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Posters

PCH-1

Interpretation of chest radiographs from children with lower respiratory tract infections

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Purpose: Pneumonia is a common diagnosis amongst children admitted to hospital. Diagnosis relies upon accurate chest radiograph (CXR) interpretation. This study compared levels of agreement amongst paediatric clinicians and consultant paediatric radiologists when interpreting CXRs
Materials and methods: Four paediatric radiologists, highlighted below, independently interpreted 5 radiological features (and no features) for each of 30 CXRs, randomly selected from 100 radiographs attained over two years from children with fever and signs of respiratory distress aged 6 months to 16 years. The same CXRs were then interpreted by 21 other paediatricians with varying experience levels. Agreement within groups, split by grade and specialty, was analysed using free-marginal multirater Kappa, assuming no prior expectation of the proportion of radiographs with each feature.
Results: Agreement (−1 relates to complete disagreement, 0 to chance agreement, and 1 to complete agreement): Agreement within Grade Agreement within Speciality Paediatric Consultants (5) Medical Students (5) Trainees FP1-2 /ST1-3 (9) Trainees ST4-9 (2) General Paediatrics /PRHO (13) Paediatric Radiology (4) Specialty (3) Consolidation 0.28 0.35 0.27 0.73 0.24 0.77 0.24 Pleural effusion 0.89 0.69 0.74 0.73 0.76 0.83 0.87 Atelectasis 0.35 0.71 0.67 0.40 0.53 0.78 0.42 Hyperinflation 0.57 0.73 0.47 0.60 0.49 0.69 0.51 Peribronchial thickening 0.27 0.37 0.21 0.47 0.28 0.67 0.16 Normal (no features) 0.71 0.73 0.78 0.87 0.78 0.96 0.69
Conclusion: Paediatric radiologists showed high levels of agreement for all features. Normal CXRs and pleural effusions were identified consistently amongst all 25 clinicians. However, interpretation of consolidation, peribronchial thickening, and atelectasis had lower levels of agreement within non paediatric radiologists. This highlights the need for more rigid training in interpreting CXRs for trainee paediatricians and the early reporting of CXRs by paediatric radiologists.

PCH-2

Illustrative and educational perspective of cystic lung lesion in children

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Cystic lung lesions are commonly identified in children. It can be challenging to make specific diagnoses based on imaging as features of each disease entity can have considerable overlap. However, accurate diagnosis is important to the clinician and patient as it dictates further management and treatment. We will illustrate and describe the radiological appearance of cystic lung lesions, and consider four main categories: congenital, acquired, systemic disease with pulmonary manifestations, and cystic-like lesions.

PCH-3

Where is the air? A review of paediatric extra-pulmonary air collections

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Purpose: Extra-pulmonary air is a relatively frequent occurrence in neonatology and paediatrics and it is important to diagnose early due to potentially serious detrimental effects. Extra-pulmonary air may represent a difficult diagnostic challenge, not only in differentiating from other disease processes and normal anatomical variants, but also in determining exactly where within the thorax the abnormal air collection is situated. This is important for both treatment and prognostic purposes. Here, we review the radiological features of extra-pulmonary thoracic air collections in neonates and children. First, we review the anatomy of the thoracic compartment, including the mediastinum and pleural spaces. Plain radiography is the typical first line investigation, and we demonstrate the radiographic appearances of different types of abnormal air collections in relation to the underlying anatomy. These include subcutaneous emphysema, pneumothorax, pneumo-mediastinum, pneumo-pericardium, as well as intravascular and intracardiac air. We also demonstrate the use of cross-sectional imaging, in particular CT, where there is diagnostic uncertainty regarding unusual air collections.

