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Scientific posters

Cardiovascular

Poster #: PO1

Detecting complications in the pediatric cardiac intensive care unit: Utility of conventional radiography and CT angiography (CTA)

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Purpose: Pediatric patients undergoing cardiothoracic surgery require constant monitoring to regulate therapy and detect potential complications. Imaging plays an important role in on-going assessment and early diagnosis of potentially life threatening abnormalities. The purpose of this educational poster is to review and illustrate the utility of conventional radiography and the indications and unique diagnostic capabilities of CTA in the post-operative period. The ideal position, appearance, and purpose of vascular lines, airway and enteric tubes, monitoring lines and leads, and other specialized support devices will be shown. Common and unusual examples of radiographically detectable complications such as tube malposition and disruption, anastomotic leak and pseudoaneurysm will be demonstrated and discussed.

Poster #: PO2

Evaluation of pediatric blunt thoracic aortic injury: Transitioning from thoracic aortography to enhanced chest CT

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Purpose: To assess if the radiographic evaluation of pediatric patients with blunt thoracic aortic injury has changed over the last 21 years.

Materials and methods: A retrospective review was performed of the medical records, and pre-operative chest radiographs, chest computed tomograms (CCT) and thoracic aortograms (TA) of all pediatric patients discharged with a surgically-proven diagnosis of blunt thoracic aortic injury between June 1986 and June 2007 (N=17). Fisher's exact test was performed to determine if there was a statistically significant difference in the number of CCTs and TAs performed on patients discharged between June 1986 and December 1997 compared to patients discharged between January 1998 and June 2007.

Results: There was a statistically significant increase (p=0.03) in the number of CCTs performed between January 1998 and June 2007 (8/8=100%) compared to those performed between June 1986 and December 1997 (4/9=44%). There was a statistically significant decrease (p=0.05) in the number of TAs performed between January 1998 and June 2007 (3/8=38%) compared to those performed between June 1986 and December 1997 (8/9=89%). All patients (17/17=100%) underwent aortic repairs, including those who only underwent CCTs between January 1998 and June 2007 (5/8=63%).

Conclusions: Radiographic evaluation of pediatric patients with blunt thoracic aortic injury has changed over the last 21 years. Enhanced chest computed tomograms are being predominantly performed rather than thoracic aortograms for the diagnosis of thoracic aortic injury, and surgeons are performing aortic repairs based on CCT results.

Poster #: PO3

Deliniation of cardiovascular anatomy and detection of abnormalities using 64 slice MDCT in patients with history of repair of tetralogy of Fallot

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Purpose: To evaluate anatomy and residual defects in patients with repaired tetralogy of Fallot with 64 slice MDCT.

Materials and methods: Five patients (11 to 26 years old) with a history of repair of tetralogy of Fallot underwent evaluation with 64 slice MDCT. In all patients there were limitations or contraindications to other imaging modalities including MRI. None of the patients were sedated. One patient received metoprolol (100 mg) and 0.4 mg of sublingual nitroglycerin. Heart rates ranged from 67–92 bpm. CT images were evaluated for cardiac anatomy and function with emphasis on size and morphology of the right ventricle, right ventricular outflow tract, and pulmonary arteries. Findings were correlated with 2D echocardiography.

Results: Diagnostic quality CT images in all phases of the cadiac cycle (0–90) were obtained in all patients. In addition to expected anatomy demonstrated by echocardiogram, unexpected findings were present in four out of five patients and included: an absent left pulmonary artery with multiple collaterals and left lung hypoplasia, right ventricular dilatation and dilated inferior vena cava, distal main pulmonary artery and branch pulmonary artery stenosis, an anomalous course of the right coronary artery, aneurysmal dilatation of the right ventricular outflow tract and main pulmonary artery with probable ventriculoseptal defect patch leak. Right venticular volume and functional assessment was able to be obtained in all patients. In addition, findings from 2D echocardiography were confirmed in all patients.

Conclusions: MDCT is a sensitive imaging modality for determining cardiac and pulmonary arterial anatomy in patients with tetralogy of Fallot repair.

Poster #: PO4

Cardiac MRI: Comparison of cardiac gating alone with combined respiratory and cardiac gating

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Purpose: Respiratory and cardiac motion both degrade cardiac MRI images. Cardiac EKG gating has been available for many years. Combined cardiac and respiratory gating has recently become available as a new imaging technique. Respiratory gating is performed by triggering scanning based on the position of the diaphragm. Our objective is to compare images obtained with combined cardiac and respiratory gating, with those obtained in the same patient using only cardiac gating. The advantages and disadvantages of each imaging method will be illustrated.

Materials and methods: We have utilized both gating methods in over 100 patients. All patients had a history of congenital heart disease, and most had had prior surgery. For every patient, both MRI imaging techniques were utilized within 30 min of each other. Both provided 3D data sets from which axial, coronal and sagital images were constructed.

Results: Images obtained with only cardiac gating are very much quicker to acquire. The overall image quality is more consistent and predictable. Images obtained with combined cardiac and respiratory gating take much longer to acquire. The acquisition time is very unpredictable. It is longest in patients with irregular breathing patterns. Visualization of small moving structures such as the coronary arteries is consistently better with combined gating. Visualization of cardiac chambers, pulmonary arteries and veins, valves and the aorta is not consistently better with either technique.

Conclusions: Combined cardiac and respiratory gating offers real advantages for visualization of small, mobile structures such as the coronary arteries. Its major disadvantages are unpredictable prolonged scan times and less predictable image quality.

Poster #: PO5

Cardiac MRI of transposition of the great vessels and truncus arteriosus: A review of MRI appearance of normal and abnormal findings and of long term complications

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Purpose: Cardiac MRI studies have been performed on patients with congenital heart disease for several years. Two common cyanotic conditions are associated with abnormality of the mediastinal great vessels. These are transposition and persistent truncus arteriosus. The objectives of this exhibit are to visually illustrate the various anatomical forms of D and L transposition of the great vessels and truncus arteriosus, and the long term problems encountered by these patients. We will also illustrate the anatomy of the various surgical procedures performed in patients with transposition and persistent truncus and complications of these procedures. We will also describe a spectrum of abnormal physiologic abnormalities. Optimal imaging techniques will be summarized.

Materials and methods: Over the past 3 years we have imaged many patients with transposition of the great vessels or persistent truncus. This exhibit illustrates a wide spectrum of normal and abnormal anatomic and physiologic findings.

Results: MRI has successfully identified a wide spectrum of anatomic and physiologic abnormal findings by in patients with transposition or persistent truncus arteriosus.

Conclusions: MRI is a very effective method of evaluating normal and abnormal anatomic and physiologic abnormalities in patients with either transposition of the great vessels or persistent truncus arteriosus. Many of these are illustrated.

Poster #: PO6

Cardiac MRI of tetralogy of Fallot: A review of the MRI appearance of normal and abnormal post operative findings and of long term complications

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Purpose: Cardiac MRI studies have been performed on patients with congenital heart disease for several years. One of the commonest indications for cardiac MRI is evaluation of patients with tetralogy of Fallot. The objectives of this exhibit are to visually illustrate the long term problems encountered by these patients. We will also illustrate the anatomy of the various surgical procedures performed in patients with tetralogy and complications of these procedures. We will also describe a spectrum of abnormal physiologic abnormalities that are identified by MRI. Optimal imaging techniques will be summarized.

Materials and methods: Over the past 3 years we have imaged over 100 patients with tetralogy of Fallot. This exhibit illustrates a wide spectrum of normal and abnormal anatomic and physiologic findings.

Results: MRI has successfully identified a wide spectrum of abnormal findings by in patients with tetralogy. These include persistent shunts, various forms of right ventricular outflow obstruction, stenoses in the main pulmonary artery and its braches, pulmonary valve regurgitation, the normal and abnormal appearance of various conduits from the right ventricle to the pulmonary arteries, and the appearance of variations of Blalock shunts.

Conclusions: MRI is a very effective method of evaluating normal and abnormal anatomic and physiologic abnormalities in patients with tetralogy of Fallot. Many of these are illustrated.

Fetal imaging

Poster #: PO7

Literature review: Normative fetal lung volume by gestational age on MRI

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Purpose: Prenatal assessment of fetal lung development and risk for pulmonary hypoplasia is highly desired for counseling, delivery location, and postnatal management decisions. In cases of fetal lung anomaly, lung hypoplasia can be clinically evaluated through MRI by comparison of fetal lung volume (FLV) measurement to a normative value. Although multiple studies have published normative FLV values per gestational age, there are major discrepancies in the literature. The variation in normative FLV is confusing for radiologists and may yield inaccurate predictions of prognosis. We reviewed the literature in order to present and analyze the variations in normal FLV for gestational age.

Materials and methods: A thorough review of the literature was conducted, and nine papers were identified. The papers were published in 1999–2006 and plotted normal FLV against gestational age. The papers were analyzed for differences in methodology, including number of patients, MRI sequence, planes, region of interest, intra- and interobserver correlations. Disparities in normative FLV were analyzed in regards to range of values and equations for FLV based on gestational age.

Results: The range of FLV varied across different studies (Table 2) as did the range of gestational age. The variability in normative FLV was greater at higher gestational ages. Three equations for normal FLV based on gestational age also showed a large variability in values especially at higher gestational ages. The papers differed widely in methodology, selecting different planes, different regions of interest as the definition of lung volume, and different MRI sequences. The number of patients varied across the studies and only two papers included intra- and inter-observer correlation.

Conclusions: Normative values for FLV based on gestational age show high variability which may be due to differences in methodology. In order to assess fetal pulmonary hypoplasia, current methods and normative values need improvement and standardization, while new approaches for estimation of fetal lung hypoplasia should also be considered.

Poster #: PO8

Fetal MRI: Pictorial essay of the abnormal placenta and correlation with ultrasound

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Purpose: An important challenge in the prenatal care of the gravid patient is the assessment of the placenta, organ which ensures appropriate exchange of respiratory gases, nutrients and waste between the fetus and mother. As the field of fetal MRI expands, it is important for the radiologist to recognize the abnormal findings of placentation. We present a pictorial essay with sonographic correlation of abnormal placentas and review their imaging findings. Findings described include chorioangiomas of the placenta, placental hemorrhage, abnormal placental implantation including placenta previa, and trophoblastic disease (partial mole). Cystic changes of the placenta as well as placentomegaly in cases of the fetus with hydrops are also described.

Poster #: PO09

Congenital pulmonary airway malformations: Simplifying cystic congenital pulmonary lesions

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Purpose: A new classification system, identifying pulmonary lesions as part of a spectrum of congenital pulmonary airway malformations has been derived by pathologists. This poster reviews current recommendations for describing congenital pulmonary lesions with examples of fetal/pediatric imaging features and pathologic correlation.

Materials and methods: Multi-modality images of multiple pediatric pulmonary lesions will be correlated with pathology slides in the context of the new classification system.

Results: Cystic congenital pulmonary lesions have classically been identified as separate and unique lesions, such as CCAM, CLE, and sequestration. This convention underestimates the complexity and feature crossover often seen with these lesions. The underlying similarity with all of these cystic lesions is malformation of the major components within the lung, often in combination.

Conclusions: The pathologic similarity in the congenital cystic pulmonary lesions has led to the current CPAM classification system. Adoption of the system may simplify the identification of the overlapping lesions as part of a spectrum.

Poster #: PO10

Fetal posterior fossa: US and MRI assessment of developmental anomalies

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Purpose: Different types of anomalies affect the developing posterior fossa, including mega cisterna magna, arachnoid cyst, Dandy Walker malformation, Chiari malformations, encephaloceles and cerebellar hypoplasia. US, as a screening tool, and MRI, as a useful complimentary tool providing more detail, are the modalities of choice in assessing these disorders prenatally.

Materials and methods: Review of the literature and retrospective review of the prenatal studies performed in our institution was performed. Normal and abnormal images were recollected for this pictorial review.

Results: Examples of fetal posterior fossa anomalies are illustrated and described.

Conclusions: Timely and accurate diagnosis is fundamental in order to help counsel families. We present a pictorial review of the normal appearance of the posterior fossa as well as the different developmental abnormalities that can be identified prenatally. (Fetal MRI is not FDA approved).

Poster #: PO11

2D-flash sequences: Should they be part of the standard protocol for fetal MRI?

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Purpose: To determine the utility of 2D-Flash sequences in fetal imaging.

Materials and methods: A retrospective review was made of 171 fetal MRI's performed at St. Louis Children's hospital from April 2003 to November 2007. All studies were performed using our standard protocol: HASTE, True-FISP and 2D-Flash images through brain, chest, abdomen and pelvis of the fetus, in all three planes. Fetuses ranged from 16 to 37 weeks gestation. 2D Flash images were compared to HASTE and True-FISP images. 2D Flash images were considered useful if they provided additional information contributing to the diagnosis.

Results: 2D-Flash images enhanced the diagnosis in 29 cases. These included 15 cases of diaphragmatic hernia, 4 cases of bowel atresia/malformation, 3 cases of cloacal malformation, 1 case of omphalocele, 3 cases of intracranial hemorrhage, 2 cases of periventricular white matter ischemia and 1 case of extrapulmonary sequestration.

Conclusions: 2D Flash images can enhance diagnosis of fetal anomalies, especially bowel and brain anomalies and should be part of standard protocols.

Poster #: PO12

Prediction of neonatal survival following previability premature rupture of membranes using fetal MRI lung-to-liver signal intensity ratios

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Purpose: Adequate lung development in utero is an important determinant of neonatal viability. Previability premature rupture of membranes (PPROM) (rupture of membranes occurring before 25 weeks gestation) is associated with a perinatal mortality of 47% due to pulmonary hypoplasia and complications of prematurity. The ability to diagnose pulmonary hypoplasia in utero would be of significant clinical importance in the antenatal management of PPROM; however, there is currently no effective way to make such a diagnosis. A normal range for fetal MRI lung-to-liver signal intensity ratios (LLSIRs) from 16 to 40 weeks gestational age has been previously published. The purpose of this study was to determine the ability of fetal LLSIRs to indirectly evaluate pulmonary hypoplasia prenatally by predicting neonatal survival.

Materials and methods: Sixteen pregnant women (15 singleton pregnancies and 1 twin pregnancy) who experienced PPROM at or before 24 weeks gestation with resultant oligohydramnios underwent MR imaging at least 1 week later to assess fetal pulmonary development. All fetal scans were greater than 20 weeks gestational age. The LLSIR values for 17 fetuses were calculated from images on a MR workstation, and values below the tenth percentile in both lungs for the corresponding gestational age in the normal population were considered abnormal. Live infant discharge from the NICU was defined as survival.

Results: In cases where a normal LLSIR was present in at least one fetal lung (7/7), all infants survived. In contrast, fetuses with LLSIRs below the tenth percentile in both lungs were spilt between survivors (5/10) and non-survivors (5/10). The positive predictive value was 0.5 (5/10). The negative predictive value was 1.0 (7/7). The sensitivity was 1.0 (5/5) and the specificity was 0.58 (7/12).

Conclusions: A LLSIR above the tenth percentile in at least one fetal lung is highly predictive of neonatal survival when PPROM occurs. Large prospective studies assessing LLSIR in PPROM are needed.

Poster #: PO13

Prenatal fetal MR imaging in genitourinary abnormalities

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Purpose: To assess the utility of fetal MR imaging in diagnosing genitourinary abnormalities.

Materials and methods: A retrospective review of 173 prenatal fetal MR examinations at St. Louis Children's hospital from July 2003 to November 2007 was performed. All cases had level II ultrasound prior to MR imaging. Prenatal US and MR imaging findings were compared when genitourinary abnormalities were encountered with either imaging modality. Clinical data and postnatal scans were subsequently used for confirmation of MR findings.

Results: Seventeen MR imaging exams (10%) were performed for the evaluation or exclusion of genitourinary tract abnormalities seen with US. One MR performed for echogenic kidneys showed no abnormality. The remainder 16 cases included a wide variety of congenital abnormalities including Potter's syndrome (n=5), renal ectopia and/or malposition (n=3), extrophy of bladder (n=2), cloacal malformation (n=2), and one case each of autosomal recessive polycystic kidney disease, uretero-pelvic junction obstruction with vaginal atresia, megacystis, and indeterminate hydronephrosis and hydroureter. MR findings confirmed ultrasound findings in seven cases (41.2%), added one or more additional findings in seven cases (41.2%), changed the US diagnosis in one (5.8%), was equivocal in one (5.8%) and was non-contributory in one (case of echogenic kidneys). Findings were confirmed postnatally in 13 cases; 4 with postnatal US and 9 with clinical features (5 cases of Potter's syndrome, 2 cases of extrophy, 2 cases of cloacal malformation). The remainder four cases could not be confirmed due to termination of pregnancy or fetal demise without autopsy. MR imaging enhanced diagnosis in eight cases (47.1%).

Conclusions: Fetal MR is a useful adjunct to US in the assessment of complex genitourinary tract anomalies. The information provided by fetal MR regarding complex genitourinary tract anomalies may be particularly beneficial towards prenatal counseling and postnatal management.

Gastrointestinal

Poster #: PO14

Neonatal presentation of wandering spleen complicated by glucose-6-phosphate dehydrogenase deficiency

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Purpose: Wandering spleen is a rare condition often requiring emergent surgery to treat torsion or severe hemorrhage. Most cases present in adulthood, and only three neonatal cases have been reported in the English language literature. Presenting signs and symptoms vary with age.

Materials and methods: We present a case in a newborn, studied by ultrasound, CT, and MRI. The case was complicated by hemorrhage and the concurrent diagnosis of G6PD deficiency.

Results: The infant was successfully treated with splenopexy.

Conclusions: Postoperative ultrasound showed a normal appearing spleen in normal anatomic position.

Poster #: PO15

Imaging of the stomach in children: Beyond pyloric stenosis

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Purpose: To present multi-modality imaging findings in a variety of conditions which affect the stomach in children.

Materials and methods: Imaging findings and medical records were reviewed in children who had imaging studies performed for a variety of gastric problems.

Results: We present unusual conditions or unusual imaging findings in gastric disorders of childhood. Ultrasound images show eosinophilic

gastritis in a newborn which mimics pyloric stenosis; these images are compared with classic findings of hypertrophic pyloric stenosis. Upper GI contrast studies show pyloric atresia, gastric duplication cyst, gastric volvulus, Crohn's disease involving the gastric antrum, gastric polyps in Gardner disease, and gastric perforation after attempted tube placement. CT images demonstrate gastric trichobezoar with perforation, gastric pneumatosis associated with wandering spleen, a large gastric fundus diverticulum which mimics an adrenal mass on MRI and marked antral wall thickening due to eosinophilic gastritis associated with eosinophilic ascites. PET-CT and MRI images of a gastrointestinal stromal tumor (GIST) arising in the stomach with liver metastases are also included.

