Over-used in the Evaluation of Cervical Spine Injury in Paediatric Blunt Trauma?

Station #1

### Participants

Joseph Davies, MBBS, MRCS, London, United Kingdom (*Presenter*) Nothing to Disclose

Sammy Anwuzia, BSc, MSc, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

Jane Evanson, MD, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

Susan Cross, MBChB, FRCR, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Traumatic c-spine injury in children is a rare but devastating event and radiological evaluation, increasingly with Computed Tomography (CT), is critical to exclude injury. The paediatric thyroid is however particularly sensitive to ionizing radiation and the dose from a single c-spine CT gives a thyroid dose up to 200 times that of a series of plain radiographs, increasing thyroid cancer risk. We set out to evaluate the use of plain radiographs and CT in the investigation of suspected cervical spine injury in paediatric patients (< 10 years) at our level 1 trauma centre.

### METHOD AND MATERIALS

Retrospective analysis of all patients <10 years undergoing c-spine imaging in the context of blunt trauma for the investigation of suspected cervical spine injury over a 5 year period. Data relating to age, mechanism of injury, clinical presentation, imaging modality and findings were collected from the hospital imaging database, electronic records and clinical notes. Children >10 at time of admission and those with incomplete clinical data were excluded.

### RESULTS

278 patients <10 years had imaging of the cervical spine acutely following blunt trauma, 217 had complete data at time of analysis and 5 (2%) had c-spine injury. All c-spine injury occurred in conjunction with significant mechanisms of injury (fall from >20 feet or high speed motor-vehicle accident) and 4 had associated significant head injury with GCS <7 on admission. 52 (24%) of all patients had a plain radiographic series alone (0 c-spine injuries), 11 (5%) plain radiographs followed by CT (1 c-spine injury, only detected by subsequent MRI). 154 (71%) underwent CT alone (4 c-spine injuries). Most (57%) of patients investigated with CT alone had low energy trauma (fall < 2m, RTA < 30 mph) and only 47 (22%) had a GCS < 14 on admission.

### CONCLUSION

CT is now frequently used as a screening investigation to exclude cervical spine injury in the paediatric population even in relatively low energy trauma and in the absence of associated findings such as head injury. Previously this was the role of plain radiographs and this change in imaging practice results in increased radiation exposure and thyroid cancer risk in patients with very low risk of cervical spine injury.

### CLINICAL RELEVANCE/APPLICATION

Our data suggest that cervical spine CT in the paediatric trauma population is likely over utilized and further studies are required in order to produce robust imaging guidelines.

#### PD221-SD- TUA2 Diagnosis of Biliary Atresia: The Value of Real-time ShearWave Elastography

Station #2

### Participants

Zhou Lu-Yao, Guangzhou, China (*Presenter*) Nothing to Disclose

Xiao-Yan Xie, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To assess the diagnostic performance of real-time ShearWave Elastography(SWE) in identifying Biliary Atresia among infants with conjugated hyperbilirubinemia.

### METHOD AND MATERIALS

After institutional ethical approval and with informed parental consent, 161 consecutive fasting infants with conjugated hyperbilirubinemia underwent detailed Grey-scale US and real-time SWE studies performed by a single operator with a Supersonic Aixplorer scanner(France) cooperated with a 7.5-MHz curvilinear transducer and a 13.5-MHz linear-array transducer. Seventy-five of them were excluded because of lacking follow-up data(n=35), refusing surgery(n=33) or SWE failure(n=7). Grey-scale US was focused on observing gallbladder morphology and triangular cord (TC) sign. After Grey-scale US scan, SWE procedure was initiated to measure the Young's Modulus value (YMv) of liver as the baby was kept in quiet. Measurement was done three times for each



baby and the average value was taken as the final. The diagnostic performance of each of parameter was calculated. The correlation between SWE and age and the correlation between SWE and serum bilirubinemia level were analysed. Data were compared by means of an unpaired t test or Chi-square test.

## RESULTS

The Ymv of BA group [ $n=41, (16.0 \pm 9.8)$  kPa] was higher than that of no-BA group [ $n=45, (P<0.001)$ ]. The area under ROC was 0.77; the best cutoff value was 10.35 kPa. Infant's age ( $r=0.306, P=0.004$ ) and serum bilirubin level ( $r=0.306, P=0.004$ ) had a low correlation with SWE, respectively. The sensitivity, specificity, accuracy, positive predictive value and negative predictive value of SWE in identification of BA was 75.6%(31/41), 68.9%(31/45), 72.1%(62/86), 68.9%(31/45), 75.6%(31/41), respectively. While the The sensitivity, specificity, accuracy of TC sign and abnormalities of GB was 90.2%(37/41), 93.3%(42/45), 91.9%(79/86) ( $P=0.001$ ) and 90.2%(37/41), 97.8%(44/45), 94.2%(81/86) ( $P<0.001$ ), respectively. Combination of TC sign, abnormal GB and SWE, the sensitivity of US in the diagnosis of BA was 97.6%(40/41).

## CONCLUSION

Real-time SWE is not as valuable as TC sign and abnormalities of GB in identifying BA. However, combination of the three parameters might increase the sensitivity of US in the diagnosis of BA.

## CLINICAL RELEVANCE/APPLICATION

SWE is valuable to identify BA and might be potentially used to assess the liver texture before surgery.

## PD222-SD- TUA3 Assessment of Virtual Monoenergetic Images from a Dual-energy CT Examination on Image Quality and Output Exposure in Contrast-enhanced Pediatric Chest CT: Phantom Study

Station #3

### Participants

Marilyn J. Siegel, MD, Saint Louis, MO (*Abstract Co-Author*) Research Consultant, Siemens AG; Speakers Bureau, Siemens AG

Juan Carlos Ramirez-Giraldo, PhD, Malvern, PA (*Presenter*) Employee, Siemens AG

Bernhard Schmidt, PhD, Forchheim, Germany (*Abstract Co-Author*) Employee, Siemens AG

Charles F. Hildebolt, DDS, PhD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To determine the energy levels that maximize contrast-to-noise ratio (CNR) in monoenergetic images from dual-energy computed tomography (CT) in pediatric sized phantoms undergoing contrast-enhanced thoracic CT and to compare the resulting image quality and output exposure with that of single energy CT at 80 kVp.

## METHOD AND MATERIALS

Three semianthropomorphic phantoms, corresponding to a neonate, small child and small adult, underwent simulated thoracic CT on a 128-slice dual-source scanner with conventional CT at 80 kVp and dual-energy CT at 80/Sn140 kVp, where Sn denotes tin filtration. All scans used automated exposure control and volume CT dose index (CTDIvol) values were recorded. For each phantom size, dual energy data were processed and monoenergetic images (range, 40 to 90 kilo electron-volt, keV) were generated with a commercially available (Mono+) algorithm. The keV that allowed the optimal CNR was determined. Second, image noise, iodine contrast, CNR and figure of merit were calculated for the optimal monochromatic energy and compared with similar indices for single energy images at 80 kVp. Percent differences for technical factors and phantom sizes were calculated.

## RESULTS

For the neonate, small child, and small adult sized-phantoms the CTDIvol values of the 80 kVp scans were 0.4, 1.2 and 2.2 mGy, respectively; while the CTDIvol values of the 80/Sn140 kVp scans were 0.5, 1.5 and 2.3, respectively. For all phantom sizes, the CNR of Mono+ images increased with decreasing keV with the optimum CNR obtained at the lowest energy level of 40 keV. For all phantom sizes, image contrast, noise, and CNR values of Mono+ images at 40 keV (median [first quartile, third quartile]) increased relative to 80 kVp images by 152.6 [54.9 - 144.8]%, 99.8 [107.8 - 197.4]%, and 26.1 [16.6 - 35.6]%, respectively ( $P \leq .01$ , in all cases). At the same time, the FOM with Mono+ images at 40 keV increased relative to 80 kVp images by 29.3 [8.7 - 50]% ( $P = .03$ ).

## CONCLUSION

Monoenergetic images at 40 keV optimize iodine CNR and allow for increased contrast and CNR relative to conventional SECT at 80 kVp without dose penalty.

## CLINICAL RELEVANCE/APPLICATION

Given the improved image quality, virtual monoenergetic images could be very useful in improving image quality in thoracic CT, particularly low-contrast soft tissue lesions, as well as in other anatomical regions where improved iodine CNR is beneficial.

## PD223-SD- TUA4 Extralobar Pulmonary Sequestration: Initial CT Findings Predicting Spontaneous Regression in Neonates

Station #4

### Participants

Hee Mang Yoon, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

Jin Seong Lee, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

Ahyoung Jung, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

Young Ah Cho, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

Chong Hyun Yoon, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

In general, it is accepted that extralobar pulmonary sequestration (EPS) may spontaneously regress. However, radiologic features associated with spontaneous regression of EPS have not been well documented. Therefore, we tried to find the CT features

predicting spontaneous regression of EPS.

## METHOD AND MATERIALS

A total of 51 patients were included in our study with the following inclusion criteria: (a) antenatally diagnosed with EPS, (b) underwent a CT scan within 1 month after birth, and (c) had more than one follow-up CT without treatment. Spontaneous regression of EPS was determined by percent decrease of volume (PDV) and decrease in diameter of feeders. Volume of EPS and diameters of feeding systemic arteries (FSA) were evaluated on all 148 CT. For the enhancement degree of EPS, CT attenuation number of EPS and the back muscle were measured on initial CT and the ratio of EPS-to-back muscle was calculated. The PDV and the changes in diameter of FSA between initial and follow-up CT scans were calculated. Univariate and multivariate linear regression analysis were performed to assess factors related to PDV and decrease in diameter of FSA.

## RESULTS

PDV more than 50% (PDV $\geq$ 50%) was noted in 20 patients (38.5%) within one year, in other 12 patients (23.1%) between one and two years, and in 6 patients after two years. The enhancement degree of EPS was significantly different between 38 patients with PDV $\geq$ 50% and 13 patients with PDV<50 % (1.0 $\pm$ 5.4 vs 2.1 $\pm$ 1.1, respectively, p<0.001). Enhancement degree of EPS was the only significant factors predicting PDV $\geq$ 50% (B=-26.227, p<0.001), and the decrease in diameter of FSA (B=-21.476, p=0.009). In addition, PDV showed significant correlation with decrease in the diameter of the FSA (r=0.602, p<0.001).

## CONCLUSION

The volume of EPS had spontaneously decreased more than 50 % within 2 years without treatment in 63% of patients. The most important factor predicting spontaneous regression of the EPS was the enhancement degree on initial CT scan. Therefore, a significant volume regression and decrease in diameter of FSA can be expected without any treatment in a neonate with EPS showing hypoenhancement on initial CT scan.

## CLINICAL RELEVANCE/APPLICATION

The enhancement degree of EPS on initial CT scan is significantly associated with spontaneous regression of EPS during follow-up. Based on this result, we can more confidently predict spontaneous regression of EPS in neonates.

## PD224-SD- Feasibility of Superb Micro Vascular Imaging (SMI) to Detect High Grade Vesicoureteral Reflux (VUR) TUA5 in Children with Urinary Tract Infection

Station #5

### Participants

Hee Kyung Kim, MD, Cincinnati, OH (*Presenter*) Nothing to Disclose

Sara M. O'Hara, MD, Cincinnati, OH (*Abstract Co-Author*) Author, Reed Elsevier; Stockholder, Reed Elsevier; Speakers Bureau, Toshiba Corporation; Medical Advisory Board, Toshiba Corporation

Bo-Kyung Je, MD, PhD, Ansan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

Steven J. Kraus, MD, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose

Paul Horn, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Superb microvascular imaging (SMI) is a new FDA approved ultrasound technique and has enabled detection of very slow flow without contrast administration. The purpose is to validate SMI in detection of high grade vesicoureteral reflux (VUR) in children with urinary tract infection.

## METHOD AND MATERIALS

We retrospectively reviewed 34 patients with both SMI and VCUG. Two groups were compared: those with high grade reflux by VCUG and those without reflux. 17 patients, 20 kidney ureter units (KUU) had grade 4 (n=11) or grade 5 (n=9) reflux on VCUG (bilateral in 3 patients, unilateral in 14 patients, mean age 1,077 days, 8 males, 9 females). Seventeen patients, 20 KUUs, without VUR with similar ages were included (mean age 1,111 days, 4 males, 13 females). SMI was performed at the long axis of the renal pelvis and/or vesicoureteral junction in two groups. Two groups were randomly mixed and reviewed without information of VCUG. Presence of reversed flow of the urine was evaluated; reversed flow at the distal UVJ was defined as "reversed jet sign". Reversed flow in the UPJ with swirl appearance was defined as "renal pelvic swirl sign".

## RESULTS

Urinary flow and direction was detectable on SMI-US. Among 20 KUUs in the group with VUR, 15 KUUs (75%) showed either reversed jet and/or renal pelvic swirl signs (9 grade 4, 6 grade 5 reflux on VCUG). None of patients in the group without VUR showed reversed jet or swirl signs on SMI.

## CONCLUSION

We validated SMI in 40 KUUs with and without VUR and found reversed jet of the ureter or renal pelvic swirl signs indicate high grade VUR.

## CLINICAL RELEVANCE/APPLICATION

This new technique can potentially decrease invasive imaging studies which require bladder catheterization and radiation exposure. Further evaluation will be needed to refine this technique and adjust the imaging protocol in a larger sample size, including patients with low grade VUR.

## PD125-ED- Inflammatory Conditions in the Pediatric Population: Expanding Role of Musculoskeletal Ultrasound TUA6

Station #6

### Participants

Jie C. Nguyen, MD, Madison, WI (*Presenter*) Nothing to Disclose

Kenneth S. Lee, MD, Madison, WI (*Abstract Co-Author*) Research Consultant, SuperSonic Imagine; Consultant, Echometrix, LLC; Royalties, Reed Elsevier



Humberto G. Rosas, MD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose

#### TEACHING POINTS

Children are often afflicted with arthritides and infection. Ultrasound has advantages over other imaging modalities including concurrent assessment of multiple joints, high spatial resolution, dynamic assessment, and often does not require sedation. However, it is underutilized due to lack of formal training and standardized protocols.

#### TABLE OF CONTENTS/OUTLINE

A thorough understanding of the normal ultrasound appearance of the immature skeleton is critical. Proper technique and a systematic approach ensure high diagnostic accuracy and reproducibility. Although MRI remains the gold standard, ultrasound is gaining popularity in the diagnosis, monitoring, and management of inflammatory processes. Findings of JIA include synovitis, joint effusion, rice bodies, tenosynovitis, cartilage injury, and bony erosions. Although ultrasound is insensitive in the evaluation of osteomyelitis, the identification of a subperiosteal fluid, soft tissue sinus track, peri-prosthetic fluid, and complex joint effusion, can change clinical management. Occasionally, clinical presentation of arthritis and infection can be similar and while no one imaging finding is diagnostic, certain combination of findings can favor a particular pathology. Ultrasound also allows the ability to safely guide needles into fluid pockets or potentially aid in biopsying areas of synovial proliferation.

#### PD005-EB- TUA Hereditary Pediatric Renal Cystic Disorders: Imaging of the Kidneys and Beyond

Hardcopy Backboard

#### Awards

##### Certificate of Merit

##### Participants

Ethan A. Smith, MD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose

Andrew T. Trout, MD, Cincinnati, OH (*Abstract Co-Author*) Advisory Board, Koninklijke Philips NV

Alex Towbin, MD, Cincinnati, OH (*Abstract Co-Author*) Author, Reed Elsevier; Consultant, Reed Elsevier; Shareholder, Merge Healthcare Incorporated; Consultant, Guerbet SA; Grant, Guerbet SA

Jonathan R. Dillman, MD, Ann Arbor, MI (*Presenter*) Research support, Bracco Group; Research support, Siemens AG

#### TEACHING POINTS

To present the clinical, genetic/biologic, and imaging features of hereditary pediatric renal cystic disorders.

#### TABLE OF CONTENTS/OUTLINE

The clinical presentation, genetic/biologic causes, and imaging (ultrasound, CT, and MRI) features of numerous hereditary renal cystic disorders will be presented. Both renal and extra-renal imaging findings will be reviewed and illustrated. Ciliopathies<sup>1</sup>. Autosomal recessive polycystic kidney disease<sup>2</sup>. Autosomal dominant polycystic kidney disease<sup>3</sup>. Other (Jeune syndrome, Joubert syndrome, Meckel-Gruber syndrome, etc.) Phakomatoses (neurocutaneous syndromes)<sup>1</sup>. Tuberous sclerosis<sup>2</sup>. Von Hippel-Lindau disease<sup>1</sup>. Dicer1 mutation<sup>1</sup>. Other hereditary renal cystic conditions<sup>1</sup>. Summary: Imaging plays an important role in the diagnosis and follow-up of hereditary pediatric renal disorders. After reviewing this exhibit, the learner should be able to identify and characterize a variety of heritable pediatric renal cystic conditions as well as gain an up-to-date understanding of the genetic/biologic causes of these disorders.

#### Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Alex Towbin, MD - 2014 Honored Educator

## Pediatric Tuesday Poster Discussions

Tuesday, Dec. 1 12:45PM - 1:15PM Location: PD Community, Learning Center

PD

AMA PRA Category 1 Credit™: .50

### Participants

Daniel J. Ashton, MD, Houston, TX (*Moderator*) Nothing to Disclose

### Sub-Events

#### PD225-SD-TUB1 Accurate Radiation Dose Monitoring during Pediatric Fluoroscopy: The Need for Age Stratified Dose Measures

Station #1

### Participants

Matthew S. Lazarus, MD, PhD, Bronx, NY (*Presenter*) Nothing to Disclose  
 Amichai J. Erdfarb, MD, Bronx, NY (*Abstract Co-Author*) Nothing to Disclose  
 Terry L. Levin, MD, Mamaroneck, NY (*Abstract Co-Author*) Nothing to Disclose  
 Eduardo Nororis, Bronx, NY (*Abstract Co-Author*) Nothing to Disclose  
 Benjamin Taragin, MD, Teaneck, NJ (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Pediatric fluoroscopic studies include patients from birth to late teens and cover a near 100-fold range in patient size. This directly impacts on common measures of radiation dose, such as dose-area product (DAP), presenting a unique challenge for accurate dose monitoring.

### METHOD AND MATERIALS

Radiation dose parameters were prospectively recorded for all fluoroscopy studies performed over a 3.5-month period in a tertiary care pediatric hospital. Recorded parameters included fluoroscopy time (FT), DAP for fluoroscopy alone (fDAP), and accumulated DAP (fluoroscopy and spot images [aDAP]). Patient age, FT, and fDAP were compared to one another by linear regression. Additionally, aDAP and fDAP were compared to quantify spot image use.

### RESULTS

A total of 168 studies were evaluated. Upper gastrointestinal series (n=76) and voiding cystourethrograms (n=39) were the most common studies. FT (113 ±59 sec) demonstrated weak, but statistically significant, correlation with fDAP (0.42 ±1.17 Gy·cm<sup>2</sup>; FT vs. fDAP, r<sup>2</sup>=0.08, p=0.0003). Age (4.9 ±5.7 years) demonstrated a stronger, also statistically significant, correlation with fDAP (age vs. fDAP, r<sup>2</sup>=0.219, p<0.0001). FT did not correlate with age (FT vs. age, r<sup>2</sup>=0.0037, p=0.4). In 36% of cases (61 out of 168), aDAP differed from fDAP as a result of spot image acquisition; additional radiation from spot images in these cases contributed 26 ±22% of accumulated DAP.

### CONCLUSION

DAP is a valuable measure of radiation dose, however its usefulness may be limited in the pediatric population due to its dependence on patient-specific parameters. While reporting FT for quality assurance purposes has the advantage of being age-independent, its surprisingly weak correlation with DAP makes it a poor surrogate for tracking radiation dose. Therefore, it will be necessary to establish dosage standards that are age, weight, and size stratified to ensure accurate monitoring of fluoroscopy radiation dose. Lastly, when spot images were used, these accounted for approximately one-quarter of total radiation dose; further limiting spot image use offers another potential means to reduce radiation exposure.

### CLINICAL RELEVANCE/APPLICATION

Typical methods for monitoring fluoroscopy radiation dose are inadequate in the pediatric population. Age-stratified standards should be established for improved accuracy in monitoring radiation dose.

#### PD226-SD-TUB2 Ultrasonographic Evaluation of Brachial Arterial Endothelial Dysfunction in Children with Kawasaki Disease

Station #2

### Participants

Yueyue Ding, Suzhou, China (*Presenter*) Nothing to Disclose

### PURPOSE

To evaluate vascular endothelial dysfunction by using brachial arterial flow-mediated dilation (FMD) in different phases of Kawasaki disease (KD)

### METHOD AND MATERIALS

Fifty children with KD were recruited as KD group (50 cases in acute phase (Acu), 3 and 2 missings for followup in subacute phase (Sub) and convalescence phase (Con), respectively. Also 19 healthy children and 28 children with fever-of-unknown (Fou) were separately chosen as healthy control (Hea) and Fou control (Fou). And 48 patients in convalescence were divided into two groups based on whether the coronary artery lesion occurred or not. The results of brachial arterial FMD were measured for statistical analyses among the five groups.

### RESULTS

The values of FMD for the five groups of Acu, Sub, Con, Hea and Fou were 4.66(0.00,10.00), 4.55(0.00,7.69), 8.33(4.17,12.50), 13.04(8.80,19.76) and 19.05(10.53,21.74), respectively. There were significant differences in the values of FMD among the five groups, ( $\chi^2=54.242, P<0.001$ ). Compared to control groups of Hea and Fou, the values of FMD significantly increased in the groups of Acu, Sub and Con (all  $P < 0.001$ ). There were no statistical significances in FMD values between the two groups with and without coronary arterial lesion in the convalescence phase. ( $P = 0.421$ )

## CONCLUSION

The impairment of vascular endothelial function was observed in acute, subacute and convalescence phases of KD. The sonography of FMD via brachial arteries is a feasible examination of systemic vascular endothelial dysfunction, and is worthy of further clinical application.

## CLINICAL RELEVANCE/APPLICATION

The sonography of FMD via brachial arteries can detect the impairment of vascular endothelial function in children's with KD, which is a potential predicting biomarker for systemic vascular endothelial dysfunction and is worthy of further clinical application.

## PD227-SD- TUB3 Gemstone Spectral Imaging in the Assessment of Pediatric Abdominal Imaging: Comparative Study of Virtual Non-enhanced and True Non-Contrast Images

Station #3

### Participants

Xiao Xia Wang, Shanghai, China (*Presenter*) Nothing to Disclose  
Li W. Hu, DIPLING, MENG, Pudong, China (*Abstract Co-Author*) Nothing to Disclose  
Rong-Zhen Ouyang, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose  
Binghua Chen, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose  
Hong Shao, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose  
Yumin Zhong, MD, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose  
Haisheng Qiu, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose  
Na Gao, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose  
Jianying Li, Beijing, China (*Abstract Co-Author*) Employee, General Electric Company

## PURPOSE

To evaluate if the virtual non-enhanced (VNE) images generated from the contrast-enhanced spectral CT images could replace the true non-enhanced (TNE) for radiation dose reduction in children.

## METHOD AND MATERIALS

A total of 21 children (17 boys and 4 girls, mean age:  $8.3 \pm 3.42$  years) underwent non-enhanced and enhanced abdominal CT using a 64-row CT scanner (GE Discovery CT 750 HD). The enhanced scan in arterial phase (AP) was using spectral CT imaging mode with low tube current (260mA). The plain and enhanced scans in portal venous phase were performed by conventional multi-slice spiral CT with 100kVp and automatic tube current modulation (50-350mA) with noise index of 11. VNE images were generated from the AP spectral CT images at 70keV. The CT attenuation values, image noises, contrast to noise ratios (CNR) of the liver, kidney, pancreas, spleen and muscle were measured in both VNE and TNE images. Two radiologists independently and blindly assessed the image quality. Effective radiation doses were calculated. The paired t test was used for statistical analysis in this study.

## RESULTS

There was no difference in CNR between VNE and TNE for liver, spleen, kidney and pancreas (all  $p > 0.05$ ). Mean CT value of VNE (at 70keV) was lower than TNE (about 65keV) for all tissue types, but with good correlations ( $62.92 \pm 7.22$  vs.  $69.34 \pm 10.58$ ,  $54.07 \pm 6.12$  vs.  $60.56 \pm 3.61$ ,  $38.16 \pm 4.11$  vs.  $44.44 \pm 3.17$ ,  $54.76 \pm 6.12$  vs.  $58.70 \pm 4.85$ ). The noise was similar between VNE and TNE images ( $13.03 \pm 1.9$  vs.  $12.64 \pm 0.89$  HU). Image quality score for VNE was lower ( $4.17 \pm 0.09$  vs.  $4.72 \pm 0.07$ ), but was acceptable for diagnosis. The dose reduction achieved by omitting TNE was approximately 25.48% in three phases (true non-contrast, arterial phase with GSI and portal venous phase). In 6 cases when lesions were detected (3 retroperitoneal solid masses, 2 renal solid masses and 1 hepatic calcification), there was no difference between VNE and TNE images.

## CONCLUSION

Image quality of VNE images is acceptable for diagnosis, and CT numbers of VNE images correlate well with TNE images. It will be potentially omit TNE as part of abdominal imaging in children, to save radiation dose.

## CLINICAL RELEVANCE/APPLICATION

Virtual non-enhanced images in spectral CT may be used to replace true non-enhanced images for abdominal imaging in children to save radiation dose.

## PD228-SD- TUB4 Distribution of Kinetic Energy in Pulmonary Artery Flow Hemodynamics in Patients with Repaired Tetralogy of Fallot using 4D Flow MRI

Station #4

### Participants

Julio Garcia, BEng, PhD, Chicago, IL (*Presenter*) Nothing to Disclose  
Silvia Hidalgo-Tobon, PhD, Mexico City, Mexico (*Abstract Co-Author*) Nothing to Disclose  
Guadalupe Sagaon Rojas, BEng, Mexico City, Mexico (*Abstract Co-Author*) Nothing to Disclose  
Benito de Celis Alonso, PhD, Puebla, Mexico (*Abstract Co-Author*) Nothing to Disclose  
Manuel Obregon, MD, Mexico City, Mexico (*Abstract Co-Author*) Nothing to Disclose  
Porfirio Ibanez, MD, Mexico City, Mexico (*Abstract Co-Author*) Nothing to Disclose  
Julio Erdmenger, MD, Mexico City, Mexico (*Abstract Co-Author*) Nothing to Disclose  
Pilar Dies-Suarez, MD, Mexico City, Mexico (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Three-dimensional, time-resolved phase-contrast MRI (4D flow) was applied to characterize 3D hemodynamics in patients with

Three-dimensional, time-resolved phase contrast MRI (4D flow) was applied to characterize 3D hemodynamics in patients with repaired tetralogy of Fallot (rTF) in the pulmonary artery. The aim was to investigate the impact on the pulmonary artery flow hemodynamics by kinetic energy.

## METHOD AND MATERIALS

10 pediatric patients with rTF (age=9±6 yrs, 4 females) underwent aortic 4D flow MRI as part of an IRB-approved protocol. A 3D phase-contrast angiogram was generated from the 4D flow data to visualize the main pulmonary artery (MPA), right pulmonary artery (RPA), and left pulmonary artery (LPA) and used to place analysis planes. From each plane (MPA, RPA, LPA) the pulmonary lumen was segmented and used to automatically extract following flow hemodynamic parameters: peak velocity (PV), maximal flow (Q<sub>max</sub>), mean flow (Q<sub>mean</sub>), and kinetic energy. The association of kinetic energy at MPA, RPA, and LPA with other flow parameters were assessed by Pearson's correlation. Kruskal-Wallis test was used to compare plane measurements.

## RESULTS

Maximal, mean kinetic energy in the pulmonary artery showed a global correlation with PV ( $r=0.47$ ,  $p=0.008$ ;  $r=0.38$ ,  $p<0.037$ ), Q<sub>max</sub> ( $r=0.49$ ,  $p<0.005$ ;  $r=0.45$ ,  $p<0.014$ ), and Q<sub>mean</sub> ( $r=0.49$ ,  $p<0.006$ ;  $r=0.44$ ,  $p<0.015$ ). Both maximal and mean kinetic energy were mainly originated from the RPA where associations with PV ( $r=0.87$ ,  $p=0.001$ ;  $r=0.84$ ,  $p<0.002$ ), Q<sub>max</sub> ( $r=0.77$ ,  $p<0.01$ ;  $r=0.75$ ,  $p<0.013$ ), and Q<sub>mean</sub> ( $r=0.69$ ,  $p=0.028$ ;  $r=0.69$ ,  $p=0.027$ ) were more important. Maximal kinetic energy was 59% higher in the MPA than in the RPA, as well as mean kinetic energy with 33% increment. Flow distribution was the major contributor to these correlations and increment in the RPA for kinetic energy. A Kruskal-Wallis test showed significant differences between groups for Q<sub>max</sub> ( $p=0.004$ ) and Q<sub>mean</sub> ( $p=0.001$ ).

## CONCLUSION

In this pilot study, maximal and mean kinetic energy in the RPA was associated with flow hemodynamic parameters, whereas kinetic energy in the MPA and LPA were not. This observation was explained by flow distribution within the pulmonary artery. A large cohort study is needed to evaluate the clinical usefulness of kinetic energy to survey patients with rTF.

## CLINICAL RELEVANCE/APPLICATION

The flow distribution in the pulmonary artery of patients with repaired tetralogy of Fallot may be linked with the expenditure of kinetic energy. Alterations in flow and kinetic energy may guide the clinical survey of this population.

## PD229-SD- Pediatric Liver MRI with Gadobenate Dimeglumine as Part of a Whole Body Imaging Protocol TUB5

Station #5

### Participants

Guenther K. Schneider, MD, PhD, Homburg, Germany (*Presenter*) Research Grant, Siemens AG; Speakers Bureau, Siemens AG; Speakers Bureau, Bracco Group; Research Grant, Bracco Group;  
Peter Fries, MD, Homburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Jonas Stroeder, MD, Homburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Arno Buecker, MD, Homburg, Germany (*Abstract Co-Author*) Consultant, Medtronic, Inc Speaker, Medtronic, Inc Co-founder, Aachen Resonance GmbH Research Grant, Siemens AG

## PURPOSE

The aim of our study was to evaluate CE MRI of the liver in pediatric patients at a dose of 0.05 mmol/kg MultiHance as part of a whole-body imaging protocol.

## METHOD AND MATERIALS

In 55 pediatric patients 209 whole-body MRI examinations were performed including a dedicated study of the liver with unenhanced T1w in-/opposed-phase, T1w fs and T2w radial sequences, diffusion weighted images as well as T1w dynamic CE GRE sequences of the liver post CM injection (0.05 mmol/kg BW gadobenate dimeglumine (MultiHance)) and T1w sequences in the equilibrium and liver specific phase. In the liver specific phase radial VIBE sequences with Dixon-technique were applied. Results were compared with PET, CT, MIBG-Szintigraphy and Ultrasound.

## RESULTS

19 of 55 patients demonstrated focal liver-lesions in staging or follow-up MR imaging. Incidental findings included FNH, regenerative nodules post chemotherapy and hemangioma in 11 patients. In 2 patients hepatoblastoma and in one patient a hemangiosarcoma of the liver were found. 3 pts. revealed infantile hemangioendothelioma. 2 pts. showed liver involvement in Hodgkin- disease and one patient metastasis of neuroblastoma. In 16 pts. liver-lesions were diagnosed as well with other imaging modalities, however 2 cases of infantile hemangioendothelioma were misdiagnosed as malignant. Regenerative nodules, one FNH and involvement of the liver in Hodgkin disease were missed in 3 pts..

## CONCLUSION

Liver MRI with MultiHance as part of a WB imaging protocol shows comparable sensitivity and specificity as established dedicated liver examinations and gives at least comparable results as FDG-PET or ultrasound. Due to the liver specific properties of MultiHance additional information regarding differential diagnosis of focal liver lesions based on lesion contrast medium uptake is available.

## CLINICAL RELEVANCE/APPLICATION

MRI of focal hepatic lesions with liver specific contrast agents is widely accepted in adult patients but still is not established in the pediatric age group. Until now only gadobenate dimeglumine (MultiHance) is approved for use in pediatric patients and this study demonstrates the utility of liver specific imaging with gadobenate dimeglumine as part of a whole-body staging protocol.

## PD133-ED- Fetal Brainstem Kinking and Ventriculomegaly: Exploring the Differential Diagnosis TUB6

Station #6

### Participants

Elizabeth Snyder, MD, Cleveland Heights, OH (*Abstract Co-Author*) Nothing to Disclose  
Tali Amir, MD, Baltimore, MD (*Presenter*) Nothing to Disclose

Andrea Poretti, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose  
Thierry Huisman, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose

#### **TEACHING POINTS**

- Recognize the normal fetal brainstem development- Discuss the differential diagnosis of a kinked brainstem in the setting of fetal ventriculomegaly- Identify key imaging features associated with a kinked fetal brainstem to facilitate the correct final diagnosis

#### **TABLE OF CONTENTS/OUTLINE**

1. Outline normal brainstem development through a pictorial review2. Discuss the differential diagnosis of a kinked brainstem in the setting of fetal ventriculomegaly, including the alpha-dystroglycanopathies, X-linked hydrocephalus due to mutations in L1CAM, and tubulinopathies3. Illustration of prenatal and postnatal MR imaging findings of diseases characterized by fetal brainstem kinking (based on cases from our hospital (two patients with genetically confirmed alpha-dystroglycanopathies and one patient with findings suggestive of a tubulinopathy) and the literature)4. Identification of distinguishing prenatal and postnatal imaging features which may facilitate diagnosis of alpha-dystroglycanopathies, X-linked hydrocephalus due to mutations in L1CAM, and tubulinopathies

## Radiation Safety and Dose Optimization (Sponsored by the Associated Sciences Consortium) (An Interactive Session)

Tuesday, Dec. 1 1:30PM - 3:00PM Location: S105AB



AMA PRA Category 1 Credits™: 1.50  
ARRT Category A+ Credits: 1.50

### Participants

Richard Evans, London, United Kingdom (*Moderator*) Nothing to Disclose  
Louise Coleman, London, United Kingdom (*Moderator*) Nothing to Disclose

### Sub-Events

#### MSAS33A Dose Optimization in Pediatric Cardiology

### Participants

Sonya L. McFadden, MD, Antrim, United Kingdom, (s.mcfadden@ulster.ac.uk) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Comprehend current levels and risks of radiation exposure in Paediatric Interventional Cardiology (PIC). 2) Be able to calculate Local Diagnostic Reference Levels (LDRL). 3) Identify the different Interventional cardiology (IC) protocols currently used across the UK/Ireland and their impact on radiation dose/image quality. 4) Apply best practice in PIC.