PCH-4

Pulmonary infections in immunocompromised children

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Purpose: This pictorial essay describes the range of respiratory infections and complications in a large cohort of immunocompromised children from a tertiary referral hospital.
Materials and methods: A large series of primary and secondary immunocompromised patients who underwent lung imaging over a 10-year period was reviewed. The cohort included patients with severe combined immunodeficiency, common variable immunodeficency, chronic granulomatous disease (CGD), post solid organ and stem cell/bone marrow transplant (SCT/BMT) recipients and HIV infected children.
Results: The commoner pulmonary infections include bacterial, viral, atypical organisms and fungal infections. Aspergillus species was prevalent in this cohort with variable manifestations, which reflected host status, with a wide range of radiological patterns, which will be

illustrated and discussed. Angio-invasive pulmonary aspergillosis was seen in the post BMT/ Stem Cell recipients, manifesting as multiple nodules with classic halo signs and less frequently with cavitation. The host neutrophil count was an important predictor for infection in the BMT group. Patients with CGD developed bronchocentric granulomatosis as a complication of fungal infection with a different radiological appearance. Clear timelines can be defined in the BMT group, which help predict the relative likelihood of particular groups of lung abnormalities. Rarer disorders including diffuse alveolar damage (DAD) and haemorrhage (DAH), and pulmonary veno occlusive disease (pVOD) and pulmonary graft versus host disease (GvHD) were observed and will be illustrated.
Conclusion: Pulmonary complications are common in immunocompromised children. An understanding of the varied interaction between host immune status and host response to the different opportunistic pathogens is very important for the radiologist.

PCH-5

Features of congenital lung malformations demonstrated by multidetector CT and correlation with histopathological findings: a pictorial essay

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Purpose: It is now recognised that there is frequent overlap between the classical diagnostic categories of congenital lung malformations such as congenital pulmonary airway malformations (CPAM), bronchogenic cysts, bronchial atresia, broncho-pulmonary sequestration and congenital lobar overinflation (CLO). The modern imaging approach to these lesions is to provide a detailed description of the features in each case, rather than to try to categorise every case into a traditional diagnostic 'box'. This study illustrates features of bronchopulmonary foregut malformations and the hypogenetic lung spectrum as shown by contrast enhanced multidetector CT (MDCT), with pathological correlation where available.
Materials and methods: We reviewed MDCT findings in over 100 children with known or suspected congenital lung malformations. We assessed the following key features: arterial supply, venous drainage, bronchial connections, lung aeration and parenchymal abnormalities. We correlated radiological features with histopathological findings in 46 patients who had surgical resection.
Results: Abnormalities of arterial supply are seen in sequestration as well as some types of hypogenetic lung. Abnormalities of venous drainage are seen in extralobar sequestration and scimitar syndrome. Absent or abnormal bronchial connections are a feature of many malformations. Abnormal lung aeration occurs in bronchial atresia and CLO. Parenchymal abnormalities occur in CPAM and bronchogenic cysts. In addition, several lesions show multiple features, producing hybrid lesions such as CPAM/Bronchial atresia and CCAM/Sequestration.
Conclusion: We describe and illustrate an approach to the classification of congenital lung malformations, based on a systematic approach to the CT features, with histopathological correlation, in these common but complex lesions.

PCH-6

Infants with neuroendocrine cell hyperplasia (NEHI) and their high resolution (HR) CT findings

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Purpose: We present HRCT of seven children with bombesin immunostaining positive (NEHI). It is a diffuse lung disease with unknown etiology. Most of the patients are infants. Clinical symptoms include dyspnea, tachypnea and hypoxia. Symptoms can persist for several months, but prognosis is usually good. Treatment is only symptomatic. Diagnosis can be confirmed by lung biopsy, where bombesin immunostaining shows an increased proportion of neuroendocrine cells. Normally the number of neuroendocrine cells decreases rapidly after the neonatal period. High resolution computed tomography (HRCT) imaging findings of these patients are typical with ground glass opacity in the right middle lobe, lingula and centrally in the other lobes.
Materials and methods: HRCT scans of NEHI patients, three girls and four boys aged 1 to 16 months were analysed. Typical symptoms were tachypnea, dyspnoe and hypoxia, especially during sleep. The beginning of the symptoms was between the ages of 2 weeks to 12 months. The children had no response to corticosteroids. HRCT and lung biopsy were performed.
Results: Five of the patients had typical symptoms and HRCT findings, ground glass opacity in the right middle lobe, lingula and centrally. Four patients had a definite neuroendocrine cell hyperplasia in biopsy. One patient had only 5–6 bombesin positive cells and thus the biopsy was not diagnostic for NEHI, but combined with symptoms and HRCT findings diagnosis was made. One patient had typical symptoms and biopsy finding, but HRCT showed ground glass only in the upper segment of left lower lobe. One patient was born preterm and was treated for respiratory distress syndrome. At the age of one week she again developed respiratory distress and at the age of one month HRCT showed ground glass opacity throughout both lungs. Lung biopsy showed neuroendocrine cell hyperplasia typical of NEHI.
Conclusion: Patients with NEHI usually have both typical symptoms and findings in HRCT.