Conclusions: Gastric pathology is unusual in children, excluding the neonate with hypertrophic pyloric stenosis. We show imaging findings in a number of less common gastric abnormalities in children. Imaging modalities include upper GI series, ultrasound, CT, MRI and PET.

Poster #: PO16

Can we use pulsed fluoroscopy to decrease the radiation dose during video fluoroscopic feeding studies in children?

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Purpose: Reducing fluoroscopic pulse rates will decrease patient radiation dose. We have explored if it might be possible to reduce the radiation dose during video fluoroscopic feeding studies, below our current 30 frames per second (continuous fluoroscopy), without missing episodes of supraglottic penetration occurring during swallowing.

Materials and methods: We evaluated ten consecutive children who had supraglottic penetration while swallowing thin barium as part of a video fluoroscopic feeding study. All fluoroscopic studies were performed with a pulse rate of 30 frames per second. We performed a frame by frame analysis of the first episode of penetration in each patient to determine on how many image frames the penetration could be detected.

Results: All studies were performed at 30 frames per second. The supraglottic penetration occurred very rapidly. In seven of the ten patients, full depth penetration, down to the level of the vocal cords, was only seen on one image frame. Statistically if the frame rate were decreased by 50%, half of the episodes of penetration in these seven patients would have been missed. In no patient was the full depth penetration seen in greater than two imaging frames.

Conclusions: Decreasing the fluoroscopic pulse rate cannot be used as a method of decreasing radiation dose during performance of video fluoroscopic studies because it will potentially result in non-detection of episodes of supraglottic penetration of liquid barium.

Poster #: PO17

Solid gastric tumors in children—A pictorial review

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Purpose: Solid gastric tumors are relatively unusual in children. We propose to present the imaging features of some of these rare lesions.

Materials and methods: We reviewed the imaging of patients presenting with biopsy proven stomach tumors. Imaging modalities included utlrasound, computed tomography, magnetic resonance imaging and PET/CT. Endoscopic correlation and gross pathology is also presented.

Results: Tumors imaged included gastro-intestinal stromal tumor (GIST), myofibroblastic inflammatory tumor, polyps of Peutz–Jeghers disease and Burkitts lymphoma.

Conclusions: The imaging features of solid gastric tumors in the pediatric population are presented with pathologic correlation.

Poster #: PO18

Rare pediatric liver tumors—A multi modality approach

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Purpose: This exhibit intends to present rare liver tumors or unusual presentations of these tumors in the pediatric population. We endeavor to describe a pragmatic approach to help differentiate amongst liver masses.

Materials and methods: We evaluated imaging studies of pediatric liver tumors obtained at our institution over a period of 2 years. Many of these cases have been evaluated with a multi-modality approach (US, CT, MR and/or FDG-PET). We develop an algorithm for differentiation of liver tumors in children based on their age, imaging characteristics and clinical findings (AFP level). The diagnosis was confirmed by clinical and imaging follow up studies and/or histopathology as a standard of reference.

Results: During the 2-year period, we evaluated 17 patients with liver tumors, including hemangioendotheliomas, mesenchymal hamartomas (cystic and one predominantly solid variant), focal nodular hyperplasia (FNH), adenomas, hepatoblastomas, HCC and undifferentiated embryonal sarcoma. We present a flow chart and a decision tree, which helps in the differential diagnosis of these masses. We discuss interesting imaging studies of a nearly completely calcified hepatoblastoma with portal vein invasion (CT and MR), MR imaging features of hemangioendotheliomas, cystic hamartomas, a rare predominantly solid hamartoma, cases of FNH (US, CT, MR) in very young patients (ages=6 weeks old infant, 4 year old child and 9 year old girl with a large pedunculated FNH)and multi-modality imaging of a undifferentiated embryonal sarcoma. We also present interesting cases of tumors with secondary liver infiltration, like a large Ewing's sarcoma of the 11th rib and a Burkitt's lymphoma with portal vein invasion. We will illustrate some treatment related effects on the liver, such as regional or focal perfusion abnormalities due to irradiation and chemotherapy.

Conclusions: In conclusion, most liver lesions can be diagnosed based on age, characteristic imaging and AFP levels. A multi-modality approach markedly increases the accuracy of the diagnosis. Our flow chart and decision tree delineate an algorithmic approach to diagnosis of liver masses in pediatric population.

Poster #: PO19

Primary hepatic masses in the pediatric population: A pictorial review

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Purpose: The evaluation of primary pediatric hepatic masses takes into account not only the imaging findings but also the age of the patient, lab work and presenting symptoms in formulating a differential diagnosis.

We will present a pictorial review of patients that presented to our institution with primary hepatic neoplasms.

Materials and methods: We reviewed the imaging of patients that presented with primary hepatic neoplasms.

Results: In patients who presented with primary hepatic neoplasms, we encountered hepatoblastoma, primary liver sarcoma, hemangioendothelioma, hemangioma, mesenchymal hamartoma, focal nodular hyperplasia, hepatic adenoma and hepatocellular carcinoma.

Conclusions: When a primary liver mass presents, imaging findings along with age, laboratory work and clinical presentation help to characterize the mass and narrow the differential diagnosis.

Poster #: PO20

Multi-modality imaging of liver diseases in children: A pictorial review

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Purpose: To illustrate and describe the imaging findings in focal and diffuse parenchymal liver diseases in children.

Materials and methods: A retrospective review of images from 22 patients, ranging in age from neonates to 16 years old, with various liver pathologies was performed. Benign and malignant conditions were categorized as focal (or multifocal) or diffuse. A multimodality imaging approach, using ultrasound (US), computed tomography (CT), and magnetic resonance imaging (MRI), was implemented to describe the characteristic features in each of the disease processes.

Results: A review of the imaging features of these common and uncommon disease processes is described. Examples of focal liver processes include hepatoblastoma, hepatic adenoma, hepatocellular carcinoma, hemangioendothelioma, focal nodular hyperplasia, Gaucher disease, embryonal cell sarcoma, and mesenchymal hamartoma. Examples of multifocal or diffuse liver pathologies include cat scratch hepatitis, B-cell leukemia, hepatic abscess, multiple hemangioendothelioma, lymphoblastic lymphoma, fatty liver, histocytosis, congenital hepatic fibrosis, veno-occlusive disease, peliosis hepatis, candidiasis, tyrosinemia, and metastatic disease.

Conclusions: Hepatic diseases are common in the pediatric population. Many diseases affecting the liver can have similar imaging appearances. Recognizing characteristic features on correlative imaging modalities should aid in their differentiation. This review provides key imaging findings of various pediatric liver processes using a multimodality approach.

Poster #: PO21

Pediatric blunt splenic trauma: A pictorial approach to imaging and management

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Purpose: This poster will review the current literature regarding the management of pediatric blunt splenic trauma, including the recommended imaging protocols and clinical practice guidelines. Multiple examples of all grades of splenic trauma based on the AAST grading system will be shown, along with various complications related to splenic trauma. We will also review the current clinical management of splenic injury patients at our community based hospital, comparing our data with the recent literature in regards to management variation at free standing children's hospitals versus a community based institution. Potential recommendations for resource utilization will also be discussed.

Materials and methods: Retrospective chart review of the trauma registry for all patients age 1 to 18 with an admitting diagnosis of splenic injury. This covered the time period 1995–2005. IRB approval was obtained. Literature review also performed.

Results: Fifty-three patients were identified that met inclusion criteria. There were 38 male and 15 female patients. Examples of all grades of splenic trauma were found and will be illustrated.

Conclusions: Based on our data, it appears that refined selecction criteria should be considered for patients with blunt splenic trauma. Modification of patient management should lead to a cost benefit.

Poster #: PO22

Magnetic resonance imaging of the surgical complications in inflammatory bowel disease

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Purpose: MR bowel evaluation in IBD was introduced to evaluate site and extent of disease. Complications and presurgical situations still had CT imaging as preferred by our surgeons. With experience we have elegantly delineated the surgical complications occuring in IBD. This poster will illustrate MR's abilibity to delineate such complications. Our utilization of CT in IBD imaging has been dramatically reduced.

Materials and methods: Our institution has performed over 125 MRI studies on patients with IBD. Our second Poster will demonstrate the technique we have developed at BC Childrens to image the abdomen in patients with IBD.

Results: Complications illustrated will include: obstruction; fistula; abcsess; perineal disease.

Conclusions: MRI is an effective imaging modality to demonstrate the complications of IBD.

Poster #: PO23

Inflammatory bowel disease: Evaluation by magnetic resonance—How we do it: Our protocol

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Purpose: Cross sectional imaging has become increasingly demanded by clinicians in evaluation of dosease extent, response to therapy and evaluation of complications. Cognisent of the very high radiation burden from CT we developed an MR imaging protocol for imaging the bowel in Inflammatory bowel disease.

Materials and methods: Outpatients are called by the radiology nurse a week before the booking or the ward is called with the instructions 1–2 days prior. Ten milligrams Dulcolax at midday the day prior to the study; a light evening meal; clear fluids only on the day of the study. Thirty minutes prior to scan time, 300 ml of oral polyethylene glycol (PEG) solution is administered. Two hundred milliliters more is given 15 min prior to the study and another 100 ml just before imaging begins. A peripheral IV is started and saline locked. Imaging sequences: (1)

Transverse Gradient Echo localizer, 21 s breathhold. (2) Coronal TruFisp localizer, 19 s breathhold. (3) Sagittal Gradient Echo localizer, 22 s breathhold. (4) Coronal T2 Haste, 22 s breathhold; *PEG solution must be visualized at the terminal ileum before the rest of the imaging proceeds. If it has not, wait 15 min then repeat the Coronal Haste until it has reached the TI. (5) Transverse T2 Haste, 6–20 s breathholds with respiratory navigator. (6) Coronal VIBE, 20 s breathhold. (7) Transverse VIBE, 20 s breathhold, two to three sets to cover from diaphragm to below perineum with overlap between groups and avoiding having the terminal ileum at the edge of one of the groups; ie optimal to have the TI in the center of one of the groups. (8) IV injection of 0.2 ml/kg of Omniscan (gadodiamide injection USP, 287 mg/ml, 0.5 mmol/ml, GE Healthcare) followed by a saline flush. Wait 1 min before post-contrast imaging starts. (9) Coronal VIBE—as before. (10) Transverse VIBE—as before. Addititional T2 sequences may be order if perineal disease present.

Results: We have now done over 125 studies and find our protocol reproducible, reliable and completed within 1 h hospital visit for the patient and 30 min magnet time.

Conclusions: The Poster will illustrate this study which has become our routine standard of imaging IBD.

Poster #: PO24

Pediatric biliary conditions: Imaging with MR and PTC

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Purpose: Biliary conditions are often overlooked in children, because clinical presentations often vary in symptomatology and severity. Imaging is crucial for early recognition and for guiding therapy. Delay in diagnosis can hamper the prognosis of biliary abnormalities (e.g. bilary atresia in newborns).

Materials and methods: Retrospective study over the last 12 years (1995–2007) of all patients who underwent either MRCP or PTC in Ste-Justine Hospital (Montréal).

Results: Our series is made of 110 patients. (1) Among native liver diseases (n=79): choledochal cyst (n=16); biliary atresia (n=18); sclerosing cholangitis (n=8); ductular hypoplasia (n=5); inspissis-sated bile duct syndrome (n=10); pancreatico-biliary duct anomalies (n=5); choledochal stones (n=9); inflammatory pseudotumor (n=3); trauma (n=4); rhabdomyosarcome (n=1). (2) Biliary complications after liver transplantation (n=31) gather stenoses, fistulae, anasto-motic leaks, and infections.

Conclusions: Imaging is paramount in the management of biliary conditions in children. From a diagnostic standpoint, ultrasound and MR are the key modalities. Percutaneous procedures play an important role either preoperatively or as the primary treatment.

Genitourinary

Poster #: PO25

Wilms tumor presenting as focal renal enlargement without a sonographically visible mass

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Purpose: To discuss two children with Wilms tumor presenting at US with focal, polar renal enlargement without an identifiable mass. In both cases, Wilms tumor was not initially considered because of the lack of a visible mass.

Materials and methods: The two cases were identified from departmental archives. One child was being followed for prenatal hydronephrosis. The other was being followed after left nephrectomy for Wilms tumor at age 9 months. The imaging studies were reviewed for both patients.

Results: Patient #1: A 2-month-old boy was being followed for mild left hydronephrosis that was detected prenatally. Periodic renal US from birth to 18 months showed stable, mild left pelvocaliectasis and renal scan was non-obstructive. At 21 months, US revealed asymmetric enlargement of the upper pole of the left kidney with tilting of the axis of the collecting system. However, the parenchymal architecture remained normal. IVP was done to assess the collecting system and confirmed the change in renal axis, but showed no evidence of a mass or distortion of the upper pole. The child returned at 26 months at which time US showed a large, solid mass in the upper pole of the left kidney, sub-sequently confirmed to be Wilms tumor. Patient #2: A 5-year-old girl with previous left nephrectomy for Wilms tumor at 9 months was having periodic US screening of her abdomen and right kidney. Following the left nephrectromy her right kidney had hypertrophied appropriately. No new abnormality was detected until 6 years at which time US revealed an increase in the size of the right kidney by 1 cm with focal enlargement of the upper pole. However, the architecture of the kidney remained normal and no mass was identified. The change in appearance was attributed either to hypertrophy or possibly pyelonephritis. US 6 months later showed a large, solid mass in the upper pole of the right kidney that was subsequently confirmed to be Wilms tumor.

Conclusions: Wilms tumor should be considered in the differential diagnosis of any focal or asymmetric enlargement of the kidney even in the absence of a definable mass or change in the parenchymal echotexture.

Poster #: PO26

Undescended testes: A new MR imaging protocol for using DWI

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Purpose: To evaluate the diagnostic value of DWI for the diagnosis of undescended testes. Ultrasonography(US) has been the primary diagnostic modality in patients with nonpalpable testes. When US findings are equivocal, magnetic resonance imaging(MRI) is indicated as further investigation. Recently, diffusion weighted imaging(DWI) is widely used for investigation of multiple organs. To our knowledge there is no report of diagnosis for undescended testes using DWI. However, it is known that the testes are high intensity on DWI. Therefore, we tried MRI using DWI for the evaluation of undescended testes.

Materials and methods: During a period of recent 2 years, nine undescended testes in seven patients underwent MRI and subsequent surgery. MRI was performed with using a 1.5-T imager. MRI protocol included T1-weighted images, T2-weighted images, and DWI at b factor with 0 and 800 s/mm^2. We retrospectively reviewed the follows; (1) the localization of undescended testes on DWI, (2) the signal intensity of undescended testes on DWI, and (3) correlation MRI findings with operative results and/or pathology reports.

Results: All nine undescended testes were diagnosed on MRI using DWI. (1) Among nine undescended testes, seven testes were within the

inguinal canal and two testes were in the abdomen. All of them were confirmed at the time of surgery. (2) Out of these nine undescended testes, eight testes were high intensity and one testis was low intensity on DWI. Eight testes with high intensity on DWI appeared more bright and clear than that of T2-weighted images. Therefore, undescended testes were easily recognized on DWI. (3) Three of nine undescended testes were removed. Pathological findings revealed normal testes in two and atrophic testis in one. Of these three testes, two normal testes were high intensity, one atrophic testis was low intensity on DWI.

Conclusions: Although our study was limited with the small series, we considered that DWI is a useful imaging tool not only diagnosing undescended testes but also having the ability to predict the viability of the testes.

Poster #: PO27

Ultrasound and MR imaging and intra-operative findings of obstructed Müllerian duct anomalies in children and adolescents

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Purpose: Müllerian duct anomalies (MDAs) are congenital entities that result from non-development, vertical or lateral fusion defect or resorption failure of the Müllerian (paramesonephric) ducts. When a duct becomes obstructed, girls may present with abdominal pain or dysmenorrhea. If the patient is not timely treated the consequences can be as severe such as infertility. In cases of obstructed MDAs imaging becomes essential for pre-operative diagnosis and further reproductive counseling. Previous studies in adults have shown that MR imaging and ultrasound are accurate tools for diagnosing MDAs. To our knowledge, no previous investigation has been conducted in this field in children. Our objective was to correlate MR and/or ultrasound images with pre-, intra- and post-operative images in children diagnosed with surgically confirmed MDAs.

Materials and methods: MR and/or ultrasound imaging data from teenager girls presenting with MDAs were collected from PACSweb (Department of Diagnostic Imaging), as well as corresponding pre-, intra-and post-surgical images. The surgical findings are considered as reference standard measures. The MRI and/or ultrasound findings have been interpreted by two radiologists and were correlated with the corresponding surgical images, for evaluation of presence of true-positive, true-negative, false-positive and false-negative results.

Results: The MRI and the ultrasound, at least suggested the correct diagnosis (true positive results) in all patients. The presence of the cervix can be evaluated in all patients.

Conclusions: Ultrasound examination accurately demonstrates an abnormal genital tract; although it is not able to identify the MDA type. In contrast, magnetic resonance imaging is a valuable technique for noninvasive evaluation of the anatomy of the female pelvis, being able to accurately classify the anomaly. Non-invasive diagnosis of gynecologic anomalies early on in the puberty, prior to initiation of sexual activity, may be of value for future reproductivity counselling and surgical management.

Poster #: PO28

Vesicoureteral reflux and urinary tract infection: Current controversies in pediatric genitourinary imaging

Ruth Lim, MD, *Division of Pediatric Radiology, Department of Radiology, Massachusetts General Hospital, Boston, MA, USA*; Katherine Nimkin, MD

Purpose: Current standards of care recommend that children and infants with urinary tract infection (UTI) undergo imaging tests to evaluate for vesicoureteral reflux (VUR), based on the hypothesis that the severity of VUR increases the risk of permanent renal scarring that may lead to serious sequelae later in life, such as hypertension, proteinuria, and end-stage renal disease. Prophylactic antibiotics and follow-up imaging tests are thought to reduce the risk of these sequelae. The purpose of this educational poster is to summarize some of the current controversies that are causing us to now question these long-accepted theories regarding the management of and the role of imaging in UTI and VUR. Correlative imaging findings are presented.

Materials and methods: Recent English-language literature was searched for controversial topics related to imaging and management of urinary tract infection and vesicoureteral reflux. Selected topics are presented in this educational poster, with an individual review of the current literature for each topic.

Results: Current topics of controversy include:—How do radiation dose and test sensitivity affect the decision to perform voiding cystourethrography (VCUG) vs. radionuclide cystography (RNC) in the diagnosis and follow up of VUR?—When should, and how can we perform sedation for cystography?—How does renal cortical scintigraphy alter patient management? How extensive must a cortical defect be to be clinically important? Can cortical scintigraphy obviate the need for reflux cystography?—Is familial screening for VUR necessary?—Are prophylactic antibiotics truly beneficial?