### ABSTRACT

**PURPOSE**The number of pediatric interventional cardiology (PIC) procedures being performed has increased rapidly in recent years due to their reliability and cost effectiveness. However, interventional cardiology procedures have been reported to contribute to the highest doses of radiation to patients from medical examinations. Previous authors have estimated DRL for PIC and identified a wide variation of radiation exposure to the patient.**METHOD AND MATERIALS**A questionnaire study was used to investigate the PIC protocols currently used in clinical departments. Experimental studies were performed on anthropomorphic phantoms investigating these different variations in practice and the subsequent effect on image quality and radiation dose. A subsequent randomised controlled trial investigating these different protocols and their effect on image quality and dose is currently ongoing in the clinical environment. The effect of different scatter removal techniques on radiation dose and associated DNA damage was also investigated by quantifying  $\gamma$ H2AX-foci as a biomarker of radiation-induced effect.**RESULTS**Wide variations in imaging protocols are currently being used across different hospitals. These variations in practice are having a significant impact on the resultant radiation dose to the patient. Results of experimental studies on anthropomorphic phantoms showed that radiation dose reductions of 30% to 50% could be achieved by removing the anti-scatter grid, introducing an air gap and decreasing the frame rate with minimal impact on image quality. Radiation induced DNA damage is evident in patients undergoing PIC procedures and mean  $\gamma$ H2AX-foci can be significantly greater in different hospitals depending on the protocol used.**CONCLUSION**Great variation in radiation exposure exists across hospitals performing similar examinations on similar sized patients. There is a clear need for standardised protocols and guidelines. The anti-scatter grid should be removed routinely for newborn and infant patients undergoing PIC. The air gap should be introduced when possible.**CLINICAL RELEVANCE/APPLICATIONS**Simple modifications to clinical protocols will ensure the radiation dose to pediatric patients is kept ALARA without affecting image quality or diagnostic efficacy.

#### MSAS33B Learning from Errors and Near-Misses

### Participants

Sarah Peters, Didcot, United Kingdom, (sarah.peters@phe.gov.uk) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Identify common causes of errors and near-misses in the UK. 2) Describe the way errors and near-misses are investigated and reported in the UK. 3) Compare several approaches to disseminating learning from errors and near-misses.

### ABSTRACT

Healthcare professionals have a duty to inform their employer when things go wrong, regardless of whether it leads to actual harm. In turn employers should create an environment where staff members are supported and encouraged to report errors and near-misses. The World Health Organization (WHO) defines an error as "the failure of a planned action to be completed as intended or the use of a wrong plan to achieve an aim. Errors may be errors of commission or omission, and usually reflect deficiencies in the systems of care". The first stage in learning from an error is to investigate not just the 'who was involved, what happened and when?' but more importantly the 'why did it happen?' These investigations should seek to establish the facts surrounding the error rather than apportion blame, unless there was obvious malicious intent. Error investigations should also include recommendations and changes to systems of work and procedures that will lead to improvements in patient safety and prevent recurrence. For every error or incident, many more near misses will occur. The reporting and subsequent investigation of near misses can reduce the chances of an actual error occurring. No system is perfect, especially when human beings play an integral part in the process. The key point is that when errors and near-misses occur, organisations and individuals must learn from them and also ensure that this learning is shared. This could be on a local, regional or even national level to avoid the same mistake happening over and over again, at multiple locations and impacting the lives of numerous patients. This presentation will look at common errors and near-misses from a UK perspective as well as a number of approaches that are used both locally and nationally to ensure that learning is shared amongst the Radiology community.



**Pediatric Series: Abdomen**

Tuesday, Dec. 1 3:00PM - 6:00PM Location: S102AB



AMA PRA Category 1 Credits™: 3.25  
ARRT Category A+ Credits: 3.50

**FDA** Discussions may include off-label uses.

**Participants**

Brian D. Coley, MD, Cincinnati, OH (*Moderator*) Editor with royalties, Reed Elsevier  
Oscar M. Navarro, MD, Toronto, ON, (oscar.navarro@sickkids.ca) (*Moderator*) Nothing to Disclose  
Ethan A. Smith, MD, Ann Arbor, MI (*Moderator*) Nothing to Disclose  
Jeanne S. Chow, MD, Boston, MA (*Moderator*) Nothing to Disclose

**Sub-Events****RC413-01 Sonography of Neonatal Necrotizing Enterocolitis**

Tuesday, Dec. 1 3:00PM - 3:20PM Location: S102AB

**Participants**

Oscar M. Navarro, MD, Toronto, ON, (oscar.navarro@sickkids.ca) (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Identify the limitations of abdominal radiographs in necrotizing enterocolitis. 2) Describe sonographic findings in necrotizing enterocolitis. 3) Define the role of sonography in necrotizing enterocolitis.

**ABSTRACT**

Necrotizing enterocolitis (NEC) is a relatively common disease affecting neonates, especially preterm infants, but can also be seen in term neonates. Despite the progress in neonatal medicine, it remains associated with significant morbidity and mortality, with reported death rates up to 20-30%. Traditionally, neonatal NEC has been imaged with abdominal radiographs, and in fact radiographic findings are part of the Bell staging clinical criteria. Radiographic assessment mainly relies in the evaluation of the bowel gas pattern and in the detection of extraluminal gas. However, most of the radiographic findings are indirect signs of bowel involvement in NEC or its complications and are not always present even in severe cases. Sonography, which can be done by the bedside and without the need of radiation, has the advantage that allows direct visualization of the bowel wall and can assess for the presence of pneumatosis, changes in wall echogenicity, wall thickening, wall thinning, peristalsis and even wall perfusion, including hyperemia and decrease or absent vascularity, all of which can be signs of NEC. Sonography also allows direct visualization of the peritoneal cavity and may detect complex free fluid and localized fluid collections, more often associated with complicated NEC. Furthermore, sonography may also detect portal venous gas and pneumoperitoneum, the latter indicative of bowel perforation. Therefore, sonography may provide information not available on radiographs and aid in the diagnosis of NEC and detection of complications. For example, sonography may allow diagnosis of bowel necrosis before perforation occurs and pneumoperitoneum becomes evident on abdominal radiographs thus facilitating early intervention. In summary, sonography has at least a complementary role to radiographs and its use may affect management of patients with neonatal NEC and possibly their outcome.

**RC413-02 Development of a Near Infra-Red (NIR) Plenoptic Imaging System for Detecting Necrotizing Enterocolitis (NEC)**

Tuesday, Dec. 1 3:20PM - 3:30PM Location: S102AB

**Participants**

Rohan Bhavane, PhD, Houston, TX (*Presenter*) Stockholder, Sensulin, LLC  
Zbigniew Starosolski, PhD, Houston, TX (*Abstract Co-Author*) Stockholder, Alzeca Biosciences, LLC  
Barbara Stoll, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Alex Kaay, BS, Santa Barbara, CA (*Abstract Co-Author*) Nothing to Disclose  
Douglas Burrin, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Ananth Annapragada, PhD, Houston, TX (*Abstract Co-Author*) Stockholder, Marval Pharma Ltd Stockholder, Alzeca Biosciences LLC  
Stockholder, Sensulin LLC Stockholder, Abbott Laboratories Stockholder, Johnson & Johnson

**PURPOSE**

An early detection of necrotizing enterocolitis (NEC) in premature infants is key in order to reduce morbidity and mortality. Imaging of premature infants is challenging, since transportation outside the NICU and sedation are both unadvisable. We therefore designed a near infra-red (NIR) plenoptic camera system to image premature infants, and a novel liposomal nanoparticle that localizes to NEC lesions upon intravenous injection. This study tested the visualization of NEC lesions in a preterm piglet model.

**METHOD AND MATERIALS**

The NIR plenoptic camera assembly consists of 3 high-resolution camera CCD detectors mounted on a gantry with 1 axis of rotation with repeatable increment of 0.1 degree. This creates up to 1260 virtual cameras each with a resolution higher than 10 microns (Fig 1.A). Phantoms consisting of a tissue block with capillary tubes filled with the NIR dye - indocyanine green were utilized to fine tune the system for NIR signal detection. For the animal studies, pre term piglets (N=11) were delivered via C-section 2 weeks before reaching full term. The animals were maintained on total parenteral nutrition (TPN) for 2 days after which oral feeds were started. The animals were injected with liposomes containing a NIR dye, indocyanine green, after the oral feeding was commenced. The abdominal region of the animals was imaged at different time points to detect NIR signal.

**RESULTS**

NIR signal was detected from the location of gastro-intestinal (GI) tract. Animals that developed NEC showed stronger signal than those that did not go on to develop NEC. Figure 1.C shows representative images from a NEC positive and NEC negative animal.

## CONCLUSION

The promising results from this preliminary study suggest that NIR optical imaging can aid in early detection of NEC.

## CLINICAL RELEVANCE/APPLICATION

NEC is an inflammatory disease of the gastro-intestinal tract that affects pre-term infants. Early detection is critical to reducing mortality. This study reports an NIR imaging method that could be used for early detection of NEC. This technique eliminates the use of radiation, and is conducive to imaging within the NICU, and without the need for sedation.

### RC413-03 Effectiveness of a Staged Ultrasound and Magnetic Resonance Imaging Protocol to Diagnose Pediatric Appendicitis

Tuesday, Dec. 1 3:30PM - 3:40PM Location: S102AB

#### Participants

Thaddeus W. Herliczek, MD, Providence, RI (*Abstract Co-Author*) Nothing to Disclose

David W. Swenson, MD, Brooklyn, CT (*Presenter*) Nothing to Disclose

Elizabeth H. Dibble, MD, Providence, RI (*Abstract Co-Author*) Nothing to Disclose

Claudia Cartagena, Providence, RI (*Abstract Co-Author*) Nothing to Disclose

Grayson L. Baird, MS, Providence, RI (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

The purpose of this study was to establish the effectiveness of a staged ultrasound (US) and magnetic resonance imaging (MRI) algorithm for the diagnosis of pediatric appendicitis.

## METHOD AND MATERIALS

A staged imaging algorithm using US and MRI in pediatric patients with suspected appendicitis was implemented at our institution on January 1, 2011, with US as the initial modality, followed by MRI when US findings were equivocal. A search of the radiology database revealed 2180 pediatric patients who underwent imaging for suspected appendicitis, 1,982 (90.9%) of whom were evaluated according to our established imaging algorithm. A review of the electronic medical record (EMR) of all patients was performed. All imaging reports were reviewed and classified as positive, negative or indeterminate/equivocal for appendicitis, and correlated with surgical and pathology reports.

## RESULTS

The prevalence of appendicitis in our patient population was 20.5% (407/1982). Ultrasound alone was performed in 1905 patients (96.1%), yielding sensitivity of 98.7% and specificity of 97.1% for appendicitis. An additional 77 patients underwent MRI following equivocal US, yielding an overall staged imaging algorithm sensitivity of 98.2% and specificity of 97.1%. 0.35% of patients experienced false negative results under the staged protocol. The negative predictive value of the staged protocol was 99.5%.

## CONCLUSION

A staged protocol of US and MRI for pediatric appendicitis is effective. Our study demonstrates a staged protocol of US and MRI has a sensitivity of 98.2% and specificity of 97.1% for appendicitis in pediatric patients.

## CLINICAL RELEVANCE/APPLICATION

We believe staged protocol of US and MRI could supplant other imaging protocols for pediatric appendicitis. Additionally, staged US and MRI is an effective algorithm to assess pediatric appendicitis without the use of ionizing radiation.

### RC413-04 Diagnostic Performance of Noncontrast MRI in Pediatric Appendicitis

Tuesday, Dec. 1 3:40PM - 3:50PM Location: S102AB

#### Participants

Gray R. Lyons, MD, PhD, New York, NY (*Presenter*) Nothing to Disclose

Pooja Renjen, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

Ashley E. Giambrone, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

Debra Beneck, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

Arzu Kovanlikaya, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

MRI is increasingly employed as a diagnostic modality for suspected appendicitis in children. However, there is discrepancy as to which MRI sequences are sufficient for safe, timely, and accurate diagnosis. We hypothesized that diffusion weighted imaging (DWI) in conjunction with T2-weighted sequences are sufficient for diagnosis.

## METHOD AND MATERIALS

All MRI examinations (n=112) performed at our institution for the evaluation of appendicitis in children were retrospectively collected for re-evaluation. Exams were re-read by blinded pediatric radiologists first as non-contrast exams, including T2-weighted and DWI sequences, then secondly as contrast exams, including T1-weighted contrast enhanced sequences. Samples were scored as positive, negative, or equivocal for appendicitis, or non-visualized appendix. Findings were compared to pathologic or clinical data in the medical record.

## RESULTS

The sensitivity (with contrast: 1.0, without contrast: 1.0) and specificity (with: 1.0, without: 0.98) of the exams were not significantly different. However, the percentage of nondiagnostic scans was higher for noncontrast exams (with: 26.1%, without: 37.7%). To test the role of contrast in improving certainty of interpretation, nondiagnostic without contrast scans were re-read



with addition of contrast sequences. With addition of contrast sequences, the number of equivocal scans was reduced from 10 to 2 (80% RR, 9.1% AR) and the number of non-visualized appendix scans was reduced from 23 to 15 (35% RR, 9.1% AR).

## CONCLUSION

In the evaluation of appendicitis in children, non-contrast MRI examinations provide similar sensitivity/specificity to contrast-enhanced examinations, however, the number of nondiagnostic studies is higher without contrast. We propose a scanning algorithm whereby an exam is initialized as a noncontrast study and reviewed by a radiologist for diagnostic quality prior to contrast administration, if necessary. With this approach, fewer children will receive intravenous contrast without deterioration in overall diagnostic quality.

## CLINICAL RELEVANCE/APPLICATION

MRI diagnosis of acute appendicitis can be performed without contrast for most patients; injection of contrast can be reserved for only those patients with nondiagnostic noncontrast imaging.

### RC413-05 Shear-wave Elastography for Evaluation of Clinically Significant Portal Hypertension and Hepatic Fibrosis in Children

Tuesday, Dec. 1 3:50PM - 4:00PM Location: S102AB

#### Participants

Hee Mang Yoon, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose  
Young Ah Cho, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Ah Young Jung, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Jin Seong Lee, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Chong Hyun Yoon, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To evaluate the correlation among the liver stiffness (LS) measured by shear wave elastography (SWE), clinically significant portal hypertension (CSPH), and degree of hepatic fibrosis in children with liver diseases.

#### METHOD AND MATERIALS

We evaluated 38 consecutive pediatric patients (mean age,  $9.7 \pm 4.6$  years) who underwent ultrasound SWE and transjugular liver biopsy with hepatic venous pressure gradient (HVP) measurement between June 2012 and March 2015. The patients had various liver diseases. Clinical and laboratory data were retrospectively collected. CSPH was defined as a HVP  $\geq 10$  mmHg. Hepatic fibrosis was evaluated based on METAVIR classification of fibrosis. Linear regression analysis was performed to correlate LS with clinically significant PHT. Kruskal-Wallis test was conducted to correlation between LS and degree of hepatic fibrosis. Diagnostic performance of predicting clinically significant PHT and degree of hepatic fibrosis were assessed based on receiver operating characteristic (ROC) curve.

#### RESULTS

LS showed moderate to strong positive correlation with HVP ( $r=0.603$ ,  $p<0.001$ ). On multivariate analysis, LS was a significant associated factor for diagnosis of CSPH (OR =1.275,  $p=0.009$ ). The area of under the curve (AUC) for predicting CSPH was 0.839 ( $p<0.001$ ) and the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) for an LS cutoff value of 19.7 kPa were 77.8%, 93.1%, and 93.1%, respectively. There was a significant positive correlation between hepatic fibrosis and LS ( $p=0.007$ ). The AUC for predicting advanced hepatic fibrosis (METAVIR stage, F3 or F4) was 0.845 ( $p<0.001$ ) and the sensitivity, specificity, PPV and NPV of an LS cutoff value of 16.2 kPa were 78.6%, 87.5%, 78.6% and 87.5%, respectively.

#### CONCLUSION

LS exhibited significant correlation with HVP and hepatic fibrosis. Cutoff values for predicting CSPH and advanced hepatic fibrosis were 19.7 kPa and 16.2 kPa, respectively.

#### CLINICAL RELEVANCE/APPLICATION

Measurement of LS using SWE can be used for noninvasive assessment and monitoring of CSPH and hepatic fibrosis in pediatric patients with various liver diseases.

### RC413-06 US Elastography of Liver and Bowel in Children

Tuesday, Dec. 1 4:00PM - 4:20PM Location: S102AB

#### Participants

Jonathan R. Dillman, MD, Ann Arbor, MI, (jonathan.dillman@cchmc.org) (*Presenter*) Research support, Bracco Group; Research support, Siemens AG

#### LEARNING OBJECTIVES

1) Compare and contrast the different US elastography techniques that can be used in children. 2) Apply US elastography to the evaluation of the pediatric abdomen.

#### ABSTRACT

Multiple forms of ultrasound (US) elastography are available on state-of-the-art clinical ultrasound systems. In general, these techniques are based on either strain or shear wave imaging, and they can easily be performed in children. The basic physics behind each type of US elastography will be explained, and specific advantages and disadvantages will be discussed. Applications of US elastography in the evaluation of the pediatric abdomen will be presented, including assessment of the liver (e.g., for detection of parenchymal fibrosis) and bowel (e.g., for detecting fibrosis within segments of intestine affected by Crohn's disease). Recently published investigations related to US elastography in pediatric populations will be highlighted.

### RC413-07 Pediatric Hepatobiliary Interventions

#### Participants

C. Matthew Hawkins, MD, Decatur, GA, (matt.hawkins@emory.edu) (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

1) To understand the spectrum of pediatric hepatobiliary disorders in which invasive imaging is required (using vascular and nonvascular interventional techniques). 2) To describe important hepatobiliary disorders where IR plays a central role in patient management (hepatic vascular malformations, vascular shunts, transplant issues). 3) To emphasize collaboration and communication between clinicians, diagnostic and interventional radiology in managing pediatric hepatobiliary disease.

#### **RC413-08 Accuracy of Multi-echo Magnitude-based MRI Proton Density Fat Fraction to Estimate Longitudinal Change in Hepatic Steatosis in Children with Known or Suspected Non-alcoholic Fatty Liver Disease Using MRS as Reference**

Tuesday, Dec. 1 5:00PM - 5:10PM Location: S102AB

#### Participants

Elhamy R. Heba, MBBCh, MD, San Diego, CA (*Presenter*) Nothing to Disclose

Kevin A. Zand, MD, San Diego, CA (*Abstract Co-Author*) Nothing to Disclose

Omid Yeganeh, MD, La Jolla, CA (*Abstract Co-Author*) Nothing to Disclose

Tanya Wolfson, MS, San Diego, CA (*Abstract Co-Author*) Nothing to Disclose

Gavin Hamilton, PhD, San Diego, CA (*Abstract Co-Author*) Nothing to Disclose

Michael S. Middleton, MD, PhD, San Diego, CA (*Abstract Co-Author*) Consultant, Allergan, Inc Institutional research contract, Bayer AG Institutional research contract, sanofi-aventis Group Institutional research contract, Isis Pharmaceuticals, Inc Institutional research contract, Johnson & Johnson Institutional research contract, Synageva BioPharma Corporation Institutional research contract, Takeda Pharmaceutical Company Limited Stockholder, General Electric Company Stockholder, Pfizer Inc Institutional research contract, Pfizer Inc

Jeffrey B. Schwimmer, MD, San Diego, CA (*Abstract Co-Author*) Nothing to Disclose

Claude B. Sirlin, MD, San Diego, CA (*Abstract Co-Author*) Research Grant, General Electric Company; Speakers Bureau, Bayer AG; Consultant, Bayer AG ; ;

#### PURPOSE

To assess the accuracy of magnitude-based MRI (M-MRI) proton density fat fraction (PDFF) to estimate hepatic steatosis longitudinal change for two to six echoes in children with known or suspected non-alcoholic fatty liver disease (NAFLD), using magnetic resonance spectroscopy (MRS) as reference.

#### METHOD AND MATERIALS

This IRB-approved, HIPAA-compliant, single center, retrospective, longitudinal analysis included children with at least two MR visits between 2008 and 2011. Two-dimensional, spoiled gradient-echo unenhanced M-MRI was used to estimate hepatic PDFF. Low flip angle (10°) and repetition times of 120 to 270 ms were used to minimize T1 dependence. To correct for T2\* decay, six nominally in- and out-of-phase echoes were obtained. Single-voxel MR spectra (STEAM) were analyzed by an experienced MR spectroscopist (8 cm<sup>3</sup> voxel size, right lobe of liver away from artifact and vessels, long TR to avoid T1 dependence, five echoes to permit T2 correction, AMARES algorithm and jMRUI platform for analysis). Three circular regions of interest were placed on fifth-echo MR images on three consecutive slices co-localized to MRS voxel location, and propagated to images for the other echoes. M-MRI estimated PDFF was calculated for each visit from the first two to six echoes using a custom Matlab algorithm. M-MRI PDFF accuracy was assessed by Bland-Altman analysis and linear regression modeling of change in MRS PDFF vs. change in M-MRI PDFF, for each M-MRI method (two to six echoes).

#### RESULTS

Seventy-two children (158 MR examinations) were included in this analysis (50 M, 22 F; mean body mass index 33.6 ± 6.0 kg/m<sup>2</sup>; range 46.1 to 23.2 kg/m<sup>2</sup>). Regression analysis showed close agreement between change in M-MRI PDFF and change in MRS across all methods, with slope and intercept ranges for two to six echoes of 1.02 - 1.04 and 0.008 - 0.017%, respectively (close to the slope and intercept of the identity line), and R<sup>2</sup> ranging from 0.93 to 0.95.

#### CONCLUSION

In comparison to MRS, M-MRI PDFF using two to six echoes provides an accurate estimate of hepatic steatosis change in children with known or suspected NAFLD.

#### CLINICAL RELEVANCE/APPLICATION

M-MRI PDFF may be used to evaluate hepatic steatosis changes in children since it shows strong agreement with MRS PDFF.

#### **RC413-09 Superb Microvascular Imaging for the Detection of Parenchymal Perfusion in Undescended Testes in Young Children**

Tuesday, Dec. 1 5:10PM - 5:20PM Location: S102AB

#### Participants

Mi-Jung Lee, MD, PhD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

Yong Seung Lee, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

Myung-Joon Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

Hyun Joo Shin, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Superb Microvascular Imaging (SMI) is a novel, highly sensitive technique that can detect low velocity microvascular flow. The purpose of this study was to evaluate differences in perfusion of undescended testes (UDT) compared with normal testes in young children using this technique.

#### METHOD AND MATERIALS

We prospectively performed testicular ultrasonography including Power Doppler Imaging (PDI) and SMI in young children. The diagnosis of UDT or normal testes was determined according to physical examination by experienced pediatric urologists. Testicular size, volume, and microvascular flow for each testis were evaluated by both PDI and SMI. Microvascular flow was categorized into four grades: grade 0, no detectable intratesticular flow; grade 1, one or two focal areas of flow; grade 2, one linear or more than two focal areas of flow; and grade 3, more than one linear flow. Statistical analysis was performed to compare the differences between undescended and normal testes.

## RESULTS

We imaged 40 testes from 20 boys (age, 2-29 months). Eleven boys had normal testes, seven had unilateral UDT, and two had bilateral UDT. The mean age was younger in boys with UDT (7.8 vs. 15.9 months,  $p < 0.001$ ). Testis sizes and volumes were similar between the 29 normal and 11 UDT. However, SMI, but not PDI, detected differences in flow grades between the groups ( $p < 0.001$ ). In univariate analysis, age (odds ratio [OR], 0.829;  $p = 0.012$ ) and low grade flow on SMI (OR of grade 0, 51.886 with  $p < 0.001$  and OR of grade 1, 14.29 with  $p = 0.017$ ) were associated with UDT. These parameters were also significant in multivariate analysis (area under the curve, 0.892).

## CONCLUSION

This study demonstrated decreased perfusion in the UDT in young children using SMI, which can be helpful for visualizing microcirculation and informing prognosis.

## CLINICAL RELEVANCE/APPLICATION

Superb Microvascular Imaging (SMI) can demonstrate microcirculation that cannot be detected using conventional Doppler imaging in young children with undescended testes.

### RC413-10 Assessment of Pediatric Hydronephrosis via Quantitative Ultrasound Imaging

Tuesday, Dec. 1 5:20PM - 5:30PM Location: S102AB

#### Participants

Juan Cerrolaza, PhD, Washington, DC (*Abstract Co-Author*) Nothing to Disclose  
Nora Lee, Washington, DC (*Abstract Co-Author*) Nothing to Disclose  
Craig A. Peters, MD, Washington, DC (*Abstract Co-Author*) Nothing to Disclose  
Marius G. Linguraru, DPhil, MS, Washington, DC (*Presenter*) Nothing to Disclose

## PURPOSE

To create new ultrasound (US) based quantitative imaging (QI) biomarkers of pediatric hydronephrosis (HN) to identify thresholds of safety for the hydronephrotic renal units where diuretic nuclear renography could be avoided.

## METHOD AND MATERIALS

The retrospective dataset (IRB approved) consists of 50 patients (mean age 9.6 months; range 0-168 months) of variable severity (grade 1 to 4 according to the Society for Fetal Urology HN scale (SFU-HS)) with concurrent renal 2DUS imaging and diuretic renography (MAG-3). Mean differential uptake was: 49% (range 14-100%). Mean washout half time (T1/2) was: 37.3 min. (range 3 to >120 min.). Manual segmentation of renal parenchyma (RP) and collecting system (CS) was performed for calibration and algorithm development. 131 morphological parameters were computed (e.g. RP and CS size, curvature). Based on these parameters, machine learning techniques (support vector machines) were used to identify critical cases based on different T1/2 thresholds that would be clinically relevant at 20, 30 and 40 min. A best-fit model was derived for each threshold using optimal morphological parameters to categorize the renal units and receiver operating characteristic curve analysis was performed. For comparison similar thresholding was performed using the SFU-HS and the HN Index (HI).

## RESULTS

For T1/2 thresholds of 20, 30 and 40 min. and at 100% sensitivity, the specificities were QI: 94, 70 and 74%, SFU-HS: 0, 39 and 33%, and HI: 52, 47, and 62%, respectively. Area under the curve values were QI: 0.98, 0.94 and 0.94, SFU-HS: 0.74, 0.78 and 0.88, and HI: 0.77, 0.78, and 0.80, respectively. The improvement obtained by the QI method was statistically significant ( $p < 0.05$  in all the cases using McNemar's statistical test).

## CONCLUSION

QI analysis of renal US allows to identify thresholds of clinically significant T1/2 with 100% sensitivity and clinically acceptable specificity. This technology can potentially and safely reduce the number of MAG-3 scans between 50 and 62%.

## CLINICAL RELEVANCE/APPLICATION

QI analysis of renal US demonstrates higher diagnostic power than SFU-HS and HI, having the potential to provide robust assessment of HN non-invasively, minimizing the use of ionizing tests and reducing clinical cost.

### RC413-11 Comparison of Contrast-enhanced Voiding Urosonography (ceVUS) in Infants and Children Using Optison to Conventional Fluoroscopic Voiding Cystourethrography (VCUG): Preliminary Results

Tuesday, Dec. 1 5:30PM - 5:40PM Location: S102AB

#### Participants

Carol E. Barnewolt, MD, Boston, MA (*Presenter*) Nothing to Disclose  
Jeanne S. Chow, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Catherine Stamoulis, PhD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Harriet J. Paltiel, MD, Boston, MA (*Abstract Co-Author*) Equipment support, Koninklijke Philips NV

## PURPOSE

ceVUS is a radiation-free technique currently used in some European centers for diagnosis of vesicoureteral reflux (VUR) in children, but has not been adopted in the USA. There are no reports on the use of Optison, a second-generation US contrast agent available in the USA, for diagnosis of VUR. This study compares our early experience using Optison for ceVUS to conventional VCUG.

## METHOD AND MATERIALS

We retrospectively reviewed 48 patients who underwent ceVUS with Optison immediately followed by VCUG for evaluation of fetal hydronephrosis (24), febrile UTI (16), solitary functioning kidney (5), urethral valves (2) and family history of VUR (1). 24 males and 24 females ranged in age from 2 days-10 years, median 5 months, (25th, 75th) quartiles (1.0, 11.5 months). Optison doses ranging from 0.125-1.25 cc were injected into 250 cc of saline and instilled via gravity through a urethral catheter into the bladder. Image clips of bladder, ureters and kidneys were obtained during bladder filling and voiding. Patients voided around the catheter and transperineal urethral images were obtained. A conventional VCUG was then performed. Studies were reviewed for presence of VUR. VUR grading for ceVUS was into the ureter (1), renal collecting system (2), upper tract dilation (3); for VCUG the International Grading system (I-V) was used.

## RESULTS

No adverse events related to Optison occurred. Optimal visualization of the urethra, bladder and upper tracts during ceVUS was achieved with a contrast dose of 0.15 cc. Urethral images were obtained in 40/48 patients, with urethral anatomy well shown in all 40 (21M, 19F). Both studies were negative for VUR in 77/96 kidneys (80%), both positive in 7/96 (7%). In 12/96 (13%), ceVUS was positive and VCUG was negative. VUR by ceVUS was grade 1 (0), grade 2 (8), grade 3 (11). VUR by VCUG was grade I (0), grade II-III (2), grade IV-V (5). Compared to VCUG, ceVUS had a sensitivity for detection of VUR of 100% and specificity of 86%.

## CONCLUSION

ceVUS with Optison was easily performed and well tolerated, with high sensitivity and relatively high specificity for diagnosis of VUR compared to VCUG, but without the need for ionizing radiation.

## CLINICAL RELEVANCE/APPLICATION

The high-sensitivity, safety, and ease of performance of ceVUS using the US contrast agent Optison has the potential to largely replace conventional fluoroscopic VCUG for diagnosis of VUR which requires exposure to ionizing radiation. Further study is needed.

## RC413-12 Pediatric Hypertension - The Radiologist's Role

Tuesday, Dec. 1 5:40PM - 6:00PM Location: S102AB

### Participants

Ethan A. Smith, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

## LEARNING OBJECTIVES

1) Have a broad understanding of causes of hypertension in children. 2) Understand the basic pathophysiology behind renin mediated hypertension. 3) Be familiar with the different imaging modalities available to evaluate suspected renin-mediated hypertension and to understand the advantages and limitations of these modalities.

## ABSTRACT

Unlike adults, hypertension in children is most commonly secondary to an underlying condition. Renovascular hypertension accounts for between 5-10% of cases of pediatric hypertension and presents clinically with significantly elevated blood pressure, usually refractory to multiple medications. Renovascular hypertension is also associated with a variety of genetic syndromes, including neurofibromatosis type 1 and Williams syndrome. In patients with clinically suspected renovascular hypertension, imaging is employed to confirm the diagnosis, to characterize the renovascular abnormality and to guide surgical or endovascular therapy. Ultrasound with Doppler is the most frequently used initial imaging test, but has historically been thought to be unreliable due to suboptimal sensitivity and specificity. Computed tomography angiography (CTA) and magnetic resonance angiography (MRA) are both useful in the evaluation of suspected renovascular hypertension in adults, but may be less useful in children due to the frequency of intra-renal vascular abnormalities in children which are difficult to resolve with non-invasive imaging. Catheter based digital subtraction angiography remains the gold standard imaging test because of its superior temporal and spatial resolution, allowing for excellent visualization of both extra-renal (aorta, main renal artery) and intra-renal vascular lesions. It is important for the diagnostic radiologist to understand the differences between pediatric and adult renovascular hypertension, and to understand the strengths and weaknesses of the different imaging modalities available, in order to help guide the treatment of these patients.

## Pediatric Wednesday Case of the Day

Wednesday, Dec. 2 7:00AM - 11:59PM Location: Case of Day, Learning Center

PD

AMA PRA Category 1 Credit™: .50

### Participants

Ting Y. Tao, MD, PhD, Saint Louis, MO (*Presenter*) Nothing to Disclose  
Asef B. Khwaja, MD, Philadelphia, MO (*Abstract Co-Author*) Author, Reed Elsevier  
Elizabeth F. Sheybani, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose  
Shannon Farmakis, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose  
Luke L. Linscott, MD, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose  
Joan K. Zawin, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1) Recognize the importance of a multimodality approach in imaging pediatric patients. 2) Form appropriate differential diagnoses based on clinical information and imaging findings. 3) Recognize the clinical implications of diagnoses.

MSCP41

## Case-based Review of Pediatric Radiology (An Interactive Session)

Wednesday, Dec. 2 8:30AM - 10:00AM Location: S406A



AMA PRA Category 1 Credits™: 1.50  
ARRT Category A+ Credits: 1.50

### Participants

Sudha A. Anupindi, MD, Philadelphia, PA (*Director*) Nothing to Disclose

### LEARNING OBJECTIVES

1) To apply a systematic approach in the evaluation of pediatric diseases. 2) To identify essential imaging features of various pediatric congenital, musculoskeletal, abdominal and neurological diseases using a multimodality approach. 3) To understand and develop best imaging practice for various pediatric diseases.

### ABSTRACT

To apply a systematic approach in the evaluation of pediatric diseases To identify essential imaging features of various pediatric congenital, musculoskeletal, abdominal and neurological diseases using a multimodality approach To understand and develop best imaging practice for various pediatric diseases

### Sub-Events

#### MSCP41A Fetal Thoracic and Abdominal Anomalies

### Participants

Christopher I. Cassady, MD, Houston, TX (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

View learning objectives under main course title.

#### MSCP41B Pediatric Abdominopelvic Tumors

### Participants

M. Beth McCarville, MD, Memphis, TN (*Presenter*) Support, General Electric Company

### LEARNING OBJECTIVES

View learning objectives under main course title.

#### MSCP41C Congenital Disorders of the Genitourinary Tract

### Participants

Tracy N. Kilborn, MBChB, Cape Town, South Africa (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

View learning objectives under main course title.

**Pediatric Series: Pediatric Oncology and Nuclear Medicine**

Wednesday, Dec. 2 8:30AM - 12:00PM Location: S102AB

MR

NM

RO

PD

AMA PRA Category 1 Credits™: 3.25  
ARRT Category A+ Credits: 3.50

FDA

 Discussions may include off-label uses.
**Participants**

Sue C. Kaste, DO, Memphis, TN (*Moderator*) Nothing to Disclose  
 Heike E. Daldrup-Link, MD, Palo Alto, CA (*Moderator*) Nothing to Disclose  
 Stephan D. Voss, MD, PhD, Boston, MA (*Moderator*) Nothing to Disclose  
 Robert Orth, MD, PhD, Houston, TX (*Moderator*) Research support, General Electric Company;  
 Whal Lee, MD, PhD, Seoul, Korea, Republic Of (*Moderator*) Nothing to Disclose

**Sub-Events****RC513-01 Bone Mineral Density Changes in Survivors of Childhood Cancer**

Wednesday, Dec. 2 8:30AM - 8:50AM Location: S102AB

**Participants**

Sue C. Kaste, DO, Memphis, TN (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Participants will learn risk factors for bone mineral density deficits in patients having been treated for childhood malignancies.

**RC513-02 Bone Marrow Edema on MRI as an Indicator of Impending Bone Collapse in Pediatric Cancer Patients on High Dose Corticosteroid Therapy**

Wednesday, Dec. 2 8:50AM - 9:00AM Location: S102AB

**Participants**

Preeti Sukerkar, MD, PhD, Palo Alto, CA (*Presenter*) Nothing to Disclose  
 Shanshan Bao, MD, Winston Salem, NC (*Abstract Co-Author*) Nothing to Disclose  
 Sandhya Kharbanda, Palo Alto, CA (*Abstract Co-Author*) Nothing to Disclose  
 Stuart Goodman, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose  
 Heike E. Daldrup-Link, MD, Palo Alto, CA (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

Osteonecrosis (ON) is a devastating complication of pediatric cancer therapy with high dose corticosteroids, with 20 % of cases progressing to bone collapse, at which point joint conservation therapy may no longer be possible. It was recently shown in adult ON patients that the presence of bone marrow edema (BME) adjacent to epiphyseal ON is correlated with the presence of micro- or macro-fractures on histopathology, and the purpose of our study is to determine whether BME correlates with eventual bone collapse in pediatric cancer patients to help identify high risk patients who would benefit from early interventions.

**METHOD AND MATERIALS**

We retrospectively reviewed imaging studies of 18 pediatric leukemia patients who underwent high dose corticosteroid therapy and had findings of epiphyseal ON on magnetic resonance imaging (MRI). Two radiologists evaluated the presence of BME. Follow up imaging was reviewed to determine lesion progression. Using Fisher's exact test, the presence of BME was compared to the patient's outcome.

**RESULTS**

Of the 18 patients, 12 were found to have pre-collapse ON lesions with sufficient follow up imaging. A total of 36 weight-bearing and 2 non-weight-bearing lesions were identified, of which 13 progressed to collapse and 22 remained stable or improved. The presence of BME was found to be significantly correlated with eventual bone collapse, with 100% of patients who progressed to collapse demonstrating BME on initial imaging ( $p < 0.0001$ ). The absence of BME initially was associated with lesion stability or even improvement ( $p < 0.0001$ ). 3 lesions were identified that progressed slightly but did not collapse, of which none had BME on initial scans.

**CONCLUSION**

The absence of BME early on is an indicator of future stability or even improvement of an ON lesion, while the presence of BME appears to precede bone collapse. These results suggest that the presence or absence of BME can be used to help identify high-risk patients earlier so they may receive joint preserving therapies. This study is ongoing to evaluate our findings in a larger patient cohort.

**CLINICAL RELEVANCE/APPLICATION**

Presence or absence of edema on MRI predicts osteonecrosis progression in pediatric cancer patients and is recommended for stratifying high-risk patients for joint preservation therapy.

**RC513-03 To Assess the Added Value of Intravenous Gadolinium for Pre-Surgical Evaluation of Osteosarcoma in Long Bones in Pediatric Patients and Young Adults**

Wednesday, Dec. 2 9:00AM - 9:10AM Location: S102AB



#### Participants

Theodore T. Pierce, MD, Boston, MA (*Presenter*) Nothing to Disclose  
Randheer Shailam, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Santiago Lozano Calderon, MD, PhD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Pallavi Sagar, MBBS, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Osteosarcoma, a malignant bone tumor, is routinely evaluated using magnetic resonance imaging (MRI) with and without intravenous (IV) gadolinium prior to surgical intervention, typically both at initial staging and following neoadjuvant chemotherapy to determine tumor extent for operative planning. A paucity of data exists showing the utility of preoperative contrast enhanced MRI for operative planning and, so far, gadolinium does not reliably help in differentiating post treatment changes from residual disease. Preoperative parameters such as intramedullary tumor length and transphyseal tumor extension are best evaluated on non-contrast T1 or STIR sequences. Uncertainty remains as to the benefit of IV contrast for evaluating neurovascular bundle involvement (NBI) and intra-articular extension (IAE), key parameters for pre-surgical evaluation.

#### METHOD AND MATERIALS

At 2 time points, 2 pediatric radiologist independently analyzed MRI examinations of patients between the ages of 0-25 years with pathology proven extremity osteosarcoma for two parameters, NBI and IAE. Initial evaluation analyzed these parameters using non-contrast MRI images only (PRE) and, after 1 week, subsequent evaluation included both the pre and post contrast images (POST). Inter-rater discrepancies were resolved by consensus. Cohen's Kappa and McNemar's test were calculated to assess agreement between PRE and POST image interpretations of NBI and IAE.

#### RESULTS

56 patients with 90 preoperative MRI examinations were analyzed. PRE and POST interpretations agreed on 47 cases of NBI, 39 cases without NBI, and had 4 discordant cases. There were 63 cases with IAE, 25 without IAE, and 2 were discordant. Kappa was 0.91 for NBI and 0.95 for IAE. McNemar's test did not show a difference between PRE and POST imaging ( $p=0.61$  NBI;  $p=0.48$  IAE).

#### CONCLUSION

No statistical difference between PRE and POST image interpretation was found. A high level of agreement between PRE and POST image interpretation suggests that non-contrast enhanced MRI may be sufficient for pre-surgical planning for long bone osteosarcoma in pediatric patients.

#### CLINICAL RELEVANCE/APPLICATION

Avoiding unnecessary gadolinium use limits adverse reaction risk, obviates the need for intravenous access and shortens image acquisition, all of which are of particular benefit in pediatric patients.

#### RC513-04 Whole Body MRI including Diffusion-weighted Imaging as the Sole Staging and Follow-up Imaging Procedure in Pediatric Tumors - Comparison with Established Imaging Modalities

Wednesday, Dec. 2 9:10AM - 9:20AM Location: S102AB

#### Participants

Guenther K. Schneider, MD, PhD, Homburg, Germany (*Presenter*) Research Grant, Siemens AG; Speakers Bureau, Siemens AG; Speakers Bureau, Bracco Group; Research Grant, Bracco Group;  
Stefan R. Rick, Homburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Peter Fries, MD, Homburg, Germany (*Abstract Co-Author*) Nothing to Disclose  
Alexander Massmann, MD, Homburg/Saar, Germany (*Abstract Co-Author*) Nothing to Disclose  
Arno Buecker, MD, Homburg, Germany (*Abstract Co-Author*) Consultant, Medtronic, Inc Speaker, Medtronic, Inc Co-founder, Aachen Resonance GmbH Research Grant, Siemens AG

#### PURPOSE

In 58 pediatric pts. with malignant tumors whole body MRI was evaluated as the sole staging procedure in comparison to established methods such as FDG-PET, MIBG or bone scintigraphy, CT and ultrasound. Findings in follow-up whole body MRI were used for evaluation of tumor response and tumor recurrence, again compared against other established imaging methods. Of particular interest was the detection of late recurrence ( $> 18$  month post initial diagnosis) at time points, at which FDG-PET or MIBG scintigraphy are routinely not available based on actual imaging recommendations.

#### CONCLUSION

Whole body MRI performed with the described technique can correctly stage and diagnose a variety of malignant tumors in pediatric patients and late recurrence of disease is detected with a high accuracy at time points, at which PET or scintigraphy is routinely not performed.

#### CLINICAL RELEVANCE/APPLICATION

Inferior accuracy of whole body MRI using only STIR sequences or just DWI was recently published, this study demonstrates the potential of whole body MRI using more advanced techniques. Detection of late recurrence only in MRI highlights the need for advanced MRI in follow-up of pediatric malignancies.

#### RC513-05 Is the Whole Body MR Imaging Necessary in the Management of Children with Acute Myeloid Leukemia?

Wednesday, Dec. 2 9:20AM - 9:30AM Location: S102AB

#### Participants

Hee Mang Yoon, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose  
Jin Seong Lee, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Ah Young Jung, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Young Ah Cho, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose



## PURPOSE

Whole body MR imaging has been frequently used for the management of children with acute myeloid leukemia (AML) because it can provide additional information besides bone marrow evaluation. In this regard, we assess the use of the whole body magnetic resonance (MR) imaging in the management of the children with AML to validate its usefulness.

## METHOD AND MATERIALS

Sixty nine whole body MR scans of 40 consecutive pediatric patients with AML were evaluated by two radiologists in consensus. Whole body MR imaging was acquired for the following purposes: work-up for initial diagnosis, work-up for relapsed AML, work-up for stem cell transplant, work-up for a new sign or symptom, or follow-up of pre-existing abnormality. We estimated the presence of abnormal findings including extramedullary granulocytic sarcoma (EGS), clinically occult lesions, and lesions explaining the patient's clinical symptoms, except the bone marrow involvement by AML.

## RESULTS

Total 76 EGSs were identified in eleven of 40 patients (27.5 %). Nine of eleven patients (81.8%) had multiple EGSs. Thirty eight EGSs were incidentally detected on 9 whole body MR scans in seven patients (17.5 %). Positive findings were most commonly observed on whole body MR scans performed as work-up for a new sign or symptom (14 of 15 MR scans, 93.3%). Six clinically occult non-EGS lesions found on whole body MR scans were small intracranial hemorrhage (n=1), bilateral otomastoiditis (n=1), pneumonia (n=1), knee joint inflammation with effusion (n=1) and disseminated infection/inflammation (n=2). Multiple lesions at anatomically distant regions were successfully evaluated with 18 whole body MR scans (26.1%) in a single session head-to-toe imaging.

## CONCLUSION

Whole body MR imaging could be helpful to detect multiple EGSs or clinically occult lesions and be used as a problem solving tool in children with a new sign or symptom by AML in a single session study.

## CLINICAL RELEVANCE/APPLICATION

Whole body MR imaging is a useful imaging modality in management of the pediatric AML patients considering tendency for multiplicity of EGSs and prevalent occult lesions as well as the intrinsic advantages of whole body MR imaging.

## RC513-06 Defining Optimal Dose Regimes for Pediatric Whole-body 18F-FDG-PET/MRI

Wednesday, Dec. 2 9:30AM - 9:40AM Location: S102AB

### Participants

Sergios Gatidis, MD, Tübingen, Germany (*Presenter*) Nothing to Disclose

Holger Schmidt, PhD, Tübingen, Germany (*Abstract Co-Author*) Nothing to Disclose

Christian la Fougere, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose

Konstantin Nikolaou, MD, Tübingen, Germany (*Abstract Co-Author*) Speakers Bureau, Siemens AG Speakers Bureau, Bracco Group Speakers Bureau, Bayer AG

Nina Schwenzer, MD, Tübingen, Germany (*Abstract Co-Author*) Nothing to Disclose

Juergen F. Schaefer, MD, Tübingen, Germany (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To find optimal tracer dose regimes for pediatric whole-body 18F-FDG PET/MRI with minimal radiation exposure and sufficient diagnostic quality.

## METHOD AND MATERIALS

Whole-body PET data sets of 30 pediatric patients (14 female, mean age  $12 \pm 6$  [1-18] years) were retrospectively analyzed. PET data were acquired in list mode on a combined PET/MR scanner (Biograph mMR, Siemens)  $65 \pm 14$  min after injection of  $3.1 \pm 0.5$  MBq 18F-FDG per kg bw for 4 min per bed position. Based on the acquired list mode data, PET images of lower tracer doses (0.25 to 2.5 MBq/kg bw 18F-FDG) were simulated by retrospective undersampling of PET list mode data. Resulting data sets were analyzed quantitatively by measurement of standardized uptake values (SUVs) in healthy organs (liver, lungs, blood pool) and pathologic lesions by volume-of-interest (VOI) analysis. Qualitative analysis was performed independently by two readers experienced in pediatric nuclear medicine. To this end, PET-data sets were analyzed beginning with the lowest simulated tracer dose (0.25 MBq/kg bw) and gradually increasing tracer doses up to the original acquired PET image. Conspicuity of organ structures (such as brain, thymus, muscle, heart etc.) and detectability of focal PET lesions were recorded and finally compared to the original full-dose data set.

## RESULTS

Image quality steadily improved with increasing simulated tracer doses. SUVs showed higher relative deviations of about 10 % at tracer doses below 1 MBq/kg bw. Conspicuity of physiologic organ structures improved steadily with increasing simulated tracer doses and was equivalent with the original acquired PET data set at simulated doses of 1-1.5 MBq/kg bw. Detectability of focal PET lesions increased continuously with increasing simulated tracer doses; all focal lesions that were detectable in the original full-dose PET were already detectable at 1.5 MBq/kg bw.

## CONCLUSION

Tracer doses can be significantly reduced in pediatric PET/MRI compared to existing standard regimes. Our results suggest that doses of 1.5 MBq/kg bw FDG are sufficient for accurate diagnostic quality of PET. These results have to be validated in larger clinical studies.

## CLINICAL RELEVANCE/APPLICATION

Reduced tracer doses will result in lower diagnostic radiation exposure in pediatric patients. Variation of PET acquisition times may enable further reduction of tracer doses.

## RC513-07 PET/MR Compared to PET/CT in the Assessment of Pediatric Histiocytoses

Wednesday, Dec. 2 9:40AM - 9:50AM Location: S102AB

#### Participants

Andrew Sher, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

Danial S. Bokhari, MD, Houston, TX (*Presenter*) Nothing to Disclose

Matthew Goette, PhD, Houston, TX (*Abstract Co-Author*) Support, Koninklijke Philips NV

Rajesh Krishnamurthy, MD, Houston, TX (*Abstract Co-Author*) Research support, Koninklijke Philips NV; Research support, Toshiba Corporation

Victor J. Seghers, MD, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Compare lesion based analysis of 18F-FDG PET/MR to 18F-FDG PET/CT in pediatric Langerhans Cell Histiocytosis (LCH) and Rosai Dorfman Disease (RD).

#### METHOD AND MATERIALS

This prospective, HIPAA compliant study had IRB approval. Following written informed consent 18 18F-FDG PET/CT and PET/MR examinations were performed on 9 patients (6 male, 3 female, mean age 6; range: 7 months to 16 years) following a single-injection dual-imaging protocol. The indication was LCH in 11 exams and RD in 7 exams. Two readers blinded to clinical history assessed the anonymized data for metabolically active disease by consensus read. PET/CT and PET/MR were viewed simultaneously and volumes of interest were drawn over lesions, with lesions defined as non-physiologic uptake above background. SUV maximum values were recorded. Lesion detection rates and classification agreement between modalities were analyzed and compared to the reference standard (all available examinations and clinical history).

#### RESULTS

94 metabolically active lesions were identified on PET/MR versus 100 on PET/CT. Of the 94 lesions identified on both exams there was concordant classification in 93 (99%), representing excellent agreement,  $\kappa = .97$  ( $p < .001$ ), 95% CI (0.94-1.0). 6 lesions were identified on PET/CT but not PET/MR, 3 were foci of active disease, 1 was an inflammatory lymph node, and 2 were artifactual or physiologic. Per the standard of reference, 101 metabolically active lesions were available for analysis (80 were active disease while 21 were benign). Compared to the reference standard, the overall sensitivity (93% vs. 96%,  $p > .05$ ) and specificity (100% vs. 95%,  $p > .05$ ) of PET/MR vs. PET/CT, respectively, demonstrated no significant difference. The accuracies of PET/MR and PET/CT measured 94% and 96%, respectively. SUV analysis demonstrated lesions on PET/MR measuring 11% lower on average than PET/CT ( $p < .001$ ). There was a strong correlation ( $\rho = .76$ ) between the SUVs of the two modalities.

#### CONCLUSION

PET/MR demonstrates no statistical difference to PET/CT for lesion detection and classification in patients with LCH or RD. PET/MR imaging is a promising lower-radiation alternative to PET/CT for this patient population.

#### CLINICAL RELEVANCE/APPLICATION

PET/MR evaluation for pediatric histiocytoses demonstrates no statistical difference in sensitivity, specificity, or accuracy of lesion detection compared to PET/CT and can contribute to patient management with lower radiation dose.

#### RC513-08 Whole Body Imaging in Pediatric Oncology

Wednesday, Dec. 2 9:50AM - 10:10AM Location: S102AB

#### Participants

Stephan D. Voss, MD, PhD, Boston, MA (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

1) The participant should understand the various whole body multi-modality imaging techniques used in Pediatric Oncology  
2) The participant should be able to discuss strategies and opportunities for radiation dose reduction when performing multi-modality whole body examinations  
3) The audience should understand the appropriate indications for whole body imaging in pediatric oncology, including the role of whole body imaging in tumor surveillance and evaluation of patients with cancer predisposition syndromes.

#### ABSTRACT

#### RC513-09 Neuroblastoma - Imaging and Therapy Update

Wednesday, Dec. 2 10:30AM - 10:50AM Location: S102AB

#### Participants

Adina L. Alazraki, MD, Atlanta, GA (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

1) Identify the common indications for I-131 MIBG in pediatric patients. 2) Describe the necessary considerations for pediatric patients prior to I-131 MIBG therapy. 3) Discuss imaging protocols and typical pre and post therapy imaging appearance as part of monitoring of response to therapy.

#### RC513-10 PET/MR Imaging in Pediatric Sarcomas and Malignant Soft Tissue Tumors: Is There a Clinical Impact?

Wednesday, Dec. 2 10:50AM - 11:00AM Location: S102AB

#### Participants

Juergen F. Schaefer, MD, Tuebingen, Germany (*Presenter*) Nothing to Disclose

Sergios Gatidis, MD, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose

Ilias Tsiflikas, MD, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose

Guido Seitz, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose

Martin Ebinger, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Christian la Fougere, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose  
Matthias Reimold, MD, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Nina Schwenzer, MD, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Konstantin Nikolaou, MD, Tuebingen, Germany (*Abstract Co-Author*) Speakers Bureau, Siemens AG Speakers Bureau, Bracco Group  
Speakers Bureau, Bayer AG

## PURPOSE

To evaluate the clinical impact of PET/MRI in pediatric sarcomas and malignant soft tissue tumors.

## METHOD AND MATERIALS

43 examinations in 30 patients (11 female, mean age  $11.1 \text{ y} \pm 5.4 \text{ y}$ ) with diagnoses of Ewing sarcoma (n=6), osteosarcoma (n=4), rhabdomyosarcoma (n=6), NF 1 suspected for MPNST (n=9), others (n=5) were included. Written informed consent was obtained. Two protocols were performed: In group A, 11 examinations were carried out using PET/CT (Biograph mCT, Siemens) and PET/MRI (Biograph mMR, Siemens). Data were acquired on the same day after administration of  $161 \pm 88 \text{ MBq } 18\text{F-FDG}$ . In group B, 32 examinations were performed using PET/MRI only, after administration of  $114 \pm 67 \text{ MBq } 18\text{F-FDG}$ . Additionally, if indicated an additional low dose chest CT was carried out. In Group A, image analysis was performed by two experienced rater teams blinded for the respective different modality. In group B, image analysis was performed by an experienced rater team: first MRI followed by PET-MRI. Histopathology and follow-up served as reference standard. Findings of PET/MRI were reevaluated by the institutional pediatric tumorboard regarding further clinical management (e.g. change of diagnostic or therapeutic regime).

## RESULTS

Group A: The rate of focal uptake on PET/MRI was equivalent to PET/CT (52 vs. 53). Local staging (4/11), anatomic allocation (2/11) and relevant additional findings were improved by MRI. Group B: Findings of PET/MRI affecting clinical management were found in 8 /32 examinations (e.g. change of surgical approach or no additional radiation). Compared to chest CT, PET/MRI detected equal numbers of metastases in 5 patients and lower numbers in 5 patients. MRI was negative in 4 patients with nodules smaller than 4 mm who had no evidence of metastases in follow-up. There was no evidence of pulmonary metastasis in 16 patients.

## CONCLUSION

Simultaneous PET/MRI in pediatric sarcomas allows a comprehensive diagnostic for both, local and systemic tumor spread. PET/MR substantially affected the clinical management. The lower detection rate of small pulmonary nodules by MRI needs to be discussed with respect to clinical importance.

## CLINICAL RELEVANCE/APPLICATION

PET/MRI improves the clinical management in pediatric soft tissue tumors and both, local and systemic staging is possible in a single approach.

## RC513-11 Brain Exams in Pediatric Epilepsy: PET/MRI Compared to PET/CT

Wednesday, Dec. 2 11:00AM - 11:10AM Location: S102AB

### Participants

Matthew Goette, PhD, Houston, TX (*Presenter*) Support, Koninklijke Philips NV  
Erica Yang, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Nadia F. Mahmood, MD, Sugar Land, TX (*Abstract Co-Author*) Nothing to Disclose  
Jeremy Y. Jones, MD, Bellaire, TX (*Abstract Co-Author*) Nothing to Disclose  
Wei Zhang, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Victor J. Seghers, MD, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Andrew Sher, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Michael J. Paldino, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

PET/MR offers the potential for diverse image contrasts in a single examination. To reach its full potential, this technology will require robust attenuation correction (AC) algorithms. The goal of this study was to compare the diagnostic accuracy of FDG-PET images of the brain processed according to MR-based AC (MRAC) with that of images obtained using traditional CT-based AC (CTAC).

## METHOD AND MATERIALS

IRB approval and informed consent were obtained for this study. All patients referred for clinical FDG-PET/CT exams of the brain were prospectively recruited to undergo an additional FDG-PET acquisition on a Philips Ingenuity PET/MR system. A bootstrap power calculation was used to determine the number of patients required to detect a 10% difference in diagnostic accuracy (power: 0.8). Raw FDG-PET images were processed according to vendor-provided MRAC or CTAC algorithms. Five expert readers were blinded to the method of AC and all other clinical/imaging data. Consensus between readers at unblinded re-review of all data was considered the gold standard. Any potential difference in the accuracy of PET/MR compared to PET/CT was assessed using McNemar's test. Cohen's kappa was calculated to measure agreement between each reader's interpretation of MRAC and CTAC.

## RESULTS

The study population comprised 35 patients referred for a diagnosis of epilepsy (mean age: 11y; range: 2-18y), with a paired PET/CT and PET/MR exam. Compared to the reference gold standard, the overall sensitivity (71.6% and 70.2%,  $p > 0.05$ ) and specificity (74.7% and 85.1%,  $p > 0.05$ ) of the blinded interpretation of the PET/MR and PET/CT images, respectively, demonstrated no significant difference. The accuracy of MRAC-processed images did not differ significantly from those obtained using CTAC (74.7% and 76.6%, respectively,  $p > 0.3$ ). Overall, there was good intra-reader agreement between the interpretation of PET/MR and PET/CT ( $\kappa$  range: 0.55-0.78).

## CONCLUSION

The accuracy of FDG-PET images generated by an MRAC algorithm was comparable to that of FDG-PET images processed by traditional CTAC. These results further support the use of integrated PET/MR systems in clinical practice.

## CLINICAL RELEVANCE/APPLICATION

The evaluation of pediatric brain exams for the diagnosis of epilepsy using PET/MR demonstrated no statistical difference in sensitivity, specificity, or accuracy compared to PET/CT, and support the use of PET/MR in patient management with lower radiation dose.

### RC513-12 What is the Optimal Way to Measure Neuroblastoma Response to Chemotherapy?

Wednesday, Dec. 2 11:10AM - 11:20AM Location: S102AB

#### Participants

Lindsey R. Klingbeil, MD, Cincinnati, OH (*Presenter*) Nothing to Disclose

Andrew T. Trout, MD, Cincinnati, OH (*Abstract Co-Author*) Advisory Board, Koninklijke Philips NV

Alex Towbin, MD, Cincinnati, OH (*Abstract Co-Author*) Author, Reed Elsevier; Consultant, Reed Elsevier; Shareholder, Merge Healthcare Incorporated; Consultant, Guerbet SA; Grant, Guerbet SA

Daniel von Allmen, MD, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

The current recommendation for determining primary neuroblastoma tumor size and response to chemotherapy is to use 3D (anteroposterior, transverse, craniocaudal) measurements. This is in contrast to the 1D measurements recommended in RECIST 1.1 and the 2D measurements recommended for Hodgkin lymphoma. There is little evidence specific to neuroblastoma to show superiority of one measurement technique. The purpose of this study was to assess the correlation between the various measurement methods and actual tumor volume in terms of response assessment.

#### METHOD AND MATERIALS

We retrospectively analyzed the radiographic data of intermediate and high-risk neuroblastoma patients with either Stage 3 or 4 disease who were diagnosed between 2003 and 2012. Primary tumors were measured in 1D, 2D and 3D at the time of diagnosis and following chemotherapy with 2D and 3D measurements expressed as a product. True tumor volume at each time point was also measured by manual segmentation of the tumor. Tumor response for each measurement method was expressed in terms of a fraction of tumor size at diagnosis. Comparisons were based on Bland-Altman analyses with agreement expressed in terms of correlation coefficients.

#### RESULTS

Imaging from 34 patients was included in the study with comparison of tumor response to true volumes for 50 1D, 50 2D, and 39 3D measurements. A statistically significant correlation was seen between both the 2D ( $p<0.05$ ) and the 3D ( $p<0.01$ ) measurements and the volumetric method of tumor response assessments with the best correlation ( $r=0.47$  versus  $0.31$ ) for the 3D measurements. 1D measurements had poor correlation with the volumetric response assessment ( $r=0.04$ ). The mean difference in tumor response relative to volumetric assessment was higher for 2D measurements than 3D measurements ( $19\% \pm 16\%$  versus  $10\% \pm 15\%$ ).

#### CONCLUSION

Correlation between single and multiplanar measurements and true tumor volume for assessment of neuroblastoma response to therapy is moderate at best likely reflecting the irregular shape and infiltrative character of these tumors. 3D measurements had the highest correlation with volumetric assessments but may over- or underestimate tumor response by 40%.

## CLINICAL RELEVANCE/APPLICATION

Accurately determining the primary tumor response to chemotherapy using imaging is critical for making therapeutic decisions and surgical planning for neuroblastoma patients.

#### Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award>

Alex Towbin, MD - 2014 Honored Educator

### RC513-13 Evaluation of the Predictive Value of Doppler Ultrasonography in Children with Clinically Suspicious Hepatic Veno-occlusive Disease after Hematopoietic Stem Cell Transplantation

Wednesday, Dec. 2 11:20AM - 11:30AM Location: S102AB

#### Participants

Ji-Eun Park, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

Young Hun Choi, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

Hyun Suk Cho, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

Yu Jin Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

Jung-Eun Cheon, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

Woo Sun Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

In-One Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To evaluate the predictive value of Doppler ultrasonography in children with clinically suspicious hepatic veno-occlusive disease (VOD) after hematopoietic stem cell transplantation (HSCT).

#### METHOD AND MATERIALS

From January 2012 to January 2015, among 216 children who underwent HSCT, 56 children underwent Doppler ultrasonography for clinical suspicion of hepatic VOD (M:F = 22:34; mean age, 8.3years; age range 8months-20years). Among 56 patients, fifteen patients were confirmed as having VOD later (VOD group), while 41 patients turned out to have other conditions (acute graft-

versus-host disease, n=10; cytomegalovirus hepatitis, n=4; other virus hepatitis, n=6; aspergilosis, n=3; unrevealed cause, n=18; non-VOD group). Doppler ultrasonography was retrospectively reviewed for the following findings: hepatomegaly, splenomegaly, gall bladder(GB) wall edema, ascites, Doppler spectral parameters of the left portal vein (peak velocity, trough velocity, pulsatile index, flow inversion), Doppler spectral parameters of the left hepatic artery (peak systolic velocity, end systolic velocity, resistance index) and phasicity of the middle hepatic vein. The Doppler US findings were compared between two groups using Student t-test, Chi square test. Multivariate logistic regression was performed to reveal the significant predictor of VOD.

## RESULTS

The VOD group showed significantly higher incidences of hepatomegaly (9/15, 60% vs. 10/41, 24%,  $p=0.016$ ), GB wall edema (9/12, 80% vs. 9/41, 22%,  $p < 0.001$ ) and ascites (12/15, 80% vs. 9/41, 22%,  $p < 0.001$ ), relative to the non-VOD group. The peak systolic velocity of the left hepatic artery was significantly higher in VOD patients compared with non-VOD patients ( $73\pm 33\text{cm/sec}$  vs.  $49\pm 21\text{cm/sec}$ ,  $p=0.002$ ). Other findings showed no statistically significant difference between the two groups. Multivariate analysis revealed that only ascites was significantly associated with VOD ( $\beta=0.345$ ).

## CONCLUSION

The presence of hepatomegaly, GB wall edema, ascites and increased peak systolic velocity of the hepatic artery were significantly associated with progression to definite VOD in pediatric HSCT patients with clinically suspicious VOD.

## CLINICAL RELEVANCE/APPLICATION

Hepatic VOD is one of the most feared complications of HSCT. Our study identified Doppler ultrasonographic findings that could be helpful in predicting progression to definite VOD.

### RC513-14 Correlation between Diffusion-weighted Imaging Combined with Conventional Magnetic Resonance Imaging Parameters and Histopathologic Findings in Eyes Primarily Enucleated for Advanced Retinoblastoma: A Retrospective Study

Wednesday, Dec. 2 11:30AM - 11:40AM Location: S102AB

#### Awards

##### Trainee Research Prize - Medical Student

#### Participants

Yanfen Cui, Shanghai, China (*Presenter*) Nothing to Disclose  
Dengbin Wang, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose  
Huanhuan Liu, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose  
Caiyuan Zhang, MD, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

to evaluate the diagnostic accuracy of conventional MR imaging in detecting tumor invasion of intraocular retinoblastoma and to correlate ADC values with high-risk pathological prognostic parameters of retinoblastoma.

## METHOD AND MATERIALS

The accuracy of MR imaging in detecting invasion extent of 63 tumors were determined. Furthermore, ADC value with b factors of 0 and 1000 seconds/mm<sup>2</sup> were calculated and correlated with high risk pathological prognostic parameters. Additionally, the correlation of Ki-67 expression with ADC value were analysed.

## RESULTS

The accuracy of conventional MRI in detecting prelaminar and postlaminar optic nerve invasion was 85.7% , focal and massive choroidal invasion 61.9%, scleral invasion 98.4% and ciliary body invasion was 95.2%. The ADC value of well-differentiated retinoblastoma were significantly different from poorly or undifferentiated tumors ( $p < 0.002$ ). There was no significant difference in the ADC value between bilateral and unilateral retinoblastomas ( $P=0.09$ ) and different growth pattern ( $P=0.74$ ). The ADC value of postlaminar optic nerve invasion has significantly different with no optic nerve invasion ( $P=0.04$ ). There was significant difference in the ADC of retinoblastoma with or without scleral invasion ( $P=0.007$ ), but has no difference in choroidal invasion ( $P=0.629$ ) or ciliary body invasion ( $P=0.532$ ). Additionally, the ki-67 index was inversely correlated with the ADC value ( $p < 0.002$ ).

## CONCLUSION

Routine MRI has limitations in reliably predicting microscopic infiltration of the retinoblastoma, where ADC correlated well with high-risk pathological prognostic parameters and Ki-67 index for retinoblastoma and may serve as a noninvasive prognostic parameter for assessment of newly diagnosed retinoblastoma.

## CLINICAL RELEVANCE/APPLICATION

Routine MRI has limitations in reliably predicting microscopic infiltration of the retinoblastoma, whereas ADC correlated well with high-risk pathological prognostic parameters and Ki-67 index for retinoblastoma and may serve as a noninvasive prognostic parameter for assessment of newly diagnosed retinoblastoma.

### RC513-15 Imaging of Tumor Syndromes

Wednesday, Dec. 2 11:40AM - 12:00PM Location: S102AB

#### Participants

Andrew T. Trout, MD, Cincinnati, OH, (andrew.trout@cchmc.org) (*Presenter*) Advisory Board, Koninklijke Philips NV

## LEARNING OBJECTIVES

1) Recognize some of the tumor predisposition syndromes that present in children/young adults. 2) Name the relevant tumors for the discussed syndromes. 3) Implement currently accepted imaging protocols for the discussed syndromes.

## ABSTRACT

MSCP42

## Case-based Review of Pediatric Radiology (An Interactive Session)

Wednesday, Dec. 2 10:30AM - 12:00PM Location: S406A



AMA PRA Category 1 Credits™: 1.50  
ARRT Category A+ Credits: 1.50

### Participants

Sudha A. Anupindi, MD, Philadelphia, PA (*Director*) Nothing to Disclose

### LEARNING OBJECTIVES

1) To apply a systematic approach in the evaluation of pediatric diseases. 2) To identify essential imaging features of various pediatric congenital, musculoskeletal, abdominal and neurological diseases using a multimodality approach. 3) To understand and develop best imaging practice for various pediatric diseases.

### ABSTRACT

To apply a systematic approach in the evaluation of pediatric diseases To identify essential imaging features of various pediatric congenital, musculoskeletal, abdominal and neurological diseases using a multimodality approach To understand and develop best imaging practice for various pediatric diseases

### Sub-Events

#### MSCP42A Pediatric Brain Abnormalities

### Participants

Manohar M. Shroff, MD, Toronto, ON, (manohar.shroff@sickkids.ca) (*Presenter*) Consultant, Guerbet SA; Consultant, Magellan Health, Inc

### LEARNING OBJECTIVES

View learning objectives under main course title.

#### MSCP42B Pediatric Sport Injuries

### Participants

Kirsten Ecklund, MD, Boston, MA, (kirsten.ecklund@childrens.harvard.edu) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

View learning objectives under main course title.

#### MSCP42C Pediatric Nuclear Medicine Cases

### Participants

Ruth Lim, MD, Boston, MA (*Presenter*) Consultant, Alexion Pharmaceuticals, Inc; Officer, New England PET Imaging System

### LEARNING OBJECTIVES

View learning objectives under main course title.



**Pediatric Wednesday Poster Discussions**

Wednesday, Dec. 2 12:15PM - 12:45PM Location: PD Community, Learning Center

**PD**

AMA PRA Category 1 Credit™: .50

**Participants**Robert Orth, MD, PhD, Houston, TX (*Moderator*) Research support, General Electric Company;**Sub-Events****PD230-SD-WEA1 Evaluation of the Automatic Tube Current Modulation (ATCM) in Pediatric CT Examinations**

Station #1

**Participants**Takanori Masuda, Hiroshima, Japan (*Presenter*) Nothing to DiscloseTakayuki Oku, Hiroshima, Japan (*Abstract Co-Author*) Nothing to DiscloseNaoyuki Imada, Hiroshima, Japan (*Abstract Co-Author*) Nothing to DiscloseYukari Yamashita, Hiroshima, Japan (*Abstract Co-Author*) Nothing to DiscloseNoritaka Noda, Hiroshima, Japan (*Abstract Co-Author*) Nothing to DiscloseKazuo Awai, MD, Hiroshima, Japan (*Abstract Co-Author*) Research Grant, Toshiba Corporation; Research Grant, Hitachi, Ltd; Research Grant, Bayer AG; Research Grant, DAIICHI SANKYO Group; Medical Advisor, DAIICHI SANKYO Group; Research Grant, Eisai Co, Ltd; Research Grant, Nemoto-Kyourindo; ; ; ;Toru Ishibashi, RT, Hiroshima, Japan (*Abstract Co-Author*) Nothing to DiscloseYukie Kobayashi, Hiroshima, Japan (*Abstract Co-Author*) Nothing to DiscloseTomoyasu Satou, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose**PURPOSE**

The ALARA recommends use of automatic tube current modulation (ATCM) for CT examination because ATCM allows for radiation dose reduction in pediatric CT examinations. However, the ATCM systems of the CT devices are not designed specifically for pediatric CTs. The purpose of this study was to evaluate the operating characteristics of ATCM with the intent of performing the appropriate dose reduction in pediatric CT examinations.

**METHOD AND MATERIALS**

We used the conical phantom to evaluate the operating characteristics of the ATCM with 64-row MDCT (Light speed VCT of GE Health care). We compared the SD values and modulated tube currents at each tube voltage (80, 100, 120kVp) and SD value (Set Noise Index from 5 to 15) in the phantom diameter positions at 10, 15, 20 cm. We performed 5 scans for 5 measurements.

**RESULTS**

There was clear correlation ( $R > 0.98$ ) between the SD value and Noise Index (NI). The measurement of SD value was significantly lower ( $P < 0.01$ ) than the set NI. At the NI 10, SD value was 6.15, 6.12 and 5.25 at 80, 100 and 120kVp in diameter 10cm and 7.78, 7.45 and 7.41 at 80, 100 and 120kVp in diameter 15cm and 9.55, 9.10 and 9.44 at 80, 100 and 120kVp in diameter 20cm, respectively. SD value of 10cm in diameter was about 37% lower than NI and 15cm in diameter was about 21% lower and 20cm in diameter was about 12% lower. There were no significant differences in the SD value between 80, 100 and 120kVp. Optimal setting NI were determined from the calculation of the image SD value required for diagnosis ( $\phi 10$ :  $SD = 0.6363 \times NI - 0.0654$ ,  $\phi 15$ :  $SD = 0.7969 \times NI - 0.0622$ ,  $\phi 20$ :  $SD = 0.9861 \times NI - 0.5901$ ).

**CONCLUSION**

The operating characteristics of ATCM may be appropriate for radiation dose reduction in pediatric CT examination.