Conclusions: A multimodality imaging approach is used to evaluate and monitor children with UTI and VUR. Despite the fact that much of pediatric imaging is done for diagnosis and monitoring of children with VUR and its sequelae, there remain many uncertainties and controversies regarding the rational use of imaging tests. Although many of our tests and management decisions are based on good clinical reasoning, evidence-based support is needed to generate updated practice guidelines.

Poster #: PO29

Neonatal scrotal abscess: Differential diagnostic challenge for the acute scrotum

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Purpose: To illustrate a case of a scrotal abscess (pyocele) encountered in a neonate and describe the clinical and imaging features of pyocele that should bring it into consideration in the differential diagnosis.

Materials and methods: A 21-day-old male had been in the neonatal intensive care unit following an uneventful Ladd's procedure for malrotation. Over the first week post-operation, he was noted to have an enlarging and increasingly tender left hemiscrotum. His white blood cell count was elevated at 15,000/mm^3 and he had a low-grade fever.

Results: Sonography demonstrated a heterogeneously echogenic and avascular mass occupying the hemiscrotum, with wall thickening. A normal testis was not seen. The processus vaginalis was not patent. The spermatic cord was not tortuous. A diagnosis of missed testicular torsion was made, and the patient underwent emergent scrotal exploration. In the operating room, a large amount of odorous purulent material, under pressure, was drained. The testis was adherent to the posterior wall of the scrotum and appeared pink and viable, and the spermatic cord appeared in a straight configuration with no twist. An orchiopexy was performed. Cultures demonstrated *Bacteriodes fragilis*.

Conclusions: Scrotal abscess is a rare occurrence in the pediatric population; with no reported cases within the United States. In this case, the pyocele may have been secondary hematogeneous seeding or direct extension from the peritoneal cavity after surgery. We describe imaging features of pyocele in sonography. As it mimics missed torsion, it is prudent to also consider it in the evaluation of the child with an acute scrotum, who is predisposed to infection.

Poster #: PO30

Estimating effective doses for voiding cystourethrogram examinations in pediatric patients

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Purpose: Our institution performs approximately 1,500 voiding cystourethrogram (VCUG) examinations annually. Currently patient dose data is limited to a dose–area–product (DAP) and an absorbed skin dose estimate that are only moderately related to the effective dose. The aim of our study was to evaluate the effective dose from VCUG examinations performed on an neonate and 1-year-old patient.

Materials and methods: Dose to organs contributing to effective dose, as outlined in ICRP 60, were measured using Metal Oxide Semiconductor Field-Effect Transistors (MOSFET) dosimeters inserted into anthropomorphic phantoms representing 0- and 1-year-old patients. To minimize measurement error, the phantoms were exposed to a mock VCUG exam with radiation exposure significantly greater than that associated with routine clinical examinations. This consisted of 5 min fluoroscopy (7.5 pulses/s) and 50 radiographic exposures each to the pelvis and renal areas. Effective dose for this mock VCUG was calculated using ICRP 60 organ weighting factors and the results then scaled to an average clinical protocol (as determined from departmental log books) of 0.82 min fluoroscopy, nine pelvic and one renal exposure. For each phantom, Monte Carlo simulations of a clinical VCUG were run and compared to measured doses using *T*-statistics.

Results: The effective dose for clinical VCUG examinations in a 0- and 1-year-old were 0.125±0.028 and 0.188±0.027 mSv, respectively. The Monte Carlo estimates were 0.156±0.006 and 0.244±0.023 mSv respectively. There was no statistical difference between measured and simulated results ($T>0.12$). Organ doses from the gonads, colon, and urinary bladder were the largest contributors to effective dose in both methods.

Conclusions: Effective doses for a VCUG exam have been derived for a 0- and 1-year-old patient. Directly measured doses were in good agreement with Monte Carlo simulations, validating the MOSFET model. Future work will derive effective doses for 5- and 10-year-old phantoms. A mathematical model for calculating effective dose per minute of fluoroscopy and per exposure is presented.

Interventional

Poster #: PO31

Image-guided intra-articular steroid injection for juvenile idiopathic arthritis

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Purpose: To provide a review of image-guided intra-articular steroid injections in children with juvenile idiopathic arthritis.

Materials and methods: Topics covered will include indications and contraindications, rationale for using image-guidance, sedation and analgesia specific to the pediatric population, equipment, choice of therapeutic solution, choice of imaging modality, injection technique, and potential complications.

Results: Intra-articular steroid injections will be reviewed.

Conclusions: Intra-articular steroid injection is a well-established procedure in pediatric rheumatology, but image-guidance can assure intra-articular placement and thus these cases are now often being referred to interventional radiology.

Poster #: PO32

Tips, tricks and techniques for spinal interventions in children

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Purpose: To describe techniques of spine interventions in children, including tips to avoid common pitfalls.

Results: Spinal interventions are often performed for diagnostic and therapeutic pain management purposes in adults. Many of these similar interventions have clinical utility in children, including diagnostic interventions such as discograms to help confirm the etiology of back pain, as well as therapeutic interventions such as epidural steroid injections, facet joint injections, transforaminal steroid injections, sacroiliac joint injections and nerve blocks to relieve chronic refractory pain. However, spinal interventions are infrequently performed in children. The techniques for performing these procedures as well as common pitfalls and tips to avoid them will be described.

Conclusions: Spine interventions can be safely and successfully performed in children.

Poster #: PO33

C-arm computed tomography: Technique and clinical applications in pediatric interventional radiology

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Purpose: C-arm cone-beam flat panel computed tomography (C-Arm CT) provides the interventionalist the opportunity to combine fluoroscopic 2D imaging with two-(2D) soft tissue and high resolution three-(3D) vascular imaging in the interventional suite. The aim of this exhibit is to review C-arm CT technique and clinical applications in a pediatric interventional practice.

Materials and methods: C-arm CT datasets are acquired along a partial circle scan with or without the injection of contrast medium. The standard fluoroscopic 2D images provide localization and guidance and if contrast is injected, dynamic flow information. The reconstructed multiplanar 2D and 3D images provide structural detail, which can be utilized for diagnostic purposes as well as road-mapping. Reconstructed images can be manipulated from any angle using multiplanar reformations (MPR), maximum intensity projections (MIP), and volume rendering (VR).

Results: In pediatric interventional radiology, C-arm CT is currently being applied for vascular and non-vascular procedures. It is essential to have fundamental knowledge of this technology so that it is applied safely and radiation exposure is minimized. In the first part of this exhibit, image acquisition, data transfer, data transformation, and visualization techniques are discussed along with technical limitations and pitfalls. In the second part, an overview of pediatric interventional radiology applications is presented.

Conclusions: Educational teaching points (1) Understand how to acquire C-arm CT datasets safely in pediatric patients. (2) Understand strategies to optimize image quality while minimizing radiation exposure. (3) Understand how to integrate advanced 2D and 3D visualization techniques in the interventional suite. (4) Understand current and future C-arm CT applications in pediatric interventional radiology.

Musculoskeletal

Poster #: PO34

MR imaging characteristics of chronic stress injury of the iliac crest in adolescents

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Purpose: To describe the MR imaging appearance of chronic repetitive stress injury of the iliac crest apophysis in adolescent athletes.

Materials and methods: Seven adolescent athletes ages 14 years 4 months–16 years 10 months (mean 15 years 7 months) were evaluated with MRI over a 14-month period for chronic hip, pelvis, or low back pain, with the subsequent diagnosis of chronic stress injury to the iliac crest. MRI exams were reviewed to record side of injury, appearance of iliac crest apophysis and adjacent physis, and bone marrow and muscle edema. If available, pelvic radiographs and prospective interpretations were reviewed. Clinical history and presenting symptoms were obtained. The offending sport and duration and location of symptoms were recorded.

Results: No patient showed iliac crest apophyseal displacement, however, all showed mild widening of the physis and adjacent bone marrow edema. Five children had surrounding muscle edema. When specified, pain was present from 3 weeks to 1 year. Four athletes had pain over the affected iliac crest, however, three had pain referred to the hip or lower back. One patient had bilateral symptoms but only unilateral imaging findings. One patient had unilateral symptoms but bilateral asymmetrical MR imaging findings. The most common offending sport was short (track) or long distance running. Of the six children with radiographs, three were interpreted as abnormal prospectively. In retrospect, all showed at least minimal widening of the iliac apophyseal physis.

Conclusions: History and clinical exam findings of prolonged, sometimes vague symptoms, involving the pelvis, hip, or low back in athletes with open iliac apophyseal physes should alert one to carefully evaluate the iliac crest for possible chronic stress injury on radiography. We suggest that MR imaging is useful to make the diagnosis if radiographs are indeterminate, or if confirmation and evaluation of extent of injury is needed prior to halting modifying sport activity. The MRI appearance of chronic stress injury includes widening of the affected iliac apophyseal physis, with adjacent bone marrow and muscle edema.

Poster #: PO35

Radiographic imaging of the mucopolysaccharidoses

Ralph S Lachman, MD, *Radiological Sciences and Pediatrics, UCLA School of Medicine/International Skeletal Dysplasia Registry, Los Angeles, CA, USA*; Helen S Nicely, PhD; Sean D Turbeville, PhD

Purpose: A new era in the treatment of the mucopolysaccharidoses (MPS) has occurred with the advent of enzyme therapy. A case in point is the new treatment Naglazyme® (galsulfase), introduced in 2005 by BioMarin Pharmaceutical Inc, specifically for the treatment of MPS VI. It is apparent that the earlier this therapy is initiated the better the expected results. Therefore it becomes imperative that 3the clinician (radiologist, geneticist, pediatrician, etc.) determines the diagnosis as early as possible. It is also suspected that perhaps certain mildly affected individuals go through life symptomatic but undiagnosed. The diagnosis is usually suggested by a combination of "clinical" and radiographic features. The radiological manifestations play an extremely important role.

Results: The mucopolysaccharidoses have in common a quite specific radiological expression, which is termed "dysostosis multiplex". All types of MPS disease exhibit these findings to a greater or lesser degree. The role of the radiologist and other clinicians is to recognize any of these diverse changes on radiographs so that the patient can be tested to ascertain which MPS disease is present for treatment, genetic counseling and management. Dysostosis multiplex changes are widespread in the skeletal system involving many different bones. At times even the "routine" chest film will reveal changes suggesting the diagnosis of possible MPS disease. This poster presentation will cover the entire skeletal system to show the spectrum of dysostosis multiplex changes suggesting the presence of MPS disease in the individual. Also several previously unreported dysostosis multiplex findings will be shown.

Conclusions: Hopefully, our awareness of these findings will result in earlier and even more frequently accurate diagnoses within this group of disorders.

Disclosure: Dr. Lachman has indicated that he is a consultant/speaker for BioMarin Pharmaceutical.

Poster #: PO37

Myositis in children—Causes and MR findings

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Purpose: To discuss causes of myositis in the pediatric population and to present their MR findings.

Materials and methods: Pre and post contrast MR images in four females and one male (age range 7–19 years) with myositis of different etioloties were reviewed. Diagnoses included juvenile dermatomyositis, benign myositis of childhood (BMC), necrotizing fasciitis with myositis (NFM), infectious myositis in a child with type I diabetes mellitus (DM) and myositis in a child following allogenic bone marrow transplant(BMT) for acute lymphocytic leukemia.

Results: All patients presented with muscle pain. Abnormal muscle signal on T2-W images and muscle enhancement was unilateral in both BMC and NFM. It was more localized and well marginated in BMC, affecting only portions of the gastrocnemius and soleus muscles.

Bilateral muscle involvement was symmetric in dermatomyositis and myositis in ALL following BMT. It was asymmetric in infectious myositis related to DM. The subcutaneous tissues were spared in dermatomyositis and BMT. They were locally affected in BMC, extensively involved in NFM and mildly involved in infectious myositis related to DM. Deep fascial involvment was present in all cases, but was most severe in NFM. A dominant fluid collection along the fascial plane was present only in the case of myositis related to DM.

Conclusions: Imaging findings of myositis are nonspecific and demonstrate high signal in the affected muscles on T2-W images and enhancement following gadolinium. Imaging features that may aid in differentiating between these entities include unilateral or bilateral muscle involvement, and degree and extent of fascial enhancement and subcutaneous edema.

Poster #: PO38

Pictorial review of the radiographic appearance of treated unicameral bone cysts

Jason P Weinman, MD, *Radiology, Children's Hospital of Philadelphia, Philadelphia, PA, USA*; Sabah Servaes, MD; Andres Pena, MD; Sudha Anupindi, MD

Purpose: Unicameral bone cysts (UBCs) are a common benign entity involving the metaphysis of growing bone, occurring within the first two decades of life. Surgical treatment is warranted if a pathologic fracture occurs or is judged imminent. Various treatment options for UBCs have varying results. Assessment of these lesions both before and after surgery is performed routinely utilizing radiographs. In this poster we present several illustrative cases with successful and incomplete healing/recurrence and describe the imaging findings through there postoperative course.

Materials and methods: The radiographs of twenty patients with known UBCs made before surgery (curettage and packing with calcium sulfate pellets) and up to 3 years after treatment were reviewed. The radiographs were reviewed by the three authors in consensus for stages in and completeness of healing and appearance of recurrence.

Results: Examples of successfully treated, incompletely healed and recurrent unicameral bone cysts will be presented. Findings that suggest incomplete healing/recurrence include: residual cystic/lucent components, enlargement of the lesion after treatment and incomplete filling in of the surgical site with bone or incomplete remodeling.

Conclusions: The appearance of surgically treated UBCs is not well appreciated by most radiologists. We depict examples of healed and incompletely healed/recurrent UBCs after treatment. Identification of incompletely healed/recurrent lesion is important as these patients may require repeat surgery to achieve cure.

Poster #: PO39

Subacute and chronic osteomylitis: A diagnostic enigma

Siddharth P Jadhav, MD, *Department of Radiology, University of Texas Medical Branch, Galveston, TX, USA*; Thomas R Sanchez, MD; Leonard E Swischuk, MD

Purpose: To review the various and protean imaging findings of chronic, often multifocal osteomyelitis.

Materials and methods: Various illustrative cases of subacute and chronic osteomyelitis involving different parts of the skeleton have been used to describe the imaging findings. Appropriate differential diagnosis is discussed.

Results: A brief discussion of pathophysiology and etiology of this condition is presented. Thereafter imaging is the focus of this presentation and is arranged on a skeletal body orientation. Each area where the disease involves the skeleton is treated separately and the various, often confusing imaging findings are presented and discussed. Ancillary imaging is discussed where applicable.

Conclusions: Subacute, chronic osteomyelitis often is an elusive diagnostic problem. It can be multifocal or unifocal. It is an indolent inflammatory process which often manifests with less than classic findings of osteomyelitis. For this reason it frequently poses a diagnostic problem or dilemma. The purpose of this presentation is to present the various and protean manifestations of this initially frequently misdiagnosed condition so as to aid the radiologist to make the correct initial diagnosis.

Poster #: PO40

Follow-up skeletal surveys for non accidental trauma: Can a more limited survey be performed?

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Purpose: Previous studies have demonstrated the value of the follow-up skeletal survey in identifying additional fractures, confirming normal findings, and aging skeletal injuries in victims of non-accidental trauma (NAT). Our goal was to determine if a more limited follow-up survey could yield the same radiologic data as a full follow-up survey.

Materials and methods: Four hundred seventy-one initial skeletal surveys were performed for suspected NAT at our institution between August 2002 and August 2007. Ninety-three of these initial surveys had follow-up surveys that met our criteria for inclusion, a follow-up performed 10 to 21 days after the initial survey. Consensus readings of both surveys were performed by two board certified pediatric radiologists. These results were compared to determine additional findings from the follow-up surveys.

Results: Two hundred twenty-six fractures in 59 patients were identified on initial skeletal surveys. These fractures included: 102 rib (45.1%), 53 lower extremity (23.5%), 27 skull (11.9%), 23 upper extremity (10.2%), 8 spine (3.5%), 5 clavicle (2.2%), 5 foot (2.2%), 1 scapula (0.4%), 2 hand (0.9%), and 0 pelvic (0%). On follow-up skeletal surveys, 39 new fractures were identified, 13 suspected fractures were confirmed, and 17 suspected fractures were deemed normal. New fractures included: 26 rib (66.7%), 8 lower extremity (20.5%), 3 upper extremity (7.7%), and 2 foot (5.1%). No new fractures of the hands, spine or pelvis were identified. Follow-up skeletal surveys gave additional clinical information about the skeletal injuries in 36 of 93 patients (37.8%).

Conclusions: Follow-up skeletal surveys play an integral role in the evaluation of NAT as they can confirm either normal or abnormal findings and identify new fractures. Our results suggest a more limited follow-up skeletal survey could be performed without missing new fractures and still allow for proper identification of confirmed fractures or normal findings. A more limited survey would also save significant radiation dose in these small children.

Poster #: PO41

Osteomyelitis of the pubic symphisis: MR findings and pitfalls in diagnosis

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Purpose: To describe the MR findings in pubic osteomyelitis/septic arthritis and discuss pitfalls in diagnosis.

Materials and methods: Two cases of pubic osteomyelitis/septic arthritis originally treated as osteitis pubis are described. Case #1: A 15-year-old male presented to St. Louis Children's Hospital with bilateral groin and inner thigh pain starting one week after developing conjunctivitis and fever. On physical exam the patient had a limp. Labs included a WBC=13.5, ESR=49and CRP=11.2. Plain films of the pelvis and hips were read as normal. The patient received a prednisone taper for 5 days for presumed osteitis pubis. He presented 2 weeks later with worsening pain and a pronounced "waddling gait." An MRI was then obtained. Case #2: A 13-year-old male presented to St. Louis Children's Hospital with left sided scrotal swelling, pain and edema and intermittent fever for 2 weeks. History was significant for a recent football camp. US performed at a private urologist's office had excluded testicular torsion. Outside MRI was described as positive for inflammatory changes in the pubic symphysis. On physical exam the patient had difficulty bearing weight. Labs included a WBC=10.3, ESR=4 and CRP=92. Plain films showed widening of the symphysis pubis. Bone scan was performed and read as normal. Patient was then placed on Naproxyn, oxycodone and a prednisone taper for 7 days for presumed osteitis pubis. He returned 2 weeks later with worsening pain and "waddling gait." An MRI was then obtained.

Results: Contrast enhanced MR findings (in both cases): A peripherally enhancing fluid collection in the pubic symphysis with associated abnormal signal (low T1 and high T2) and abnormal enhancement in the pubic bones. The diagnosis of pubic septic arthritis/osteomyelitis was made and antibiotic therapy initiated. Cultures of joint fluid grew *Streptococcus pneumoniae* in case #1 and *Fusobacterium nucleatum* in case #2.

Conclusions: Distinguishing between osteitis pubis and pubic osteomyelitis can be difficult clinically as well as radiographically. MR may be helpful prior to the initiation of prednisone taper in cases of presumed oseitis pubis.

Poster #: PO42

Direct MR arthrography of hip joint in children for assessment of acetabular labrum—Technique, findings and pitfalls

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Purpose: To describe the technique of fluoroscopy guided hip arthrography. To understand the development of hip joint and its biomechanics. To understand the MR anatomy of the acetabular labrum in children and normal variants mimicking labral tear. To familiarize with the MR imaging technique in children, findings in labral pathology, and imaging pitfalls.

Materials and methods: Data was collected from 38 MR arthrography, which were performed in our institution in patients below the age of 18 years. All direct atrhrography was performed under fluoroscopic guidance, using anterior vertical approach. Buffered lidocaine was used in all patients for local anesthesia. A 0.75% or 1% solution of gadolinium mixed with normal saline, iodinated contrast and long acting local anesthetics was used. All patients underwent MRI imaging in 1.5 T GE scanner within 2 h of arthrography. Three-plane T1 fat suppressed, coronal IR and coronal 3DSPGR imaging were performed in all patients. 3D coronal imaging was reconstructed in axial and sagittal plane. Labral pathology was described as involving the anterosuperior, superolateral and posterior quadrant.

Results: Out of 38 hip arthrogram 26 patients had anterosuperior labral tear, 6 patients had superolateral labral tear and 6 patients had no tear. Variable degree of labral degeneration was noted depending on clinical presentation. Two patient had both anterosuperior and superolateral labral tear. Depending on the clinical and MR finding patients were offered conservative or surgical management. Radiology–surgery correlation confirmed high sensitivity and specificity of MR arthrography.

Conclusions: Direct MR arthrography is an effective tool for assessment of labral pathology in children. Knowledge of anatomy and normal variants are essential to avoid inappropriate interpretation. Fluoroscopy guided anterior vertical approach arthrography is an easy and effective way of hip joint contrast administration.

Poster #: PO43

Acute hip pain in children: To establish a limited but efficient MR imaging protocol

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Purpose: Acute hip pain is a common cause of emergency room visit in children. Most common etiology is transient synovitis, however, investigation is required to exclude serious condition such as septic arthritis. MR imaging (MRI) of the hip is widely used in the assessment of a large spectrum of pathological conditions of the hip in children. But, the availability of MRI in the urgent is limited. Purpose of this study is to compare findings between STIR images and fat-suppressed contrast-enhanced T1-weighted image and to assess the role of a limited of MR protocol as the initial MRI in children with hip pain.

Materials and methods: During 68 months, 116 patients with acute hip pain at our institution underwent MRI of the hip. Among them, 19 patients (9 male, 10 female, mean age of 8 years) had MRI with contrast in addition to images without contrast. MR protocol included T1-, T2-weighted images, STIR images, and fat suppressed T1-weighted images without/with contrast. We retrospectively reviewed the follows: (1) MR findings and final diagnosis in 19 patients, (2) comparison between STIR images and fat-suppressed contrast-enhanced T1-weighted images. Final diagnosis were established based on clinical diagnoses.

Results: (1) MR findings were joint effusion in 14 cases, abnormalities of periarticular soft tissue in 12 cases, and bone marrow abnormalities in 9 cases. Final diagnoses were transient synovitis in seven cases, septic arthritis in two cases, osteomyelitis in three cases, bone marrow metastasis in two cases, and others conditions such as insufficiency fracture were seen in five cases. Diagnosis of MRI were agreement with the final diagnosis. (2) Findings of fat-suppressed contrast-enhanced T1-weighted images were similar to STIR images except for synovial enhancement.

Conclusions: MRI is an accurate diagnostic tool for pediatric hip pain. Any abnormalities can be detected on STIR images and there are few

additional findings on fat-suppressed contrast-enhanced T1-weighted images. Therefore, fat-suppressed contrast-enhanced T1-weighted images can be omitted on initial MRI, especially when STIR images appear to be normal.

Poster #: PO44

MRI of congenital and developmental problems of the knee

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Purpose: Congenital and developmental abnormalities of the knee are often initially identified on radiographs, but MRI can be utilized to detect physeal, epiphyseal, meniscal, and ligamentous abnormalities not suspected radiographically. The knee is the most common joint imaged by MRI in the pediatric population, and thus these abnormalities are not uncommonly encountered.

Materials and methods: A search in the radiology database and teaching file at our institution identified cases of congenital and developmental problems of the knee.

Results: In this educational poster, we will illustrate the MRI findings demonstrated in multiple congenital and developmental abnormalities of the knee. In congenital dislocation of the knee, MRI demonstrates abnormal femoro-tibial epiphyseal relationships, and abnormal course of the cruciate ligaments. In congenitally short femur, MRI demonstrates absence of the cruciate ligaments. In tibial hemimelia the proximal fibular epiphysis is enlarged and articulates with the distal femoral epiphysis. The cartilaginous anlage of the patella is hypoplastic in nail-patella syndrome, and there is abnormal ossification. Epiphyseal dysplasia results in irregularities in the signal intensity of the cartilage and delayed ossification. Blount disease demonstrates a spectrum of abnormalities related to stress of the medial compartment of the knee. The proximal tibial epiphysis is thinned, the adjacent physis is curved or closed, the medial meniscus is enlarged and degenerated, and the distal femoral physis is thickened. Other disorders demonstrate a more focused site of involvement. For example, rickets primarily involves the physis, with increased thickness and signal intensity of the cartilage. The discoid meniscus is the primary congenital disorder of the meniscus, with increased volume and signal intensity of the lateral meniscus.

Conclusions: MRI can be utilized to detect and characterize the physeal, epiphyseal, meniscal, and ligamentous abnormalities associated with congenital and developmental disorders of the knee.

Poster #: PO45

Bisphosphonate-induced osteopetrosis: Novel bone modeling defects, osteosclerosis fractures, and metaphyseal osteopenia after drug exposure ceases

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Purpose: The first reported person with drug-induced osteopetrosis agreed to reevaluation 5 years following diagnosis and 6–1/2 years after pamidronate (PMD) exposure stopped.

Materials and methods: At age 17 years, biochemical, radiological, and histopathological parameters of skeletal homeostasis were reassessed.

Results: Idiopathic bone pain, although diminished, persisted. Radiographs again showed persistent club shaped modeling defects of osteopetrosis, yet with features suggesting some recovery. Metaphyseal surfaces remained widened, but had regained some concavity. Metaphyseal osteosclerosis had remodeled to become diaphyseal osteosclerosis. However, newer metaphyseal bone was unexpectedly osteopenic with thin cortices and cystic areas documented by computed tomography. A "bone-in-bone" configuration was now present throughout his skeleton. L5 spondylolysis had progressed to spondylolithesis and L4 spondylolysis developed. Interval fractures included a Salter II break of an osteosclerotic distal radius, and a "chalkstick" break through dense diaphyseal bone in an ulna which remained incompletely healed 2 years later despite solid periosteal bone. Multiple other fractures occurred. Iliac crest biopsy showed an excess of unresorbed primary spongiosa, but it was significantly less than that seen during PMD infusions.

Conclusions: Bisphosphonate toxicity during childhood can disturb skeletal modeling and remodeling with changes that evolve and carry into adult life.

Poster #: PO46

Physeal closure from chronic vitamin A intoxication

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Purpose: Vitamin A excess causes periosteal calcification, diffuse idiopathic skeletal hyperostosis, and fractures. In pediatric patients, skeletal growth, modeling, and remodeling can be disrupted. Premature growth plate fusion from vitamin A and D toxicity was first reported in animal hind limbs ("hyena disease"). Subsequently, in 1962, three of seven children with growth retardation from vitamin A toxicity had early lower limb physeal closure (JAMA 182:980). Further reports concerned vitamin A derivatives used in severe pediatric dermatoses or cancers. Physeal narrowing from isotretinoin can be reversible. We studied a 6-year-old boy who had many complications of hypervitaminosis A including physeal fusions in the lower limbs. We reviewed the symptoms and signs of vitamin A toxicity, mechanisms of physeal injury, and studies in animals.

Materials and methods: A 6-year-old boy with vitamin A toxicity was studied clinically and radiographically.

Results: The boy had a number of features of vitamin A toxicity including physeal fusions at the knees and ankles with bowing and contractures, hepatic fibrosis splenomegaly, pseudotumor cerebri with resultant hydrocephalus, anemia, telangiectasias, and a bleeding tendency.

Conclusions: Physicians should be alert to vitamin supplement use in children. The bony manifestations of hypervitaminosis A can range from pain, with or without fractures, to significant skeletal deformity including permanent physeal fusions.

Poster #: PO47

Osteoprotegerin deficiency (juvenile Paget's disease): Responses to oral and IV bisphosphonates in three children

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Purpose: Osteoprotegerin (OPG) deficiency, the principle variant in juvenile Paget's disease (JPD), is a rare autosomal recessive osteopathy affecting the entire skeleton featuring remarkably accelerated bone turnover. Loss-of-function mutation of TNFRSF11B, the gene encoding osteoprotegerin (OPG) accounts for most patients, thus the disorder can now be called OPG deficiency. JPD can be fatal if untreated with antiresorptives. We studied three patients with JPD with different homozygous OPG deletions or other mutations for their response to oral or IV biphosphonate therapy.

Materials and methods: Three unrelated children were studied clinically, radiographically, and genetically. Their response to BP therapy was recorded.

Results: Pt 1 and 2 had different, homozygous, loss-of-function defects in exon 2 of TNFRSF11B encoding OPG. Pt #1 had a frame-shift, single base deletion (c.278delT), likely forming no functional protein, consistent with severe disease. Pt #2 had a missense mutation (C. T349C, p.Phe117Leu) causing a less severe phenotype. Pt #3 is deleted for OPG. All patients did respond to BP therapy. Their responses did vary and was in part predictable in keeping with their genotype.

Conclusions: Children with OPG deficiency show varying responsivity to BP, reflecting the underlying OPG mutation.

Poster #: PO48

Molecular exclusion of mutations in EXT1 and EXT2 as the cause of metachondromatosis

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Purpose: Metachondromatosis (OMIM # 156250) is a rare, autosomal dominant, skeletal dysplasia featuring multiple metaphyseal juxtaepiphyseal exostoses (characteristically pointing toward the adjacent joint, and often involving the bones of the hands and feet), metaphyseal striated enchondromas, periarticular ossification, and femoral head deformities resembling avascular necrosis. Metachondromatosis shares clinical similarities with hereditary multiple exostoses (HME, OMIM #133700 and #133701) also an autosomal dominant disorder; HME is caused by loss-of-function mutations in the *EXT1* or *EXT2* genes. It has been postulated that mutations in these genes could also cause metachondromatosis. At least 22 cases of metachondromatosis have been reported, although lack of large families has precluded identification of the genetic defect through linkage analysis. We have clinically evaluated two families with multigenerational metachondromatosis.

Materials and methods: Genomic DNA was isolated from blood leukocytes in the two families. All 11 exons for EXT1 and 15 exons for EXT2 including the entire coding region and adjacent mRNA splice sites, were amplified by PCR and sequenced in both directions. DNA sequence was examined using VectorNTI-AlilgnX software.

Results: No mutations were found in the *EXT1* or *EXT2* genes.

Conclusions: There were no mutations in the *EXT1* or *EXT2* genes that would explain metachondromatosis. The metachondromatosis gene encodes a protein necessary for endochondral bone development, including shaping (defects result in exostoses) and ossification (defects result in enchondromas). We hypothesize that the metachondrometosis protein plays a role in the regulation of the critical pathways, including PTHrP and IHH, essential in chondrocyte differentation and endochondral bone formation.

Poster #: PO49

Synovial cell sarcoma: Imaging clues to the diagnosis

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Purpose: Synovial cell sarcoma (SCS) is commonly misdiagnosed as a benign lesion. This study reviews the MRI imaging features of SCS and delineates imaging features that facilitate an early diagnosis.

Materials and methods: We retrospectively identified electronic medical records and imaging reports for MRI examinations in patients with pathologically proven SCS over the past 5 years. Demographic variables, MRI imaging characteristics and initial diagnoses were tabulated.

Results: We identified 15 patients (9 male, 6 female) with pathology proven SCS. Patients had a mean age of 10.7 years (range 3 to 17 years). Locations affected included brachial plexus (1), chest wall (1), elbow (1), scapula (1) forearm (1), wrist (1), knee (5), ankle (1), foot (2), and pancreas (1). In 11 patients MRI revealed small (<4 cm) masses with non-aggressive imaging features which led to imaging diagnosis of a benign process. SCS was suggested on the basis of imaging in only three cases. Lesions later proven to represent SCS were most often misdiagnosed as venous malformation or nerve sheath tumor at MRI. Other diagnoses considered included rhabdomyosarcoma, desmoid, osteochondroma, ganglion and popliteal cysts, and PVNS. Since SCSs frequently demonstrated increased signal on T2-weighted imaging, ultrasound was employed in some cases to discriminate between a solid versus a cystic mass. Contrast-enhanced MRI was also critical for demonstrating the solid nature of SCS's. Lastly, conventional radiographs were infrequently obtained as part of the routine evaluation of these patients, despite their valuable role in demonstrating calcifications often present in SCS's.

Conclusions: Synovial cell sarcoma often has non-aggressive features on MRI imaging which lead to a misdiagnosis of a benign lesion such as venous malformation or nerve sheath tumor. Employing a multimodality imaging approach, using ultrasound and conventional radiography to complement MRI evaluation of peri-articular or musculoskeletal masses, will enable the radiologist to suggest an early diagnosis of SCS and expedite appropriate therapy.

Poster #: PO50

Evaluation of multiple unexplained fractures in infants: Non accidental trauma or osteogenesis imperfecta?

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Purpose: When infants present with multiple unexplained fractures, the differential diagnosis can be difficult. Although child abuse is the most frequent cause of multiple fractures in children in this age group, there are other pathologies that can present this way. This includes various forms of osteogenesis imperfecta. We discuss the clinical presentation, radiological findings and differential diagnosis of these two conditions.

Materials and methods: Retrospective case notes review of patients presented at a district general hospital and at a tertiary referral centre in the United Kingdom over the past 5 years are presented with clinical details and imaging findings.

Results: Differentiating between non accidental trauma and osteogenesis imperfecta can be difficult. We present a few radiological clues that can help in the diagnosis and management of these conditions.

Conclusions: There are a few conditions which present with multiple fractures in infants, of which non accidental trauma and osteogenesis imperfecta are important. Radiological findings can be subtle and difficult. Accurate and timely diagnosis helps in the appropriate management of these conditions.

Neuroradiology

Poster #: PO51

Congenital craniofacial deformities: Spectrum of multidetector computed tomographic findings

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Purpose: To present the multidetector CT imaging findings of different types of congenital craniofacial deformities.

Materials and methods: Twenty children presenting clinically with different types of congenital craniofacial deformities were studied with axial CT. All cases were examined by multidetector CT scanners. Three dimensional and multiplanar sagittal and coronal reconstructed images were obtained. Four of these cases were examined by magnetic resonance imaging (MRI) for asessment of associated intracranial anomalies.

Results: We will present in some detail the different CT imaging findings in these 20 children. Based on the CT and clinical findings we classified these patients into the following groups: (1) Eleven patients with craniosynostosis, 6 of whom were diagnosed to be non-syndromic including 2 cases of scaphocephaly, 1 case of trigonocephaly and 3 cases of plagiocephaly. The other five patients were proved to be syndromic, four were diagnosed as Apert syndrome and one was diagnosed as Crouzon syndrome. (2) Four cases of facial clefts, one was diagnosed as frontonasal dysplasia associated with agenesis of corpus callosum and interhemispheric lipoma as confirmed by MRI. Another case was associated with hypotelorism and was diagnosed as semilobar holoprosencephaly by MRI. The third patient had a nasal cleft, and the fourth had a premaxillarycleft. (3) Five patients with branchial arch anomalies included a case of hemifacial microsomia, a case of Treacher Collins syndrome, two cases of mandibular hypoplasia and one patient with microtia.

Conclusions: Multidetector CT is considered nowadays to be the modality of choice in evaluating patients presenting with congenital craniofacial deformities. This allows for multiplanar reformatting and three dimensional reconstruction which are crucial for accurate diagnosis and eventual surgical management.

Poster #: PO52

SISCOM and epilepsy surgery: A review of selected cases

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Purpose: To present selected cases from our institution involving children with refractory epilepsy who have undergone surgical resection of lesions based on SISCOM (Subtraction Ictal SPECT Co-registered to MRI) and EEG findings.

Materials and methods: SPECT imaging studies were performed with a low-energy, high-resolution, dual-head camera using 99mTc-ECD. Images were reconstructed by filtered back-projection. The interictal studies were performed after a 24-h seizure-free period. For ictal studies, patients underwent continuous video-EEG monitoring and the isotope was injected immediately after the clinical onset of a seizure. Images were acquired 30 min after the injection of ECD. MR studies used for SISCOM were obtained with a 3D volumetric T1-weighted sequence. The procedure consisted of three steps: SPECT-MRI coregistration, ictal–interictal SPECT subtraction, and fusion of MRI and subtracted SPECT images. SISCOM-identified lesions were considered for neurosurgical resection as part of a multidisciplinary management approach. Post-surgical outcomes were correlated with original, conventional MR imaging findings in order to include patients with no demonstrable lesions, single lesions, and multiple lesions.

Results: Selected cases demonstrate the utility of SISCOM for identifying seizure foci, including patients with successful surgical outcomes and others with atypical results.

Conclusions: SISCOM is a helpful tool in identifying seizure foci in children with intractable epilepsy, potentially guiding surgeons to lesions which, when resected, can reduce seizure activity and therefore improve patients' quality of life.

Poster #: PO53

Pediatric cerebral sinovenous thrombosis: Imaging spectrum and diagnostic challenges

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Purpose: Cerebral sinovenous thrombosis (CSVT) is an uncommon but serious cause of stroke in the pediatric population. Imaging findings are variable, and there are many pitfalls in imaging analysis as well as diagnostic challenges specific to the pediatric age group in this condition. We present a single center retrospective analysis of the imaging findings in pediatric CSVT.

Materials and methods: Cases of pediatric CSVT (birth–18 years) were identified by searching radiology reports for the terms "cerebral venous thrombosis" and "dural sinus thrombosis" from January 2000 until September 2007. Fifty-one cases of CSVT were identified in this interval. This group formed the core population for imaging analysis. Other historical cases, as well as examples of diagnostic pitfalls were also collected for demonstration purposes.