**CLINICAL RELEVANCE/APPLICATION**

Our calculation formula with ATCM may be applied for maintaining the SD value using low radiation dose protocol pediatric CT examination.

**PD231-SD-WEA2 Negative Pseudo-normalization Demonstrated by Diffusion-weighted Imaging in Term Neonates with Hypoxic-ischemic Encephalopathy Undergoing Therapeutic Hypothermia**

Station #2

**Participants**Katsumi Hayakawa, MD, Kyoto, Japan (*Presenter*) Nothing to DiscloseSachiko Koshino, Kyoto, Japan (*Abstract Co-Author*) Nothing to DiscloseOsamu Sato, MD, PhD, Kyoto, Japan (*Abstract Co-Author*) Nothing to DiscloseKoichi Tanda, Kyoto, Japan (*Abstract Co-Author*) Nothing to DiscloseMinako Kihara, MD, PhD, Muroran, Japan (*Abstract Co-Author*) Nothing to DiscloseAkira Nishimura, Kyoto, Japan (*Abstract Co-Author*) Nothing to Disclose**PURPOSE**

Perinatal hypoxic-ischemic encephalopathy (HIE) is a major cause of death and disability in infants. Recently, increasing use of therapeutic hypothermia has improved the outcome of HIE neonates. MRI, especially diffusion-weighted imaging (DWI), is a powerful tool for assessment of these high-risk neonates, but pseudonormalization (PN) poses a significant problem in that it tends to underestimate brain injury after 8-10 days of age. We have noticed that some neonates showed a lack of PN on DWI. The aim of this study was to correlate the DWI abnormality and negative or positive PN of restricted diffusion on DWI with clinical outcomes in these neonates.

## METHOD AND MATERIALS

Seventeen term neonates (10 males and 7 females) who were judged to have moderate (N=13) or severe (N=4) HIE underwent therapeutic hypothermia. Their mean gestational age and birth weight were 38.3 weeks and 2620 g. They were examined by MRI using 1.5T machine twice at mean ages of 3 and 10 days. The presence of restricted diffusion and also the presence or absence of PN, were evaluated at the time of the second MRI during the second week of life, and the results of DWI and PN were also correlated with clinical outcomes.

## RESULTS

DWI demonstrated no abnormality in 7 neonates. Among 10 neonates with abnormal DWI findings, 3 were positive for PN and 7 were negative. Except for 2 neonates who were lost to follow-up, 5 of the 7 neonates with normal DWI findings all had normal clinical outcome. On the other hand, among the 10 neonates with abnormal DWI findings, 8 had cerebral palsy, 1 was borderline, and 1 had a normal outcome. There was a statistical difference in clinical outcome between neonates with normal and abnormal DWI findings ( $P=0.002$ ). Among 8 neonates with normal DWI findings and positivity for PN, one had major disability and seven did not. For the patients who were PN negative, the outcome was major disability in all cases. The difference in clinical outcome between neonates with PN negative and the others was statistically significant ( $P=0.0004$ ).

## CONCLUSION

Normal DWI findings are predictive of a favorable outcome. Abnormal DWI findings with PN negativity may suggest more severe brain injury than PN positivity and predict major disability as an adverse outcome.

## CLINICAL RELEVANCE/APPLICATION

Negativity for PN demonstrated by a second MRI examination during the second week of life can be a robust and objective biomarker of adverse clinical outcome.

### PD233-SD- Whole Body Simultaneous FDG-PET/MR for Pediatric Lymphoma: Initial Experience WEA4

Station #4

#### Participants

Maria R. Ponisio, MD, St. Louis, MO (*Presenter*) Research Consultant, Eli Lilly and Company  
Jonathan E. McConathy, MD, PhD, Saint Louis, MO (*Abstract Co-Author*) Research Consultant, Eli Lilly and Company; Research Consultant, Blue Earth Diagnostics Ltd; Research Consultant, Siemens AG; Research support, GlaxoSmithKline plc  
Richard Laforest, PhD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose  
Pamela K. Woodard, MD, Saint Louis, MO (*Abstract Co-Author*) Research Consultant, Bristol-Myers Squibb Company; Research Grant, Astellas Group; Research Grant, F. Hoffmann-La Roche Ltd; Research Grant, Bayer AG; Research agreement, Siemens AG; Research Grant, Actelion Ltd; Research Grant, Guerbet SA; ;  
Geetika Khanna, MD, MS, Iowa City, IA (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To evaluate the feasibility and diagnostic performance of simultaneous whole body FDG-PET/MRI for pediatric patients with lymphoma. To compare dosimetry and SUV measurements for normal organs and FDG-avid lesions measured with PET/CT and PET/MR.

## METHOD AND MATERIALS

This is a retrospective, IRB approved, HIPAA compliant study. Pediatric patients undergoing standard of care FDG-PET/CT were recruited for simultaneous whole body PET/MRI performed immediately after the PET/CT. Studies were performed with Siemens Biograph mMR PET/MR, and Biograph 40 and mCT PET/CT systems. MR sequences included whole body Dixon, T2 HASTE and diffusion-weighted imaging. PET/MR images were interpreted by two radiologists in consensus. Images were evaluated for quality, lesion detection and anatomic localization of FDG uptake. Maximum and mean standardized uptake value (SUVmax/mean) for normal organs (lungs, blood pool, liver, skeletal muscle and lumbar spine) and SUVmax for FDG-avid lesions on PET/MRI and PET/CT were measured. Estimates of radiation doses were calculated from the administered dosage of FDG and CT protocol parameters using pediatric models.

## RESULTS

9 PET/MR scans were performed in 8 subjects (6M, 2F, mean age=15.3 yrs.) with aggressive lymphomas (4 Hodgkin disease, 2 diffuse large B-cell lymphoma and 2 Burkitt lymphoma). The mean delay between PET/CT and PET/MRI was  $51 \pm 10$  mins. PET/MR demonstrated good image quality and localization of FDG-avid lesions. SUV measured with PET/MR and PET/CT showed statistically significant correlation for normal organs (SUVmax  $r^2=0.88$ ; SUVmean  $r^2=0.88$ ) and FDG-avid lesions (SUVmax  $r^2=0.94$ ) (Figure). The mean effective doses of whole body PET/CT examinations was 13.48 mSv, with PET accounting for 8.23 mSv and CT accounting for 5.25 mSv.

## CONCLUSION

Pediatric whole body simultaneous PET/MR is technically feasible and performs well in terms of image quality and SUV quantification comparable to PET/CT. PET/MR demonstrated an average 39% radiation exposure reduction compared with our standard FDG-PET/CT protocol.

## CLINICAL RELEVANCE/APPLICATION

Whole body PET/MR is a promising new technology for staging, treatment planning, and follow-up of pediatric patients with lymphoma.

### PD234-SD- Transthoracic Ultrasound of Lungs in the Diagnosis of HMD and Non HMD Causes of Respiratory WEA5 Distress in Preterm Newborns

Station #5

#### Participants

Laxmikant Gupta, MBBS,MD, Chandigarh, India (*Presenter*) Nothing to Disclose



Akshay K. Saxena, MD, Chandigarh, India (*Abstract Co-Author*) Nothing to Disclose  
Kushaljit S. Sodhi, MBBS, MD, Chandigarh, India (*Abstract Co-Author*) Nothing to Disclose  
Anmol Bhatia, MBBS, MD, Chandigarh, India (*Abstract Co-Author*) Nothing to Disclose  
Praveen Kumar, MD, Chandigarh, India (*Abstract Co-Author*) Nothing to Disclose  
Niranjan Khandelwal, MD, Chandigarh, India (*Abstract Co-Author*) Nothing to Disclose

## **PURPOSE**

To evaluate the diagnostic performance of transthoracic sonography(TTS) in the diagnosis of hyaline membrane disease(HMD) and other etiologies of respiratory distress in preterm newborns.

## **METHOD AND MATERIALS**

This was a prospective study approved by the ethics committee. Ninety-one preterm newborns with respiratory distress within 6 hours of life were enrolled. All the patients underwent lung ultrasound through transthoracic approach by a trainee radiologist during first 24 hours of respiratory distress. The images were evaluated by an experienced pediatric radiologist who was blinded to the clinical diagnosis, and made the sonographic diagnosis. The clinical diagnosis which was considered as the gold standard, was made by the clinician who was blinded to the sonographic diagnosis but was aware of chest radiographic diagnosis made by another pediatric radiologist. The sonographic findings were classified as "A" line, "B" line, alveolar interstitial syndrome, localized consolidation, pleural line abnormality, spared areas, large consolidations, localized consolidation, double lung point and lung sliding. Based on the findings, patients were classified into different patterns including normal, HMD, transient tachypnea of newborn, pneumothorax, pneumonia and other causes. The sonographic diagnosis was compared with the clinical diagnosis and the diagnostic performance of TTS was evaluated.

## **RESULTS**

Taking all the parameters into consideration, the sonographic diagnosis had sensitivity, specificity, PPV and NPV of 76.5%, 97.5%, 97.5%, and 76.5% respectively for differentiating HMD from the non HMD group. There was a high degree of agreement between the sonographic and clinical diagnosis ( $k = 0.718$ ). TTS had a sensitivity and specificity of 100%, when done within 8 hours of birth.

## **CONCLUSION**

TTS is a useful and accurate modality in the diagnosis of different etiologies of respiratory distress in preterm newborns, and aids in differentiating HMD from the non HMD cases. TTS can be useful in making judicial decisions of using surfactant in the preterm newborns.

## **CLINICAL RELEVANCE/APPLICATION**

TTS is a useful modality for the diagnosis of different etiologies of respiratory distress and also useful in making decisions of using surfactant in the preterm newborns.

## Pediatric Wednesday Poster Discussions

Wednesday, Dec. 2 12:45PM - 1:15PM Location: PD Community, Learning Center

PD

AMA PRA Category 1 Credit™: .50

FDA

Discussions may include off-label uses.

### Participants

Robert Orth, MD, PhD, Houston, TX (*Moderator*) Research support, General Electric Company;

### Sub-Events

#### PD235-SD- WEB1 Comparative Study of Image Quality and Contrast-enhancement between Spectral CT and Conventional CT for Pediatric Patients: A Phantom Study

Station #1

### Participants

Yang Yang, MD, Beijing, China (*Presenter*) Nothing to Disclose

Yuchun Yan, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

Xinyu Yuan, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

Yun Shen, PhD, Beijing, China (*Abstract Co-Author*) Employee, General Electric Company Researcher, General Electric Company

Huizhi Cao, PhD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To compare the image quality and contrast-enhancement of pediatric body CT with spectral imaging and conventional 120 kVp scan mode, under the same CT dose index (CTDI) and dose-length product (DLP) .

### METHOD AND MATERIALS

The CTDI phantom of pediatric body size was scanned with both the conventional 120 kVp mode and Gemstone Spectral Imaging (GSI) mode with the same CTDI (9.0 mGy) and DLP(77.9mGy). Five syringes filled with iohexol (8.2mgI/ml (230HU@120kVp)) were placed into the phantom mimic the blood vessel. One syringe was placed in the center and the other four were placed into four quadrants with equal distance from edge. All the GSI data was transferred to GSI viewer to obtain 4 monochromatic images (55-70keV, interval of 5keV). Image noise, CT value and contrast-to-noise ratio (CNR) were compared between the GSI and conventional 120 kVp CT images.

### RESULTS

The CT values (in HU)at 55, 60, 65 and 70 keV were 359.2±3.5, 284.2±3.3, 234.8±3.2,195.3±2.8 respectively, the corresponding CNR values were 24.2, 24.7, 20.0 and 9.9, and image noise values were 10.7, 6.9, 5.6, 6.5 respectively. CT value of conventional 120 kVp image was 230.6HU±1.9HU, CNR was 20.4, noise was 5.0. Of the 4 sets of monochromatic images , CNR of the 60 keV image (24.7) was the highest, which was better than that of the 120 kVp image; noise of the 65 keV image (5.6HU) was the lowest, slightly larger than that of the 120 kVp image. Compared with the contrast-enhancement of 120 kVp images (CT value of 230.6HU±1.9HU), 65 keV monochromatic image (234.8HU±3.2HU) had the closest value to it.

### CONCLUSION

The monochromatic images at 60 keV offer the best CNR that is better than the 120 kVp images. 65keV monochromatic images have the lowest noise among all the spectral images and provide similar contrast-enhancement as the 120 kVp images.

### CLINICAL RELEVANCE/APPLICATION

Monochromatic spectral CT images at optimal level provide higher image quality and contrast-enhancement to help pediatrician to make early diagnosis.

#### PD236-SD- WEB2 The Image Gently Campaign Website: Using Google Analytics to Improve Impact

Station #2

### Participants

Benjamin Wildman-Tobriner, MD, Durham, NC (*Presenter*) Nothing to Disclose

Michael J. Callahan, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

Marilyn J. Goske, MD, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose

Donald P. Frush, MD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

The Alliance for Radiation Safety in Pediatric Imaging (Image Gently®-IG) created social marketing campaigns to raise awareness for radiation protection in pediatric imaging. Developed in 2008, the IG website is the primary portal for educational materials for healthcare providers and patients/caregivers, with increasing global acclaim. However, expanding opportunities must resonate with informed and resource-conscious strategies. Our purpose was to perform the first known Google Analytics IG review as a tool to guide effective website enhancement.

### METHOD AND MATERIALS

Google Analytics (Google, Mountain View, CA) was accessed to track IG website (imagegently.org) data between 1-1-12 and 1-1-15, using both metrics inherent to Google Analytics as well as customized dashboards. Data included visitor frequency, demographics, behavior, and type of device used for access, among others.

## RESULTS

For the 3-yr period, the website had over 127K unique visitors, 177K total visits, and 1 million page views. 71.2% of visits were new, with 28.6% returning visitors. Traffic came from the US (74 %), with other visits from Brazil (2.1%), India (1.8%), Canada (1.8%), and the UK (1.6%). Following English (86%), languages used to access content included Spanish, Italian, and Japanese (<2% each). Spikes in activity corresponded to both planned rollouts as well as public media events. Users were 14-20x more likely to access from desktops than mobile and tablets. The bounce rate (leaving on first page without exploring further) was only 20.6%. Surprisingly, the average pages per session were 5-6. The most visited pages (after homepage) were titled "education", "CT", "Technologists", and "protocol".

## CONCLUSION

Google Analytics proved an effective method to obtain feedback regarding the IG website. Based on these data, efforts directed at translations will be reduced, and more user friendly navigation on the homepage to the preferred sites (e.g., education and CT protocols) will be designed, as nearly 80% of users explored multiple pages and 74% were new. Low personal device usage may be due to absence of an app, which is currently under design. Finally, orchestrated roll-outs are effective in increasing radioprotection awareness for children.

## CLINICAL RELEVANCE/APPLICATION

Image Gently communications and outreach can be improved through website analytics, which allows targeted website portal enhancement and better communication of radiation safety information.

### PD237-SD- WEB3 Feasibility of Using Continuity-Based Correlative Enhancement for Improving Recognition of Structural Details Based on Gray-White Differentiation in Head CT Images

Station #3

#### Participants

Aseem Sharma, MBBS, Saint Louis, MO (*Presenter*) Stockholder, General Electric Company; Consultant, BioMedical Systems; Co-Founder, Correlative Enhancement, LLC

Pooria Javadi, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose

Lance A. Warren, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose

Matthew S. Parsons, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose

Charles F. Hildebolt, DDS, PhD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Optimization of head CT protocols involves reducing radiation dose while maintaining ability of images to convey structural details such as gray-white differentiation. Here, we test the ability of an image-processing algorithm (patent pending) to improve gray-white differentiation in head CT images acquired using different radiation doses.

## METHOD AND MATERIALS

From normal head CTs obtained in 30 consecutively scanned children (15 each with "normal" and "low-dose" protocols), we selected 30 images across basal ganglia and 30 through the centrum semiovale. These baseline images were manipulated using a custom image-processing algorithm (patent-pending) in MATLAB program to create enhanced images based on continuity-based correlation amongst individual pixels. Two masked readers rated baseline and enhanced images for overall diagnostic quality, gray-white differentiation, insular cortex definition, basal ganglia definition, and artifacts on Likert-type scales. Baseline ratings were subtracted from the enhanced ratings and differences compared using one-sample, signed rank test (two-tailed, with a test value of 0). In addition, readers also rated the comparative diagnostic quality of two types of images on a 5-point scale in which a rating of 3 was considered equivalent. Comparative ratings were compared for significant differences using one-sample, signed rank test (two-tailed, with a test value of 3). P-values of <0.05 were considered significant.

## RESULTS

Significantly higher rating of gray-white differentiation, basal ganglia definition, and insular cortex definition for enhanced images was observed ( $p < 0.01$  for both readers). Overall diagnostic quality was rated higher by one reader ( $p < 0.01$ ) but equivalent by the other ( $p = 0.14$ ). Presence of artifacts did not significantly change. Enhanced images were given higher comparative diagnostic quality ratings by both readers ( $p < 0.01$  both readers).

## CONCLUSION

Continuity-based correlative enhancement can improve recognition of structural details that are dependent upon ease of gray-white matter differentiation within the head CT images. These benefits are recognized in head CTs obtained at varying aggressiveness of radiation dose reduction.

## CLINICAL RELEVANCE/APPLICATION

Continuity-based correlative enhancement may help extract useful information from head CT images obtained at low radiation dose.

### PD238-SD- WEB4 Safety of Ferumoxytol for MR Imaging in Children

Station #4

#### Awards

**Trainee Research Prize - Fellow**

#### Participants

Anne Muehe, MD, Stanford, CA (*Presenter*) Nothing to Disclose

Dan Feng, PhD, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose

Heike E. Daldrup-Link, MD, Palo Alto, CA (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To assess the safety profile of ferumoxytol as an intravenous magnetic resonance (MR) imaging contrast agent in pediatric patients

## METHOD AND MATERIALS

Four pilot studies of developing new MR imaging techniques for malignant tumors and kidney transplant rejection, conducted at two centers, were HIPAA compliant, approved by the respective institutional review boards, and performed under an investigator initiated IND after informed consents were obtained. Between January 2009 and February 2015, 49 pediatric patients (age 5-18 years) were enrolled, and received either a single dose of ferumoxytol at 5mg Fe/kg or 2-4 doses of ferumoxytol at 0.7- 4mg Fe/kg. Patients were observed for immediate adverse events, and were closely monitored for blood pressure and heart rate for 1 hour. Approximately 50% of the patients had weekly CBCs and metabolic panels within 1 month of injection, and changes in hemoglobin, renal and liver function were evaluated. Safety data before and at different time points after ferumoxytol injection were compared for significant differences using within-subject repeated ANOVA.

## RESULTS

Out of 65 ferumoxytol injections in 49 pediatric patients, only 1 episode of immediate adverse event was observed: a case of nausea. Evaluation of vital signs revealed 2 episodes of mild hypotension (3.0%) without related clinical signs or symptoms. Overall, there was no significant change in blood pressure or heart rate following ferumoxytol injection. At a dose of 5mg Fe/kg or lower, ferumoxytol injection had no significant effect on hemoglobin levels. In addition, analysis of BUN and creatinine levels revealed no significant changes in renal function. In particular, there were minimal or no decreases in glomerular filtration rates (GFRs) in patients with preexisting renal insufficiency. Similarly, no significant changes in liver function tests (LFTs) were found.

## CONCLUSION

Ferumoxytol doses of up to 5 mg Fe/kg administered for MR imaging as a slow intravenous injection were well tolerated by our pediatric patients. Larger prospective studies are needed to determine the incidence and frequency of allergic reactions in comparison to traditional gadolinium-based contrast agents.

## CLINICAL RELEVANCE/APPLICATION

We reported by far the largest safety study of ferumoxytol use as an MR contrast agent in children, which is critical for development of new ferumoxytol-based MR imaging techniques with better image quality and less toxicity.

### PD239-SD- WEB5 Esophagrams Are Not Indicated in Pediatric Patients Presenting with Spontaneous Pneumomediastinum

Station #5

#### Participants

Edward J. Richer, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

Ramon Sanchez, MD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Esophagrams are frequently obtained in pediatric patients presenting with pneumomediastinum on chest radiograph or CT, due to concern for potential esophageal perforation as the source. Our purpose is to show that esophagrams in the setting of spontaneous pneumomediastinum are unrevealing of esophageal abnormality and expose patients to unnecessary radiation, and are therefore unindicated.

## METHOD AND MATERIALS

Following IRB approval, a retrospective review was performed by querying the radiology information system (RIS) at our institution for fluoroscopic examinations that included the keyword 'pneumomediastinum.' The time period queried was 2000-2015, and patient ages were 0-18. Examinations that were performed for reasons other than spontaneous pneumomediastinum, such as recent esophageal dilation, were excluded. This review produced a list of 30 patients with spontaneous pneumomediastinum, and 13 patients with pneumomediastinum following a traumatic event. The clinical and radiologic findings for these patients were then reviewed, including presence or absence of fever at time of diagnosis, findings on initial imaging studies, esophagram results and radiation dose, length of stay, and follow up imaging.

## RESULTS

In the 30 patients presenting with spontaneous pneumomediastinum who underwent esophagram, no patient demonstrated an esophageal perforation. For exams in which radiation dose was available, average fluoroscopic time was 1.1 minutes and average DAP was 0.686 Gy-cm<sup>2</sup>. Preliminary data reveals an average patient age of 15.6 years, a length of stay in hospital of 2.4 days, and follow up imaging of at least 1 chest radiograph per patient. In the 13 patients with pneumomediastinum following a traumatic event who underwent esophagram, no patient demonstrated an esophageal perforation. One patient was subsequently favored to have an occult esophageal perforation on clinical grounds, however this patient's esophagram did not demonstrate a leak.

## CONCLUSION

Esophagrams are unrevealing in pediatric patients with spontaneous pneumomediastinum and expose patients to unnecessary radiation, and as such are unindicated. Esophagrams may also not be indicated in patients with pneumomediastinum in the setting of trauma, in the absence of other imaging findings suggestive of esophageal perforation.

## CLINICAL RELEVANCE/APPLICATION

The results of our study may alter practice patterns and reduce radiation exposure in pediatric patients.

### PD144-ED- WEB6 A Review of Vascular Anomalies Based on the Updated International Society for the Study of Vascular Anomalies (ISSVA) Classification (2014): Part 2 - Vascular Malformations

Station #6

#### Participants

Michael P. Yannes, MD, Pittsburgh, PA (*Presenter*) Nothing to Disclose

Amy Davis, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose

Lynn Malec, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose

James Cooper, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose

Lorelei Grunwaldt, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
Sabri Yilmaz, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

Over the past three decades, many changes have occurred in the world of vascular anomalies. The field is complicated because different types of vascular anomalies often look similar and their nomenclature can be confusing. Therefore, medical imaging has become critically important in the differential diagnosis and treatment planning of vascular anomalies. In 2014, the International Society for Vascular Anomalies (ISSVA) adopted an updated classification for evaluation of vascular anomalies. We provide imaging and photographs of vascular malformations within the context of the recently updated classification system.

## TABLE OF CONTENTS/OUTLINE

New Classification Scheme (2014): Simple: Capillary malformations Cutaneous/mucosal With other anomalies (Sturge-Weber syndrome) Telangiectasia Hereditary Hemorrhagic Telangiectasia (HHT) Nevus Simplex Lymphatic malformations Macrocystic (Figure 1) Microcystic Venous malformations (Figure 2) Arteriovenous malformations (Figure 3) Arteriovenous fistula Combined Of Major Named Vessels Associated with Other Anomalies: Klippel-Trenaunay Syndrome (Figure 4) CLOVES syndrome (Figure 5) Parkes Weber Syndrome Maffucci Syndrome Bannayan-Riley-Ruvalcaba Syndrome (Cowden Syndrome) (PTENHS)

MSES43

## Essentials of Pediatric Imaging

Wednesday, Dec. 2 1:30PM - 3:00PM Location: S100AB



AMA PRA Category 1 Credits™: 1.50  
ARRT Category A+ Credits: 1.50

### Participants

### Sub-Events

#### MSES43A Traumatic Hemorrhage within the Extra-axial Spaces: Accidental or Inflicted?

### Participants

Gary L. Hedlund, DO, Salt Lake City, UT, (gary.hedlund@imail.org) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Contrast the differences between pediatric and adult epidural intracranial hemorrhages. 2) Develop an expanded understanding of traumatic pediatric subdural hemorrhage. 3) Identify the clinical significance and imaging characteristics of subdural hygroma. 4) Describe the CT and MRI features of subdural hemorrhage arising from abusive and accidental trauma. 5) Identify pediatric subarachnoid hemorrhage, recognize its significance, and differentiate it from pseudo-subarachnoid hemorrhage.

### ABSTRACT

The presence of post-traumatic hemorrhage within the pediatric intracranial extra-axial compartments should be viewed as a proxy for underlying brain injury. This live RSNA activity will review the coverings of the brain and the compartments that may be involved in accumulating post-traumatic hemorrhage. The session will address hemorrhage within the epidural space, subdural compartment, and subarachnoid space. The focus will be upon hemorrhages within the subdural compartment, their clinical significance in the pediatric population, origin, imaging characteristics, and the features of subdural hemorrhage more commonly observed with accidental and inflicted head trauma. The complimentary nature of non-enhanced CT (NECT) and MRI in characterizing and estimating age of the pediatric subdural hemorrhage will be emphasized. The value of serial imaging will be discussed.

#### MSES43B Imaging of Congenital Chest Abnormalities

### Participants

Stephanie P. Ryan, MD, Dublin, Ireland (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Interpret chest radiographs in newborns with congenital pulmonary abnormality. 2) Plan further imaging assessment in the newborn with congenital pulmonary abnormality. 3) Recognise imaging findings and plan further imaging investigation in an older child with congenital pulmonary abnormality.

### ABSTRACT

This session will address the radiographic findings and further imaging in congenital chest abnormalities including cystic adenomatoid malformation, congenital lobar emphysema and different forms of sequestration. The imaging findings of tracheo-esophageal fistula, of chylothorax and of different types of diaphragmatic hernia will also be addressed. There will be an emphasis on the imaging findings that affect management and some controversies around imaging and management will be reviewed.

#### MSES43C Ventral Wall Abnormalities in the Neonate

### Participants

Henry J. Baskin JR, MD, Salt Lake Cty, UT (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Describe the most common ventral wall abnormalities in neonates, including omphalocele, gastroschisis, bladder exstrophy, and prune-belly syndrome. 2) Compare and contrast the clinical characteristics of these defects. 3) Identify the imaging features of each of these ventral wall abnormalities. 4) Understand the treatment of these defects, and be familiar with their imaging implications in older children.

### ABSTRACT

Neonatal ventral wall abnormalities encompass a broad group of rare congenital defects such as omphalocele, gastroschisis, bladder exstrophy, and prune-belly syndrome. Although these congenital abnormalities are varied in terms of pathophysiology, clinical findings, and treatment, their similarities allow them to be easily confused by radiologists. This is especially problematic as children with ventral wall abnormalities have very high rates of associated gastrointestinal, musculoskeletal, urogenital, and cardiovascular problems, and so often require fairly extensive medical imaging expertise. This activity will compare and contrast the clinical characteristics of ventral wall abnormalities, illustrate the important imaging features of each, and familiarize the attendee with how these abnormalities are treated.

**ISP: Pediatrics (General and Neonatal Imaging)**

Wednesday, Dec. 2 3:00PM - 4:00PM Location: S102AB



AMA PRA Category 1 Credit™: 1.00  
ARRT Category A+ Credit: 1.00

**Participants**

Richard A. Barth, MD, Stanford, CA (*Moderator*) Nothing to Disclose  
Ellen M. Chung, MD, Bethesda, MD (*Moderator*) Nothing to Disclose

**Sub-Events****SSM20-01 Biomodeling and 3D Printing for Simulation of Surgical Separation of Conjoint Twins**

Wednesday, Dec. 2 3:00PM - 3:10PM Location: S102AB

**Participants**

Rajesh Krishnamurthy, MD, Houston, TX (*Presenter*) Research support, Koninklijke Philips NV; Research support, Toshiba Corporation  
Nicholas Dodd, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Darrell Cass, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Amrita Murali, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Jayanthi Parthasarathy, Dallas, TX (*Abstract Co-Author*) Employee, VanDuzen, Inc

**PURPOSE**

We describe a unique use of biomodeling and 3D printing in the setting of surgical simulation of thoracoabdominal conjoint twin separation.

**METHOD AND MATERIALS**

Surgical planning on thoraco-omphalo-pyopagus female twins commenced at 7 months for planned separation at 10 months of life. The modeling process was initiated by a volumetric CT using a 320 detector scanner with target mode prospective EKG gating for the cardiovascular structures, and helical ungated acquisition for the chest, abdomen and pelvis. Intravenous contrast was separately administered into both twins, while oral contrast was administered only into 1 twin. Image segmentation yielded individual segments of the skin, skeleton, heart, lungs, airway, GI tract, abdominal vasculature, urinary tract, and gynecologic structures. In preparation for 3D printing, structures to support the models in a vertical position were created. In one operation, polyjet multi-material 3D printing was used to print skeletal structures, base and supports in hard plastic resin, and the organs in rubber like material. The livers were printed as separate pieces of the transparent resin, with the hepatic and portal vessels in white for better visibility. Pegs were designed so the liver could be attached or removed from the assembly. The models were designed such that they could be assembled together or separated during the surgical planning process. Findings on biomodels and 3-D print were compared to findings at surgical separation.

**RESULTS**

The twins underwent surgical separation by a multidisciplinary surgical team. No discrepancy was noted involving the cardiopulmonary, hepatic, intestinal, renal and skeletal anatomy. Preoperative simulation successfully predicted assignment of the pelvic viscera to each twin based on the vasculature. There was one hemorrhagic complication at surgery, unrelated to preoperative anatomical characterization.

**CONCLUSION**

We have demonstrated a unique use of 3D modeling and 3D printing for simulation and planning of conjoint twin separation, with representation of the surgically relevant viscera and vasculature in a single 3D printed model.

**CLINICAL RELEVANCE/APPLICATION**

Describe a novel application of 3D printing for simulating conjoint twin separation, which involves representation of all surgically relevant visceral and vascular anatomy in a single 3D print.

**SSM20-02 Estimates of Diagnostic Reference Levels for Common Pediatric Fluoroscopic Procedures**

Wednesday, Dec. 2 3:10PM - 3:20PM Location: S102AB

**Participants**

Keith J. Strauss, FAAPM, FACR, Cincinnati, OH (*Presenter*) Research Consultant, Koninklijke Philips NV; Speakers Bureau, Koninklijke Philips NV  
Rami Nachabe, PhD, Best, Netherlands (*Abstract Co-Author*) Employee, Koninklijke Philips NV  
Steven J. Kraus, MD, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To survey radiation dose indices of four common general pediatric fluoroscopic procedures at a tertiary care pediatric hospital. These results allow estimates of diagnostic reference levels (DRLs) from dose indices.

**METHOD AND MATERIALS**

Radiation dose structured reports were retrospectively collected for > 2,000 pediatric general fluoroscopic cases. Kerma Area Product (KAP), air Kerma (Kair), fluoroscopy time (FT), thickness of body part irradiated, and patient age were collected for pediatric video swallow (VS), upper GI (UGI), lower GI (LGI) and voiding cystourethrogram (VCUG) studies. Each group of patients for a study was limited to a size variance of only 3 cm with targeted number of cases > 30 per group. 1st, 2nd, 3rd quartiles for



each group were calculated for each type of study. A fitted exponential curve of mean patient Kair vs thickness and 95% predictive bounds are presented with a scatter plot of data for each type of study. Nineteen of 20 additional patients should fall within the 95% predictive bounds.

## RESULTS

Only data for the Kair for our 585 VCUG cases is presented here. For group sizes of 5-7, 8-10, 11-13, 14-16, 17-19, 20-22, 23-25 cm the number of cases and 3rd percentile estimate of DRL respectively were 16, 99, 229, 133, 67, 29, 14 and 0.26, 0.55, 0.89, 1.46, 3.52, 6.39, 11.28 mGy. For an exponential fit of patient Kair vs thickness ( $ae^{-bx}$ ),  $a = 0.07$  and  $b = 0.2$ . In addition to scatter plots of the data with fitted curves for each type of study, a data table is also provided for each study type that lists the 1st, 2nd, and 3rd quartile of AK, KAP, FT, AK/FT, KAP/FT as a function of the patient group thicknesses along with published average age, height, mass, and BMI corresponding to that measured thicknesses. Calculated DAP/AK ratios allow conversion between these two indices if one is known.

## CONCLUSION

Estimates of 3rd quartile dose indices of four common pediatric fluoroscopic procedures as a function of patient thickness should assist departments in the development of DRL values using dose indices.

## CLINICAL RELEVANCE/APPLICATION

Fluoroscopic DRL values based on a department's unique patients and imaging equipment foster better management of radiation dose and image quality to improve pediatric patient care.

### SSM20-03 Optimizing the US Diagnosis of Biliary Atresia with a Modified Triangular Cord Thickness and More Objective Gallbladder Classification

Wednesday, Dec. 2 3:20PM - 3:30PM Location: S102AB

#### Participants

Zhou Lu-Yao, Guangzhou, China (*Presenter*) Nothing to Disclose

Xiao-Yan Xie, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To evaluate the diagnostic performance of US in identification and exclusion of biliary atresia by a modified triangular cord thickness metric together with a gallbladder classification scheme, as well as hepatic artery (HA) diameter and liver and spleen size, in a large sample of jaundiced infants.

## METHOD AND MATERIALS

Ethics Committee approved the study, and written informed parental consent was obtained. 273 infants with conjugated hyperbilirubinemia (total bilirubin  $\geq 31.2 \mu\text{mol/L}$  with direct bilirubin  $>$  indirect bilirubin) underwent detailed abdominal US examination to exclude biliary atresia and on this basis were classified as biliary atresia ( $n=129$ ) or not-biliary atresia ( $n=144$ ). A modified triangular cord thickness measured at the anterior branch of the right portal vein and a gallbladder classification scheme that incorporated the appearance of the gallbladder as well as length: width ratio  $\leq 5.2$  when the lumen was visualized, as well as HA diameter, liver and spleen size, were identified and measured. Reference standard diagnosis was based on one or more of the following: surgery, liver biopsy, cholangiography, and clinical follow-up. Area under the receiver operating characteristic curve (AUC), binary logistic regression analyses, Fisher's exact test and unpaired t test were performed.

## RESULTS

Triangular cord thickness, HA diameter, the ratio of gallbladder length to gallbladder width, liver size and spleen size exhibited statistically significant differences (all  $P < .05$ ) between the biliary atresia and not-biliary atresia groups. AUCs of triangular cord thickness, gallbladder ratio of length over width and HA diameter were 0.952, 0.844 and 0.838, respectively. Logistic regression analysis demonstrated that these three US parameters were significantly associated (all  $P < .05$ ) with biliary atresia. The combination of triangular cord thickness and gallbladder classification could yield a comparable AUCs (0.915 vs 0.933,  $P = .400$ ) and a higher sensitivity (96.9% vs 92.2%), compare to triangular cord thickness alone.

## CONCLUSION

Using the combination of the modified triangular cord thickness and a gallbladder classification scheme, most infants with biliary atresia could be identified.

## CLINICAL RELEVANCE/APPLICATION

Use of a modified triangular cord thickness measurement and a gallbladder classification, can potentially reduce the number of patients requiring nuclear scintigraphy and liver biopsy.