Results: There were 31 males and 20 females in the study population. Age at presentation: 8—neonatal, 11—1 month–2 years, 7—>2–6 years, and 25—>6 years. There were associated brain parenchymal abnormalities in 21 cases (41%), including parenchymal hemorrhage (14), edema (19), and enhancement (3). Diagnostic modalities used for initial work-up included CT (42), MRI (17), and US (2). Confirmatory tests included MRI+C (16), CT+C (20), CT-venography (12), and MR-venography (25). Multiple tests were routinely used in each patient for a complete diagnostic assessment.

Conclusions: The entire imaging spectrum of CSVT in the pediatric population is reviewed including findings on MRI, MRV, CT-

venography, MR spectroscopy, MR perfusion, and diffusion weighted imaging. Age specific imaging issues are addressed and the application of various imaging techniques is presented. Imaging modality and technique recommendations are made based upon our review.

Poster #: PO54

Normal deep venous drainage in vein of galen aneurysmal malformations: Description and clinical significance

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Purpose: The existence of normal deep venous drainage through the vein of Galen in cases of vein of Galen aneurysmal malformation (VGAM) remains debated. Three observations of galenic drainage of deep cerebral veins in children with a VGAM are documented, and the clinical implications of such drainage are ilustrated with an additional case complicated by cerebral hemorrhage.

Materials and methods: Case 1: newborn successfully treated for a VGAM by transarterial embolization. Follow-up MRI obtained at age 2 documents normal galenic drainage of an internal cerebral vein (ICV). Case 2: 3-year-old boy successfully treated for a VGAM by transarterial and staged transvenous embolizations. Follow-up MRI obtained at age 5 documents normal galenic drainage of both ICVs. Case 3: 8-year-old boy treated at birth for a VGAM with cardiac failure, presenting with a remote temporal arteriovenous fistula draining into the residual VGAM through a basal vein of Rosenthal. Case 4: newborn with a VGAM resulting in cardiac and respiratory failure, stabilized by four transarterial procedures (three during first 10 days, one at 3 months). Onset of severe pulmonary hypertension at 6 months of age, leading to successful transvenous embolization of the residual VGAM. Basal ganglia hemorrhage 2 days after the procedure resulting in death.

Results: Case 1 and 2 document normal galenic drainage of ICVs on follow-up MRI after successful treatment of a VGAM. Of note, these veins were not seen at the time of therapy. Case 3 documents a basal vein draining a separate arteriovenous fistula into a residual VGAM. Case 4 shows a basal ganglia hemorrhage occurring 2 days after successful transvenous obliteration of a VGAM, consistent with hemorrhagic transformation of deep venous infarction.

Conclusions: A communication between a deep cerebral vein and the vein of Galen is unequivocally demonstrated in three cases of VGAM. We believe that the hemorrhagic infarct occurring in the fourth case results from impairment of such deep venous drainage by rapid transvenous occlusion of the VGAM, and illustrates a potential pitfall of this therapeutic approach.

Disclosure: Dr. Gailloud has indicated that he is a consultant and receives an honoraria from Cordis Neurovascular.

Poster #: PO55

Probability templates for spatial normalization and segmentation of infant brain

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Purpose: Spatial normalization of infant brain imaging data based on adult reference data in either the Talairach or MNI coordinate frame may not be appropriate due to the developmental differences between the infant and adult brain. Therefore we set out to construct an infant brain template and a priori brain tissue probability maps that can be used for spatial normalization and segmentation of infant brain images.

Materials and methods: High resolution T1-weighted, 3D brain images were acquired in 76 sedated infants (9–15 months) being scanned clinically for auditory neuropathy and other indications, using the MPRAGE method on a 3T Siemens MRI scanner. IRB approval was obtained for use of the image data. Grey matter (GM) white matter (WM) and CSF were separated using segmentation scheme that does not require any prior information about the distribution of these tissue types in the infant brain. By averaging the normalized, segmented and T1 weighted images, an infant template was constructed in SPM5 compatible format.

Results: Infant brain image templates showing probability distributions for GM, WM and CSF will be presented. Comparisons between the default SPM5 adult templates versus the new infant templates will be presented.

Conclusions: Segmentation of infant brain images based on a priori information from adult brain data may lead to errors due to the substantial differences in tissue distribution and tissue classes, as well as their composition and signal characteristics. The segmentation approach taken here for infant T1W brain images without the use of adult prior probability maps provides de novo probability maps for GM, WM, CSF distributions in infant brain images. These templates can now be used in SPM5 as prior probability distributions for segmentation and normalization of subsequent infant brain images.

Poster #: PO56

Neural substrate differences in language networks and associated language-related behavioral impairments in children with TBI

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Purpose: This study investigates abnormalities in language-related neuronal circuitry in pediatric patients with traumatic brain injury (TBI) using functional magnetic resonance imaging (fMRI) and neurocognitive testing of language functions.

Materials and methods: Eight children with TBI and a comparison group of nine children with orthopedic injuries (OI) participated in an fMRI study of covert verb generation (VG). VG was performed in a block-periodic design with 30 s intervals of verb generation interleaved with 30 s control intervals of self-paced bilateral finger tapping. During the active epochs, the subjects silently generated appropriate verbs, such as "throw" or "kick", to aurally-presented nouns such as "ball". Scanning for this study was performed an average of 2.5 years post TBI using a 3.0-T MRI scanner and EPI imaging.

Results: The composite activation maps were computed for both the OI and TBI groups using the general linear model with random effects for the VG task. Both groups displayed strong left hemispheric dominance of frontal and temporal language activation. However, the TBI cohort's activation pattern in the right superior temporal gyrus and the right middle temporal gyrus differed significantly from that in the OI group. Specifically, activation in the TBI group was strongly concentrated in relatively few language-related areas compared to the OI cohort. The Z-score difference maps showing positive and negative differences between the two groups will be presented. The TBI group demonstrated significantly greater activation than the controls in the

left frontal and pre-frontal regions. We found significant associations between the BOLD signal activation and performance on language specific neuropsychological tests (NEPSY verbal fluency scores, Verbal IQ) and Glasgow Coma Scale scores (GCS). Correlation maps between the fMRI results and the language scales will also be presented.

Conclusions: Findings suggest that children with TBI experience significant lasting alterations in brain activation patterns in the language circuitry compared to a group of children with OI.

Poster #: PO57

Delayed development of a middle cerebral artery pseudoaneurysm after acute dissection in a 6-month-old girl: Imaging and endovascular therapy

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Materials and methods: A six-month-old girl presented with focal seizures and left hemiparesis. MRI/MRA disclosed severe narrowing of the M1 segment of the right middle cerebral artery (MCA) suggestive of a dissection or an embolic event, and restricted diffusion in the right basal ganglia. The work-up for an embolic source remained negative. The patient was placed under daily aspirin, with favorable evolution leading to near complete recovery of the left sided hemiparesis. Follow-up MRI/MRA at 6 months disclosed the formation of an aneurysmal lesion at the site of the MCA stenosis. Catheter angiography confirmed the presence of a 3.5-mm aneurysm, and showed severe stenosis of the M1 segment with collateral filling of the distal MCA from the right anterior cerebral artery. Endovascular treatment of the aneurysm with detachable microcoils was performed considering the high cumulative lifetime risk of aneurysm rupture in this patient. Endovascular therapy was preferred to surgical clipping in view of the complex collateral circulation surrounding the lesion. There was no procedural complication.

Conclusions: Spontaneous intracranial artery dissection is rare in children. The reported case illustrates the typical evolution of an MCA dissection with delayed formation of a pseudoaneurysm. This potential evolution stresses the importance of obtaining follow-up MRA or CTA in cases of intracranial dissection, even in the absence of early aneurysmal lesion. In the reported case, MRA revealed the delayed formation of a pseudoaneurysm 6 months after the initial ischemic event. Coil embolization of the pseudoaneurysm was performed uneventfully, leading to complete obliteration of the lesion without immediate or delayed complication at the 2-month follow up visit. This observation supports the use of coil embolization as a safe and effective alternative therapy for intracranial aneurysm in very young children. Long-term follow-up of children treated by endovascular means is needed before this therapeutic approach can be recommended as a first line option.

Poster #: PO58

Reliability of fMRI for studies of language recovery and development

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Purpose: To quantify the reliability of fMRI as a tool for mapping neural reorganization and development by assessing the inter-scan and inter-subject variability of language activation patterns associated with verb generation and semantic/tone decision tasks in healthy controls and aphasic patients with left middle cerebral artery (LMCA) infarcts.

Materials and methods: Variability measures are reported for fMRI activation patterns associated with a verb generation (VG) task and a semantic/tone decision (SDTD) task in four healthy controls and four post-recovery stroke subjects. A series of ten fMRI scans was performed for each task for each subject (40 control scans each for SDTD and VG; 1 stroke subject—5 and 6 scans for SDTD and VG, respectively; 35 and 36 total stroke subject scans for SDTD and VG, respectively) using a 4-T MRI scanner. Reliability was assessed on a voxel-by-voxel basis using an intraclass correlation coefficient (ICC) that was computed across all subjects and all trials for VG and SDTD activation patterns.

Results: The patterns of reliable activation for the VG and SDTD tasks correspond well to those regions typically activated by these tasks in healthy and aphasic subjects. Reliability coefficients for activation were consistently high ($R \sim 0.8$) for individual tasks among both control and aphasic subjects. These voxel-wise measures of reliability highlight regions of low inter-scan variability within language circuitry (i.e. regions that the language paradigm consistently activates or doesn't activate over successive scans for a given subject).

Conclusions: One hurdle to longitudinal fMRI studies of neuroplasticity and brain development is the accurate distinction between variability arising from inter-scan and inter-subject sources and variability arising from the mechanisms of functional reorganization. This study shows excellent reliability of the fMRI language activation patterns in healthy and stroke subjects. These quantitative measures of inter-scan variability support the proposed use of these fMRI paradigms for longitudinal mapping of neural reorganization and development of language.

Poster #: PO59

Pediatric infratemporal fossa lesions: Imaging features and approach to diagnosis

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Purpose: Infratemporal fossa neoplasms usually present late due to relative inaccessibilty of this region. Many lesions are insidious and symptoms can be vague and referrable to other structures. Treatment depends on imaging findings, pathology and staging of the tumor. Accurate delineation of the relationship of the lesion to skull base foramina, intracranial structures, orbit, paranasal sinuses and nasopharynx assists surgical planning for combined intracranial and skull base procedures. Understanding of various skull base approaches and reconstructive procedures helps in interpreting post treatment imaging findings.

Materials and methods: A review of the imaging database over the last 3 years at a academic centre was used to identify infratemporal fossa lesions. Key imaging features useful in formulating a diagnosis were identified.

Results: Pediatric patients present with a variety of tumors in the infratemporal fossa ranging from benign vascular malformations, and nasopharyngeal fibromas to malignant rhabdomyosarcoma and undifferentiated sarcomas. Some lesions with aggressive imaging features have a relatively benign prognosis like desmoid and myofibroblastic tumors.Some lesions are confined to the infratempotral

region and others invade the adjacent structres, extending intracranially through the skull base foramina. *Contiguous lesions* arise from surrounding areas and *primary tumors* arise from the fossa itself. Metastatic tumors are rare. Lesions that 'push' adjacent structures are considered less aggressive than 'bone-destroying' lytic lesions. Tumor enhancement patterns, importance of assessing the signal intensity of lesions to help formulate a diagnosis and potenial pitfalls are illustrated. Neurovascular involvement and perineural spread of lesions like adenoid cystic carcinomas should be actively looked for using multiplanar reformats. Clinical course of some lesions with post treatment imaging findings is described.

Conclusions: Imaging plays an important role in management of infratemporal fossa lesions. A systematic approach and multidsicplinary cooperation is a must to ensure accurate diagnosis and optimal managment.

Poster #: PO60

Post-treatment brain MRI in pediatric tumors: A practical approach

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Purpose: We have reviewed the brain MRIs performed by children affected with tumors during the period 2004–2007 to understand if we can establish a common protocol for different tumor hystotypes.

Materials and methods: One hundred forty-eight post-treatment brain MRIs performed by 66 patients affected with tumors were re-evaluated. They were performed with the same 1.5 T scanner (Philips, Eclipse). 131 included Diffusion weighted images and 47 included ^{1}H-MR spectroscopy.

Results: We divided the MRIs in subgroups consisting in post-surgical treatment, post-chemiotherapy and post-radiotherapy. The MRIs showed the total or partial removal of the intracranial mass, the recurrence of the disease, the presence of metastasis, the direct effects of the therapies and the secondary effects (e.g. infections).

Conclusions: In pediatric oncologic patients, a standard protocol for the post-treatment MRI must always include the use of contrast media, since some of the secondary effect (e.g. angioitis, infections) may be detected only in post-contrast images. DWI should also be included in the protocol to reveal subtle abnormalities (e.g. early stages of infections or PRESS). MRS is usually performed in cases of suspected recurrence of the tumor. We will show the variety of patterns that is possible to find in these patients.

Poster #: PO61

Incidence of intracranial hemorrhage in patients with coagulopathy and cerebral venous sinus thrombosis

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Purpose: To evaluate the incidence of intracranial hemorrhage in patients with coagulopathy and intracranial venous sinus thrombosis.

Materials and methods: Retrospective chart and film review of patients at our institution with discharge diagnosis of coagulopathy or intracranial venous sinus thrombosis from August 1997 to August 2007. Patients with cranial CT or brain MRI were evaluated for the presence of intracranial hemorrhage. If hemorrhage was present, it was classified, associated findings were described, and correlation with clinical history was made. Patient ages ranged from 7 days to 19 years. In the coagulopathy group (99 total examinations), the age breakdown was as follows: 13 (0–1 years), 32 (1–5 years), 32 (6–10 years), 14 (11–15 years), and 8 (16–19 years). In the intracranial venous sinus thrombosis group, (36 total examinations), the age breakdown was: 20 (0–1 years), and 16 (1–5 years).

Results: A total of 48 patients with the diagnosis of coagulopathy had cranial CT imaging and/or brain MRI (99 examinations). Five patients had a diagnosis of intracranial venous sinus thrombosis (36 examinations). Two patients in the coagulopathy group had intracranial hemorrhages (one epidural, one subdural). The epidural hematoma was focal and occurred after a 7-year-old patient fell off a bicycle. The subdural hematoma was bilateral and posterior in a 7-day-old with high fever and group B streptococcal meningitis. Whether the subdural hematoma occurred during delivery or from other etiology could not be determined. In the intracranial venous sinus thrombosis group, one patient had hemorrhagic infarcts, and no patients had subdural, epidural, or intraventricular hemorrhage.

Conclusions: Coagulopathy patients had a low incidence of intracranial hemorrhage (4.2%). Intracranial venous sinus thrombosis patients had a 20% incidence of hemorrhagic cerebral infarction, with a 0% incidence of extraaxial hemorrhage.

Poster #: PO62

Where do these cystic masses, fistulae and sinuses in the neck come from?

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Purpose: To review the embryology of the branchial apparatus and primitive pharynx and the derived developmental anomalies.

Materials and methods: Detailed description of the embryological development of the branchial apparatus and primitive pharynx as well as the CT and/or MRI appearance of various developmental anomalies.

Results: Some of the most frequently encountered cystic neck masses in the pediatric population arise from maldevelopment of the branchial apparatus and primitive pharynx. These embryological structures form during early gestation and give rise to many cervical structures. The most commonly encountered developmental anomalies include cystic lesions of the second branchial clefts and the thyroglossal duct. Less commonly encountered lesions include cysts of the first, third and fourth branchial clefts, thymic cysts and branchial fistulae and sinuses in general. It is noteworthy that these developmental anomalies often manifest themselves upon infection and therefore knowledge of their imaging characteristics and typical locations is important as it may facilitate diagnosis and impact patient management.

Conclusions: (1) Review the embryological development of the branchial apparatus and primitive pharynx. (2) Discuss the imaging characteristics of various cysts, fistulae and sinuses arising from their maldevelopment.

Poster #: PO63

Comparison between event-related and block-periodic fMRI data from a story processing task in children

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Purpose: Processing an aurally-presented story is supported by a specific network of auditory and language-processing brain regions that changes during development. Previous fMRI studies examined this network in children, using a block-periodic (BP) design contrasting short stories with tone sequences. The present study compares the BP story paradigm to an event-related (ER) version that adds on-line performance monitoring and a sparse acquisition paradigm that eliminates scanner noise during auditory presentation.

Materials and methods: Nineteen children (ages 10–12) completed both BP and ER versions of the story task. The BP version consisted of alternating 30-second blocks of story presentation and tones. The ER version presented two-sentence story segments, comprehension questions, or 5-s tone sequences, with fMRI acquisitions between stimulus presentations. Scanning was performed on a 3T MRI scanner with a gradient-echo EPI method. MRI data was processed using CCHIPS© to compute group activation maps for each paradigm for all 19 participants. We also computed a measure of effect size to compare the effectiveness of each in generating task-related activation.

Results: The BP and ER story processing tasks both elicited activation in primary auditory cortex (A1, BA41) and superior temporal gyrus (BA22) bilaterally. The ER version of the task showed a left dominant pattern of activation in temporal and parietal areas (BA22, 3739) and additional areas of activation in left inferior frontal and dorsolateral prefrontal cortex (BA9,45,46) and the anterior portion of posterior cingulate cortex. Effect size analysis suggested that the ER paradigm generated greater magnitude activation.

Conclusions: Patterns of activation for story processing in children are similar in BP and ER paradigms, but added areas of activation in the ER task were likely associated with maintaining story segments in memory and increased attention across acquisition intervals in order to construct the complete story. More effective activation in the ER paradigm may be due to this greater attention to task and elimination of scanner noise.

Poster #: PO64

Neural activity in language areas reflects verb generation performance in children

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Purpose: Covert verb generation is a convenient functional MRI (fMRI) task for mapping of language areas in pediatric neurosurgery patients. Because the covert responses are not monitored explicitly, the relationship between fMRI activation and task performance is unknown. Our study compared the activation from this covert task with a version of the Verb Generation task including overt responses.

Materials and methods: Fifteen children, ages 11–13, were presented with a series of concrete nouns and were prompted to respond with related verbs. The paradigm alternated between 30-s blocks of covert response, overt response, and a control task of overt noun repetition. A clustered fMRI acquisition method allowed for recording of overt responses during quiescent scanner intervals. Individual covert generation versus noun repetition (covert-rep) and overt generation versus noun repetition (overt-rep) contrast *t*-maps were generated using the General Linear Model (GLM) in Cincinnati Children's Hospital Image Processing Software (CCHIPS©). GLM regression analysis determined correlations between contrast *t*-scores and the mean number of verbs generated overtly for each subject, modeling full-scale IQ as a confounding factor.

Results: For the covert-rep contrast, the left inferior frontal gyrus (LIFG, BA 44) and left posterior superior temporal gyrus (LSTG, BA 22) showed positive correlations with verb generation performance (LIFG: r^2=.62, p<.001; LSTG: r^2=.53, p<.003). The overt-rep contrast also showed positive correlations in both LIFG (r^2=.31, p <.039) and LSTG (r^2=.36, p<.023).