### SSM20-04 Pediatrics Keynote Speaker: How Does Fetal Imaging Influence Neonatal Imaging?

Wednesday, Dec. 2 3:30PM - 3:40PM Location: S102AB

#### Participants

Richard A. Barth, MD, Stanford, CA (*Presenter*) Nothing to Disclose

### SSM20-05 Virtual Rounds: Bringing Radiology Back to the ICU

Wednesday, Dec. 2 3:40PM - 3:50PM Location: S102AB

#### Participants

Janet R. Reid, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

David T. Saul, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

Maria A. Bedoya, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

Hannah Stinson, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

Brian Hopely, BA, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose



Parvez Kazmi, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose  
Donald Boyer, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Digital imaging has greatly improved clinician access to images and timely reports but may have eroded face-to-face communication between clinicians and radiologists, especially in the ICU. Increased radiology workload together with demands for on-site presence of ICU house staff have made it difficult to hold morning radiology rounds. Despite this, benefits of digital imaging have far outweighed the limitations, and the new hurdles require new thinking. This project leverages simple technology to create personalized point of care radiology consultation in the ICU.

## METHOD AND MATERIALS

Using Lync 13, 20 minute interactive rounds were delivered by a radiologist from a workstation located in the radiology reading room to a clinical team in a 55 bed pediatric ICU. Images were shared from PACS (Philips iSite) to a large screen in a central meeting space in the ICU, with both stations equipped with panoramic web-cams with built-in audio. There were 12 sessions over 1 month, first and last session reserved for testing. Ten micro-didactic lectures were prepared covering top 10 items from the ABP Core Content for Critical Care; each session started with the lecture followed by review of daily inpatient imaging including all modalities and body systems. Assessment tools: Demographics (experience and background); Skills (image-based pre- and post-test); Confidence (self-reporting questionnaire); Format (learning effectiveness, strengths and weaknesses). The study was granted IRB exemption with consent.

## RESULTS

8 residents participated (4 control/4 intervention). There was a more significant increase in test scores in the intervention group over the controls ( $p=0.031$ ). Test time: 12.9 minutes (8-17). Confidence scores increased significantly for modalities and diagnoses, with pre to post-test scores of 55.6% (40.7-59.3) to 57.4% (44.4-77.8)  $p=0.031$  and 66.7% (47.9-89.6) to 81.1% (62.5-100)  $p=0.016$  respectively. Format scored 4-5/5, with positive comments about level of interactivity and time allotment. Weaknesses included intermittent video bandwidth loss and limited time to cover the curriculum.

## CONCLUSION

Virtual conferencing contributes positively to radiology education, has potential for significant impact on patient care in the ICU and is a viable alternative to interdepartmental travel for radiology rounds.

## CLINICAL RELEVANCE/APPLICATION

Interdisciplinary dialogue is essential in building knowledge and adds value to patient care through radiology consultation.

## SSM20-06 Getting Published in Paediatric Radiology: What Does it Take?

Wednesday, Dec. 2 3:50PM - 4:00PM Location: S102AB

### Participants

Susan C. Shelmerdine, MBBS, FRCR, London, United Kingdom (*Presenter*) Nothing to Disclose  
Jeremy Lynch I, BMBCh, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose  
Owen Arthurs, MBChir, PhD, Cambridge, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Presentation of new research and emerging techniques at scientific conferences allows dissemination of expertise and enables future development within the specialty. Studies that do not result in a subsequent publication limit the impact of the work undertaken. This study establishes the conversion rate and identifies predictive factors for journal publication of oral scientific presentations within paediatric radiology.

## METHOD AND MATERIALS

Oral presentations from the European Society of Paediatric Radiology, International Society of Pediatric Radiology and Society of Pediatric Radiology conferences between 2010 and 2012 were identified from published conference proceedings. A literature search was performed to ascertain whether publication in a MEDLINE indexed journal was achieved by April 2015. Logistic regression was performed using R, version 3.1.3 to identify predictive factors.

## RESULTS

300 out of 715 (41%) oral presentation abstracts were subsequently published, most commonly in the journals: Pediatric Radiology (74, 25%), AJR (34, 11%) and Radiology (22, 7%). The majority of presentations (169, 56%) were published within 24 months of the conference date (1 - 59 months). Countries with the highest abstract to publication conversion rates were USA (169, 56%), Canada (18, 6%), France (16, 5%) and United Kingdom (15, 5%). Factors that were predictive of publication included sample size ( $p=0.007$ ), publication within the subspecialty subject areas of radiation protection ( $p=0.02$ ), neurological imaging ( $p=0.03$ ), and functional imaging ( $p=0.04$ ). Factors that did not have any effect on subsequent publication included study type, prospective nature of the study or origin of study from an academic or paediatric tertiary centre.

## CONCLUSION

In this retrospective study of pediatric radiology conference proceedings, fewer than half of all presented oral abstracts result in publication. Studies with a larger sample size and within certain subspecialty areas in paediatric radiology were associated with subsequent publication. Identification of predictive factors in journal publications may help future investigators plan and design successful research projects.

## CLINICAL RELEVANCE/APPLICATION

Identification of predictive factors in journal publications may help future investigators plan and design successful research projects.

MSSR44

## RSNA/ESR Emergency Symposium: General Principles, Pediatric and ENT Emergencies (An Interactive Session)

Wednesday, Dec. 2 3:30PM - 5:00PM Location: S402AB



AMA PRA Category 1 Credits™: 1.50  
ARRT Category A+ Credits: 1.50

### Participants

Ronald J. Zagoria, MD, San Francisco, CA, (ron.zagoria@ucsf.edu) (*Moderator*) Nothing to Disclose  
Andras Palko, MD, PhD, Szeged, Hungary (*Moderator*) Medical Advisory Board, Affidea Group;

### Sub-Events

#### MSSR44A Polytrauma

### Participants

Ulrich Linsenmaler, MD, Munich, Germany (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Demonstrate general principles of diagnostic imaging in Emergency Radiology in traumatic and non-traumatic emergencies. 2) Analyze etiology, background and management of common radiological emergencies. 3) Identify the role, indications and protocols for US, CR, MDCT in modern emergency radiology.

### ABSTRACT

Multiple trauma / polytrauma remains the leading cause of death in a patient population below the age of 45 years. Modern Emergency Radiology plays today a key role in an interdisciplinary team guiding diagnosis and treatment in the initial clinical workup. This lecture will cover the following topics: To describe background, incidence and regional differences in patients with polytrauma / multiple trauma. To appreciate the clinical significance and to analyze critical triage criteria to undergo ER / shock room admission and concepts of initial clinical management (ATLS). To review imaging techniques and radiological management and logistic concepts for patients with polytrauma / multiple trauma within a clinical algorithm. To review the use of whole body computed tomography (WBCT), CTA as well as conventional radiography (CR) and ultrasound (US) in the initial work-up. To describe common and uncommon imaging findings. Image reading and data management, individualized CT protocols and outcome control.

#### MSSR44B Challenges of Imaging Pediatric Abdominal Emergencies

### Participants

Susan D. John, MD, Houston, TX (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Understand the variations of pathology that cause abdominal pain and vomiting in infants and children. 2) Plan safe and effective imaging protocols using US, CT, and MRI. 3) Recognize pitfalls in the diagnosis of pediatric abdominal emergencies with imaging.

### ABSTRACT

#### MSSR44C Imaging in ENT Emergencies

### Participants

Diego B. Nunez JR, MD, MPH, New Haven, CT, (diego.nunez@yale.edu) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Analyze imaging findings in patients presenting with acute head and neck conditions using a systematic spatial approach. 2) Demonstrate understanding of the role and indications of CT and MR in acute non-traumatic ENT case management. 3) Identify the extent of disease and recognize specific complications of cervicofacial infections.

### ABSTRACT

SPSC41

## Controversy Session: US, CT, or MR Imaging in Possible Appendicitis in Children: Three Pegs and Often Only One Hole

Wednesday, Dec. 2 4:30PM - 6:00PM Location: E451A



AMA PRA Category 1 Credits™: 1.50  
ARRT Category A+ Credits: 1.50

### Participants

Nancy R. Fefferman, MD, New York, NY, (nancy.fefferman@nyumc.org) (*Moderator*) Nothing to Disclose

### LEARNING OBJECTIVES

#### Sub-Events

#### SPSC41A US

### Participants

Nancy R. Fefferman, MD, New York, NY, (nancy.fefferman@nyumc.org) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Describe the advantages, disadvantages and limitations of US as an effective imaging modality in the diagnosis of appendicitis in children. 2) Review the current literature addressing the diagnostic performance of US for pediatric appendicitis. 3) Discuss the role of US in the imaging evaluation of suspected appendicitis in children.

### ABSTRACT

#### SPSC41B CT

### Participants

Michael J. Callahan, MD, Boston, MA, (michael.callahan@childrens.harvard.edu) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Highlight the advantages, disadvantages and versatility of computed tomography for the diagnosis of suspected acute appendicitis in children. 2) Describe published sensitivity and specificity values for computed tomography in the setting of suspected acute appendicitis in the pediatric population. 3) Explain the challenges and potential barriers for standardization of pediatric appendicitis clinical practice guidelines at academic and non-academic centers.

#### SPSC41C MR

### Participants

R. Paul Guilleman, MD, Houston, TX, (rpguille@texaschildrens.org) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Develop an MRI protocol for suspected pediatric appendicitis. 2) Estimate the diagnostic efficacy of MRI for suspected pediatric appendicitis. 3) Appraise how radiation-induced cancer risks and diagnostic performance characteristics influence the optimal selection of US, CT and MRI for suspected pediatric appendicitis.

ED012-TH

## Pediatric Thursday Case of the Day

Thursday, Dec. 3 7:00AM - 11:59PM Location: Case of Day, Learning Center

PD

AMA PRA Category 1 Credit™: .50

### Participants

Ting Y. Tao, MD, PhD, Saint Louis, MO (*Presenter*) Nothing to Disclose  
Asef B. Khwaja, MD, Philadelphia, MO (*Abstract Co-Author*) Author, Reed Elsevier  
Elizabeth F. Sheybani, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose  
Shannon Farmakis, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose  
Luke L. Linscott, MD, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose  
Joan K. Zawin, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1) Recognize the importance of a multimodality approach in imaging pediatric patients. 2) Form appropriate differential diagnoses based on clinical information and imaging findings. 3) Recognize the clinical implications of diagnoses.

RC613

## Peds Neuro

Thursday, Dec. 3 8:30AM - 10:00AM Location: E350



AMA PRA Category 1 Credits™: 1.50  
ARRT Category A+ Credits: 1.50

### Participants

#### Sub-Events

#### **RC613A Imaging of Sensorineural Hearing Loss in Children**

##### Participants

Maura E. Ryan, MD, Chicago, IL, (mryan@luriechildrens.org) (*Presenter*) Nothing to Disclose

##### LEARNING OBJECTIVES

1) Review pertinent anatomy of the inner ear structures. 2) Describe pathologic CT and MRI findings of the inner ear, membranous labyrinth and cochlear nerve associated with pediatric sensorineural hearing loss.

**Active Handout:** Maura E. Ryan

[http://abstract.rsna.org/uploads/2015/15002058/RC613A\\_MR.pdf](http://abstract.rsna.org/uploads/2015/15002058/RC613A_MR.pdf)

#### **RC613B Imaging Approach to Seizures in Children**

##### Participants

Luke L. Linscott, MD, Cincinnati, OH, (luke.linscott@cchmc.org) (*Presenter*) Nothing to Disclose

##### LEARNING OBJECTIVES

1) Identify major causes of seizures in children. 2) Understand importance of optimal MR imaging technique for epilepsy evaluation.

#### **RC613C Perinatal Imaging of Congenital Posterior Fossa Anomalies**

##### Participants

Ashley J. Robinson, MBChB, Doha, Qatar, (ASH@RADIOLOGIST.NET) (*Presenter*) Nothing to Disclose

##### LEARNING OBJECTIVES

1) Review the relevant embryology of the posterior fossa, including the brainstem, cerebellum and cisterna magna. 2) Review several criteria for evaluation of congenital posterior fossa anomalies using a case-based approach.

##### ABSTRACT

**Active Handout:** Ashley James Robinson

<http://abstract.rsna.org/uploads/2015/15002062/RC613C.pdf>

**Pediatric Series: Optimizing Acquisition and Achieving Efficiency in Pediatric Imaging**

Thursday, Dec. 3 8:30AM - 12:00PM Location: S102D



AMA PRA Category 1 Credits™: 3.25  
ARRT Category A+ Credits: 3.50

**FDA** Discussions may include off-label uses.

**Participants**

Donald P. Frush, MD, Durham, NC (*Moderator*) Nothing to Disclose  
 Aliya Qayyum, MBBS, Houston, TX (*Moderator*) Nothing to Disclose  
 Rajesh Krishnamurthy, MD, Houston, TX (*Moderator*) Research support, Koninklijke Philips NV; Research support, Toshiba Corporation  
 A. James Barkovich, MD, San Francisco, CA (*Moderator*) Nothing to Disclose

**LEARNING OBJECTIVES****ABSTRACT**

This session will focus on the importance of minimizing general endotracheal anesthesia in children and discuss recent papers that highlights risks in children. It will discuss techniques for minimizing the use of sedation and intubation in pediatric imaging, including use of abbreviated protocols for common indications, feed and wrap techniques, and state of the art MR sequences for free-breathing 2-D and 3-D acquisition of morphology, function and flow in children.

**Sub-Events****RC651-01 Minimizing Sedation in Pediatric Neuroimaging**

Thursday, Dec. 3 8:30AM - 8:50AM Location: S102D

**Participants**

A. James Barkovich, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**ABSTRACT**

There are several keys to minimizing sedation in Pediatric Neuroimaging. Most important are targeting the study to obtaining the specific answer requested by the referring clinician, and obtaining the data as efficiently as possible by using sequences that will answer the question in the shortest time. The second is that the strategy changes depending upon the age of the patient: neonates most often can be scanned without sedation; a relatively short scan can be performed on infants by the 'feed and swaddle' method, and older children (6 years and above) can very frequently be studied without sedation if training and/or movies (to give them focus) are used. For neonates requiring a relatively short scan (is injury present or not), a useful technique is to feed the baby immediately before the procedure and then wrap them in a vacuum bean bag or wrap (swaddle) them in a blanket. Reducing noise by use of ear muffs, insulating the inner bore of the magnet, parallel imaging or ultra-short TE sequences can help, as can retrospective motion correction. Infants can also be scanned using feed and swaddle; it helps to do the scan during their nap time, if possible, and to take them to a quiet room with a parent so that they are asleep when placed in the MRI scanner. Use quiet sequences early in the study, saving the noisier ones for the end. Again, use of parallel imaging or ultra-short TE sequences helps to reduce noise. It is very difficult to image children between ages of 1 and 6 years without sedation. The goal is to scan efficiently. For older children, a training session before the scan to reduce anxiety is useful. Use of a system that allows the child to watch a movie of their own choice is very helpful as well.

**RC651-02 Comparison of Non-sedated Brain MRI and CT for the Detection of Acute Traumatic Injury in Children Less than 5 Years Old**

Thursday, Dec. 3 8:50AM - 9:00AM Location: S102D

**Participants**

Joseph Y. Young, MD, Boston, MA (*Presenter*) Nothing to Disclose  
 Ann-Christine Duhaime, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
 Paul A. Caruso, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
 Ari Cohen, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
 Jean Klig, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
 Sandra Rincon, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

The 2014 ACR Appropriateness Criteria consider CT the first line study for acute intracranial injury in children because of its wide availability, detection of acute hemorrhage, and lack of sedation. A tailored MRI study with rapidly acquired sequences can obviate the need for sedation and radiation. We compared the sensitivity of rapid non-sedated brain MRI and CT for the detection of traumatic head injury in young children.

**METHOD AND MATERIALS**

We reviewed a consecutive series of children less than 5 years old who presented to our ED during a 5 year period with head trauma and received a non-sedated brain MRI and CT within 24 hours of injury. Most MRI studies were limited to triplane T2 and susceptibility sequences. A few studies had additional sequences, including FLAIR and DWI, if clinically indicated and if the patient could tolerate a longer exam. Two neuroradiologists concurrently reviewed the MRI and CT studies on separate days and assessed

for the following five findings: fracture, epidural hematoma (EDH)/subdural hematoma (SDH), subarachnoid hemorrhage (SAH), intraventricular hemorrhage (IVH), and parenchymal injury.

## RESULTS

27 patients met inclusion criteria with a mean age of 21 months. A total of 49 abnormalities was noted in 25 patients, with 21 patients having intracranial findings. There was 79% agreement between the two modalities assessing for the presence of fracture, EDH/SDH, SAH, IVH, and parenchymal injury for each patient. CT missed 13 findings which included 6 EDH/SDH, 5 SAH, and 2 parenchymal injuries. MRI missed 13 findings which included 10 non-displaced fractures (of 17 fractures), 2 small EDH/SDH, and 1 SAH. The CT was negative for 4 patients in whom the MRI demonstrated intracranial findings (4 EDH/SDH, 2 SAH, 2 parenchymal). MRI was negative in 1 patient for whom CT had intracranial findings (1 small EDH/SDH).

## CONCLUSION

Non-sedated MRI is at least as sensitive as CT for the detection of intracranial injury in young children presenting with acute head trauma, though missed 10 of 17 fractures. Non-sedated MRI may be a useful alternative to CT in select populations. Low-dose CT may be obtained when fracture detection is clinically indicated.

## CLINICAL RELEVANCE/APPLICATION

Non-sedated MRI may be a useful alternative to CT for young children presenting with acute head trauma, thereby avoiding associated radiation risks.

### RC651-03 Quantifying the Radiation Dose Savings of Implementing an Ultra-Fast Brain MRI Protocol for Children with Hydrocephalus

Thursday, Dec. 3 9:00AM - 9:10AM Location: S102D

#### Participants

Daniel Durand, MD, Baltimore, MD (*Presenter*) Stockholder, Evolent Health, LLC; Advisor, National Decision Support Company; Advisor, Radiology Response; Founder, am-I-ok.com  
Mahadevappa Mahesh, MS, PhD, Baltimore, MD (*Abstract Co-Author*) Author with royalties, Wolters Kluwer nv  
Thierry Huisman, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose  
Eric M. Jackson, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose  
Allison Greene, BS, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose  
Siyuan Cao, BS, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose  
Aylin Tekes, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Children with shunted hydrocephalus frequently require neuroimaging to evaluate shunt function. For a number of practical reasons including length of study, need for sedation, and scanner availability, CT is favored over MRI at most centers. Children are also more susceptible than adults to radiation-induced cancer, with empirical evidence showing that the pediatric brain is particularly prone to cancers associated with CT. Previous reports have shown that ultrafast MRI can be used in place of head CT for evaluating hydrocephalus without any loss of sensitivity or specificity. The purpose of our study was to quantify the net radiation dose savings associated with transitioning from head CT to ultrafast brain MRI in this population.

## METHOD AND MATERIALS

An ultra-fast brain MRI protocol without sedation/anesthesia with an average scan time under 5 min was implemented for children with shunted hydrocephalus. A RIS query was designed to extract all neuroimaging orders for obstructive hydrocephalus for two time periods: a 3 month baseline period and a 6 month post-intervention period. The number of CTs performed per month was determined for each period and used to determine the number of cases avoided per month. Size-specific dose estimates for 30 patients in the baseline group were determined using measurements of anteroposterior and mediolateral head diameter as well as CTDIvol and scan length data stored on the PACS. The average dose per case and the CT avoidance rate were used to yield estimates of the annual radiation dose savings to the population in units of size-specific dose estimate (mGy) and age-adjusted effective dose (mSv).

## RESULTS

The pre- and post-intervention imaging rates were 20.7 and 8.5, yielding a CT avoidance rate of 12.2 per month. The mean size-specific dose estimate (Figure 1) per CT was 30.40 mGy and the mean age-adjusted effective dose was 1.76 mSv. The annual population radiation dose savings was 4,450 mGy and 258 mSv.

## CONCLUSION

Implementing a standard protocol to encourage the use of ultrafast brain MRI in place of head CT significantly reduced the annual radiation dose to pediatric patients imaged for hydrocephalus.

## CLINICAL RELEVANCE/APPLICATION

Our results show the benefit of using ultrafast brain MRI in place of head CT for suspected hydrocephalus. The method used here to quantify population radiation dose savings can be used more generally to highlight the value that radiologists and medical physicists bring to care pathway redesign.

### RC651-04 Silent MRI Reduces Children's Risk by Decreasing Need for Additional Sedation

Thursday, Dec. 3 9:10AM - 9:20AM Location: S102D

#### Participants

Chisato Matsuo, MD, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose  
Yoshiyuki Watanabe, MD, PhD, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose  
Hisashi Tanaka, MD, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose  
Hiroto Takahashi, MD, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose  
Atsuko Arisawa, MD, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose  
Noriyuki Tomiyama, MD, PhD, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose

Eri Yoshioka, MD, Matsubara, Japan (*Presenter*) Nothing to Disclose  
Shin Nabatame, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose  
Sayaka Nakano, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose  
Matthew W. Lukies, MBBS, Osaka, Japan (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Sedated children often wake up during magnetic resonance imaging (MRI) and additional sedatives are needed; the acoustic noise during the MR scanning might be the main cause of this. We hypothesized that silent MRI would decrease the frequency of arousal and additional administration of sedatives during examinations when compared with conventional MRI.

## METHOD AND MATERIALS

Twenty-eight children (M:F=18:10, age 13 months-8 years, mean 4.3 years, median 5 years) who underwent silent brain MRI from January to August in 2014 were retrospectively compared to 26 children (M:F=10:16, age 4 months-8 years, mean 4.0 years, median 3 years) who underwent conventional brain MRI from May to December in 2013 with the same 3T MR unit. The pediatrician administered intravenous sedatives including thiopental to all patients. Data from the medical chart of each patient was reviewed as follows: administered sedatives, doses, and need for additional intravenous injections during examinations. Unpaired t-test was used in the statistical analysis of the initial dose of thiopental. The need for additional sedation was assessed by Fisher's exact test.

## RESULTS

The mean initial dose of thiopental was 3.1 mg/kg for conventional MRI group and 3.3 mg/kg for silent MRI group. There was no significant difference between the two groups ( $p=0.55$ ). Ten out of twenty-six patients (38%) woke up during conventional MRI and additional sedatives were needed. On the other hand, three out of twenty-eight patients (11%) woke up during silent MRI and required additional sedatives. There was a significant difference between the two groups ( $p=0.02$ ).

## CONCLUSION

Silent MRI decreased the frequency of arousal and additional intravenous sedation during examinations. This can reduce patient risk and may possibly reduce the amount of time required for examinations.

## CLINICAL RELEVANCE/APPLICATION

Silent MRI can reduce children's risk by decreasing the need for additional sedation and may possibly reduce the amount of time required for examinations; silent MRI is recommended in routine brain evaluation for children.

## RC651-05 High-pitch CT of the Chest in Newborns and Infants: Is Sedation or Breath-hold Still Necessary?

Thursday, Dec. 3 9:20AM - 9:30AM Location: S102D

### Participants

Ilias Tsiflikas, MD, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Matthias Teufel, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Michael Esser, MD, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Sergios Gatidis, MD, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Ines Ketelsen, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Sabrina Fleischer, MD, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose  
Konstantin Nikolaou, MD, Tuebingen, Germany (*Abstract Co-Author*) Speakers Bureau, Siemens AG Speakers Bureau, Bracco Group  
Speakers Bureau, Bayer AG  
Juergen F. Schaefer, MD, Tuebingen, Germany (*Presenter*) Nothing to Disclose

## PURPOSE

To evaluate feasibility and image quality of high-pitch computed tomography of the chest without sedation or breath-hold in newborns and infants under the age of 12 months.

## METHOD AND MATERIALS

IRB waived informed consent and approved this retrospective, HIPAA-compliant study. 88 patients (48 boys, age  $153 \pm 103$  days) received 123 high-pitch CT examinations (HPCT) of the chest between October 2010 and December 2014. All examinations were scanned in free breathing. 84 HPCT were without sedation or general anesthesia, whereas 39 examinations were performed in general anesthesia because of patients' clinical condition. 84/123 HPCT were contrast-enhanced. Tube voltage and current were determined according to our institutional weight-adopted standard scanning protocol (70-100 kV; 6 - 80 mAs). Image quality was evaluated by two experienced pediatric radiologists with respect to typical artifacts arising from movement, breathing or pulsation of the heart or pulmonary vessels (0 - no; 1 - moderate; 2 - severe artifacts). Effective dose ( $E_{eff}$ ) was estimated according to the European Guidelines on Quality Criteria for Multislice Computed Tomography.

## RESULTS

All examinations were performed without the notice of moving artifacts. In awake patients there was a higher frequency of moderate breathing artifacts (19/84 vs. 1/39,  $p<0.01$ ) and pulsation artifacts (19/84 vs. 8/39,  $p=0.79$ ), but in no examination severe artifacts could be detected. The overall dose was very low ( $0.52 \pm 0.30$  mSv). As expected the estimated  $E_{eff}$  was higher in contrast-enhanced examinations than in non-enhanced scans ( $0.58 \pm 0.33$  vs.  $0.40 \pm 0.18$  mSv). Further  $E_{eff}$  was higher in examinations in general anesthesia ( $0.61 \pm 0.42$  vs.  $0.48 \pm 0.22$  mSv), what might be explained due to a higher rate of contrast-enhanced scans (79% vs. 63%) in this patient group.

## CONCLUSION

High-pitch scanning allows the examination of the chest in newborns and infants without sedation or breath-hold in sufficient image quality and with low effective doses.

## CLINICAL RELEVANCE/APPLICATION

Newborns and infants undergoing chest CT can be examined without sedation or breath-hold without significant loss in image quality.



## **RC651-06 The Optimal Scanning Protocol of Prospective ECG-triggering DSCT Thoracic Angiography in Children with Tetralogy of Fallot**

Thursday, Dec. 3 9:30AM - 9:40AM Location: S102D

### **Participants**

Yanhua Duan, MD, Jinan, China (*Presenter*) Nothing to Disclose

Ximing Wang, Jinan, China (*Abstract Co-Author*) Nothing to Disclose

### **PURPOSE**

To evaluate the effect of 4 different scanning protocols (bolus-tracking technique, test-bolus technique, fixed delay time technique and "manual" bolus-tracking technique) on image quality and effective dose of prospective ECG-triggering DSCT thoracic angiography in children with TOF.

### **METHOD AND MATERIALS**

Eighty consecutive children (48 boys; mean age of 3.5 years; mean heart rate: 97 bpm) with known or suspected TOF were enrolled between December 2008 and September 2014 in our institute. All children underwent prospective ECG-triggering DSCT thoracic angiography. All patients were assigned to 4 groups randomly according to the different enhanced scanning protocols: bolus-tracking technique (n=20, group A), test-bolus technique (n=20, group B), fixed delay time (25s) technique (n=20, group C) and "manual" bolus-tracking technique (place the region of interest in the background at the level of four-chamber, a monitoring scanning started at 18s after injection, the acquisition was manually triggered at the moment that the contrast medium artifact in the right atrium began to disappear) (n=20, group D). Subjective image quality was independently assessed by two radiologists. The total effective dose (including premonitoring, monitoring scanning and angiographic scanning) were calculated.

### **RESULTS**

All prospective ECG-triggering DSCT angiographic scans were successful. The image quality scores of groups A, B, C and D were  $3.20 \pm 1.06$ ,  $3.10 \pm 1.12$ ,  $3.40 \pm 1.30$ ,  $4.15 \pm 0.81$ , respectively, there were significant differences among the four groups ( $p=0.012$ ). The total effective dose of groups A, B and C were  $(0.40 \pm 0.06)$ mSv,  $(0.56 \pm 0.14)$ mSv,  $(0.38 \pm 0.06)$ mSv,  $(0.39 \pm 0.09)$ mSv, respectively, there were significant differences among 4 groups ( $p=0.023$ ).

### **CONCLUSION**

The scanning protocol has a significant impact on the image quality with a significantly different radiation dose. Considered the image quality and radiation dose together, the optimal scanning protocol for patient with TOF was the "manual" bolus-tracking technique.

### **CLINICAL RELEVANCE/APPLICATION**

"Manual" bolus-tracking technique is an excellent scanning protocol for TOF patients.

## **RC651-07 Minimizing Sedation and Radiation in Pediatric Cardiovascular Imaging**

Thursday, Dec. 3 9:40AM - 10:00AM Location: S102D

### **Participants**

Rajesh Krishnamurthy, MD, Houston, TX (*Presenter*) Research support, Koninklijke Philips NV; Research support, Toshiba Corporation

### **LEARNING OBJECTIVES**

View learning objectives under main course title.

## **RC651-08 Minimizing Sedation in Pediatric Abdominal and Musculoskeletal MRI**

Thursday, Dec. 3 10:20AM - 10:40AM Location: S102D

### **Participants**

Shreyas S. Vasanawala, MD, PhD, Palo Alto, CA (*Presenter*) Research collaboration, General Electric Company; Consultant, Arterys; Research Grant, Bayer AG;

### **LEARNING OBJECTIVES**

View learning objectives under main course title.

### **ABSTRACT**

Sedation for pediatric MRI has multiple disadvantages. It confers risk of adverse events for what is an otherwise non-invasive procedure. Additionally, sedation contributes to cost, makes exam scheduling complex, and leads to inefficient imaging utilization. This presentation will present some approaches to reduce the incidence, duration, and depth of sedation for pediatric abdominal and musculoskeletal indications. An overview of child developmental approaches that reduce the incidence of sedation will be given. Then an approach for compact protocols to minimize duration of sedation will be presented. This will be followed by discussion of methods of managing respiratory motion artifacts without periods of suspended respiration, thus reducing depth of anesthesia.

## **RC651-09 High-pitch Low-dose Whole Body CT for the Assessment of Ventriculo-peritoneal Shunts in Pediatric Patients: An Experimental ex-Vivo Study in a Rabbit Model**

Thursday, Dec. 3 10:40AM - 10:50AM Location: S102D

### **Participants**

Ahmed E. Othman, MD, Tuebingen, Germany (*Presenter*) Nothing to Disclose

Saif Afat, MD, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose

Rastislav Pjontek, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose

Marc A. Brockmann, MD, Luebeck, Germany (*Abstract Co-Author*) Nothing to Disclose

Omid Nikoubashman, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose

Konstantin Nikolaou, MD, Tuebingen, Germany (*Abstract Co-Author*) Speakers Bureau, Siemens AG Speakers Bureau, Bracco Group Speakers Bureau, Bayer AG  
Martin Wiesmann, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To assess the sensitivity of whole-body Low-Dose CT (LD-CT) in pediatric patients, regarding the detection of ventriculo-peritoneal shunt (VP-shunt) complications in comparison to radiographic shunt series (SS), with special regards to radiation exposure, using an ex vivo rabbit model.

#### METHOD AND MATERIALS

In a first step, an optimized low dose CT imaging protocol, with low tube voltages (70 kVp and 80 kVp) was assessed on a 16 cm phantom regarding signal-to-noise ratio (SNR) and radiation dose (with and without iterative reconstruction). After defining the CT protocol with the lowest possible radiation dose, 12 VP-shunts were implanted in 6 rabbit cadavers (weight, 4 - 6 kg). 24 mechanical complications (extracranial and extraperitoneal malpositioning, breakages, disconnections) were induced in 6 VP-shunts. LD-CT scans with the lowest possible radiation doses (80 kVp; 4 mAs) as well as conventional SS were acquired. Blinded readings on image quality and diagnostic accuracy regarding shunt complications as well as radiation dose estimations were performed.

#### RESULTS

For the detection of shunt complications, LD-CT yielded a sensitivity of 1.0 for both readers. SS yielded a sensitivity of 0.79 for reader A and 0.71 for reader B with moderate agreement ( $\kappa=0.56$ ) (Figure). No false positive findings were registered. Mean effective radiation doses for LD-CT were as low as  $0.069 \pm 0.003$  mSv and therefore comparable to reported doses for SS (0.047 mSv - 0.086 mSv).

#### CONCLUSION

LD-CT allows accurate detection of VP-shunt complications in pediatric patients with higher sensitivity than SS and comparably low radiation exposure. Thus, LD-CT provides a potentially superior alternative to radiographic shunt series for imaging VP-shunts.

#### CLINICAL RELEVANCE/APPLICATION

The improvement of accurate diagnostic tools such as LD-CT might potentially reduce time-to-diagnosis and patient turnaround time and might therefore improve the poor outcome and quality of life for children with shunted hydrocephalus.

#### RC651-10 Application of T1-weighted BLADE Sequences to Abdominal MR Imaging of Young Children: Comparison with Turbo Spin Echo Sequence

Thursday, Dec. 3 10:50AM - 11:00AM Location: S102D

#### Participants

Kyusung -. Choi, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose  
Young Hun Choi, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Jung-Eun Cheon, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Ji-Eun Park, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Hyun Suk Cho, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Yu Jin Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Woo Sun Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
In-One Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To evaluate the usefulness of T1-weighted BLADE sequences for axial T1-weighted abdominal imaging in small children who cannot hold their breath.

#### METHOD AND MATERIALS

Two different BLADE sequences with (IR-BLADE) and without inversion pulse (BLADE) were compared to TSE with six number of signal acquired (NSA) in fifteen consecutive pediatric patients (mean age of 4.4 years, range 0.5-8 years) who were incapable of holding their breath. The overall image quality, motion artifact, radial artifact, sharpness of hepatic vessels, renal corticomedullary differentiation and lesion conspicuity were retrospectively assessed by two radiologists in a qualitative manner, using four or five-point scaled scoring systems. Signal variations of each sequence were measured in the liver, muscle and air for quantitative comparison. The acquisition times of three sequences were compared.

#### RESULTS

IR-BLADE and BLADE showed improved overall image quality and reduced motion artifact compared with TSE ( $p<0.01$ ). IR-BLADE showed better edge sharpness of hepatic vessels and corticomedullary differentiation, compared with both BLADE and TSE ( $p<0.001$ ). Radial artifacts were only observed on IR-BLADE and BLADE. In seven patients with lesions, IR-BLADE showed improved lesion conspicuity, compared with both BLADE and TSE ( $p=0.023$ ). Both IR-BLADE and BLADE showed decreased signal variation in the liver, muscle and increased signal variation in the air, compared with the TSE. The mean acquisition times for IR-BLADE, BLADE and TSE were 3min 47s, 3min 32s, and 3min 26s respectively.

#### CONCLUSION

Application of BLADE technique with inversion pulse for the T1-weighted MR imaging of the pediatric abdomen resulted in improved image quality, tissue contrast and lesion conspicuity with a diminished respiratory motion artifact and a comparable acquisition time, compared with the conventional TSE sequence.

#### CLINICAL RELEVANCE/APPLICATION

IR-BLADE could be a promising alternative to conventional TSE sequence for T1-weighted abdominal imaging of small children.

#### RC651-11 Performing Screening Lumbar Spine MRIs in Infants without Sedation - The L-Spine Feed and Sleep

Thursday, Dec. 3 11:00AM - 11:10AM Location: S102D

## Participants

Nicholas V. Stence, MD, Aurora, CO (*Presenter*) Nothing to Disclose  
Patrick T. McCormick, MD, Aurora, CO (*Abstract Co-Author*) Nothing to Disclose  
David M. Mirsky, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose  
Laura Z. Fenton, MD, Greenwood Village, CO (*Abstract Co-Author*) Nothing to Disclose  
John D. Strain, MD, Greenwood Village, CO (*Abstract Co-Author*) Nothing to Disclose  
John A. Maloney, MD, Denver, CO (*Abstract Co-Author*) Nothing to Disclose  
Brent O'Neill, MD, Aurora, CO (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

The feed and sleep technique is used in infants to avoid general anesthesia during MRI. The method typically involves fasting an infant prior to exam, feeding and swaddling immediately before scanning until asleep. This technique is commonly used in children's hospitals for neonatal brain MRI, and has been described in the literature in brain and cardiac MRIs. We describe the application of this technique in our institution to outpatient screening lumbar spine MRIs ordered for sacral dimples in children less than 6 months of age.

## METHOD AND MATERIALS

This project was undertaken as an internal quality improvement project and therefore did not require IRB approval. The departmental Montage database (Montage Healthcare Solutions) was queried for the number of outpatient, non-contrast lumbar spine MRI exams performed in infants less than 6 months of age over the last 5 years. The number of exams performed as non-sedated feed and sleeps was extracted. The feed and sleep method is performed as follows: Infants are scheduled for exams between 7 p.m. and 9 p.m. Parents are instructed to keep the child awake and fasted for 3-4 hours prior to arrival in the department. On arrival, the MRI technologist aids the parents with swaddling and feeding the infant. Once the child is asleep, they are placed in the scanner and provided ear protection with both a headset and a Philips foam acoustic shield.

## RESULTS

From January 2009 through January 2014, 111 of 342 (32%) of outpatient screening lumbar spine MRIs were successfully performed using the feed and sleep method, compared to 52 of 98 (53%) exams performed March 2014 through March 2015. The average age of successful feed and sleep exams in the last year was 3.3 months. Over the last year, approximately 10% of the exams attempted as feed and sleeps required rescheduling with general anesthesia after the attempt was unsuccessful.

## CONCLUSION

Our institution was able to avoid the use of general anesthesia in 52 of 98 infants who required a screening lumbar spine MRI for sacral dimples. The successful use of this method has increased over the past 5 years. This is likely due to increased MRI technologist confidence and skill with the technique, as well as an increasing awareness of this technique among referring clinicians.

## CLINICAL RELEVANCE/APPLICATION

Wider application of this technique could lead to a reduction in general anesthesia for this type of exam, leading to decreases in cost and risk to the patient.

## RC651-12 A Retrospective Analysis of the Safety and Cost Implications of Pediatric Contrast Enhanced Ultrasound in a Single Centre

Thursday, Dec. 3 11:10AM - 11:20AM Location: S102D

## Participants

Gibran Yusuf, MBBS, London, United Kingdom (*Presenter*) Nothing to Disclose  
Maria E. Sellars, MD, FRCR, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose  
Annamaria Deganello, MD, London, United Kingdom (*Abstract Co-Author*) Speaker, Bracco Group  
David O. Cosgrove, MBBCh, FRCR, London, United Kingdom (*Abstract Co-Author*) Research Consultant, SuperSonic Imagine; Research Consultant, Bracco Group; Speakers Bureau, Toshiba Corporation  
Paul S. Sidhu, MRCP, FRCR, London, United Kingdom (*Abstract Co-Author*) Speaker, Bracco Group; Speaker, General Electric Company

## PURPOSE

There are concerns over increasing use of ionising radiation in children. Contrast enhanced ultrasound (CEUS) offers a cheaper radiation free alternative licensed in adults, widely used in Europe for liver assessment but used "off-label" in non-liver indications. Pediatric CEUS is "off label", and safety has not been assessed. We retrospectively analyse the prevalence of adverse incidents in a cohort of paediatric CEUS and investigate the financial implication of subsequent reduced CT and MR imaging.

## METHOD AND MATERIALS

Pediatric ( $\leq 18$  yrs) CEUS examinations (January 2008 and March 2015) were analysed. Parental informed consent was obtained and any reaction considered related to the contrast examination was documented in the radiology report, with electronic patient records examined for reactions  $\leq 24$ hrs. Using tariffs calculated from National Institute of Clinical Excellence (UK) analysis; CEUS cost (\$168) was compared to the cost for CT (\$172) and MR (\$280) imaging, the normal diagnostic imaging pathway. The possible reduction in cost when CEUS would have precluded further imaging was calculated.

## RESULTS

240 paediatric CEUS were performed (144 male, 96 female, age range 1-18 years). The majority of studies were performed for characterising liver lesions (123/240; 51%) and trauma (86/240; 36%), with renal and vascular assessment the remaining. There were no immediate adverse reactions. Two patients (2/240; 0.8%) experienced delayed adverse reactions of transient hypertension (n=1) and transient tachycardia (n=1) deemed not due to the underlying disorder; neither were symptomatic.

## CONCLUSION

CEUS in children is "off label"; however, our experience shows paediatric CEUS is both safe and can offer a cost-effective imaging

modality.

#### CLINICAL RELEVANCE/APPLICATION

CEUS in paediatrics offers a safe, cost effective alternative to MR and CT imaging in a variety of settings without the risk of ionising radiation, iodinated contrast or risks of sedation which may otherwise be needed.

#### RC651-13 Sonographic Evaluation of MAGEC Growing Scoliosis Rods in Pediatric Patients

Thursday, Dec. 3 11:20AM - 11:30AM Location: S102D

##### Participants

Sara M. O'Hara, MD, Cincinnati, OH (*Presenter*) Author, Reed Elsevier; Stockholder, Reed Elsevier; Speakers Bureau, Toshiba Corporation; Medical Advisory Board, Toshiba Corporation

Peter F. Sturm, MD, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose

Sarah E. Gilday, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Adjustable, magnetically controlled "growing" scoliosis rods (MAGEC rods) are increasingly used in pediatric patients, and require periodic adjustments and confirmation of lengthening following this non-invasive procedure. Previously, adjustable rods required open surgical procedures for lengthening. The purpose of our study was to determine if these MAGEC rods could be adequately visualized and measured with ultrasound, thereby minimizing radiation exposure from serial spine X-rays.

#### METHOD AND MATERIALS

All patients with recently implanted MAGEC rods were examined with ultrasound before and after their first transcutaneous magnetic rod lengthening procedures. Measurements obtained sonographically were compared with baseline scoliosis X-rays and the length programmed into the magnetic motor used to extend the rod. Measurements will also be compared with scoliosis X-rays obtained once or twice each year.

#### RESULTS

12 patients have been studied to this point (3 month period) - 6 female, and 6 male, between 6 and 10 years of age. All of the MAGEC rod components including extension motors and expandable rod segments were well visualized sonographically before and after lengthening procedure. All of the patients showed good correlation between post-op scoliosis measurements and first, pre-lengthening ultrasound measurements. 4 of the 13 patients rods showed less lengthening than expected based on the length programmed into the magnetic motor driver. All patients will be re-imaged in the next few months to quantify measurement reliability and compare with expected extension parameters.

#### CONCLUSION

MAGEC rods can be reliably imaged with ultrasound before and after transcutaneous lengthening procedures, thereby reducing radiation exposure. In addition, the ultrasound may offer additional confidence that the rods have in fact extended the length programmed into the magnetic motor.

#### CLINICAL RELEVANCE/APPLICATION

Ultrasound should be the preferred method for serial imaging of MAGEC adjustable scoliosis rods in pediatric patients to minimize exposure to ionizing radiation.

#### RC651-14 Low Dose Pediatric Chest CT: Radiation Dose Comparison of a 70 kVp CT Protocol and a 100 kVp Protocol Using a Tin Filter for Spectral Beam Shaping

Thursday, Dec. 3 11:30AM - 11:40AM Location: S102D

##### Participants

Meike Weidner, Mannheim, Germany (*Presenter*) Nothing to Disclose

Thomas Henzler, MD, Mannheim, Germany (*Abstract Co-Author*) Nothing to Disclose

Holger Haubenreisser, Mannheim, Germany (*Abstract Co-Author*) Speaker, Siemens AG; Speaker, Bayer AG

Mathias Meyer, Mannheim, Germany (*Abstract Co-Author*) Speaker, Siemens AG; Speaker, Bracco Group

Sonja Sudarski, MD, Mannheim, Germany (*Abstract Co-Author*) Nothing to Disclose

Stefan O. Schoenberg, MD, PhD, Mannheim, Germany (*Abstract Co-Author*) Institutional research agreement, Siemens AG

Wolfgang Neff, MD, PhD, Alzey, Germany (*Abstract Co-Author*) Nothing to Disclose

Claudia Hagelstein, MD, Mannheim, Germany (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

With the introduction of 3rd generation dual-source CT two competitive techniques for further radiation dose reduction became clinically available. On the one hand the CT peak tube voltage can be decreased down to 70 kVp whereas on the other hand 100 kVp imaging can be combined with a dedicated 0.6 mm tin (Sn) filter behind the x-ray tube in order to filter-out low energy photons. We aimed to compare radiation dose in pediatric chest CT scans between 70kV and 100kVp-Sn acquisitions.

#### METHOD AND MATERIALS

All chest CT examinations were performed on a 3rd generation 2 x 192 slice dual source system (Somatom Force, Siemens Healthcare, Germany) using a pitch factor of 3.2 and automatic tube current modulation without any sedation. In total, 46 examinations were included in this study (mean age 5.8±5.9 years, 70kV n=26; 100Sn n=20). Radiation dose was compared by the CT dose index (CTDIvol), effective dose (ED) after ICRP guideline 103 and organ doses. The latter were calculated with commercially available software (Radimetrics, Bayer, Germany). Signal to noise ratio (SNR) was calculated for lung tissue.

#### RESULTS

CTDIvol was significantly lower in the 100 kVp-Sn examinations (0.26±0.13 mGy) when compared to 70kVp (0.81±0.73 mGy; p<0.0001). Accordingly, mean effective dose was significantly reduced when using 100 kVp-Sn (0.30±0.09 mSv) compared to 70kVp acquisitions (0.84±0.54 mSv; p<0.0001; Fig. 1). Organ doses were also significantly lower with the 100 kVp-Sn protocol

compared to the 70kVp protocol, e.g. breast dose with 100 kVp-Sn was 0.49 mSv vs. 1.57 mSv with 70kV, resulting in a factor of 3.2 ( $p<0.0001$ ). SNR in lung tissue was comparable between both examination protocols ( $p=0.1$ ).

## CONCLUSION

Both, tube voltage reduction to 70kV and Sn-filter based spectral shaping at 100kVp allow to acquire pediatric chest CT scans at sub-mSv dose levels. In direct comparison 100Sn even performs at lower dose levels. Consequently, chest CT scans without contrast agent should be performed with this technique.

## CLINICAL RELEVANCE/APPLICATION

Pediatric chest CT scans can be performed with sub-mSv dose levels when using either 70kVp tube voltage or spectral beam shaping with an additional tin filter at 100kVp (100 kVp-Sn). All pediatric chest CT scans without contrast agent should be acquired with 100 kVp-Sn.

## RC651-15 Comparative Assessment of New Generation CT Scanners for Pediatric Applications

Thursday, Dec. 3 11:40AM - 12:00PM Location: S102D

### Participants

Whal Lee, MD, PhD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

## LEARNING OBJECTIVES

1) Reviewing the mechanical development of CT machines. 2) Comparative Assessment of New Generation CT Scanners. 3) Knowing new applications and new pitfalls in scanning in children.

## ABSTRACT

Computed tomography scanner was introduced at 1974. The scan was sequential at that time, in which the gantry made a complete rotation to acquire an image of a slice. This conventional step-and-shoot technique needed a long scan time because of the interscan delays between the slices. In the late 1980's and early 1990's, spiral scanners were introduced. The gantry continuously rotates, while the table is continuously moving. This spiral scanning allowed fast and continuous acquisition of a complete set of volume image data. In 1998, multi-detector technology was announced with first 4 channels MDCT. Since then, the number of rows of detectors has ever increased, 8, 16, 64, 128 and reaching 320 in 2008. The fast rotation speed of gantry is essential for imaging of an organ. The gantry rotation times have been fast up to 270 msec. There is a machine of two X-ray tube and two detector systems in a gantry which allow only one forth rotation enough to make a slice of image and high pitch fast scanning. The wide detector CT and high pitch scanning is fascinating imaging method for child to overcome motion artifact and reducing radiation dose. However, we have to know the pitfalls in these new scan mode. The overscan range is larger than that of past and wide beam angle of wide detector scanner gave us geometrical unused radiation and that cannot be neglected. In this lecture we will review the mechanical development of CT machines and new applications and new pitfalls in scanning in children.

### Active Handout: Whal Lee

<http://abstract.rsna.org/uploads/2015/14044487/RC651-15 new CT ped app handout.pdf>

**Case-based Review of Neuroradiology (An Interactive Session)**

Thursday, Dec. 3 10:30AM - 12:00PM Location: S100AB

AMA PRA Category 1 Credits™: 1.50  
ARRT Category A+ Credits: 1.50**Participants**Pina C. Sanelli, MD, Manhasset, NY (*Director*) Nothing to Disclose**LEARNING OBJECTIVES**

1) Improve basic knowledge and skills relevant to clinical practice. 2) Practice formulating a differential diagnosis for pathologic diseases involving the brain, spine, head and neck. 3) Apply principles of critical thinking to challenging diagnostic imaging cases.

**ABSTRACT**

The learning objectives are to enable attendees to: 1. Improve basic knowledge and skills relevant to clinical practice. 2. Practice formulating a differential diagnosis for pathologic diseases involving the brain, spine, head and neck. 3. Apply principles of critical thinking to challenging diagnostic imaging cases.

**Sub-Events****MSCN52A Pediatric Brain****Participants**Tina Y. Poussaint, MD, Boston, MA (*Presenter*) Nothing to Disclose**LEARNING OBJECTIVES**

1) To select the appropriate modality or modalities in evaluating a suspected or diagnosed case of pediatric CNS disease with focus on MR imaging. 2) To review key MR imaging features of pediatric brain diseases. 3) To evaluate neuroimaging of pediatric CNS disease as it relates to understanding the developing brain in childhood.

**ABSTRACT**

Pediatric brain diseases will be discussed in a case based format.

**MSCN52B Pediatric Spine****Participants**Christopher G. Filippi, MD, Grand Isle, VT, (cfilippi@nshs.edu) (*Presenter*) Research Consultant, Regeneron Pharmaceuticals, Inc; Research Consultant, Syntactx**LEARNING OBJECTIVES**

1) Identify the basic anatomic, physiologic and pathologic features of diseases affecting the pediatric spine. 2) Identify the key imaging features of various common pediatric spine diseases. 3) Recognize common patterns for spine and spinal cord pathology and organize these patterns into categories of diseases processes.

**ABSTRACT**

Common pediatric spine and spinal cord diseases will be discussed in a case-based format.

**MSCN52C Pediatric Head and Neck****Participants**Laurie A. Loevner, MD, Gladwyne, PA (*Presenter*) Stockholder, General Electric Company; Stockholder, Pfizer Inc; Stockholder, Merck & Co, Inc; Stockholder, Johnson & Johnson; Stockholder, Amgen Inc; Stockholder, GlaxoSmithKline plc**LEARNING OBJECTIVES**

1) Identify the salient imaging features of common pathologies of the pediatric head and neck. 2) Identify pertinent anatomy in the neck and skull base through the illustration of head and neck pathology. 3) Recognize patterns for disease that allow a succinct differential diagnosis. 4) Apply radiologic findings to identify next appropriate steps in patient work-up.



SSQ18

## Pediatrics (Interventional Radiology)

Thursday, Dec. 3 10:30AM - 12:00PM Location: S102C



AMA PRA Category 1 Credits™: 1.50  
ARRT Category A+ Credits: 1.50



Discussions may include off-label uses.

### Participants

Anne Marie Cahill, MBBCh, Philadelphia, PA (*Moderator*) Nothing to Disclose  
Kamlesh U. Kukreja, MD, Bellaire, TX (*Moderator*) Nothing to Disclose

### Sub-Events

#### SSQ18-01 Tunneled Central Venous Catheter Placement through the Subclavian Vein Results in Higher Rates of Mechanical Malfunction in Pediatric Patients: One Year Outcome Analysis at a Tertiary-Care Center

Thursday, Dec. 3 10:30AM - 10:40AM Location: S102C

### Participants

Michael P. Yannes, MD, Pittsburgh, PA (*Presenter*) Nothing to Disclose  
Orrie N. Close, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
Donghoon Shin, MS, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
Charles R. Fitz, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
John J. Crowley, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
Sabri Yilmaz, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To evaluate pediatric tunneled central venous catheter complication incidence and time to removal with respect to site of insertion.

### METHOD AND MATERIALS

A single-institution, IRB-approved, retrospective review was undertaken of all patients who underwent tunneled central venous catheter placement by either the General Surgery or Interventional Radiology services over a one-year period. Patient electronic medical records were reviewed for technical details, complications, dwell time, indication for placement, and removal. We compared the time-to-removal of tunneled lines for mechanical failure using product limit survival estimates in order to better account for censoring and dwell time of tunneled lines.

### RESULTS

288 central venous lines were placed during a one-year period. Of these, 205 (71%) were placed through the internal jugular vein and 83 (29%) were placed through the subclavian vein. Mechanical malfunction was documented as the indication for removal in 22 of internal jugular lines (11%), versus 19 of subclavian lines (23%) ( $p < .01$ ). Specifically, a higher rate of left-sided subclavian vein lines were removed for mechanical malfunction compared to the right-sided subclavian vein lines (28% vs. 18%, respectively), but time to mechanical failure was not statistically different ( $p = .37$ ).

### CONCLUSION

Placement of tunneled subclavian central venous catheters in the pediatric population results in a higher incidence of mechanical malfunction and a decreased dwell time compared to internal jugular vein placement. Left-sided subclavian catheters tend to have a higher mechanical malfunction rate compared to right-sided subclavian catheters.

### CLINICAL RELEVANCE/APPLICATION

The placement of tunneled subclavian central venous catheters in the pediatric population results in a higher incidence of mechanical malfunction and a decreased dwell time compared to tunneled internal jugular venous central catheters.

#### SSQ18-02 Complication Rates for PICCs Exchanged Over the Wire at a Large Children's Hospital

Thursday, Dec. 3 10:40AM - 10:50AM Location: S102C

### Participants

Nicole Riccioni, Houston, TX (*Presenter*) Nothing to Disclose  
Daniel J. Ashton, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Alberto J. Hernandez, MD, Galveston, TX (*Abstract Co-Author*) Nothing to Disclose  
Christopher I. Cassady, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Sheena Pimpalwar, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Kamlesh U. Kukreja, MD, Bellaire, TX (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Long term venous access is integral to the treatment and therapy of many patients. Complications with line function other than infection can be remedied at times by exchanging the catheter over a wire for a new catheter (rewire). This retrospective study was designed to analyze PICC line complications rates after rewire compared to the overall PICC population.

### METHOD AND MATERIALS

IRB approval allowed retrospective study at a large children's hospital of the electronic medical record and PACS system, which were queried for all PICCs placed from January 2014 through June 2014. Data points collected for each patient included catheter

dwelling time (in days), location of line placement, type of line securement, and complications including infection, malposition, occluded lumen. After compilation, the database was statistically analyzed using Fisher's exact test. Comparisons were made between the total population and those patients that had their PICC exchanged over a wire.

## RESULTS

A total of 665 PICCs were placed in the study period with 73 patients having a rewire of their line. In all patients the complication rate and infection rate were 16% and 6.4%, respectively. In rewire patients the complication rate and infection rate were 48.0% ( $P<0.0001$ ) and 13.7% (NS). The most common reasons for rewire were malposition (43.5%) and cracked catheter hub (22.4%). The two most common patient populations requiring rewires were oncology (40.7%) and TPN dependent short gut patients (16.3%). Average catheter dwell time in all patients was 23.0 days and in rewire patients was 50 days.

## CONCLUSION

The overall complication rate for catheters after rewire was higher than the entire PICC population. The infection rate was not significantly higher, even though the average dwell time of the catheter was longer in the rewire patients compared to the PICC population.

## CLINICAL RELEVANCE/APPLICATION

For patients that require indefinite venous access such as certain oncology and TPN dependent patients rewire of the malfunctioning line does not incur a higher risk of subsequent infection.

### SSQ18-03 Pediatric Tunneled Central Catheter Placement at A Single Tertiary-Care Center by Interventional Radiology: One Year Outcome Analysis

Thursday, Dec. 3 10:50AM - 11:00AM Location: S102C

#### Participants

Donghoon Shin, MS, Pittsburgh, PA (*Presenter*) Nothing to Disclose  
Michael P. Yannes, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
Orrie N. Close, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
Fernando A. Escobar, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
Charles R. Fitz, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
John J. Crowley, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
Sabri Yilmaz, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

The insertion of tunneled central catheters by Pediatric Interventional Radiology services is a daily occurrence. However, little data with respect to placement outcomes of pediatric-tunneled central catheter placement is known. We examine outcomes of all subclavian and internal jugular tunneled central venous catheters placed over a one year period.

## METHOD AND MATERIALS

An IRB-approved, retrospective review was undertaken for all patients who underwent tunneled central venous catheter placement by the Interventional Radiology service over a one year period. Patient electronic medical records were reviewed for technical details, complications, dwell time, indication for placement, and reason and date of removal. Catheters which were removed due to completion of treatment were censored from the analysis.

## RESULTS

192 (66% of the total hospital placements) tunneled internal jugular and subclavian central venous catheters were placed in 173 patients by the Interventional Radiology service during the study period. 187 (97%) were via the internal jugular vein; 5 (3%) were placed via the subclavian vein. The most frequent indications included chemotherapy (88 placements, 46% of total) and nutrition and frequent blood draws (73 placements, 38%). The median dwell time was 139.5 days (IQR 43-345); time to removal was significantly shorter ( $p<0.0005$ ) in the nutrition/frequent blood draw group. Clinical concern for infection was the indication for removal in 31 (16%) of lines, and of these, 15 (8%) had positive blood cultures. Catheters placed for nutrition and frequent blood draws resulted in higher rates of infection ( $N=25$ ) when compared to those being used for chemotherapy ( $N=14$ ). 20 (10%) catheters were removed for mechanical malfunction.

## CONCLUSION

Tunneled central venous catheters placed for nutrition and frequent blood draws resulted in a higher incidence of infection and decreased dwell time, specifically when compared to catheters placed for chemotherapy. Clinical concern for infection was the most common indication for removal, and mechanical malfunction was the second most common indication for line removal.

## CLINICAL RELEVANCE/APPLICATION

Tunneled central venous catheters placed for nutrition and need for frequent blood draws by the Pediatric Interventional Radiology service resulted in a higher incidence of infection and decreased dwell time than lines placed for other reasons, most notably administration of chemotherapy.

### SSQ18-04 Complication Rates for PICCs in Patients with AML

Thursday, Dec. 3 11:00AM - 11:10AM Location: S102C

#### Participants

Anoosha Moturu, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Daniel J. Ashton, MD, Houston, TX (*Presenter*) Nothing to Disclose  
Kamlesh U. Kukreja, MD, Bellaire, TX (*Abstract Co-Author*) Nothing to Disclose  
J. Alberto Hernandez, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Christopher I. Cassady, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Treatment of patients with Acute Myeloid Leukemia (AML) requires long-term venous access, one option for which is with a



peripherally inserted central line (PICC). This retrospective study was designed to analyze PICC line infection rates in AML patients compared to the overall PICC and the general oncology populations.

#### **METHOD AND MATERIALS**

IRB approval allowed retrospective study at a large children's hospital of the electronic medical record and PACS system, which were queried for all PICCs placed from January 2014 through June 2014. Data points collected for each patient included catheter dwell time (in days), location of line placement, type of line securement, and complications including infection, malposition, occluded lumen. After compilation, the database was statistically analyzed using Fisher's exact test. Comparisons were made between the total population and those diagnosed with any cancer and patients diagnosed specifically with AML.

#### **RESULTS**

A total of 665 PICCs were placed in the study period, 158 in oncology patients and 23 in AML patients specifically. In all patients the complication rate and infection rate were 16% and 6.4%, respectively. In oncology patients the complication rate and infection rate were 27.2% and 16.5%, respectively ( $P < 0.0001$  for both). In AML patients the complication rate and infection rate were 34.8% (NSS) and 30.4% ( $P < 0.0001$ ), respectively. Average catheter dwell time in all patients was 23.0 days, in oncology patients was 56.5 days, and in AML patients 74.8 days.

#### **CONCLUSION**

Oncology patients and, in particular, AML patients have increased rates of infection compared to the population as a whole. This is in part due to the patients' immunocompromised states and the much longer dwell times of the PICCs used for their treatments. Interventions for decreasing infection rates should be targeted at these high risk populations.

#### **CLINICAL RELEVANCE/APPLICATION**

Acute Myeloid Leukemia patients have an increased risk of infection of PICCs. Identifying populations at high risk allows for targeting changes in practice to reduce infection rates.

#### **SSQ18-05 How Much is Too Much? Radiation Exposure during Percutaneous Gastrojejunostomy Tube Exchanges in Pediatric Patients**

Thursday, Dec. 3 11:10AM - 11:20AM Location: S102C

##### **Participants**

Matthew Hudnall, BA, San Francisco, CA (*Presenter*) Nothing to Disclose  
Kevin S. Koo, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose  
Andrew G. Taylor, MD, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose  
Kanti P. Kolli, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose  
Nicholas Fidelman, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose  
Robert K. Kerlan JR, MD, Kentfield, CA (*Abstract Co-Author*) Nothing to Disclose  
Maureen P. Kohi, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose

#### **PURPOSE**

To evaluate the radiation exposure of pediatric patients during exchange of percutaneous gastrojejunostomy tubes.

#### **METHOD AND MATERIALS**

A retrospective review of consecutive pediatric patients undergoing percutaneous gastrojejunostomy tube exchanges from January 1, 2010 to April 1, 2015 was performed. Fluoroscopy time, cumulative air kerma (mGy) and cumulative dose area product (DAP) (mGycm<sup>2</sup>) values were obtained from procedural reports. Total number of procedures, indications, and time between procedures were also recorded. Patients were subdivided into an increased cumulative procedure group if 3 or more procedures were performed and an increased frequency group if the interval between any 2 procedures was less than 6 months during the study period.

#### **RESULTS**

In the 63-month study period, 130 exchanges of gastrojejunostomy tubes were performed on 48 patients. The median age of all patients was 52.5 months (range 2-206 months). 18 patients underwent a single procedure. Mean cumulative air kerma and DAP were 7.75 mGy (range 2-11.6) and 1353.89 mGycm<sup>2</sup> (range 285-3000) respectively for each procedure. Mean fluoroscopy time was 3.1 minutes (range 1-7). 20 patients were categorized into the increased cumulative procedures group, with a mean of 5 procedures (range 3-8) during the study period. Mean cumulative air kerma and DAP were 53.52 mGy (range 0.4-507) and 4333.45 mGycm<sup>2</sup> (range 102-72,479) respectively for each procedure. Mean fluoroscopy time was 8.6 minutes (range 0.2-40). 25 patients were classified into the increased frequency group, with a mean 4.3 month interval between procedures. Mean cumulative air kerma and DAP were 34.33 mGy (range 0.4-504.8) and 4105.62 mGycm<sup>2</sup> (range 102-72,479) respectively for each procedure. Mean fluoroscopy time was 8.4 minutes (range 0.2-40).

#### **CONCLUSION**

Undergoing percutaneous gastrojejunostomy tube exchanges is necessary in many chronically ill pediatric patients but subjects them to significant radiation exposure at an early age, particularly if repeat procedures are needed. Patients requiring frequent exchanges may benefit from alternative methods to maintain enteral feedings, such as through surgical intervention.

#### **CLINICAL RELEVANCE/APPLICATION**

Radiation exposure in pediatric patients during percutaneous gastrojejunostomy tube exchanges can be significant, and may be underappreciated when considering how to maintain enteral feeding.

#### **SSQ18-06 Incidence and Management of Oesophageal Ruptures Following Fluoroscopic Balloon Dilatation in Children with Benign Strictures**

Thursday, Dec. 3 11:20AM - 11:30AM Location: S102C

##### **Participants**

Jung-Hoon Park, MS, RT, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

Ho-Young Song, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Wei-Zhong Zhou, Nanjing, China (*Abstract Co-Author*) Nothing to Disclose  
Jiaywei Tsauo, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Young Chul Cho, BS, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

The purpose of this study is to investigate the incidence and management of oesophageal ruptures following fluoroscopic balloon dilatation (FBD) in children with benign oesophageal strictures.

#### METHOD AND MATERIALS

Between October 1996 and November 2013, 62 children with benign oesophageal strictures underwent FBDs. Oesophageal rupture was categorized as intramural (type 1), transmural (type 2) or transmural with free leakage (type 3). The possible risk factors for oesophageal ruptures were analyzed.

#### RESULTS

One hundred and twenty-nine FBDs were performed in these patients. The oesophageal rupture rate was 17.1% (22/129). The majority (21/22) of ruptures were type 1 and type 2, both were treated conservatively. Only one patient had a type 3 rupture and underwent esophagoesophagostomy. The patient gender, age, and the length and cause of the stricture showed no significant effect on the rupture ( $p>0.05$ ). However, for the patients  $\leq 2$  years old, the initial balloon with a diameter  $\geq 10$ mm showed a higher oesophageal rupture rate than those  $<10$ mm during the first session ( $p<0.05$ ).

#### CONCLUSION

Although the oesophageal rupture rate in children was 17.1%, the severe rupture (type 3) rate was 0.8%, which usually requires aggressive treatment. For children  $\leq 2$  years old, the initial balloon diameter should be  $<10$ mm in the first session for decreasing the risk of oesophageal rupture.

#### CLINICAL RELEVANCE/APPLICATION

For children  $\leq 2$  years, the initial balloon diameter should be  $<10$ mm.

#### SSQ18-07 Initial Experience with Pre-procedural MR and Intraprocedural C-arm CT Fusion for Biopsy of MR-positive CT-negative Pelvic Bone Lesions at a Single Pediatric Institution

Thursday, Dec. 3 11:30AM - 11:40AM Location: S102C

##### Participants

Sphoorti Shellikeri, Philadelphia, PA (*Presenter*) Research funded, Siemens AG  
Randolph M. Setser, DSc, PhD, Cleveland, OH (*Abstract Co-Author*) Employee, Siemens AG  
Xiaowei Zhu, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose  
Anne Marie Cahill, MBChB, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Biopsy of bone marrow abnormalities that are CT/fluoroscopically negative but MR-positive often require the physician to review the MRI on a separate console and cross reference anatomic landmarks to the image modality used during biopsy. This pilot study describes our initial experience with pre-procedural MR and intraprocedural C-arm CT fusion for biopsy of MR-positive CT-negative pelvic bone lesions in IR suite at a single pediatric institution.

#### METHOD AND MATERIALS

In this IRB-approved prospective study, 5 patients (4F, 1M; mean age 14.8 yrs) with MR-positive CT-negative pelvic bone lesions undergoing bone biopsies were included. A pre-procedural MRI sequence with optimal lesion visualization was fused with an intra-procedural C-arm CT (DynaCT) using 3D/3D fusion software (Siemens Healthcare) and a biopsy path was then planned on the MRI using syngo iGuide. The 3D path was overlaid on the intraprocedural fluoroscopic images. Effective dose was assessed using PCXMC software (v2013, STUK) with an age appropriate model.

#### RESULTS

All bone biopsies were performed by the same physician. The mean time interval between the pre-procedural MR and the biopsy was 10 days (range 2-22d). 4/5 biopsies were diagnostic (80% accuracy- 2 neuroblastoma, langerhans cell histiocytosis, chronic osteomyelitis). There were no procedure related complications. The non-diagnostic biopsy was performed in the left iliac bone in a patient with a subtle low standard uptake value MIBG positive lesion concerning for neuroblastoma superimposed on a more diffuse MR-positive abnormality. The MIBG scan was additionally referred to plan the needle path possibly resulting in inaccurate lesion localization. The mean fluoroscopic and procedural times were  $3.8\pm 2.7$  min and  $87\pm 22$  min. The mean effective radiation dose was  $6.2\pm 4$  mSv (1.8, 7.1, 8.4, 11.2, 2.5 mSv).

#### CONCLUSION

This pilot experience demonstrates the feasibility of MR-C arm CT fusion for biopsy of CT-negative MR-positive pelvic bone lesions in the IR suite. The advantage of this technique is that it allows the needle path to be planned directly on MRI while visualizing the target lesion. Further validation of this technique will be established with increased patient recruitment.

#### CLINICAL RELEVANCE/APPLICATION

3D/3D fusion followed by iGuide technology provides the ability to perform CT-negative MR-positive bone biopsies in the IR suite using real-time fluoroscopic guidance.

#### SSQ18-08 Long-term (>5 years) Clinical and Histological Follow-up of Successful Radiological Percutaneous Treatment of Biliary Strictures in Pediatric Liver Transplant Recipients

Thursday, Dec. 3 11:40AM - 11:50AM Location: S102C

##### Participants

Roberto Miraglia, MD, Palermo, Italy (*Presenter*) Nothing to Disclose  
Luigi Maruzzelli, MD, Palermo, Italy (*Abstract Co-Author*) Nothing to Disclose  
Mario D'Amico, MS, Palermo, Italy (*Abstract Co-Author*) Nothing to Disclose  
Silvia Riva, Palermo, Italy (*Abstract Co-Author*) Nothing to Disclose  
Marco Spada, MD, Palermo, Italy (*Abstract Co-Author*) Nothing to Disclose  
Angelo Luca, MD, Palermo, Italy (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Good results are reported for percutaneous treatment (PT) of biliary strictures (BS) in children underwent liver transplant (LT) however, in majority of the published studies on this topic, only a short or mid-term follow-up is available. Aim of this study is to retrospectively evaluate long-term follow-up (>5 years) of successful PT of BS in children underwent LT.

## METHOD AND MATERIALS

From 1/2004 to 12/2014, 70 pediatric LT recipients underwent PT of BS in our hospital. 35 out of 70 had a follow-up longer than 5 years and represent our study cohort. Mean recipient age at the time of PT was 5 y/o (range, 8 months -16 y/o). Anastomotic BS was present in 29 patients, anastomotic and intrahepatic BS were present in 6 patients.

## RESULTS

In all patients percutaneous stenting and bilioplasty were successfully performed without major complications. Mean number of balloon dilatation performed was 4 (range, 3-8). Mean duration of catheter placement was 5 months (range 2-10). In 10 out of 35 patients (28%) two courses of PT were necessary; the mean time to recurrence was 19 months (range, 3-61 months). One patient had redo LT 91 months after PT for chronic rejection; one patient is with a biliary catheter in place for portal biliopathy secondary to portal cavernoma and is on waiting list for redo LT. 33 patients are symptom-free with respect to BS at a mean follow-up of 95 months (range, 65-131 months). 32 out of 35 patients underwent liver biopsy at a mean follow-up of 5 years (range 3-8 years) after last PT with evidence of mild cholestasis N=7 (22%), moderate/severe cholestasis N=3 (10%), chronic rejection N= 2 (6%), no cholestasis N=20 (62%).

## CONCLUSION

Clinical and histological good response can be maintained in a long-term follow-up in more than half of pediatric LT recipients with BS treated with percutaneous approach.

## CLINICAL RELEVANCE/APPLICATION

Percutaneous treatment of BS is a safe and effective procedure in pediatric LT recipients, however more large-scale research and longer follow up are needed.

## SSQ18-09 Comparison of Safety and Efficiency of Image Guided Enema Reduction Techniques for Pediatric Intussusception: A Review of the Literature

Thursday, Dec. 3 11:50AM - 12:00PM Location: S102C

### Participants

Renny Chew, MBBS, Footscray, Australia (*Presenter*) Nothing to Disclose  
Stacy K. Goergen, MBBS, Clayton, Australia (*Abstract Co-Author*) Nothing to Disclose  
Michael R. Ditchfield, MBBS, Parkville, Australia (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

There is variable practice regarding the technique of image guided enema reduction of paediatric intussusception (IGPIR) and use of procedural sedation/general anaesthesia (GA). Our objectives are to review the literature regarding efficacy and safety of hydrostatic versus pneumatic reduction performed under fluoroscopic versus ultrasound control. A secondary outcome is to determine whether procedural sedation/general anaesthesia (GA) influences outcomes.