Conclusions: These results suggest that increased Verb Generation performance leads to increased fMRI activation in language areas, independent of inter-subject differences in IQ. In addition, the relationship between fMRI activation and Verb Generation performance was similar in the overt and covert conditions. This suggests that overt performance (which may be collected outside of the scanner) may be used as an effective estimator of covert performance.

Poster #: PO65

Neurofibromatosis type I and II: A pictorial review of the CNS manifestations in pediatric patients

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Purpose: Review the epidemiology and pertinent clinical considerations of NF-1 and NF-2. Discuss the various methods of evaluating the CNS in children suspected of or diagnosed with NF-1 and NF-2. Review the characteristic CNS findings on CT and MRI imaging studies in children with NF-1 and NF-2.

Materials and methods: Cross-sectional neuroimaging studies in 62 patients with Neurofibromatosis I or II were retrieved from our institution's electronic archives. Imaging findings in the brain, cranial nerves and spine were reviewed and analyzed.

Results: Neurofibromatosis (NF) is the most common of the phakomatoses yet many affected individuals go undiagnosed as children. At least eight different forms of neurofibromatosis have been described with neurofibromatosis type 1 (NF-1) and neurofibromatosis type 2 (NF-2) regarded as the most common and best understood. Both are autosomal dominant disorders with increased risk of malignancy however they are clinically distinct diseases. Although both NF-1 and NF-2 may affect many organ systems, central nervous system involvement tends to be most frequent and often times the most disabling. A thorough understanding of the common CNS manifestations of NF-1 and NF-2 in children is necessary to facilitate diagnosis and management.

Conclusions: This poster will provide a concise review of the epidemiology and pertinent clinical considerations of NF-1 and NF-2 and discuss the current recommended radiographic standards used for evaluating the CNS with a pictorial review of the characteristic CNS findings on CT and MRI in these patients.

Nuclear medicine

Poster #: PO66

PET-CT of the normal spinal cord during childhood

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Purpose: To characterize the morphologic and functional appearance of the normal spinal cord in children using FDG PET-CT.

Materials and methods: We retrospectively reviewed axial PET-CT images of 128 consecutive children treated at our cancer hospital, from January, 2003 thru April, 2007 and assessed FDG activity in the pons and spinal cord at three cervical levels, three thoracic levels and two lumbar levels. All PET-CTs were performed before initiation of chemotherapy or radiation therapy. Patients with spinal disease were excluded. FDG activity was subjectively graded as minimal if ≤ paraspinal muscle, moderate if > but ≤3 times muscle or intense if >3 times muscle activity. Regions of interest were drawn around the pons and cord at each level and the maximum SUV determined. Patients were grouped by age; group 1; 0 thru 4 years, group 2; 5 thru 9 years, group 3; 10 thru 14 years and group 4; 15 thru 21 years. To test for differences between age groups for the subjective grade and SUV in the pons and each spinal cord level we used the Kruskal–Wallis test. The level for alpha was set at 0.0046 based on the Bonferroni correction for multiple comparisons.

Results: Of the 54 girls and 74 boys included, there were 16 patients in group 1, 19 in group 2, 33 in group 3 and 60 in group 4. Subjective grade and SUV values were highest in the pons and higher in the low cervical and low thoracic areas than elsewhere, in all age groups. There was no difference in subjective grade of the pons or lumbar area between age groups. Subjective grade significantly increased with age in the cervical and thoracic cord (all $P \leq 0.0005$). There were significant increases in SUV measurements in the pons and all spinal cord levels with increasing age (all $P \leq 0.0008$).

Conclusions: In children, the spinal cord appears to become more metabolically active with increasing age. On PET imaging the normal spinal cord can appear very intense in the low cervical and low thoracic areas, probably because the brachial and lumbar nerve plexuses arise at these levels.

Oncology

Poster #: PO67

Unusual presentations of neuroblastomas mimicking other disease entities

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Purpose: We present four cases of biopsy proven neuroblastoma/ganglioneuroblastoma arising from the neck, chest, abdomen and pelvis with unusual clinical and radiologic characteristics that mimic other disease entities.

Materials and methods: These are four cases of biopsy proven neuroblastomas/ganglioneuroblastomas that show imaging characteristics mimicking other disease entities.

Results: Neuroblastoma is the most common extracranial solid tumor in children. In the US, it represents 8% of all childhood cancer with approximately 650 new cases each year. It has been described as the great mimicker because of its various clinical manifestations related to the primary tumor site, metastatic spread, metabolic end products, and paraneoplastic syndromes. We present four cases of biopsy proven neuroblastoma/ganglioneuroblastoma arising from the neck, chest, abdomen and pelvis with unusual clinical and radiologic characteristics that mimic other disease entities. Case 1 is a 14-month-old female with enlarging right supraorbital and left lateral neck mass that was thought to represent multiple hemangiomas by US and CT. Case 2 is a 10-year-old female complaining of myoclonus and fever with clinical and chest X-ray findings suggestive of empyema. Case 3 is a 5-year-old asymptomatic male with an incidental left flank mass that was diagnosed as an intrarenal mass by US and CT compatible with Wilm's tumor. Case 4 is a 24-year-old female complaining of sudden lower extremity paralysis. US and CT showed a complex mass with calcifications and necrosis as well as sacral bone involvement. It was initially considered to be a malignant teratoma.

Conclusions: Neuroblastoma is a great mimicker since it causes different clinical manifestations and radiologic characteristics that could imitate other disease entities.

Poster #: PO68

Diagnostic imaging of malignancy in the adolescent population: A pictorial review

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Purpose: Review the role of diagnostic radiology in the evaluation of the distinctive spectrum of malignancies in the adolescent population. Illustrate through a multimodality approach the most common radiographic features of malignancy in adolescents through current imaging techniques and explore emerging technologies and methods for the evaluation of neoplasms.

Materials and methods: Multimodality images of pathology proven cases of the most common malignancies in adolescent patients (age 15- to 19-year-olds) will be collected from the Department of Radiology at the Children's Hospital of Philadelphia.

Results: This exhibit is a pictorial review interested in demonstrate the most common cancers in the adolescent population and its diagnostic imaging evaluation. No new scientific data will be generated from this exhibit.

Conclusions: The spectrum of malignancy among adolescents follows a distinctive spectrum from younger patients and adults. Understanding of these differences by the viewer and the current methods for assessment of neoplasms would allow a more specific and precise evaluation of malignancies in this population.

Poster #: PO69

The imaging spectrum of hemophagocytic lymphohistiocytosis: New MRI findings

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Purpose: Hemophagocytic lymphohistiocytosis is a rare disorder with a high morbidity and mortality rate. The radiologic features are important to know in order to make a timely diagnosis and to aggressively treat the disease.

Materials and methods: We studied images of five patients ranging from ages 4 to 18 years old diagnosed with hemophagocytic lymphohistiocytosis during 2005–2007. The most recent literature regarding hemophagocytic lymphohistiocytosis was reviewed.

Results: We encountered hemophagocytic lymphohistiocytosis with the previously described features of hepatosplenomegaly, gallbladder wall thickening, adenopathy, ascites, and cerebral volume loss. Additionally we describe for the first time abnormal MRI findings involving the bone marrow as well as renal abnormalities (as seen on CT and MR).

Conclusions: Radiographic findings seen with hemophagocytic lymphohistiocytosis are important to recognize in order to suggest the diagnosis in a timely manner. MRI of the abdomen can be a useful tool to evaluate for many of the abnormalities associated with hemophagocytic lymphohistiocytosis that include newly described abnormalities in bone marrow and kidneys.

Poster #: PO70

Estimation of cumulative effective doses from diagnostic and interventional radiological examinations in pediatric oncology patients

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Purpose: Extensive imaging is used in the diagnosis and surveillance of pediatric oncology patients, and is central to patient management. However, serial high dose examinations may lead to a significant cumulative radiation exposure. As survival rates for childhood malignancy continue to improve, the long term sequelae related to all aspects of diagnosis and management are of increasing importance to adult survivors. Our aim is to estimate cumulative effective doses from radiological examinations in pediatric oncology patients.

Materials and methods: Retrospective review of the imaging history for 5 years following diagnosis in 150 children (30 each of 5 subgroups—leukemia, lymphoma, brain tumors, neuroblastoma and assorted solid tumors) was performed using PACS and available departmental radiation dose records. All procedures involving ionizing radiation were recorded—radiographs, fluoroscopy, nuclear medicine, CT and interventional procedures. Age-specific effective dose estimates for each examination were derived from institutional data and the pediatric radiological literature. Cumulative effective dose estimates were calculated.

Results: For the whole cohort, estimates of cumulative effective doses ranged from <1 to 642 mSv, with a median of 61 mSv. CT and nuclear medicine were the greatest contributors; CT comprised 30% of examinations but 52% of the total cumulative effective dose, and nuclear medicine 20% and 46% respectively. There was considerable variability between tumor subgroups; cumulative effective doses were highest in the neuroblastoma (median 214 mSv, range 36–492 mSv) and lymphoma (median 191 mSv, range 10–642 mSv) groups, and lowest in leukemia patients (median 5 mSv, range 0.3–58 mSv).

Conclusions: The cumulative effective dose from imaging in pediatric oncology patients varies considerably with diagnosis, individual clinical course and imaging modality employed. An increased awareness may promote strategies to reduce the radiation burden to this population.

Poster #: PO71

Estimated cumulative radiation dose from PET/CT in pediatric patients with malignancies—A 5-year retrospective review

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Purpose: To estimate the cumulative radiation dose from PET/CT studies to pediatric patients with malignancy.

Materials and methods: Two hundred forty-eight clinical PET/CT studies performed on 78 patients (50 males/28 females, 1.3 to 18 years of age between December 2002 and October 2007) were reviewed. Effective dose from CT was estimated using the ImPACT Patient Dosimetry Calculator (http://www.impactscan.org) with patient specific scan parameters. Effective dose from PET was estimated using the OLINDA software (Vanderbilt University) with patient specific FDG doses. Dose estimates were adjusted for patient age according to published values.

Results: The average number of PET/CT studies was 3.1 per patient (range 1–14).The average effective dose of an individual CT study was 20.3 mSv (range 2.7–54.2), of PET study was 4.6 mSv (range 0.4–7.7) and of PET/CT study was 24.8 mSv (range 6.2–60.7). The average cumulative dose per patient from CT studies was 64.4 mSv (range 2.7–326), from PET studies was 14.5 mSv (range 2.8–73) and from PET/CT studies was 78.9 mSv (range 6.2–399). Radiation doses varied significantly depending on the number of studies as well as the number of additional CT scans performed. 58% (45 patients) received no radiation therapy and 42% (33 patients) received radiation therapy. Of all patients, 27% (21 patients) received >100 mSv cumulative dose; this consisted of 9% (7 patients) with no radiation therapy, and 18% (14 patients) with radiation therapy.

Conclusions: The radiation exposure from PET/CT studies may be negligible in patients who receive radiation therapy, but is considerable in patients who do not receive radiation therapy. The ALARA principle must be applied either by reducing the CT tube current or by considering alternative diagnostic approaches such as limited CT scan length or PET/MRI. PET/CT remains an important non-invasive diagnostic, staging, and surveillance modality for certain pediatric malignancies. The decision to utilize PET/CT should be made with particular awareness to the cumulative radiation dose and its overall benefit.

Other

Poster #: PO72

The imaging spectrum of pediatric coccidioidomycosis

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Purpose: *Coccidioides immitis* and *Coccidioidis posadasii* are endemic in the southwestern United States as well as regions of Mexico, Central America, and South America. Although infection may be asymptomatic in approximately 60% of cases, these closely related thermally dimorphic fungi may also present with a broad spectrum of significant clinical and imaging findings in the pediatric population. The purpose of this display is to present an overview of the spectrum of imaging findings seen following infection by these organisms.

Materials and methods: A review of the literature and several cases from our institution was performed.

Results: A pictorial review of the biology of *Coccidioides immitis*/*posadasii* is provided and images have been selected to illustrate the presentation of the disease in the CNS, the chest, and the musculoskeletal system.

Conclusions: A diverse array of imaging presentations of *Coccidioides immitis*/*posadasii* may be seen in the pediatric population.

Poster #: PO73

Digesting the alphabet soup of immunodeficiencies

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Purpose: Most physicians leave medical school with a simplistic view of immunodeficiencies; either there are not enough B cells or not enough T cells. Occasionally there would be a patient with a deficiency of both, a patient with CVID (common variable immunodeficiency). Then in the late 1970s and early 1980s, an element of confusion was added to the mixture. It was the era of the AIDS epidemic, and although children were not the most commonly affected, they were also not immune from its scourges. Our lexicon was expanded to include such phrases as CD4 counts and anti-retrovirals. Throughout the next couple of decades, it was common to divide children with HIV/AIDS into those likely to be affected with PCP or those with a more indolent disease who were more likely to be affected by LIP. With the advent of effective therapy, the numbers of children in this country affected by HIV/AIDS has steadily decreased such that today, it is extremely rare to see a child in whom there had been vertical transmission of the disease. Instead, the "alphabet soup" of immunodeficiencies much more commonly includes PTLD (post-transplant lymphoproliferative disease) as children survive malignancies in greater numbers, but may develop complications of therapy. Additionally, there are immunodeficiencies which are being elucidated such as HLH (hemophagocytic lymphohistiocytic syndrome) and MAS (macrophage activation syndrome as well as X-linked lymphoproliferative syndrome. This exhibit will review the pathophysiology of each immunodeficiency and will illustrate examples of patients with each in an attempt to sort out characteristics unique to each and clinical and imaging features which are shared by the various diseases.

Poster #: PO74

Pediatric CT radiation dose: How low can you go?

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Purpose: The need to minimize pediatric radiation dose is widely accepted. A less discussed risk of pediatric CT radiation dose control is the risk to the patient of a false diagnosis consequent on utilizing a radiation exposure/dose that is too low. This non scientific pictorial display asks the viewer to gauge their own level of comfort in making a confident diagnosis from very low dose CT images.

Materials and methods: It is unethical to scan a patient twice, with different radiation doses. Retrospective review has identified a number of children who have had clinically indicated repeat CT scans within a short time period. These scans have had different scan parameters. We will present many paired images of the chest and abdomen, providing the scan parameters as an indication of dose. The viewer will be asked to form their own subjective opinion/feeling regarding their diagnostic confidence when viewing the lower dose image.

Results: Our desire is for each viewer to determine their own decreasing diagnostic confidence as CT radiation dose is lowered. Our hope is to make the viewers aware of the need to maintain a balanced perspective between the risks of using excessive radiation and the risks and consequences of making an erroneous diagnosis.

Conclusions: As radiation dose decreases, image quality is degraded. Reseach is hampered by our inability to ethically scan patients twice and by our inabilty to detrmine the rate of false positive or negative calls on very low dose images. Phantom studie help, but they cannot substitue for clinical sutuations.This exhibit draws attention to the reality that there is no clearly defined cutoff between adequate dose and too low dose. Our desire is for each viewer to determine their own decreasing diagnostic confidence as CT radiation dose is lowered. Our hope is to make the viewers aware of the need to maintain a balanced perspective between the risks of using excessive radiation and the risks and consequences of making an erroneous diagnosis.

Poster #: PO75

Critical values in pediatric radiology

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Purpose: To investigate the critical value lists at radiology departments of children's hospitals in the United States.

Materials and methods: Using the SCORCH database, the membership was asked to submit a listing of the critical values that they report at their institutions as a part of the Joint Commission requirements for this process. The lists were compiled and the responses collated to assess for similar findings.

Results: Twenty-three institutions responded with their lists. Fifteen or more sites had the following values listed: tension pneumothorax, feeding tube in airway, child abuse, pneumoperitoneum, impending brain herniation, intracranial hemorrhage. Ten or more sites had the following: malpositioned endotracheal tube or feeding tube, spinal cord compression, pneumopericardium, necrotizing enterocolitis (pneumatosis, portal vein gas). The following were listed at least five sites: airway foreign body, midgut volvulus, intussusception, testis/ovary torsion, bowel obstruction, vascular catheter malposition, unstable spine fracture, stroke, brain tumor, airway compression, pericardial tamponade, pulmonary embolus. All other diagnoses were cited in less than five sites' critical value lists. Most all sites had a disclaimer that the finding needed to be unsuspected, not previously reported, or not corrected on subsequent studies.

Conclusions: The lists of critical values reported by children's hospitals' radiology departments contain many of the same items. Using the results of this study, hospitals could verify the completeness of their lists. Adult organizations could use the results to insure the inclusion of diagnoses specific to pediatric radiology.

Poster #: PO76

The spectrum of imaging utilization and findings in children with MRSA

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Purpose: Community-acquired methicillin resistant staph aureus (MRSA) is being seen in increasing frequency in pediatric patients throughout the United States. Many of these patients undergo imaging and are admitted to the hospital for treatment and imaging of their infections. To our knowledge, imaging findings in children have not been described. *Objective*: To describe the imaging utilization and findings in children with MRSA.

Materials and methods: A retrospective review was performed of all MRSA culture positive inpatients and outpatients, over 4.5 years. Charts were reviewed to identify infection related imaging and the imaging findings were assessed.

Results: Three hundred sixty-five children had MRSA positive cultures from 1 January 2003 to 8 June 2007. Imaging was performed in 251. 122 patients had radiographs only; 91 ultrasound; 11 MRI; 9 CT scans; and 2 nuclear medicine scans. Imaging diagnoses included 218 patients with cellulitis (19 of these with abscess), 16 with osteomyelitis; 13 had pneumonia; and 4 with other diagnoses. Radiographs of the extremities generally showed extensive soft tissue swelling. Ultrasounds were generally performed for soft tissue infection and showed diffuse soft tissue edema with multiple tiny fluid collections consistent with aggressive cellulitis. MRI imaging was performed for concern of osteomyelitis and, when osteomyelitis was present, it was generally associated with a subperiosteal or soft tissue abscess. In patients with pneumonia, pleural effusions were always present on chest radiograph.

Conclusions: MRSA is a virulent infection often requiring imaging to evaluate the site and type of infection and to help guide surgical or medical treatment options. Cellulitis is the most common manifestation of this bacteria, but all areas imaged demonstrate an aggressive appearance of infection. With the exception of extremity radiographs, imaging of MRSA uniformly demonstrated fluid collections.

Poster #: PO77

Utility of intraoperative US prior to tongue reduction surgery in children

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Purpose: Midline tongue reduction surgery is performed in children to treat obstructive sleep apnea. This surgery involves debulking of the midline tongue tissue; if the precise location of the lingual arteries is known, the plane of reduction can extend farther laterally and a more aggressive debulking can be performed. We review the utility of doppler US of the tongue prior to tongue reduction surgery.

Materials and methods: Retrospective chart review of patients who underwent intraoperative tongue US prior to tongue reduction surgery for obstructive sleep apnea.

Results: Four patients (three males and one female) with mean age 14 years (range 5–19 years) underwent US prior to midline tongue reduction. Doppler US was used to accurately locate and map out the distance of the lingual arteries from midline as well as the depth of the arteries from the tongue surface. Because of this mapping, the surgeon was able to perform a more aggressive resection of midline lingual tissue in order to provide more effective clinical relief.

Conclusions: Intraoperative doppler US of the tongue helps to optimize clinical success of tongue reduction surgery in children by providing accurate localization of the lingual arteries prior to midline surgical resection.

Poster #: PO78

Effective dose from common imaging examinations: How we answered the IRB

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Purpose: The IRB requested help in evaluating clinical research protocols which include imaging that uses ionizing radiation. We sought to provide the IRB with a standardized framework for understanding radiation dose from common exams by providing: (1) a table of effective doses easily accessible to investigators, (2) a context for interpreting these data with respect to the risk of developing a radiation related cancer, and (3) recommendations for consent language.

Materials and methods: We identified the 15 most common exams using radiation. For each, we derived effective dose (ED) measurements using one of three sources: the literature for radionuclide exams, the Shrimpton et al. method using a CTDI phantom and 100 mm ionization chamber for CT exams, and a novel method of estimating ED for chest X-rays in children using anthropomorphic phantoms. ED were estimated for age groups: 1, 5, 10, 15 years and adult sized patients for each imaging study.

Results: Examinations evaluated included: neck–chest–abd–pelvis CT, chest–abd–pelvis CT, chest CT, chest–abd CT, abd–pelvis CT, hi-res chest CT, sinus CT, head CT, QCT, body and head PET/CT, bone scan, liver–spleen scan, MIBG scan, CXR and bone age. ED estimates were given in both mrem and mSv in tabular form and will be presented. Consent form language recommendations were given for three ED ranges: <300 mrem, between 300–5,000 mrem, and >5,000 mrem.

Conclusions: By determining the ED and risk estimates for the most common imaging exams involving radiation, we have provided our IRB and clinicians a reference for protocol and consent development. Such a comprehensive program will lend uniformity to IRB decision-making, allow the investigators to better prepare risk assessments and appropriate consent language in advance of submissions, and help to standardize the institutional approach to radiation exposure in clinical research. Having online access to these data through the IRB webpage will be helpful to investigators. The data can be updated in the future to include organ specific doses, equipment changes, and technique modifications.

Respiratory

Poster #: PO79

Evaluation of tracheobronchial cartilage with optical coherence tomography (OCT)

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Purpose: OCT is an interferometric technique. Polychromatic near-infrared light (peak wavelength 1,280 to 1,350 nm) generated by a superluminescent diode is split into imaging and reference fields. Images of biological structures are generated by analyzing interference between the recombined fields. Theoretical spatial resolution is

about 15 μm, but the imaging depth is limited to about 1.5 to 2 mm. The diameter of the OCT probe is 0.15 mm, meaning that it can be inserted through endoscopes or angiographic catheters. Evaluation of airway cartilage may be important in children with various causes of airway obstruction, especially stenosis of uncertain origin and tracheobronchomalacia. The standard technique is bronchoscopy, which is ideal for assessment of the airway mucosa, and for practical purposes is often sufficient for evaluation of airway cartilage. Bronchoscopy, however, cannot be used to measure the thickness of the cartilage, and views may be limited by granulation tissue related to endotracheal intubation or previous surgery. In addition, bronchoscopy distal to a tight tracheal stenosis may be hazardous. Cross-sectional imaging with CT or MRI does not currently provide adequate information about airway cartilage. We present early experience with the use of OCT for the evaluation of tracheobronchial cartilage in children.

Materials and methods: Prospective review of clinical use of OCT at a single children's hospital.

Results: OCT has been found to be most useful in two clinical situations. Firstly, when an infant has suspected long segment congenital tracheal stenosis but it is difficult to see the complete tracheal rings at bronchoscopy. (This is usually due to granulation tissue related to intubation.) Secondly, some children with tracheo-esophageal fistula have severe airway collapse because a segment of trachea has absence of cartilage rings. These patients must be distinguished from the common type of tracheomalacia seen in this condition, which responds well to aortopexy.

Conclusions: OCT is a promising technique for the evaluation of airway cartilage in children. It is not FDA approved for this indication.

Poster #: PO80

Correlation of adenoidal–nasopharyngeal ratio and palatine tonsil size in lateral soft tissue neck radiograph with polysomnogram among 2- to 8-year-old children symptomatic for sleep apnea

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Purpose: The objective is to determine the correlation of the adenoidal–nasopharyngeal ratio and palatine tonsil size measured in the lateral soft tissue neck radiograph with polysomnogram among 2- to 8-year-old children who are symptomatic for sleep apnea.

Materials and methods: Thirty-five children suspected with obstructive sleep apnea syndrome (OSAS) underwent polysomnogram and supine and upright lateral soft tissue neck radiographs. The adenoidal–nasopharyngeal ratio (ANR) advocated by Fujioka et al. was determined. The palatine tonsil size was obtained at its widest diameter. The apneic–hypopneic index (AHI) from the polysomnogram was correlated with the radiographic parameters.

Results: All of the patients had symptoms of sleep apnea (snoring, having trouble breathing or apneas witnessed by a parent/guardian). Twenty-seven were male and eight were female. The males and females are comparable in all variables ($p>0.05$). The mean age is 5 years old. Of the 35 children, 5 did not have hypopneic nor apneic episodes (AHI=0). Thirty patients had AHI ranging from 0.29 to 43.6 (mean± SD=11.19±10.85). There is no significant difference in the ANR with change in position ($p=0.906$). The palatine tonsil size is significantly increased in the supine view ($p\leq0.001$). Pearson's product moment correlation coefficient (r) showed significant positive correlations between the ANR and AHI in both upright ($r=0.544$, $p=0.001$) and supine positions ($r=0.351$, $p=0.039$). Positive correlation was also noted between the palatine tonsil size and the AHI (upright: $r=0.455$, $p=0.006$, supine: $r=0.529$, $p=0.001$).

Conclusions: Assessment of the adenoids and palatine tonsils using the lateral soft tissue neck radiograph is beneficial in the evaluation of 2- to 8-year-old children with symptoms of OSAS.

Poster #: PO81

Subpleural lung cysts in Down syndrome: Prevalence and association with other coexisting diagnoses

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Purpose: Although subpleural cysts are known to be associated with Down syndrome, the etiology and prevalence remains unknown. The purpose of this study is to to better define the prevalence and the location of subpleural cysts in patients with Down syndrome who have undergone past CT imaging and determine the association with prematurity, CHD, extracorpeal membrane oxygenation (ECMO), and chronic ventilator support.

Materials and methods: A review of the CT examinations of 25 patients with Down syndrome was performed to determine the presence, location, and distribution of cysts along with associated abnormalities. Charts were reviewed and coexistent diagnoses and past treatments were recorded.

Results: The prevalence of subpleural cysts was 36% with no significant association with CHD, ECMO, or chronic ventilator support. An association was found with in the two patients with a history of prematurity. The cysts were most commonly found in the anteromedial portion of the lung.

Conclusions: Subpleural cysts are common in Down syndrome and should not be confused with another pathologic process. An association with prematurity was found but the low number of patients in this study makes the connection uncertain. The etiology remains unclear but it has been hypothesized that the cysts are associated with lung hypoplasia.

Poster #: PO82

Pulmonary CT angiography for pulmonary embolism in children at two adult-centered community hospitals

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Purpose: Pulmonary CT Angiography (CTA) to rule out pulmonary embolism (PE) is ordered relatively infrequently at pediatric hospitals. At these centers, pediatric radiologists and pediatric emergency physicians are educated regarding the risks of radiation exposure in children, and the low incidence of pulmonary emboli in otherwise normal pediatric patients. Little has been reported regarding the use of pulmonary CTA in children visiting adult-centered hospitals, where CT utilization and radiation doses may differ from those at pediatric centers.

Materials and methods: An IRB-approved retrospective analysis of medical records was conducted at two separate adult-centered community hospitals. Patients aged 0–19 who underwent pulmonary

CTA were identified. Clinical information and test results were extracted. CTA radiation doses on representative pediatric patients at these institutions were calculated. One month of data is described here; 1 year of data will be reported at the national SPR meeting.

Results: In 1 month, a total of nine pulmonary CTA studies were performed on pediatric patients, aged 16 to 19. All studies were negative for PE. Prior to CT, D-dimer assays were obtained in two patients (22%), and chest radiography in four patients (44%). Seven CTA studies were on female patients (78%); five of these patients were either pregnant (two), recently post-partum (two), or taking oral contraceptives (one). Pneumonia was diagnosed by CT in two patients, neither of whom had undergone chest radiography. Radiation dose per CTA ranged from 4 to 8 mSv.

Conclusions: Preliminary results show a diagnostic rate of 0% for PE on chest CTA in nine pediatric-aged patients. Some of these studies may have been avoided with rigorous use of D-dimer screening and chest radiography, which appear to be underutilized in this setting. Pregnancy and oral contraceptive use play a dominant role in the decision to order pulmonary CTA in teenagers. To ensure the appropriate use of pulmonary CTA in children, education regarding radiation safety must extend from Pediatric Radiology and Pediatric Emergency Medicine into adult-centered medical practices.

Scientific electronic posters

Cardiovascular

Poster #: PO83

3D CTA and MRA in the evaluations of total anomalous pulmonary venous return (TAPVR)

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Purpose: We present an interactive computer exhibit to describe the utility of cardiac CTA and MRA with 3D reconstruction in the preoperative evaluation of patients with TAPVR, as well as to help the user better understand the complex anatomy, variations, and associated findings of TAPVR.

Materials and methods: Nine patients with TAPVR underwent CTA and/or MRA imaging of the chest with 3D reconstructions using a commercially available workstation. Based on the Darling classification, four had supracardiac TAPVR while two had infracardiac TAPVR and three were mixed or complex types of TAPVR. Other associated findings included: Truncus arteriosus, cor triatriatum and hypoplastic left heart syndrome. 3D reconstructions were instrumental to the pediatric cardiothoracic surgeons for presurgical planning.

Results: 3D rotating color coded labeled models of the CTAs and MRAs will be presented to better illustrate the complex anatomy. Three groups of models will be presented based on Darling classification: Supracardiac, Infracardiac and Mixed or complex types of TAPVR.

Conclusions: The exhibit will help the learner to be better equipped to identify the types of TAPVR as well as the variations and associated findings in these patients. The exhibit will help the viewer better understand the role of cardiac CTA and MRA in the evaluation of patients with TAPVR.

Poster #: PO84

3D CT in the evaluation of pulmonary atresia, pre and post repair in a cohort of pediatric patients

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Purpose: The objective of this study was to determine the value of three dimensional reconstructed spiral CT in the assessment of pulmonary atresia, before and after operative repair in a cohort of pediatric patients.

Materials and methods: Spiral CT was performed on ten patients with pulmonary atresia, five male (n=5) and five female (n=5) ranging from 0–18 years. All the scans were performed on a Siemens Sensation 16 slice scanner. Contrast was delivered through an upper extremity vein using a power injector.In some instances simultaneous hand injection of an upper extremity vein and power injection of a dorsal foot vein were carried out resulting in nearly equal opacification of the branch pulmonary arteries and the vena cavae.The scan was triggered using the bolus tracking technique, with the region of interest for the study depending on the cardiac anatomy. After the CT angiography, post processing was done on a 3D workstation like VOXAR or VITREA. 3D reconstuctions were obtained in all, which included multiplanar reformations, maximum intensity projections, volume rendering and surface shaded displays.

Results: The studies were evaluated for main (n=8) or branch pulmonary artery atresia (n=2), length of atretic segment, presence or absence of a confluence, reconstitution of branch pulmonary arteries by a patent ductus or aortopulmonary collaterals (n=4) and collateral vessel stenoses (n=0). Post repair, 3D CT was used in the evaluation of right ventricle to pulmonary artery homografts (n=4), complications associated with the same (n=1), pulmonary artery stents (n=3) and finally narrowing/occlusion of stents (n=2). The results were compared with findings at surgery and cardiac catheterization, which revealed a sensitivity of 90% and specificity of 100%, with bronchial collateral stenosis not picked up in one patient.

Conclusions: 3D spiral CT allowed excellent evaluation in this subset of patients and created an easy roadmap for the pediatric surgeons, for the purpose of operative planning and for the followup of patients with a prior repair.

Poster #: PO85

Multidetector CT angiography in the evaluation of congenital thoracic aortic anomalies in the pediatric age group

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Purpose: To describe the imaging findings of congenital thoracic aortic anomalies in the pediatric age group using multidetector computed tomograghy angiography (MDCT-A) as the imaging modality.

Materials and methods: MDCT-A imaging features of 20 (n=20) patients who underwent CT angiography for aortic evaluation, in the age group of <20 years were retrospectively reviewed by two observers.The study included 12 boys (n=12) and 8 girls (n=8). All the scans were performed on a Siemens Sensation 16 slice scanner. To reduce the radiation dose, the kvp was set at 80 for patients <2 years, 100 for those between 2 and 6 years and 100–120 thereafter depending on the body weight. Contrast was delivered through an upper

extremity vein using a power injector and in some instances hand injection of a central line or an upper extremity vein was performed. The scan was triggered using a bolus tracking technique, with the region of interest cursor placed in the ascending aorta, however this was altered in some instances depending on the cardiac anatomy and associated congenital heart disease. When the contrast was hand injected, scan delay was adjusted as per the anatomy (8–12 s usually). The scans were performed using a collimation of 1.5 mm and a pitch of 1. Images were reconstructed with 0.75 mm collimation. Multiplanar reformations and 3D renderings were used to document and confirm the findings.

Results: The anomalies evaluated included: anomalous coronary origin, bicuspid aortic valve; aortic root involvement in Marfans syndrome; double aortic arch, bovine arch, right aortic arch with mirror image branching and aberrant left subclavian artery, diverticulum of Kommerell, aberrant right subclavian artery and innominate artery syndrome; aortic coarctation and psuedocoarctation; interrupted aortic arch type 1; aortic involvement in Williams syndrome.

Conclusions: MDCT-A could successfully evaluate the type of anomaly, as well as provide excellent detail and accurate dimensions for the pediatric surgeon.

Poster #: PO86

Role of virtual angioscopy and virtual bronchoscopy in pediatric cardiovascular disease

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Purpose: Virtual endoscopy offers a noninvasive means of viewing the endoluminal surfaces of the vasculature and bronchial tree using three-dimensional (3D) datasets from CT or MRI. However, its use has been limited to adult applications, with a lack of data in the pediatric population.

Materials and methods: A retrospective review of pathologic conditions where virtual endoscopy was used in the setting of pediatric cardiovascular disease was performed, with comparison to conventional 3D image processing techniques, such as volume-rendering, maximum intensity projection and multiplanar reconstruction. Processed images were reviewed by a pediatric cardiovascular surgeon and a pediatric cardiologist, and the incremental benefit of virtual endoscopy over the remaining 3D visualization techniques was graded by a semi-quantitative scale.

Results: The utility of virtual angioscopy was explored in the following situations: (1) Assessing luminal caliber and configuration in the setting of vessel tortuosity, irregular or eccentric stenosis, anastomotic stenosis, aneurysms, pseudo-aneurysms, and following vessel stenting. (2) Evaluating intravascular filling defects in the setting of pulmonary embolism, fibrin sheaths, or intravascular catheters. (3) Mural abnormalities like atherosclerotic deposits in patients with familial hypercholesterolemia. (4) Abnormal vascular branching patterns, as in anomalous coronary artery origin, anomalous pulmonary venous return, and pulmonary sling The utility of virtual bronchoscopy was evaluated in the following settings: (1) Tracheal branching anomalies in the setting of heterotaxy and pulmonary sling. (2) Extrinsic tracheal and bronchial stenosis related to vascular rings, pulmonary sling, crossing innominate artery, and dilated native or surgically-created mediastinal vascular structures. (3) Fixed versus dynamic airway obstruction in the setting of extrinsic vascular compression.

Conclusions: Virtual endoscopy provides incremental benefit when compared to existing 3D post-processing techniques, by improving diagnostic confidence, and by providing a unique perspective of the disease which helps surgical planning.

Poster #: PO87

Standardized color-coded 3D reconstructions of complex congenital heart disease using cardiac CTA

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Purpose: To standardize color-coding of the anatomical structures in 3D reconstructions of congenital heart diseases using cardiac CTA.

Materials and methods: ECG gated cardiac CTA was performed using a multidetector CT scanner. A retrospective review of 53 patients with complex congenital heart disease who underwent cardiac CTA was performed. 3D reconstructions of the anatomy were performed using a commercially available workstation.

Results: Postsurgical confirmation of anatomy was ascertained at a weekly cardiology conference. A color-coding scheme for the various thoracic structures was developed and standardized. The aorta was colored bright red along with its branches including the great vessels and the coronaries. The pulmonary arteries were colored dark blue and the pulmonary veins were colored pink. The ventricles were colored in a lighter shade of their respective outflow tracts to delineate the two chambers. Hence, the left ventricle was colored a lighter shade of red and the right ventricle was colored a lighter shade of blue. The left and right atria were colored pink and aqua, respectively. The trachea was depicted in yellow. This color-coding scheme was used to display multiple congenital heart anomalies.

Conclusions: Cardiac CTA is a viable noninvasive modality well suited to detect different types of congenital heart disease. The 3D reconstructions and color standardization facilitate presurgical planning and clearly demonstrate the anatomy for teaching purposes.

Education and training

Poster #: PO88

The comprehensive digital case file system: a single portable resource for identifying, searching, sorting, and displaying cases of interest

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Purpose: To develop a portable data system to identify, search, sort, and display radiographic cases that can be incorporated into the daily radiology workflow.

Materials and methods: A Microsoft Access Database was created and stored on a shared network drive, accessible from any reading station during the workday as well as from off site through a secured Internet connection. The system has four major components: case identification and entry, clinical/pathological follow-up, search and sort, and case presentation. As little or as much information as desired can be entered at the time of case identification. Cases evolve from being simply identified as an interesting or potentially interesting case, to becoming a presentable case with images, to becoming a completed teaching case

with findings, differential diagnosis, and discussion. Search, filter, and sorting features allow rapid case sorting and identification. Cases can be easily presented or modified directly from a search or filtered list.