## METHOD AND MATERIALS

Articles were identified by searching OVID Medline on 21/2/14 using keywords "intussusception", "child" and "treatment" and by scanning retrieved articles reference lists. Letters, editorials, and narrative reviews were excluded. Systematic reviews (SR) were appraised with the PRISMA critical appraisal tool. Primary studies underwent a critical appraisal designed by reviewers and successes and perforations per attempt were calculated for each study and an average calculated for each technique.

## RESULTS

One SR and 87 primary studies were included (5 comparative studies, 82 studies on single techniques and no RCT). Of the 88 studies, 17 reported consistent use of sedation and 4 the use of GA. The SR included 20 studies comparing the success rate of hydrostatic versus pneumatic reduction (including 2 RCTs) and supports pneumatic over hydrostatic reduction. Hydrostatic reduction under ultrasound control appears to have similar efficacy and safety to pneumatic reduction under fluoroscopic control. Efficacy and perforation rates for the studies on single techniques are listed in the figure provided.

## CONCLUSION

Limited RCT data is available to support one IGPIR method over another. Pneumatic reduction would be preferable over hydrostatic reduction under fluoroscopic guidance based on greater efficacy and comparably low perforation rate. Hydrostatic reduction under ultrasound control should be considered an alternative, as it affords no ionised radiation exposure. Sedation does not appear to alter likelihood of reduction or procedural morbidity. Data relating to GA are too limited to allow practice recommendations with regard to its effect on efficacy and safety.

## CLINICAL RELEVANCE/APPLICATION

Practice variation of image guided enema reduction techniques for paediatric intussusception may impact on perforation rates, ionising radiation exposure, requirement for surgery, and adverse patient experience.

## Pediatric Thursday Poster Discussions

Thursday, Dec. 3 12:15PM - 12:45PM Location: PD Community, Learning Center

PD

AMA PRA Category 1 Credit™: .50

FDA

Discussions may include off-label uses.

### Participants

Rajesh Krishnamurthy, MD, Bellaire, TX (*Moderator*) Research support, Koninklijke Philips NV; Research support, Toshiba Corporation

### Sub-Events

#### PD240-SD- Beam Hardening Artifact in Pediatric CT: A CTDI Phantom Study THA1

Station #1

### Participants

Yuchun Yan, MD, Beijing, China (*Presenter*) Nothing to Disclose  
Yang Yang, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose  
Xinyu Yuan, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose  
Yun Shen, Beijing, China (*Abstract Co-Author*) Nothing to Disclose  
Huizhi Cao, PhD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To analyze the variation trend of beam hardening artifact with different level of kilovolt peak in pediatric CT.

### METHOD AND MATERIALS

A CTDI phantom ( $\Phi=100\text{mm}$ ) was simulated as pediatric head. Five syringes filled with high concentration iohexol were placed into the phantom. One was placed in the center, the other four were placed into four quadrants with equal distance from edge. During the CT scan, 80 kVp, 100 kVp, 120 kVp and 140 kVp were selected to the phantom respectively. The standard deviation (SD) of CT value of the beam hardening artifact were respectively measured in continuous three images in every mid-area of each two syringes. An artifact index ( $\text{AI} = \text{SQRT}(\text{SDa} \cdot \text{SDa} - \text{SDbg} \cdot \text{SDbg})$ ) was calculated to evaluate the trend of beam hardening artifact changing in different Kvp level.

### RESULTS

The average AI of 80kVp, 100kVp, 120kVp, 140kVp were  $20.2 \pm 5.6$ ,  $16.4 \pm 4.3$ ,  $14.6 \pm 3.8$ ,  $12.6 \pm 3.5$  respectively. The mean AI of A1-A4 was  $20.0 \pm 3.8$  and the mean AI of A5-A8 was  $11.8 \pm 2.2$ . The AI of peripheral parts (A5-A8) were lower than central parts (A1-A4) ( $t=10.587$ ,  $p<0.001$ ). The quadratic model of AI (A1-A4) was  $\text{AI} = 56.521 - 0.525\text{kVp} + 0.002\text{kVp} \cdot \text{kVp}$  ( $R^2=0.900$ ,  $p<0.001$ ). The quadratic model of AI (A5-A8) was  $\text{AI} = 29.694 - 0.237\text{kVp} + 0.001\text{kVp} \cdot \text{kVp}$  ( $R^2=0.958$ ,  $p<0.001$ ). With increasing of kVp level, the beam hardening artifact index of pediatric head phantom was declined.

### CONCLUSION

Raising the kVp level in a reasonable range will decrease the beam hardening artifact in pediatric CT scan.

### CLINICAL RELEVANCE/APPLICATION

Fewer studies researched pediatric CT beam hardening artifact. As a reasonable tool, selecting appropriate kVp level would effectively reduce beam hardening artifacts in target organ CT scan in order to avoid exam failure and protect patients from extra radiation exposure of repeat CT scans.

#### PD241-SD- The Overexposure Area in Pediatric Plain Radiography: What is the Post-processing Hiding? THA2

Station #2

### Participants

Graciano N. Paulo, MSC, RT, Coimbra, Portugal (*Presenter*) Nothing to Disclose  
Joana Santos, PhD, Coimbra, Portugal (*Abstract Co-Author*) Nothing to Disclose  
Ana Pereira, RT, Coimbra, Portugal (*Abstract Co-Author*) Nothing to Disclose  
Barbara Piores, Coimbra, Portugal (*Abstract Co-Author*) Nothing to Disclose  
Adriano Rodrigues, Coimbra, Portugal (*Abstract Co-Author*) Nothing to Disclose  
Eliseo Vano, PhD, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

The development and implementation into daily practice of digital radiography systems have created a real revolution in the medical imaging procedures workflow, not always followed by an expected dose reduction, despite the new technological features and high efficiency of the new digital detectors. The linear dynamic range response of the digital systems combined with the possibility of post-processing images is, in some cases contributing to the increase on patient dose exposure. The purpose of this work was to evaluate the overexposed area in chest, abdomen and pelvis plain radiography, in pediatric imaging.

### METHOD AND MATERIALS

Retrospective data collection of the Digital Imaging and Communications in Medicine (DICOM) headers available on Picture Archiving and Communication System (PACS) was performed on 100 chest, 79 abdomen and 66 pelvis radiographs. Tube voltage (kV), tube current time product (mAs), exposure time (ms), Dose Area Product (DAP-Gy.cm<sup>2</sup>), irradiated detector area and post-processing electronic collimated area was registered.

## RESULTS

An average overexposure area of 13% (min. 7% - max. 66%), 17% (min. 9% - max. 31%) and 27% (min. 16% - max. 34%); was identified on chest, abdomen and pelvis radiographs, respectively.

## CONCLUSION

Technologists (Radiographers) play a crucial role in applying the ALARA principal in daily practice. This is even more important in pediatric examination, since the dose to the patient is more critical than for adults because of the acknowledged greater radio sensitivity of the children and infants. This study shows that the use of post-processing tools, such as electronic collimation, hides an unnecessary overexposure, that could be substantially reduced if a bigger emphasize is given to an appropriate collimation before exposure.

## CLINICAL RELEVANCE/APPLICATION

The results from this study will raise awareness amongst Technologists (Radiographers) for the need to optimize the collimation of plain radiography procedures in order to decrease patient dose exposure.

### PD242-SD-THA3 Pediatric Fracture Detection Study: A Task-Based Observer Study Evaluating Enhanced Image Presentation and Potential Dose Reduction

Station #3

#### Participants

Lynn La Pietra, PhD, Rochester, NY (*Presenter*) Employee, Carestream Health, Inc  
Samuel Richard, PhD, Rochester, NY (*Abstract Co-Author*) Employee, Carestream Health, Inc  
Sosamma T. Methratta, MD, Hummelstown, PA (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To evaluate the potential of dose reduction in pediatric imaging, comparing standard and enhanced processing, for the detection of skeletal fractures.

## METHOD AND MATERIALS

De-identified DR pediatric exams were collected retrospectively and categorized by age and exam type. 150 exams (50 with fractures, 100 without) were presented to five pediatric radiologists with: (1) original exposure, standard processing (OES); (2) reduced exposure (720 equivalent film-speed), standard processing (RES); (3) original exposure, enhanced processing (OEE); (4) reduced exposure, enhanced processing (REE). OES renderings were acquired with site specific default techniques, then processed with default parameters of a pediatric tuned multi-frequency rendering algorithm. OEE and REE renderings add a companion view to the OES and RES renderings respectively, accentuating skeletal interruptions. Base images used for RES and REE were simulated from original exposure images with a validated noise-add model. Reader marked fracture locations and likelihood (definite or probable) first for either OES or RES exam, then with added OEE or REE rendering, respectively. For a given exam, the reduced or original exposure exam was presented in one of two sessions, separated by 1 month.

## RESULTS

Fracture detection sensitivity contrasts radiologist defined ground truth fractures (established on "time of injury" DR acquisitions given healing follow-up acquisitions and exam indication) with locations provided by study participants. True positives exist when participants locate fractures in at least one view (i.e. AP or LAT). False positives exist where non-fractures are indicated as fractures. True negatives were tracked per case, where no fractures are indicated when none exist. Missed fractures are false negatives). Results demonstrated that viewing RES and REE together is comparable to viewing only ODS for detecting fractures in DR images with an improved confidence using the OEE.

## CONCLUSION

Diagnostic quality pediatric images may be captured with DR using exposures as low as 720 equivalent film-speed exposures. Enhanced image processing may be used to improve the visibility of fine detail in pediatric images or increase confidence in detection.

## CLINICAL RELEVANCE/APPLICATION

Efforts to reduce cumulative dose to pediatric patients reduces long term radiation risk. Task based studies may be utilized to determine the adequacy of reduced dose for particular tasks.

### PD243-SD-THA4 Evaluation of Body Mass Index (BMI) as a Surrogate Parameter for Size Specific Dose Estimates (SSDE) in Pediatric Computed Tomography

Station #4

#### Participants

Johannes Boos, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Lino Sawicki, MD, Dusseldorf, Germany (*Abstract Co-Author*) Nothing to Disclose  
Philipp Heusch, MD, Dusseldorf, Germany (*Abstract Co-Author*) Nothing to Disclose  
Patric Kroepil, MD, Dusseldorf, Germany (*Abstract Co-Author*) Nothing to Disclose  
Gerald Antoch, MD, Dusseldorf, Germany (*Abstract Co-Author*) Nothing to Disclose  
Rotem S. Lanzman, MD, Dusseldorf, Germany (*Presenter*) Nothing to Disclose

## PURPOSE

The aim of this study was to assess the value of the BMI as a surrogate parameter for SSDE in pediatric CT scans of the abdomen and chest.

## METHOD AND MATERIALS

213 children (116 male, 97 female, mean age 10.1±5.0 years) undergoing CT examinations of the thorax and abdomen were included in this retrospective analysis. Patients' weight and size at the time of the examinations were used to calculate the BMI



(weight/size<sup>2</sup>). The effective diameter (Deff) was assessed by two independent radiologists performing diameter measurements on the axial midslice of the CT volume. Correlation between BMI, weight, height, age and effective diameter was calculated and SSDE were calculated based on the different variables.

## RESULTS

Mean size, weight and BMI were 135.2±30.3cm, 35.4±19.8kg and 17.7±4.3kg/cm<sup>2</sup>, respectively. Mean lateral diameter, a.p. diameter and Deff were 25.2±5.5, 16.5±3.4 and 20.4±4.2, respectively. There was a significant correlation between BMI and Deff ( $r=0.62$ ,  $p<0.05$ ), weight and Deff ( $r=0.87$ ,  $p<0.05$ ), size and Deff ( $r=0.86$ ,  $p<0.05$ ) as well as age and Deff ( $r=0.85$ ,  $p<0.05$ ). SSDE calculation based on either BMI, weight, size and age did not significantly differ from SSDE calculated based on Deff.

## CONCLUSION

BMI has a significant correlation with Deff in pediatric CT examinations and SSDE based on BMI does not differ significantly from SSDE based on Deff. Nevertheless, body weight showed a stronger correlation to Deff and might therefore be preferred as a surrogate for SSDE in pediatric thoracoabdominal CT.

## CLINICAL RELEVANCE/APPLICATION

Body weight seems adequate for SSDE in pediatric CT examinations.

### PD244-SD-THA5 Comparison of Safety and Efficiency of Image Guided Enema Reduction Techniques for Pediatric Intussusception: A Review of the Literature

Station #5

#### Participants

Renny Chew, MBBS, Footscray, Australia (*Presenter*) Nothing to Disclose

Stacy K. Goergen, MBBS, Clayton, Australia (*Abstract Co-Author*) Nothing to Disclose

Michael R. Ditchfield, MBBS, Parkville, Australia (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

There is variable practice regarding the technique of image guided enema reduction of paediatric intussusception (IGPIR) and use of procedural sedation/general anaesthesia (GA). Our objectives are to review the literature regarding efficacy and safety of hydrostatic versus pneumatic reduction performed under fluoroscopic versus ultrasound control. A secondary outcome is to determine whether procedural sedation/general anaesthesia (GA) influences outcomes.

## METHOD AND MATERIALS

Articles were identified by searching OVID Medline on 21/2/14 using keywords "intussusception", "child" and "treatment" and by scanning retrieved articles reference lists. Letters, editorials, and narrative reviews were excluded. Systematic reviews (SR) were appraised with the PRISMA critical appraisal tool. Primary studies underwent a critical appraisal designed by reviewers and successes and perforations per attempt were calculated for each study and an average calculated for each technique.

## RESULTS

One SR and 87 primary studies were included (5 comparative studies, 82 studies on single techniques and no RCT). Of the 88 studies, 17 reported consistent use of sedation and 4 the use of GA. The SR included 20 studies comparing the success rate of hydrostatic versus pneumatic reduction (including 2 RCTs) and supports pneumatic over hydrostatic reduction. Hydrostatic reduction under ultrasound control appears to have similar efficacy and safety to pneumatic reduction under fluoroscopic control. Efficacy and perforation rates for the studies on single techniques are listed in the figure provided.

## CONCLUSION

Limited RCT data is available to support one IGPIR method over another. Pneumatic reduction would be preferable over hydrostatic reduction under fluoroscopic guidance based on greater efficacy and comparably low perforation rate. Hydrostatic reduction under ultrasound control should be considered an alternative, as it affords no ionised radiation exposure. Sedation does not appear to alter likelihood of reduction or procedural morbidity. Data relating to GA are too limited to allow practice recommendations with regard to its effect on efficacy and safety.

## CLINICAL RELEVANCE/APPLICATION

Practice variation of image guided enema reduction techniques for paediatric intussusception may impact on perforation rates, ionising radiation exposure, requirement for surgery, and adverse patient experience.

### PD245-SD-THA6 Assessment of Cerebral Blood Flow Change in Children with a 3D Pseudo-continuous Arterial Spin Labeling Pulse Sequence Using a Distributed Spiral-In/Spiral-Out Trajectory

Station #6

#### Participants

Houchun H. Hu, PhD, Phoenix, AZ (*Presenter*) Nothing to Disclose

Zhiqiang Li, PhD, Phoenix, AZ (*Abstract Co-Author*) Nothing to Disclose

Amber Pokorney, ARRT, Phoenix, AZ (*Abstract Co-Author*) Nothing to Disclose

Jeffrey H. Miller, MD, Ballwin, MO (*Abstract Co-Author*) Nothing to Disclose

James Pipe, PhD, Phoenix, AZ (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To assess cerebral blood flow (CBF) in pediatric patients before and after an acetazolamide (Diamox) challenge using a 3D pseudo-continuous arterial spin labeling (pCASL) pulse sequence with a spiral-in/spiral-out k-space trajectory.

## METHOD AND MATERIALS

Exams were performed on a 3T Ingenia MR platform from Philips Healthcare, utilizing a 32-channel head array. Three patients have been studied thus far: Patient 1 - an 8y old girl with Moyamoya disease, Patient 2 - a 14y boy with neurofibromatosis 1 migraines,

and Patient 3 - a 21y old girl with an optic glioma. The pCASL sequence was added to a standard brain exam, and used 3x3x4 mm<sup>3</sup> voxels, 30 transverse slices, a square field-of-view of 260 mm, SPIR fat suppression, TR 4.5 s, TE 20 ms, 4 non-selective background suppression pulses, three inferior slice-selective saturation pulses, and both a tagging label duration and a post label delay of 1500 ms. Scan time for pCASL was 4 minutes 30 seconds. Diamox dosages were 490 mg, 800 mg, and 780 mg, respectively, for the three patients. pCASL was performed twice, immediately before and 15 minutes after Diamox injection. Spiral raw data were reconstructed offline and quantitative CBF maps were generated. White and gray matters voxels were extracted using FSL and Matlab software and a CBF histogram of the whole-brain was computed.

## RESULTS

In Patient 1, time-of-flight (TOF) angiography demonstrated impaired flow in both the right middle cerebral (MCA) and internal carotid arteries (ICA). The Moyamoya patient exhibited very little CBF change in response to Diamox (pre- CBF average: 59.5 ml/100g/min, post- CBF average: 59.4 ml/100g/min), suggesting limited CBF reserve. In Patient 2, the response to Diamox was moderate, with mean CBF increasing from 42.7 to 56.0 ml/100g/min. TOF confirms a marked narrowing of the right MCA, and dynamic susceptibility contrast imaging further corroborates decreased CBF in the affected brain parenchyma. Patient 3 exhibited significant flow voids in the right distal MCA and ICA. The patient demonstrated significant increase in CBF in response to Diamox, from 28.9 to 49.8 ml/100g/min.

## CONCLUSION

3D spiral pCASL provides a clinically useful quantitative approach to assess CBF in pediatric patients.

## CLINICAL RELEVANCE/APPLICATION

3D spiral pCASL provides an efficient and robust approach to assess CBF reserve, and yields quantitative perfusion information that supports clinical findings from conventional angiography.

## PD145-ED-THA7 A Review of Vascular Anomalies based on the Updated International Society for the Study of Vascular Anomalies (ISSVA) Classification (2014): Part 1 - Vascular Tumors and Provisionally Unclassified Vascular Anomalies

Station #7

### Participants

Michael P. Yannes, MD, Pittsburgh, PA (*Presenter*) Nothing to Disclose  
Amy Davis, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
Lorelei Grunwaldt, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
Sabri Yilmaz, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
Amanda Brown, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
Andrew McCormick, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose  
Meghan Natali, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

The imaging, management, and treatment of vascular tumors have flourished over the past three decades. Nevertheless, the field of vascular anomalies is confusing because numerous types of vascular anomalies exist, different lesions often look similar, and many practitioners use imprecise terminology. In 2014, the International Society for the Study of Vascular Anomalies (ISSVA) adopted an updated classification for evaluation of vascular tumors. We discuss the imaging findings of both common and uncommon vascular tumors and their associations within the context of the newly updated classification system.

## TABLE OF CONTENTS/OUTLINE

New Classification Scheme (2014): Benign: Infantile hemangioma (Figure 1) Congenital hemangioma Rapidly involuting Non-involuting (Figure 2) Partially involuting Tufted angioma (Figure 3) Spindle-cell hemangioma Epithelioid hemangioma Pyogenic hemangioma Locally Aggressive or Borderline Kaposiform hemangioendothelioma (Figure 4) Retiform hemangioendothelioma Composite hemangioendothelioma Kaposi sarcoma Malignant Angiosarcoma Epithelioid hemangioendothelioma Unclassified Vascular Anomalies: Verrucous hemangioma Angiokeratoma Kaposiform lymphangiomatosis PTEN Hamartoma Syndrome (Figure 5)

## Pediatric Thursday Poster Discussions

Thursday, Dec. 3 12:45PM - 1:15PM Location: PD Community, Learning Center

PD

AMA PRA Category 1 Credit™: .50

FDA

Discussions may include off-label uses.

### Participants

Rajesh Krishnamurthy, MD, Bellaire, TX (*Moderator*) Research support, Koninklijke Philips NV; Research support, Toshiba Corporation

### Sub-Events

#### PD246-SD- THB1 Low Dose CT for Craniosynostosis: Preserving Benefit with Substantial Radiation Dose Reduction

Station #1

### Participants

Laurence J. Eckel, MD, Rochester, MN (*Presenter*) Nothing to Disclose  
 David R. De Lone, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose  
 Amy L. Kotsenas, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose  
 Felix E. Diehn, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose  
 Maria Shiung, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose  
 Juan Montoya, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose  
 Rickey Carter, PhD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose  
 Cynthia H. McCollough, PhD, Rochester, MN (*Abstract Co-Author*) Research Grant, Siemens AG  
 Joel G. Fletcher, MD, Rochester, MN (*Abstract Co-Author*) Grant, Siemens AG; ;  
 Adam Bartley, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Routine head CT doses are used for evaluation of craniosynostosis, despite the fact that the critical structure is the bony cranium and not the brain. We sought to evaluate the potential for substantial radiation dose reduction in patients with potential craniosynostosis.

### METHOD AND MATERIALS

CT projection data for pediatric patients undergoing routine pediatric head CT for craniosynostosis were archived [CT acquisition: 120 kV, 220 Quality Ref. mAs [QRM], 1mm slices, iterative reconstruction kernel (J30, SAFIRE strength = 2); Siemens Definition FLASH, CTDIvol dose level 34 mGy]. Lower dose images were simulated corresponding to 55 QRM, 25 QRM and 5 QRM (SAFIRE strengths 3, 4 or 5, respectively; corresponding CTDIvol = 8.4, 3.8 and 0.8 mGy). Cases were anonymized and randomized so that at each of 4 reading sessions, a neuroradiologist evaluated each patient only once. Each suture was evaluated for craniosynostosis (positive, partial, or negative) using axial bone window images. Indeterminate confidence in diagnosis was noted. Subsequently, the neuroradiologist evaluated 2D and 3D images together. The routine-dose 220 QRM diagnosis was compared to the diagnosis at the lower dose levels, with per-patient and per-suture comparisons performed.

### RESULTS

272 sutures were evaluated in 34 patients. 21 patients (62%) had craniosynostosis. Agreement for craniosynostosis presence per suture was 92% (249/272) at 55 QRM, 92% (249/272) at 25 QRM and 87% (236/272) at 5 QRM using axial images only. Using 2D and 3D images, agreement was similar [94% (256/272), 94% (255/272), and 89% (241/272), respectively]. Accuracy for craniosynostosis on a per-patient level was  $\geq 84\%$  (28/34) using axial images and  $\geq 94\%$  (32/34) using 2D and 3D images at 55 and 25 QRM. The number of sutures with indeterminate diagnostic confidence was low at all dose levels.

### CONCLUSION

1. Substantial dose reduction is possible using iterative reconstruction for pediatric evaluation of craniosynostosis. 2. Multi-reader validation is needed to determine if routine dose levels can be reduced to 25 QRM as suggested by our single reader, retrospective evaluation. 3. 3D images improve diagnosis of craniosynostosis at lower dose CT.

### CLINICAL RELEVANCE/APPLICATION

Pediatric head CT evaluations can likely be performed at substantially lower doses. When iterative reconstruction is used, dose reductions of greater than 75% appear possible.

#### PD247-SD- THB2 Computed Tomography Dose Index and Image Quality in Pediatric Head CT

Station #2

### Participants

Benson R. Langdon, Charleston, SC (*Presenter*) Nothing to Disclose  
 Kathleen Byington, DO, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose  
 Maria G. Matheus, MD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose  
 Sameer Tipnis, PhD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose  
 Maria Vittoria Spampinato, MD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

We retrospectively evaluated radiation doses and image quality of pediatric head CT studies to make recommendations for age-appropriate pediatric head CT protocols.



## METHOD AND MATERIALS

We retrospectively reviewed all pediatric head CT examinations acquired at our institution over 6 months in children aged 5 to 9 years. Information regarding age, tube current, CT dose index (CTDIvol) and total DLP were obtained. Two neuroradiology attendings and a neuroradiology fellow assessed the scans on diagnostic image quality using a 5-point scoring system, where 1 = non-diagnostic and 5 = excellent diagnostic quality. From each exam, two slices, one at the level of basal ganglia (BG) and one at the level of posterior fossa (PF) were selected. Scores  $\geq 3$  were considered sufficient for clinical diagnostic purposes. Inter-rater agreement was evaluated using the Spearman correlation coefficients. Ratings for low-dose and high-dose studies were compared using the Person Chi-Square test. Statistical significance was achieved when  $p < 0.05$ .

## RESULTS

A total of 100 pediatric head CTs of patients aged 5 to 9 were considered. All CT examinations were helical acquisitions on 16 and 64-slice CT scanners. There was moderate inter-observer agreement in evaluation of the BG and PF images (Spearman range = 0.65-0.71 and 0.63-0.77). Median CTDIvol was 26 mGy (range = 15-63, SD = 17). We found significant difference in image quality ratings of BG and PF images obtained with CTDIvol lower versus  $\geq$  to 35 mGy (BG  $p < 0.001$ ; PF  $p < 0.001$ ). In the low-dose subgroup, image quality was deemed satisfactory (rating  $\geq 3$ ) in the evaluation of the BG and PF respectively in 13/55 cases and 26/55 cases. In the high-dose subgroup, image quality was satisfactory in 36/45 cases and 41/45 cases respectively. Seven of the 13 non-diagnostic CT images obtained with a CTDIvol greater than 35 mGy were degraded by significant artifact due to hardware, e.g. VP shunts, external drains, etc.

## CONCLUSION

We evaluated the diagnostic quality of pediatric head CT performed using a wide range of CTDIvol values in children aged 5 to 9. Based on our results, a CTDIvol of at least 35 mGy should be used in pediatric head CT in this age group.

## CLINICAL RELEVANCE/APPLICATION

Protocol optimization is essential in pediatric imaging. Effective radiation dose in children is higher than in adults when using the same technical factors. Furthermore, lifetime cancer mortality from CT radiation is higher in children.

### PD248-SD- THB3 Assessing Leg length Discrepancy Using a Biplane Low Dose Imaging System. A Comparative Diagnostic Study

Station #3

#### Participants

Janni Jensen, MSc, BSc, Odense C, Denmark (*Presenter*) Nothing to Disclose  
Bo R. Mussmann, MSc, RT, Odense C, Denmark (*Abstract Co-Author*) Nothing to Disclose  
Trine Torfing, MD, Odense C, Denmark (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

The etiology of leg length discrepancy (LLD) is multiple and children with LLD often undergo repetitive radiographic assessment and monitoring, stressing the need for a reliable measuring tool whilst administering as little radiation to the child as possible. The aim of this retrospective study was to evaluate the diagnostic accuracy of leg length (LL) measurements performed on low dose pre-view images acquired using a new bi-planar imaging system. The administered radiation dose from the pre-view image is approximately 20,17 $\mu$ Gycm<sup>2</sup> vs. 2670 $\mu$ Gycm<sup>2</sup> when acquiring the diagnostic image

## METHOD AND MATERIALS

Pre-view and diagnostic images from 22 patients were retrospectively collected (44 images) and included in the study. All images were anonymized and interpreted independently by two senior musculoskeletal radiologists. Three sets of measurements were performed on both the pre-view- and the diagnostic images, the mechanical axis lines of the femur and the tibia as well as the anatomical line of the entire extremity. Variance within and between the two raters was assessed by the intra-class correlation coefficient (ICC) and comparisons between LL measurements in the pre-view and the diagnostic image were made using the paired t-test

## RESULTS

No statistical significance was found between measurements performed on the pre-view and on the diagnostic image with a mean femoral length difference for the observers of 0.11cm ( $p=0.09$ ) and 0.07cm ( $p=0.24$ ) respectively; 0.02cm ( $p=0.77$ ) and 0.01cm ( $p=0.84$ ) for the tibial measurements and the mean difference for total LLD was 0.01cm ( $p=0.92$ ) and 0.03cm ( $p=0.73$ ). All ICC calculations were  $>.99$  indicating excellent inter- and intra-rater reliability

## CONCLUSION

The results strongly imply that LL measurements performed on pre-view images acquired with a new bi-planar imaging system are accurate and reliable

## CLINICAL RELEVANCE/APPLICATION

This study shows that it is possible to save approximately 99% in radiation to a pediatric patient group often undergoing repetitive x-ray examinations without compromising the diagnostic accuracy

### PD250-SD- THB5 Initial Experience with Tunneled Internal Jugular Vein Access PICC Lines in Children

Station #5

#### Participants

Melissa C. Cano, RRA, Houston, TX (*Presenter*) Nothing to Disclose  
Kamlesh U. Kukreja, MD, Bellaire, TX (*Abstract Co-Author*) Nothing to Disclose  
Holly Phan-Tran, MS, RN, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
J. Alberto Hernandez, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Sheena Pimpalwar, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Christopher I. Cassady, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Peripherally inserted central lines (PICC) lines are the most common method of vascular access in children. Although the clear incidence of venous thrombosis in children from PICC lines is unknown, we postulated that the benefits and risks from non-cuffed tunneled internal jugular vein lines will be similar to peripherally placed lines. We would like to share our initial experience with placement of non-cuffed tunneled IJ PICC lines in children.

## METHOD AND MATERIALS

IRB approved imaging and clinical database review of PICC lines placed between Jan 2014 to December 2014 via internal jugular vein access tunneled to the chest was performed. PICC related features such as technique of placement, type of PICC, number of lumens and complications related to PICC line were reviewed.

## RESULTS

43 PICC lines were placed in 37 patients between the age range of 21 days to 16 years. PICC lines used were BioFlo (18), Medcomp (14), and Cook (10), with 26 being 3 Fr single lumens, 13 being 4 Fr double lumen and 4 being 5 Fr double lumen non-cuffed for lines for most common indication of need for total parenteral nutrition. Total complications (infection, malposition and mechanical obstruction) were 13 with infection in 8 lines. Infection (6) was most common in patients with Acute myeloid leukemia (AML).

## CONCLUSION

IJ PICC lines are technically feasible and safe in children with similar complication to peripherally placed lines, however they may have lower incidence of thrombosis in younger children.

## CLINICAL RELEVANCE/APPLICATION

Considering the general population as a whole, tunneled non-cuffed IJ PICC's do not offer any significant advantage in regards to thrombosis rate when compared to peripheral PICC placement.

## PD251-SD- THB6 Mapping Neonatal Brain Myelination using a T1- and T2-weighted MRI Ratio

Station #6

### Participants

Jennifer Soun, MD, New York, NY (*Presenter*) Nothing to Disclose

Michael Z. Liu, MS, New York, NY (*Abstract Co-Author*) Nothing to Disclose

Keith A. Cauley, MD, PhD, Worcester, MA (*Abstract Co-Author*) Nothing to Disclose

Jack Grinband, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To evaluate a novel T1w/T2w ratio technique as compared to routine T1w, T2w, and ADC images in detecting myelin in term neonates with normal-appearing brain parenchyma.

## METHOD AND MATERIALS

This retrospective IRB-approved study included ten term neonates (mean gestational age = 38.7 weeks) scanned on a single 1.5 T MRI scanner (mean post-natal day 4.7). These scans were independently reviewed by a board-certified neuroradiologist (K.C.) and a 2nd year radiology resident (J.S.) and determined to be normal by standard imaging criteria. Images were bias corrected, co-registered, and intensity normalized, and T1w/T2w ratio images were created for each subject. ROIs were drawn in the posterior limb of the internal capsule (PLIC) and optic radiations for all post-processed sequences. These ROIs were chosen based on areas of known myelination (PLIC) and very little myelination (optic radiations) at term birth. A quantitative measure of contrast luminance intensity, the Michelson contrast, was compared between image types:  $MC = (I_{max} - I_{min}) / (I_{max} + I_{min})$  where  $I_{max}$  was assumed to be the mean intensity value of the PLIC ROI and  $I_{min}$  was assumed to be the mean intensity value of the optic radiation ROI. Linear regression analysis was used to compare whole brain ratio and ADC values. All analyses were performed with Matlab, Advanced Normalization Tools, and FSL.

## RESULTS

The means and standard deviations of the Michelson contrast were  $0.17 \pm 0.02$ ,  $0.11 \pm 0.03$ ,  $0.15 \pm 0.03$ , and  $0.27 \pm 0.04$  for T1w, T2w, ADC, and ratio images, respectively. The Michelson contrast for the T1w/T2w ratio is 1.6 times higher than T1w, 2.6 times higher than T2w images, and 1.76 times higher than ADC images ( $p < .04 \times 10^{-5}$ ,  $p < .01 \times 10^{-7}$ ,  $p < .02 \times 10^{-3}$  respectively). Linear regression analysis of whole brain ratio versus ADC values shows a significant negative relationship (intercept = 0.58, slope = -0.0001,  $R^2 = 0.05$ , and  $p < 0.005$ ).

## CONCLUSION

The T1w/T2w ratio significantly increases Michelson contrast compared to standard imaging, allowing for improved detection of myelin. In addition, voxels with high T1w/T2w ratio values are significantly associated with low ADC values, consistent with myelin-related restriction of water diffusion.

## CLINICAL RELEVANCE/APPLICATION

Ratio myelin mapping accentuates myelin contrast compared to standard imaging and may serve to increase the sensitivity of evaluation of normal and abnormal myelination in the neonatal brain.

## PD161-ED- THB7 Pelvic Pain in the Middle of the Night: Pediatric Pathology on Pelvic MRI

Station #7

### Participants

Rama S. Ayyala, MD, New York, NY (*Presenter*) Nothing to Disclose

Susie S. Chen, MD, Fort Lee, NJ (*Abstract Co-Author*) Nothing to Disclose

#### **TEACHING POINTS**

Acute pelvic pain in pediatric female patients is a common cause of emergency room visits. Given the various pathologies that can cause pelvic pain, imaging plays a crucial role in the clinical evaluation. Ultrasound and radiographs are typical first line imaging modalities, however MRI is a helpful adjunct modality. Advantages of MRI include superior delineation of anatomy and higher tissue contrast resolution particularly of the pelvis structures, with the benefit of no associated ionizing radiation, especially advantageous in pediatric female patients. Use of MRI in difficult cases can help provide a targeted and accurate differential diagnosis. The purpose of this exhibit is as follows: To highlight various causes of acute pelvic pain in female patients. To discuss the use of MRI in the evaluation of acute pelvic pain in female patients. To review imaging findings of various pelvic pathologies with specific emphasis on MRI findings.

#### **TABLE OF CONTENTS/OUTLINE**

Introduction Technique of MRI of pelvis: sequences, advantages, disadvantages and tips for optimizing Review of Etiologies of Pelvic Pain with Examples: using US and MRI correlation Summary

SPDL51

## RSNA Diagnosis Live™: Peds, IR, Potpourri

Thursday, Dec. 3 3:00PM - 4:00PM Location: E451B



AMA PRA Category 1 Credit™: 1.00  
ARRT Category A+ Credit: 1.00

### Participants

Paul J. Chang, MD, Chicago, IL, (pchang@radiology.bsd.uchicago.edu) (*Presenter*) Co-founder, Stentor/Koninklijke Philips NV; Researcher, Koninklijke Philips NV; Medical Advisory Board, lifeIMAGE Inc; Medical Advisory Board, Merge Healthcare Incorporated  
Brian S. Funaki, MD, Riverside, IL (*Presenter*) Data Safety Monitoring Board, Novate Medical  
Kate A. Feinstein, MD, Chicago, IL, (kfeinstein@radiology.bsd.uchicago.edu) (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) The participant will be introduced to a series of radiology case studies via an interactive team game approach designed to encourage "active" consumption of educational content. 2) The participant will be able to use their mobile wireless device (tablet, phone, laptop) to electronically respond to various imaging case challenges; participants will be able to monitor their individual and team performance in real time. 3) The attendee will receive a personalized self-assessment report via email that will review the case material presented during the session, along with individual and team performance. This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

RC705

## Pediatric Neuroradiology

Thursday, Dec. 3 4:30PM - 6:00PM Location: N230



AMA PRA Category 1 Credits™: 1.50  
ARRT Category A+ Credits: 1.50

### Participants

Erin S. Schwartz, MD, Philadelphia, PA (*Moderator*) Nothing to Disclose

Bruno P. Soares, MD, Atlanta, GA (*Moderator*) Nothing to Disclose

### Sub-Events

#### RC705A Imaging of the Developmentally Delayed Child

### Participants

A. James Barkovich, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) How to properly protocol an MRI of the brain for developmental delay. 2) How the proper protocol depends on the age of the patient at the time of the scan. 3) Where to get information to help you to perform the best sequences ('developmental delay' is often not sufficient).

### ABSTRACT

Developmental delay is a common indication for brain imaging in children, most commonly in the first few years of life. To be a useful study, the imaging examination must assess the brain for the most common causes of delayed development. These include malformations (genetic or acquired), injury from prior vascular event or infection (pre- or postnatal), inborn errors of metabolism and phakomatoses. Sometimes the presenting history will give a clue that helps to protocol the scan, but other times it is not until the first or second sequence is reviewed that the cause of the delay begins to become clear. This lecture will discuss: 1. The optimal imaging protocols for the diagnoses of these disorders 2. Clues from imaging as to the etiology of the brain abnormality 3. When additional sequences are necessary and how they should be performed The following structures must always be assessed in Developmentally Delayed patients: a. Midline structures: cerebral commissures, hypothalamus, pituitary gland, tectum, 4th ventricle, cerebellar vermis, brain stem. b. Cerebral Cortex: too thick (pachygyria), too thin (injury or insufficient neuron production/migration), too few sulci (oligogyria), too many sulci (if tiny, consider polymicrogyria). c. White matter: If too little white matter, consider a primary axonal disorder, either axonal navigation or axonal formation. If too much white matter (much less common) consider an overgrowth syndrome. If hypomyelinated, consider metabolic hypomyelination syndrome or delayed myelination due to illness or malnutrition. If damaged white matter, think of infection (usually asymmetric), inflammatory condition, or metabolic disorder (usually symmetric and often associated with symmetric deep gray matter, brain stem or cerebellar white matter damage). If heterotopic gray matter is present, think of in utero ependymal disruption or malformation syndrome. d. Midline Structures: Look for interhemispheric fissure; if gray matter crosses the midline from one hemisphere to the other, consider holoprosencephaly. If septum pellucidum is absent, look for gray matter crossing midline, look for optic nerve hypoplasia, ectopic posterior pituitary or small anterior pituitary (Septo-Optic Dysplasia); also look at the cerebellum for missing vermis (rhombencephalosynapsis), especially if hydrocephalus is present. Look at cerebral aqueduct. e. Posterior fossa: Make sure the cerebellum is completely formed, is of normal size compared to the cerebrum and that the vermis and hemisphere are proportional. Make sure all the lobules of the vermis are present. Look at the brain stem for proper proportions of the midbrain, pons and medulla.

#### RC705B Evidence-based Imaging of the Traumatized Pediatric Spine

### Participants

Erin S. Schwartz, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Be familiar with the current evidence regarding the value of radiographs, computer tomography, and magnetic resonance imaging in the evaluation of the traumatized pediatric spine. 2) Apply evidence-based imaging protocols to the evaluation of pediatric patients suspected of cervical spine trauma at your home institution.

### ABSTRACT

Imaging of the traumatized pediatric spine has unique requirements due to the anatomy and injury patterns in the developing spine, susceptibility to soft tissue injury in the absence of fracture, and radiation dose sensitivity. Radiology Departments may be incorrectly applying imaging protocols developed for adult patients to "clear" their injured pediatric patients. Judicious use of radiographs, appropriately-dosed CT scanning, and MRI must be in the setting of a dedicated clinical protocol for the evaluation of the pediatric cervical spine. We will review the current literature on pediatric cervical spine trauma and the clinical/radiological pathway currently being implemented at The Children's Hospital of Philadelphia.

#### RC705C A Pattern-based Approach to Pediatric Metabolic Disease

### Participants

Thierry Huisman, MD, Baltimore, MD (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Become familiar with frequent and less frequent metabolic diseases that may injure the neonatal brain. 2) How to approach the imaging findings using a pattern recognition approach.

## **ABSTRACT**

Neuroimaging pattern recognition in white matter disorders was initiated by Marjo van der Knaap and Jaap Valk, a pediatric neurologist and a pediatric neuroradiologist, and first published in 1991. This approach not only simplified and guided the diagnosis of many gray and white matter disorders, but also made it possible to cluster patients with identical or similar MR patterns, allowing further clinical, laboratory, genetic and molecular exploration. Multiple, initially unknown or unclassified disease entities could consequently be identified along this track. In the current lecture the pattern recognition approach will be discussed and applied in a variety of pediatric metabolic disorders to demonstrate its value in facilitating the correct diagnosis of inherited white and gray matter diseases. In addition, we will discuss why various patterns of neuroimaging findings are best explained.

RC713

## Pediatric Fetal (An Interactive Session)

Thursday, Dec. 3 4:30PM - 6:00PM Location: E351

**CH** **GI** **HN** **NR** **OB** **PD**

AMA PRA Category 1 Credits™: 1.50  
ARRT Category A+ Credits: 1.50

### Participants

#### LEARNING OBJECTIVES

Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

### Sub-Events

#### RC713A Fetal Ear and Orbital Anomalies

##### Participants

Maria A. Calvo-Garcia, MD, Cincinnati, OH (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

1) Identify major fetal external ear and orbital malformations. 2) Apply useful search patterns during US and fetal MRI evaluation of external ear and orbital anomalies.

#### ABSTRACT

Assessment of the fetal face is an important part of the sonographic structural survey. Craniofacial abnormalities occur as an isolated phenomenon or in the context of syndromes, chromosomal abnormalities or environmental insults. Along the course of this presentation we will review the standard facial anatomic survey with US and the main embryologic steps involved in the development of the face. Subsequently we will discuss major malformations involving the external ear and orbits and their expected association. The presentation will include clinical cases evaluated with US and fetal MRI and their postnatal correlations.

#### RC713B Fetal Chest Anomalies

##### Participants

Teresa Victoria, MD, PhD, Philadelphia, PA, (victoria@email.chop.edu) (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

1) To discuss the most common fetal lung masses. 2) To identify imaging algorithms and patterns that can be helpful in reaching a diagnosis.

#### ABSTRACT

Accurate diagnosis of fetal lung lesions is crucial for appropriate counseling and management of the abnormalities in hand. During the lecture, the normal appearance of the fetal chest will be briefly done, in order to approach a review of the most common pulmonary lesions encountered during the fetal period. Diagnostic clues that will guide accurate diagnosis will be discussed. Rare lung lesions and their imaging diagnostic approach will also be discussed.

#### RC713C Fetal GI Anomalies

##### Participants

Erika Rubesova, MD, Stanford, CA (*Presenter*) Researcher, Siemens AG

#### LEARNING OBJECTIVES

1) After the presentation, the learners should be able to recognize the normal appearance of developing fetal bowel, as well as the most common and uncommon presentations of congenital bowel anomalies on ultrasound and MRI. They will become familiar with the specific information provided by each of the two modalities. The course will present a review of bowel anomalies of the fetus and will be illustrated by representative cases with the objective for the learners to understand the systematic approach of image analysis that can lead to the accurate diagnosis or limited list of differential diagnoses.

#### ABSTRACT

Diagnosis of fetal bowel anomalies usually presents on ultrasound as bowel dilatation or echogenic bowel. Echogenic bowel is associated with multiple other congenital conditions such as chromosomal anomalies, viral infections or cystic fibrosis. Dilatation of bowel may have various etiologies and systematic review of the findings including bowel wall thickening, number of distended bowel loops or the increased echogenicity of the content may help to localize bowel obstruction and narrow the list of differential diagnosis. Fetal MRI adds precious information to the ultrasound thanks the larger field of view, better tissue contrast but mainly thanks to high T1 signal intensity of meconium. Meconium is formed in the entire bowel and accumulates in the rectum that acts as a reservoir. While meconium is seen in the small bowel and colon in the second trimester, it is mainly seen in the fetal colon after 30 weeks of gestational age. Meconium acts as intraluminal contrast, similar to a barium enema. Systematic review of the distribution of meconium and analysis of the bowel caliber in comparison to normal values for gestational age helps to establish or narrow the list of differential diagnoses of fetal gastrointestinal abnormalities. In this presentation, we will review the advantages and limitations of ultrasound and MRI for diagnosis of fetal anomalies, we will discuss and illustrate, by representative cases, the approach to the most common and some more rare or atypical congenital bowel anomalies on ultrasound and MRI, in order to establish a single or short list of differential diagnoses.

**Handout:Erika Rubesova**

[http://abstract.rsna.org/uploads/2015/15002067/Rubesova GI RSNA 2015.pptx](http://abstract.rsna.org/uploads/2015/15002067/Rubesova_GI_RSNA_2015.pptx)



RC813

## Pediatric MSK

Friday, Dec. 4 8:30AM - 10:00AM Location: S502AB



AMA PRA Category 1 Credits™: 1.50  
ARRT Category A+ Credits: 1.50

### Participants

### Sub-Events

#### RC813A Imaging of Pediatric Musculoskeletal Infections

##### Participants

Robert Orth, MD, PhD, Houston, TX (*Presenter*) Research support, General Electric Company;

##### LEARNING OBJECTIVES

1) Describe the optimal imaging strategy for evaluating suspected pediatric musculoskeletal infections including specifics of the MRI protocol. 2) List common missed diagnoses and imaging pitfalls. 3) Describe methods for differentiating musculoskeletal infections from alternative diagnoses.

#### RC813B Imaging of Osteochondritis Dissecans

##### Participants

Jonathan D. Samet, MD, Chicago, IL, (jsamet@luriechildrens.org) (*Presenter*) Nothing to Disclose

##### LEARNING OBJECTIVES

1) To identify imaging features of osteochondritis dissecans (OCD) using multiple modalities. 2) To recognize the spectrum of findings between low and high grade lesions. 3) To identify the varying postoperative appearances after surgical intervention.

##### ABSTRACT

For 'Imaging of Osteochondritis Dissecans' 1. To identify imaging features of osteochondritis dissecans (OCD) using multiple modalities. 2. To recognize the spectrum of findings between low and high grade lesions. 3. To identify the varying postoperative appearances after surgical intervention.

#### RC813C Imaging of Musculoskeletal Soft Tissue Masses

##### Participants

Michele M. Walters, MD, Boston, MA (*Presenter*) Nothing to Disclose

SST12

## Pediatrics (Neuroradiology)

Friday, Dec. 4 10:30AM - 12:00PM Location: N229



AMA PRA Category 1 Credits™: 1.50  
ARRT Category A+ Credits: 1.50

### Participants

Manohar M. Shroff, MD, Toronto, ON (*Moderator*) Consultant, Guerbet SA; Consultant, Magellan Health, Inc  
Jeremy Y. Jones, MD, Bellaire, TX (*Moderator*) Nothing to Disclose

### Sub-Events

#### SST12-01 Comparison of CBF Measured with Velocity-selective Arterial Spin Labeling (ASL) MRI and Pulsed ASL MRI in Pediatric Patients with Prolonged Arterial Transit Times Due to Moyamoya Disease

Friday, Dec. 4 10:30AM - 10:40AM Location: N229

### Participants

Divya S. Bolar, MD, PhD, Boston, MA (*Presenter*) Nothing to Disclose  
Borjan Gagoski, PhD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Richard L. Robertson, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose  
Elfar Adalsteinsson, PhD, Stanford, CA (*Abstract Co-Author*) Research grant, Siemens AG  
Bruce R. Rosen, MD, PhD, Charlestown, MA (*Abstract Co-Author*) Research Consultant, Siemens AG  
Ellen Grant, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To show that velocity-selective arterial spin labeling (VS-ASL) MRI is superior to pulsed ASL (PASL) MRI for measuring cerebral blood flow (CBF) in Moyamoya patients, as VS-ASL is theoretically insensitive to arterial transit delays (ATD) that can render PASL approaches inaccurate.

### METHOD AND MATERIALS

Five pediatric Moyamoya patients (2F, 3M, ages 3-9), two with unilateral and three with bilateral disease, one pre- and four post-synangiomas, were imaged with both VS-ASL and PASL MRI at 3T (Siemens). VS-ASL parameters were VC=2.1 cm/s and TI=1300ms. PASL parameters were TI1=700 ms, TI2=2000-2400ms, tag width=100mm, and gap=21-25mm. Perfusion time-series data for PASL and VS-ASL were generated by performing pairwise subtractions between tag and control images. CBF maps were generated by averaging voxels across the perfusion time series and calibrating via ASL signal equations. CBF maps and values from gray matter (GM) are reported.

### RESULTS

For all patients, PASL shows large focal perfusion deficits and macrovascular flow artifacts, consistent with tag accumulating in large vessels and failing to reach target microvasculature. These findings highlight PASL sensitivity to increased regional ATD, resulting in artifact and apparent lack of parenchymal perfusion, a finding that could be misinterpreted as ischemia. VS-ASL, on the other hand, yields symmetric parenchymal perfusion bilaterally, and thus appears largely insensitive to the known ATD's seen in these patients. Angiographic data from one patient correlates the findings; both hemispheres show capillary blush, albeit delayed on the diseased side, as this tissue is primarily supplied by delayed flow through pial-pial collaterals. Quantitatively, VS-ASL GM CBF is similar in both hemispheres and in physiologic range ( $50.8 \pm 9.8$  ml/100g-min). PASL GM CBF, on the other hand, is more heterogeneous due to both perfusion deficit and macrovascular artifact, and measures below the normal physiological range ( $29.2 \pm 9.0$  ml/100g-min).

### CONCLUSION

VS-ASL MRI is largely insensitive to arterial transit delays and as such more accurately images CBF and parenchymal perfusion in Moyamoya patients, compared to traditional PASL MRI.

### CLINICAL RELEVANCE/APPLICATION

VS-ASL has great potential for assessing perfusion in stroke, carotid stenosis, and Moyamoya patients, who often have delayed arterial transit due to large artery stenosis and secondary collateralization.

#### SST12-02 Non-invasive Quantification of Cerebral Oxygen Metabolism in Children with Sickle Cell Disease

Friday, Dec. 4 10:40AM - 10:50AM Location: N229

### Participants

Paula L. Croal, PhD, MSc, Toronto, ON (*Presenter*) Nothing to Disclose  
Jackie Leung, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose  
Andrea Kassner, PhD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Ischemic stroke is a serious complication of sickle cell disease (SCD) that manifests in more than 10% of children SCD by the age of 20. It occurs when oxygen (O<sub>2</sub>) availability is inadequate to meet cerebral metabolic demands, despite the compensatory increase in cerebral blood flow (CBF) in SCD. The cerebral metabolic rate of O<sub>2</sub> (CMRO<sub>2</sub>) may be a potential disease biomarker for ischemic risk in SCD. However, CMRO<sub>2</sub> has not yet been quantified in children with SCD. Here, we combine MRI measurements of oxygen extraction fraction (OEF) and CBF to provide the first non-invasive quantitative measurement of CMRO<sub>2</sub> in children with SCD.

### METHOD AND MATERIALS

Five SCD patients (11-18 yrs) and 4 healthy controls (12-18 yrs) were imaged on a 3T MRI scanner. Gray matter CBF was obtained using PICOE-Q2TIPS pulsed arterial spin labelling (TR/TE=2500/13ms, TI1/TI2=700/1800ms, voxel=3.4×3.4×4.5mm), quantified with a single-compartment kinetic model. T1 of blood was assumed to be 1660ms for a hematocrit (Hct) of 0.4 and corrected for reduced Hct on an individual basis. Global OEF is calculated from the arteriovenous difference, where arterial O2 saturation (SaO2) is assumed to be 1 in healthy controls and measured using pulse oximetry in patients. Using a 3D-FLASH GRE sequence (TR/TE=28/20ms, voxel=0.8x0.7x1.2mm), venous O2 saturation (SvO2) was measured from the phase difference between blood in the superior sagittal sinus and surrounding tissue. From Fick's principle, CMRO2 can be computed from the product of OEF, CBF, and arterial O2 content, which is a function of SaO2 and Hct. Statistical comparisons were made between groups using an independent samples Student's t-test (SPSSv22).

## RESULTS

There was a trend for elevated GM CBF in SCD (87.3±20 ml/min/100g vs. 68.7±21 ml/min/100g), while significant reductions were observed in arterial O2 content (5.1±0.8 µmol O2/ml vs. 7.4±0.4 µmol O2/ml, p<0.01) and OEF (0.18±0.05 vs. 0.30±0.04, p<0.01). This resulted in a significantly reduced CMRO2 (78.4±23.4 µmol O2/min/100g vs. 149.4±44.9 µmol O2/min/100g, p=0.42) (Figure 1).

## CONCLUSION

Global CMRO2 is significantly reduced in children with SCD and may present a novel biomarker for assessing stroke risk in this population.

## CLINICAL RELEVANCE/APPLICATION

CMRO2 may provide a novel non-invasive biomarker for assessment of stroke risk in children with sickle cell disease

### SST12-03 Quantification of Age and Gender Dependence of Normal Cardiac and Intracranial Blood Flow in Pediatric Volunteers Using 2D Phase Contrast and 4D Flow MR Imaging

Friday, Dec. 4 10:50AM - 11:00AM Location: N229

#### Participants

Amir R. Honarmand, MD, Chicago, IL (*Presenter*) Nothing to Disclose  
Can Wu, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose  
Samantha E. Schoeneman, BA, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose  
Ryan Kuhn, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose  
Susanne Schnell, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose  
Sameer A. Ansari, MD, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose  
Ali Shaibani, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose  
Michael Markl, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To analyze the normal age and gender induced variability of cardiac and intracranial blood flow in pediatric volunteers using 2D Phase Contrast (PC) and 4D flow MRI.

## METHOD AND MATERIALS

ECG-gated 4D flow MRI with volumetric coverage of the major intracranial vessels (spatial resolution =1.2mmx1.2mmx1.5mm, temporal resolution=44ms, acquisition time~10 min) was performed on volunteers under 18 years (range 6 months - 17 years) with no history of cardio/cerebrovascular diseases on 1.5 and 3T MRI scanners. In addition, 2D PC-MRI with through-plane velocity encoding at the level of proximal ascending aorta (AAo) and descending aorta (DAo) was performed in the same imaging session for all subjects. Following pre-processing, intracranial blood flow was quantified at manually positioned 2D planes orthogonal to the vessels (Fig. a). Total cerebral blood flow (TCBF) was defined as the sum of flow in bilateral intracranial carotid (ICA) and basilar arteries (BA). Aortic flow was quantified by manual segmentation of the AAo and DAo flow contours. Demographics, body mass index (BMI), and body surface area (BSA) were obtained. Cardiac index (CI) was defined as AAo flow/BSA. Pearson correlation coefficient and polynomial and multiple regression models were used for statistical analyses.

## RESULTS

Fifty two volunteers (mean age (yr) ± SD: 7.95 ± 5.04) were recruited. Both females (31) and males (21) had similar distributions of age, BMI, BSA, TCBF, and CI. An excellent correlation was observed between age and AAo/DAo flow (P<0.001, r=0.80/0.85, Fig. b). TCBF and TCBF/AAo ratio vs. age were best fitted with cubic polynomial models (P<0.001, r=0.84, r=0.93, respectively, Figs. c, d). Overall, a moderate but significant inverse correlation was detected between age and TCBF (P=0.013, r=-0.34). TCBF/AAo ratio and CI were inversely correlated with age (p<0.001, r=-0.90 -0.65, respectively) (Figs. d, e). Stepwise multiple regression analysis selected CI as the only independent variable that was a predictor of TCBF (P=0.006).

## CONCLUSION

These findings highlight the importance of age matched control data for the characterization of intracranial and aortic hemodynamics in children with anthropometric changes.

## CLINICAL RELEVANCE/APPLICATION

Providing a control dataset for age-specific cardiac and cerebral hemodynamics in children is crucial to detect abnormal hemodynamics especially in cerebrovascular diseases' early stages.

### SST12-04 Assessment of Cerebral/Intestinal Perfusion Ratio Using Dynamic Color Doppler Sonography Quantification in Neonates with Hypoxic Ischemic Encephalopathy (HIE) Treated with Therapeutic Hypothermia

Friday, Dec. 4 11:00AM - 11:10AM Location: N229

#### Participants

Ricardo Faingold, MD, Montreal, QC (*Presenter*) Nothing to Disclose  
Linda Morneault, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose

Guilherme Santanna, MD, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

The objective of this study was to evaluate the perfusion ratio of the basal ganglia and intestinal wall using dynamic color Doppler sonography (CDS) in HIE neonates treated with hypothermia. We also aimed to investigate the correlation between this ratio and survival.

## METHOD AND MATERIALS

Head ultrasound (HUS) and abdominal ultrasound were performed in all HIE neonates receiving hypothermia, as part of their routine care. CDS was performed with an 11LW4 MHz linear transducer to obtain DICOM color Doppler videos of the blood flow in the basal ganglia, in the coronal plane and sampled bowel loops in all quadrants. Videos of 3 seconds each were obtained for the region of interest (ROI) and used to calculate the cerebral perfusion intensity (CPI) of basal ganglia and intestinal perfusion intensity (IPI). Measurements of CPI and IPI were evaluated retrospectively by 2 radiologists using dedicated software. It allows automatic quantification of color Doppler data from a region of interest (ROI) by dynamically assessing color pixels and flow velocity during the heart cycle. Data is expressed in cm/sec and is calculated by multiplying the mean velocity of all pixels by the area divided by the ROI. Clinical and radiological data were evaluated retrospectively. Data are presented as mean  $\pm$  SEM or median (quartiles). Appropriate statistical analysis was applied.

## RESULTS

A total of 28 neonates were included: 16 male, 12 female, mean gestational age  $39 \pm 2$  weeks, birth weight  $3469 \pm 607$  grams, studies performed at  $17.1 \pm 10.5$  hours of life. Seven neonates died. The basal ganglia /intestinal perfusion ratio was significantly higher in the 7 non survivors when compared to the 21 survivors ( $10.389 \pm 7.9$  versus  $2.660 \pm 2.5$ ;  $p=0.001$ ).

## CONCLUSION

An increased basal ganglia /intestinal perfusion ratio was observed in non survivor neonates, submitted to hypothermia with severe HIE. Assessment of perfusion quantification with dynamic CDS in HIE might be a potential bedside biomarker of severity of insult in this critical population.

## CLINICAL RELEVANCE/APPLICATION

Perfusion quantification with bedside ultrasound, using dynamic CDS, opens a window to better understand reperfusion injury and diving reflex in HIE neonates. This technique has the potential to be used as biomarker of severity of insult in this critical population.

## SST12-05 Lesional Hyperperfusion in Leigh Disease Demonstrated by Arterial Spin-labeling

Friday, Dec. 4 11:10AM - 11:20AM Location: N229

### Participants

Matt Whitehead, MD, Washington, DC (*Presenter*) Nothing to Disclose

Bonmyong Lee, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose

Andrea L. Gropman, MD, Washington, DC (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

Leigh disease is metabolic disorder of the respiratory chain or related components culminating in symmetric necrotizing lesions in the basal ganglia and/or brainstem among other locations. Apart from the classical gliotic and necrotic lesions found on histopathology, small vessel proliferation is also characteristic. Arterial spin-labeling (ASL) imaging has become a powerful adjunct for the detection of perfusion abnormalities during brain MR imaging. We have observed several cases of lesional hyperperfusion demonstrated by ASL sequences in patients with Leigh disease. The aim of this study is to evaluate lesional ASL perfusion characteristics in patients with Leigh disease and compare them to aged-matched normal exams.

## METHOD AND MATERIALS

The brain MR imaging database from a single academic children's hospital was searched for the terms "ASL, arterial spin labeling, perfusion, and Leigh" to build a cohort for analysis. Each patient's electronic medical record was reviewed to confirm a diagnosis of Leigh disease. MR exams with excessive motion artifact, technical limitations, and without ASL images were excluded. ASL perfusion images were evaluated by a board certified neuroradiologist for the degree and extent of cerebral blood flow and relationship to brain lesions. Images were compared to normal exams from an aged-matched cohort.

## RESULTS

The search yielded 33 exams; 23 were excluded. 10 exams from 5 separate Leigh patients were analyzed. 10 normal exams from aged-matched patients were also evaluated. In general, Leigh brain lesions ranged from hyperintense ( $n=8$ ) to hypointense ( $n=2$ ) on ASL perfusion images. Gliotic and necrotic lesions tended to be hypointense/hypoperfused. More active or recent lesions with associated restricted diffusion demonstrated hyperperfusion. ASL perfusion patterns differed significantly from aged-matched normal studies ( $p<.0001$ ).

## CONCLUSION

Leigh disease patients have abnormal perfusion to brain lesions. Hyperperfusion is associated with more recent or active brain lesions, possibly corresponding to small vessel proliferation characteristic to the disease.

## CLINICAL RELEVANCE/APPLICATION

ASL hyperperfusion could help distinguish Leigh disease from other similar appearing metabolic abnormalities and disease mimickers.

## SST12-06 The Effect of Conscious Sedation on SWI Sequence of Brain MRI

Friday, Dec. 4 11:20AM - 11:30AM Location: N229

### Awards

Trainee Research Prize - Resident

#### Participants

Yaser Al-Qasimi, MBBS, Detroit, MI (*Presenter*) Nothing to Disclose

Deniz Altinok, MD, Troy, MI (*Abstract Co-Author*) Nothing to Disclose

Sheena Saleem, MD, MBBS, Grosse Pointe Farms, MI (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Conscious sedation is frequently provided during MRI exams, especially in pediatric population. Medications used for conscious sedation have the inherent risk of affecting the oxygenation status, in part by their CNS inhibitory effect. The sensitivity of SWI sequence to deoxyhemoglobin is utilized in this study to evaluate the effects of various sedation medications on cerebral oxygenation.

#### METHOD AND MATERIALS

After applying selection criteria, retrospective analysis of SWI sequences from brain MRIs is performed. The degree of visualization of cerebral veins is evaluated and graded on a scale from 1 to 4. Other information recorded for each patient includes: the use of sedation medication, the use of supplemental oxygen, and the lowest recorded oxygen saturation during the exam. The investigators were blinded to patient information. The degree of visualization of cerebral veins is compared between different groups. Correlation is made to the lowest recorded oxygen saturation.

#### RESULTS

A total of 107 cases were enrolled: 33 non-sedated, 31 received pentobarbital (Nembutal), 31 received dexmedetomidine (Precedex), and 12 received diazepam (Valium). Patients who received Nembutal demonstrated significantly increased visualization of cerebral veins ( $p < 0.0001$ ), regardless of the use of supplemental oxygen. Patients who received either Precedex or Valium did not have statistically significant change in cerebral venous visualization compared to non-sedated patients. There was no correlation between the lowest recorded peripheral arterial oxygen saturation (pulse oximetry) readings and the degree of cerebral venous visualization on SWI. There was no statistically significant difference between pulse oximetry readings of different groups.

#### CONCLUSION

Evaluation of the SWI sequence shows evidence that pentobarbital administration is associated with higher concentrations of deoxyhemoglobin in cerebral venous blood. At the doses used for conscious sedation, this appears to be mediated by pentobarbital's known effect on cerebral blood flow (decreased) rather than arterial hypoxia and central hypoventilation. This raises the concern for temporary cerebral hypoxia associated with pentobarbital use, and needs to be further investigated. SWI sequence appears to be promising in evaluating cerebral hypoxia.

#### CLINICAL RELEVANCE/APPLICATION

SWI sequence proves an important, non-invasive method to evaluate the oxygenation status of the brain.

#### SST12-07 Whole-brain T2 qMRI Relaxometry of Extremely Low Gestational Age Newborn (ELGAN) Children at Ten Years of Age: Gender Differences

Friday, Dec. 4 11:30AM - 11:40AM Location: N229

#### Participants

Adam Aakil, MA, MBA, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

Osamu Sakai, MD, PhD, Boston, MA (*Abstract Co-Author*) Speaker, Bracco Group; Speaker, Eisai Co, Ltd; Consultant, Guerbet SA

Alexander M. Norbash, MD, Boston, MA (*Abstract Co-Author*) Co-founder, Boston Imaging Core Laboratories, LLC;

Mufeed Mahd, PhD, Lowell, MA (*Abstract Co-Author*) Nothing to Disclose

Hernan Jara, PhD, Belmont, MA (*Presenter*) Patent holder, qMRI algorithms Research Grant, General Electric Company Royalties, World Scientific Publishing Co

#### PURPOSE

Extremely low gestational age newborns (ELGANs) are defined as infants born before the 28th week after gestation. The purpose herein was to study the whole-brain qMRI distributions of the transverse relaxation time (T2) in a population of ELGAN infants at nine to ten years of age. A further objective was to detect potential brain tissue T2 gender differences.

#### METHOD AND MATERIALS

Children were MRI scanned at twelve ELGAN participating sites: all scanners were 3T (GE, Philips and Siemens), except one 1.5T (GE). The dual-echo turbo spin echo (DE-TSE) MR images of ninety-eight subjects (38 males and 60 females) were qMRI processed resulting in three-dimensional T2 maps covering the whole head. All tissues contained in the intracranium (intracranial matter (ICM) = gray matter plus white matter plus meninges and cerebrospinal fluid) were segmented using a dual-clustering algorithm programmed in Mathcad. The ninety-eight ICM T2 histograms were tabulated in Excel as a function of increasing ICM volume and separated by gender; these were further processed in Mathcad to yield individual and population measures: mean and standard deviation brain T2 values.

#### RESULTS

The mean brain T2 values are graphed in Fig. 1 (top) for males (left) and females (right): the population T2 averages are  $90.5 \pm 13.5$  ms and  $89.5 \pm 12.6$  ms for males and females respectively. The combined population histograms are shown in Fig. 1 (bottom): note the much higher T2 data uniformity for female versus male infants (dotted red lines).

#### CONCLUSION

Both graphic data displays (Fig. 1 top and bottom) as well as the statistical measures point to a significantly higher T2 heterogeneity for the ELGAN brains of male versus female infants. This initial finding could indicate a higher vulnerability of very early preterm birth in males versus females.

#### CLINICAL RELEVANCE/APPLICATION

T2 qMRI relaxometry could become a valuable clinical tool for assessing the brain tissue integrity of children in the context of preterm birth.

## Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: <https://www.rsna.org/Honored-Educator-Award/>

Hernan Jara, PhD - 2014 Honored Educator  
Osamu Sakai, MD, PhD - 2013 Honored Educator  
Osamu Sakai, MD, PhD - 2014 Honored Educator  
Osamu Sakai, MD, PhD - 2015 Honored Educator

## SST12-08 Neuroimaging Findings in a New Pattern of Neonatal Ischemic Encephalopathy Associated with Excessive Uterine Activity

Friday, Dec. 4 11:40AM - 11:50AM Location: N229

### Participants

Jill V. Hunter, MD, Houston, TX (*Presenter*) Author with royalties, UpToDate, Inc  
Stewart Ater, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose  
Michelle L. Murray, PhD, RN, Albuquerque, NM (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To test the null hypothesis that a pattern of neonatal, predominantly cortical, ischemic injury would not be associated with a labor and delivery during which there were extended periods of shortened resting interval.

### METHOD AND MATERIALS

The neonatal imaging in 10 full term children with established motor and cognitive delays, in whom perinatal infection and metabolic disorders had been ruled out, was retrospectively reviewed and correlated with the electronic fetal monitoring (EFM) strips.

### RESULTS

The children had a pattern of cortical laminar necrosis that was not a classic watershed, and with a lesser degree of deep gray nuclear ischemia that did not conform to the established patterns of a typical prolonged partial or acute profound hypoxic-ischemic injury. Most of these infants, (8/10), were delivered with a pH >7.0 and without features of systemic asphyxia. Retrospective analysis of the EFM in these 10 cases revealed a pattern of more than 2 hours of continuous excessive uterine activity with resting intervals of less than 60 seconds duration. Nine of the 10 mothers were nulliparous.

### CONCLUSION

The null hypothesis is not proven and the results suggest an association between shortened resting intervals and a previously unrecognized pattern of neonatal, predominantly cortical, ischemic injury.

### CLINICAL RELEVANCE/APPLICATION

Cerebral palsy and the sequelae of a previously unrecognized pattern of ischemic encephalopathy has enormous fiscal implications. These neonates do not meet current criteria for hypothermia therapy which may help improve their outcome. In addition if the underlying causes of a shortened resting interval can be recognized prospectively and terminated by the more judicious use of uterine stimulants then it may be feasible to prevent or minimize this cause of neonatal brain injury.

## SST12-09 An Intraoral B0 Field Correction Device for Decreasing Magnetic Susceptibility Artifacts on Brain MRI Induced by Stainless Steel Orthodontic Appliances

Friday, Dec. 4 11:50AM - 12:00PM Location: N229

### Participants

Zhiyue J. Wang, PhD, Dallas, TX (*Presenter*) Nothing to Disclose  
Yong Jong Park, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose  
Youngseob Seo, PhD, Daejeon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose  
Michael C. Morriss, MD, Pinehurst, TX (*Abstract Co-Author*) Nothing to Disclose  
Nancy K. Rollins, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Susceptibility artifacts from orthodontia are a common problem that can interfere with MRI for acute CNS diseases. The artifacts result from ferromagnetic materials in the orthodontia and alteration in B0 field. Recently available rare earth iron permanent magnets have the potential in cancellation of the unwanted B0 effects. We report the initial experience with a prototype field correction device.

### METHOD AND MATERIALS

Commercial NdFeB rectangular prism magnets (grade N38EH, intrinsic coercivity 30 kOe) were embedded in front of the teeth between 2 layers of dental plastic sheets in the shape of a mouth-guard, with the magnetization opposing the B0 field. The first prototype had one upper and one lower piece for maxillary and mandibular arches with a total magnetic moment of 0.124 A·m<sup>2</sup>. Subsequent modifications used multiple upper and lower pieces to cover a range of magnetic moment from 0.010 to 0.200 A·m<sup>2</sup>. Human subject studies were conducted with IRB approval at 1.5T without sedation. We studied 3 volunteers with orthodontia and one patient. Brain MRI scans were acquired without and with the subject wearing the field correction device.

### RESULTS

Based on B0 map, the total induced magnetic moment of braces in the subjects ranged from 0.009 to 0.194 A·m<sup>2</sup>, with a median value of 0.134 A·m<sup>2</sup>. For the case of the lowest magnetic moment, the braces were essentially non-magnetic and the artifact arose from a unilateral ferromagnetic implant. The device improved B0 homogeneity. In 3 subjects adequate quality EPI-DWI scans were acquired with the device. However, complete correction of geometric distortions was not achieved. Sufficient correction of

geometric distortion on sequences sensitive to susceptibility, e.g. DWI, requires a fairly close match between the device and braces both in the total value and the spatial distribution of magnetic moment. The device may experience noticeable forces and torques near or inside MRI scanners. The device may break or escape from the mouth. The device should be wrapped inside a thin, soft plastic sheet and tethered down using a string during the MRI study for patient protection.

## **CONCLUSION**

Susceptibility artifacts from orthodontia can be decreased with a novel B0 field correction device. This approach is promising although further improvement is needed.

## **CLINICAL RELEVANCE/APPLICATION**

The study may lead to a device that enables diagnostic quality MR examinations for patients wearing braces.