Results: Since implementation 3 months ago, a total of 2,920 interesting cases have been entered into the case file. This includes 640 cases that were identified since the system has been in place, and 2,290 cases that had been recorded manually over the previous 3 years. 342 cases have associated presentable images, 171 of which are completed teaching cases. Over 3,000 cases from a traditional hard copy teaching file are being digitized and incorporated into the case file. Users report that the system is minimally disruptive to the work flow, cases are effectively retained and accessed, and conferences are easily prepared and shared. Interesting cases that were once only available to the original authors are now accessible to all authorized system users. At the same time, individual users also employ the system as their personal case file.

Conclusions: A comprehensive digital case file system can allow convenient case entry, minimize duplicated effort and provide a convenient tool for accessing and displaying interesting cases.

Fetal imaging

Poster #: PO89

Digital atlas of fetal brain magnetic resonance imaging

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Purpose: Evaluation of a fetal MRI study requires the understanding of fetal brain development and the evolving appearance of the fetal brain throughout gestation. To enable interpretation of fetal brain findings on MRI, this program provides representative images of the normal fetal brain at sequential gestational ages in an interactive digital atlas.

Materials and methods: Images are obtained from studies of pregnant patients at gestational ages of 17 through 40 weeks, as determined by the mother's last menstrual period or by a first-trimester ultrasound. Cases are collected from approximately 30 patients. T2-weighted images in three planes through the fetal head are obtained. All cases were determined to have normal fetal brain findings on MRI, based on the radiologist's interpretation and based on the absence of postnatal neurologic compromise or abnormal postnatal follow-up brain MRI. The software program used for viewing the atlas is written in C# and permits functions such as linked scrolling and the selection of overlayed annotation for definition of anatomy.

Results: The digital atlas provides the radiologist with a useful tool to identify abnormalities of the fetal brain based on comparison with a collection of normal images.

Conclusions: Availability of a digital atlas will be greater than that of a printed anatomy atlas and will serve as an educational tool for trainees and radiologists learning how to perform and interpret fetal MRI.

Gastrointestinal

Poster #: PO90

Intraluminal filling defects in the pediatric gut: What's inside?

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Purpose: Intraluminal filling defects are a very common finding in the pediatric gut. These can be found incidentally or as the first manifestation or a complication of intrinsic gastrointestinal pathology. On this exhibit we depict multiple examples of various filling defects from the esophagus to the rectum using different imaging modalities such as CT scans, ultrasounds and fluoroscopic examinations and the corresponding intra-operative findings.

Materials and methods: We are classifying them as extrinsic/foreign bodies and intrinsic related to underlying pathology. We will show multiple examples of swallowed foreign bodies, the clinical implications and possible complications especially of the more dangerous ones such as lead, batteries and magnets. We will also show examples of different bezoars (lactobezoar, trichobezoar and phytobezoar). Then we will show examples of intrinsic filling defects such as lymphoma, polyps, meckles diverticulum, carcinoid, mucocele, choledochocele, hematomas and different enteroliths as well as meconium ileus and meconium ileus equivalent seen in cystic fibrosis.

Results: We will discuss and show examples of predisposing factors such as webs or stenosis and complications including bowel obstruction, perforation, fistulas, abscesses and intussusceptions.

Conclusions: Intraluminal gut filling defects in children are very common and can be found in every imaging modality. These can be extrinsic (foreign bodies) or intrinsic heralding underlying pathology. It is important not only to identify them but also to recognize predisposing factors and anticipate complications.

Musculoskeletal

Poster #: PO91

Cartilaginous tumors in the pediatric population

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Purpose: Cartilaginous tumors are among the most common bone lesions encountered in the pediatric population. Although the vast majority of these tumors are benign, their imaging characteristics span a wide range of appearances from nonaggressive to aggressive features. The differential diagnosis for these lesions is typically generated from the initial radiographs, with particular consideration for the patient's age and the location of the lesion. Multimodality imaging allows for further characterization of the tumor, while also assessing its extent and associated complications. This educational exhibit will provide an interactive tour of multimodality imaging of benign and malignant chondroid lesions in children and adolescents.

Materials and methods: Educational exhibit.

Results: Educational exhibit.

Conclusions: Educational exhibit.

Poster #: PO92

MRI of the wrist in children

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Purpose: To illustrate the MRI appearances of the most common wrist disorders in the pediatric population and the MRI technique and most useful protocols according to the literature and our experience.

Materials and methods: This exhibit illustrates and discusses the MRI technique of a variety of acquired conditions including inflammatory, metabolic, post traumatic, benign and malignant processes.

Results: The lack of ionizing radiation, the multiplanar capability associated to the characterization of pathology, establish MR imaging as a key imaging modality in the paediatric population.

Conclusions: MRI is great modality for assessment of the wrist in paediatric population. MRI accurately depicts the pathology, leading to a better understanding of the disease process with optimal patient management and follow-up without the use of ionizing radiation.

Poster #: PO93

The full spectrum of pediatric stress injuries

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Purpose: To demonstrate the spectrum of commonly seen to unusual stress related injuries in the pediatric population with emphasis on MR imaging.

Materials and methods: Each example will be presented as a clinical case followed by the relevant imaging and teaching points. An overview of the spectrum of overuse injuries in the pediatric patient from stress injury through to overt fracture will be illustrated.

Results: The described population includes stress related changes at the following sites: femoral neck, calcaneus, tibia, metatarsal, pubic bones, cuboid, os trigonum, sesamoid, navicular tarsal bone, proximal humerus, distal radius and ulna, elbow, first rib, and pars interarticularis. The spectrum will include examples of fatigue fractures and insufficiency fractures. X-rays showed no changes in early cases and signs of a healing fracture in delayed cases. The defining MR features were focally increased T2 and STIR signal with linear area of decreased T1 signal through the involved bony cortex and medullary space. Associated soft tissue edema was also noted.

Conclusions: Imaging, in particular MRI, makes early detection of all stress related injuries possible. Early detection and recognition of stress injuries may impact treatment, reduce unnecessary exams and decrease morbidity related to the injuries. Increased recognition of these injuries in children is important with increased adolescent sports activities.

Neuroradiology

Poster #: PO94

Inborn errors of metabolism: Neuroimaging features

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Purpose: Inborn errors of metabolism involving central nervous system encompass a wide spectrum of inherited neurodegenerative disorders. The purpose of this study is to present and discuss imaging features of the more common and important metabolic diseases involving central nervous system.

Materials and methods: We describe the neuroimaging features of inborn errors of metabolism according to their predilection of location, direction of extension, pattern of contrast enhancement and changes after follow-up period.

Results: Although the imaging features of the inborn errors of metabolism are often nonspecific, a systemic analysis of the finer details of involvement by neuroimaging may permit a narrower differential diagnosis for the underlying disorder that the clinician can pursue through historical factors, clinical testing, and metabolic analysis.

Conclusions: A systemic analysis of the imaging features can provide a framework for approaching the diagnosis of in inborn errors of metabolism involving central nervous system.

Poster #: PO95

Head trauma in children suffering all-terrain vehicle injuries

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Purpose: All terrain vehicle (ATV) use among children is increasing, but the frequency of serious head injuries is not well recognized by pediatric radiologists. The purpose of our paper is to describe facial and neurocranial findings in children suffering ATV injuries and identify significant associations between types of injuries and long term outcome.

Materials and methods: The study included 234 consecutive children <20 years old (168 male, 66 female) who had head trauma associated with ATV injuries and had CT scans at a tertiary care pediatric hospital. Patient mean age was 11.7 years (SD 4.1 years). Patients were drivers (168) or riders (66). CT scans were analyzed for facial, cranial, dural and brain injuries. Medical records were reviewed to assess long term disability or death. Long term disability was defined as findings requiring >6 months follow up care or permanent disability or disfigurement. Significant associations were defined by χ^2 tests with $p<0.05$.

Results: Cranial–neural findings included: cranial skull fracture 94, epidural hematoma 27, subdural hematoma 44, subarachnoid hematoma 6, and brain injury 69. Significant associations were present between skull fracture and epidural hematoma ($p<0.001$) and brain injury ($p<0.004$). Extra-axial hemorrhages were associated with brain injuries ($p<0.001$). Face findings included: orbit fracture 42, non-orbit facial fracture 45, and eye injuries 14. Eye injuries were associated with orbit fractures ($p\leq 0.001$). Brain injuries were not associated with facial fractures or eye injuries. Five boys with head injuries died. Long term disability was present in 82 children. Death or long term disability was associated with brain injury ($p<0.001$), orbit fracture ($p=0.014$) and eye injury ($p<0.001$). No association between child age, sex or driver/rider status was identified.

Conclusions: ATV are dangerous for children regardless of sex, age, or driver/rider status. Brain injuries were associated with skull fractures and extra-axial hematomas. Orbital fractures are associated with eye injuries. Death and long term disability are associated with brain injuries, orbit fractures, and eye injuries.

Poster #: PO96

Pediatric head and neck vascular anomalies–Do you know it all?

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Purpose: Diagnosis and management of vascular tumours and malformations of the head and neck is best performed by a multidisciplinary team approach. Application of correct and consistent

terminology for these lesions is essential for proper diagnosis, and appropriate treatment. Difficulties in diagnosis and management have been partly due to a variety of confounding classification systems.

Materials and methods: This presentation is designed in a quiz format and takes the audience through the whole spectrum of these lesions, with emphasis on helpful imaging findings that help formulate a diagnosis, usage of correct terminology and appropriate management selection. Examples of cases with clinical photographs and imaging findings will used to illustrate the classification, treatment options and results of various therapeutic approaches.Pitfalls in imaging diagnosis will also be emphasised.

Results: The International Society for the Study of Vascular Anomalies (ISSVA) classification reflecting modification of the description by Mulliken and Glowacki is based on clinical characteristics, histological features, and natural history describes two major categories of vascular lesions—*tumors*, which arise by endothelial hyperplasia and *malformations* that arise by dysmorphogenesis and exhibit normal endothelial turnover. Clinical history, physical exam, morphology and localization of these lesions allow diagnosis of most patients. Imaging studies can be optimised to allow precise definition of their extension, localization, relationship to the adjacent structures, and different morphological characteristics.

Conclusions: Sonography, CT and MR, and in some cases catheter angiography, can help in differentiating vascular tumours and vascular malformations, in defining their extent, and in planning treatment. Certain findings on imaging studies can help confirm diagnosis in conjucntion with clinical history and clinical exam. Radiological treatment options include percutaneous sclerotherapy and endovascular embolization. The radiologist plays an important role in the follow-up of these lesions.

Other

Poster #: PO97

Accurate placement of catheters and tubes in children

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Purpose: Placement of catheters and tubes is routine in the management of critically ill patients. However, these procedures have complications, generally mandating a postprocedural imaging to confirm adequate position and to rule out procedure-related complications. A summary of radiological landmarks needed to define the proper positioning of these devices is provided.

Materials and methods: Review of literature about currently standard images used to evaluate the position and malposition of lines and tubes, proposed radiographic landmarks for the proper positioning, the standard of care for follow-up as well as technical aspects of the procedures, comorbitily and postprocedural complications.

Results: Guidelines regarding catheter and tubes tip location in children have not been widely publicized. Knowledge about normal position of catheters and tubes could reliably predict complications and malpositioning placement.

Conclusions: The identification of anatomic radiographic landmarks for the proper tip placement of tubes and lines in pediatric patients help to early detection and prevention of complications.

Poster #: PO98

A very unusual case of a dorsal heteropagus twin

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Purpose: This is to report a bizarre case of a dorsal heteropagus type of conjoined twinning also known as an incomplete or parasitic rachipagus. A review of the current literature regarding this rare type of malformation will also be presented.

Materials and methods: A 3-year old male who was otherwise asymptomatic but born with a dorsal mass was referred to our institution for CT angiography. An MRI of the spine done in another center was also submitted for re-evaluation.

Results: Physical examination of the parasite reveals an immobile lower limb in flexion, buttocks, an orifice which may resemble an anal opening and a phallic structure just above the foot. The CT and MR studies show a large predominantly fatty mass with malformed bones, some soft tissue and cystic components. No discernible organs are identified. Multi-level spina bifida and a syrinx at the midthoracic level are also seen in the host. Below the syrinx, the spinal cord appears to be shared by the parasite. Blood supply comes from a prominent spinal branch of an intercostal artery from the descending thoracic aorta. No large draining veins are noted. The visualized thoracic cavity including the heart and abdominal cavity of the autosite are grossly unremarkable.

Conclusions: We report a very unusual case of 3-year old boy with a parasitic rachipagus where CT and MRI played a very important role in the diagnosis, assessment of other congenital anomalies, surgical planning and prognostication.

Poster #: PO99

"Diagnosis is in your hand"—Diagnosis of condition from a single hand radiograph in a "Jeopardy" quiz format

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Purpose: To review classic hand radiographs in children that can lead to diagnosis of certain diseases or conditions.

Materials and methods: Classic hand radiographs will be depicted on Microsoft Powerpoint using a format similar to the popular TV quiz show 'Jeopardy'. There will be increasing level of difficulty with increasing points. Delegates evaluating these cases will be able to score themsevles with a point system based on the level of difficulty. Every answer will lead to additional important points or information on the condition.

Conclusions: Certain classic conditions can be diagnosed on a single hand radiograph. Familiarity of these classic radiographs and the game format will introduce some fun into the learning process.

Respiratory

Poster #: PO100

The continuum of dysmorphic lung syndrome: A unifying concept

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Purpose: Congenital lung malformations include a group of anomalies affecting the lung parenchyma as well as the arterial supply and venous drainage. These malformations are classified into focal and diffuse. Much has been talked about focal malformations (sequestration, CCAM, etc.)

but little about the diffuse type or dysmorphic lung syndrome. Even though it can present as a variant of normal in older patients, it may generate confusion. It can also be associated with other pathology requiring interventions in infants. To better understand the dysmorphic lung syndrome we first discuss the normal embryology of the lung, tracheobronchial tree and pulmonary vessels and the way they interact and depend on each other for the normal development as a unit. Then we'll define dysmorphic lung syndrome as a continuum classifying it in two groups based on its CT appearance: lung agenesis–hypoplasia complex and lobar agenesis–hypoplasia complex. Further characterization will be made based on pulmonary venous drainage ranging from hypogenetic lung syndrome/normal venous drainage, unilateral single draining pulmonary vein/varix, levo-atriocardinal vein to congenital venolobar syndrome/scimitar vein.

Materials and methods: Radiologic correlation with chest radiographs, CT angiograms and conventional arteriograms will depict the spectrum of anomalies, and associated findings including horseshoe lung, duplicated diaphragm, pulmonary systemic arterialization, ASD, bronchial anomalies, hypoplastic or absent pulmonary artery, etc. The case examples and text will be displayed in an interactive user-driven powerpoint format.

Conclusions: Dysmorphic lung syndrome is a continuum of anatomical anomalies affecting the lung parenchyma, tracheobronchial tree and pulmonary vasculature. Although on occasions, some of these may represent variants of normal with little clinical consequence in older patients, it may generate confusion. In the infant form, due to the associated anomalies, it has significant clinical implications especially when there is underlying congenital heart disease affecting the therapeutic approach and prognosis.

Poster #: PO101

Tip of the iceberg: Thoracic manifestations of systemic diseases of childhood

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Purpose: Pediatric diseases with multisystemic involvement often have characteristic findings on cardiothoracic imaging. These clues may be the first indication of a more diffuse process—the radiological tip of the iceberg.

Materials and methods: Documented cases of systemic disorders with characteristic thoracic abnormalities were collected. Using a multimodality approach including high resolution CT, our interactive computer module reviews the essential thoracic manifestations of various systemic diseases. Participants will actively test their cardiothoracic imaging knowledge while analyzing unknown cases. Differential diagnosis of classic findings will be summarized. The gamut of radiologic findings in each of these systemic diseases will be presented.

Results: Common as well as uncommon systemic disorders are included in our educational module. Entities discussed include collagen vascular diseases, Loeys–Dietz syndrome, sarcoidosis, lymphoma/leukemia, Langerhans cell histiocytosis, sickle cell disease, thalassemia, tuberous sclerosis, mucopolysaccharidosis, cystic fibrosis, HIV, tuberculosis, and thoracic manifestations of renal insufficiency.

Conclusions: Cardiothoracic abnormalities may be the first signs of a systemic disease process in children. Our interactive computer module summarizes the essential manifestations of cardiothoracic imaging in these diseases.

Poster #: PO102

Management of bronchopulmonary malformations: Results of the SPR and ESPR survey

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Purpose: Widespread use of prenatal ultrasound screening has led to increased diagnosis of congenital bronchopulmonary malformations (BPM) with unknown natural history and variable management. There is no consensus on the surgical management or imaging algorithm for BPMs. We present the results of surveys undertaken to evaluate these issues.

Materials and methods: Surveys were sent to radiologists and surgeons via Society of Pediatric Radiology (SPR) and European Society of Pediatric Radiology (ESPR). Questions included case volume, surgical management of asymptomatic BPM, imaging management such as fetal MRI, postnatal plain films, CT and MR and concern for infection of BPM and malignancy in congenital pulmonary airway malformations (CPAM).

Results: Radiologists from 88 (43 USA, 24 EU, 21 other countries) and surgeons from 35 institutions (15 USA, 17 EU, 4 other countries) answered the survey. Radiologist's suggest that operations are performed in 84% of US institutions for CPAM and sequestration versus 66% for CPAM and 51% for sequestration in non-US countries. Resection of asymptomatic congenital lobar overinflation is performed in 23% of US, 9% of non-US institutions. Survey responses are discordant between radiologists and surgeons regarding surgical management for CPAM (45% discordance) and CLO (30%). Fetal MRI for BPM diagnosed in utero is performed mainly in institutions seeing >20 BPM/year. CT for prenatally diagnosed BPM is performed at birth in 78% of US, 53% of non-US institutions. CT before surgery is obtained in 82% of US, 73% of non-US institutions. 26/54% of respondents (radiologists/surgeons) believe there is a risk of malignant transformation of CPAM, 38/29% are undecided, 33/17% disagree, 84/89% agree on the predisposition of BPM to infection.

Conclusions: Major disparities exist between surgical and radiology colleagues and between institutions, particularly US and non-US institutions, regarding the imaging algorithm and surgical management of BPM. Collaborative multi-institutional studies on the natural history of BPM need to be done in order to reach a rational consensus about the appropriate surgical and radiological management of these lesions.

Poster #: PO103

Etiology and imaging of stridor in children

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Purpose: Upper airway obstruction is a common and distressing problem in childhood. Various etiologies need to be considered during imaging. Although ultrasound, computed tomography and magnetic resonance imaging have become increasingly popular modalities for use in many pediatric diseases, plain radiography and fluoroscopy continue to be the mainstays for the evaluation of stridor in children. With a history of stridor, imaging should be directed at the airway for evidence of infection, post traumatic injuries, neoplastic or developmental abnormalities.This exhibit will review imaging of children who presented with stridor.