PCH-7

CT manifestations of thoracic involvement in pediatric patients with HIV infection

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Purpose: 1. To conduct a comprehensive review of imaging findings in CT of thoracic conditions peculiar to AIDS and to illustrate the typical and atypical imaging features. 2. To identify any specific pattern of involvement that can help in diagnosis and further treatment of such patients.
Materials and methods: Pediatric HIV clinic patients with clinical suspicion of thoracic disease were included in the study. A complete radiological work up of the thorax which included chest skiagram and contrast enhanced CT scans were done in all cases with HRCT in relevant cases.
Results: Various CT patterns were encountered which include lobar/segmental consolidation, bronchiectasis, diffuse reticulonodular pattern, tree in bud appearance, pleural effusion with infiltrates, hilar and mediastinal lymphadenopathy. The common pulmonary pathologies include lymphocytic interstitial pneumonia; infection by viral, bacterial, fungal, and protozoal agents and malignant diseases, including lymphoma. Thoracic smooth muscle tumors, thymic cysts and cardiomyopathy are the extrapulmonary manifestations.
Conclusion: With the advent of early institution of ART in newborns and infants diagnosed with HIV, there has been an increase in their life expectancy. Early identification of the thoracic complications of HIV infection is crucial for appropriate management.

PCH-8

Pleuropulmonary blastoma mimicking a complicated pneumonia in an otherwise healthy 3-year-old

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Purpose: To describe the unusual presentation of this rare tumour in children, to discuss the clinical and diagnostic pitfalls and how to avoid them and to stress the importance of effective communication between radiologists and other health professionals.
Materials and methods: An otherwise healthy 3-year-old Bahraini boy presented to the emergency department of Salmaniya Medical Complex with an short 2 week history of low grade fever, shortness of breath and productive cough. Apart from a few limited upper respiratory tract infections, he has been in very good health and had no major illness. On presentation to the emergency room his vitals were temperature 37.2 C, respiratory rate 58/min, pulse 110/min. He had clubbing of fingers and a pigeon chest and was dyspneic with suprasternal retractions and retractions. There was reduced air entry on the right chest with no wheeze. Chest radiograph was requested, and on presentation was read by the treating doctor and radiology resident as a diaphragmatic hernia and the child was taken for surgery on the same day. Exploratory laparotomy showed an intact diaphragm pushed and stretched inferiorly. The surgeons opted to request a CT scan and reconsider their diagnosis. A post operative contrast CT scan of the chest and abdomen read by the paediatric radiologist revealed the presence of a complex solid cystic right chest mass occupying the entire right thoracic cavity and displacing the heart and mediastinum to the opposite side. Differential diagnosis of complicated congenital cystic adenomatoid malformation or bronchopleural fistula or intrathoracic neoplasm. Video Assisted Thoracoscopy (VATS) revealed a large right upper lobe complex.The cystic mass was attached to the mediastinal pleura and was compressing the middle and lower lobe. The patient underwent right transverse thoracotomy and the lesion was dissected from the mediastinal pleura and lungs. Histopathological diagnosis was type 11 pleuropulmonary blastoma. Postoperatively, the child did well. This case was registered in the International Pleuropulmonary Blastoma registery for recommendation in management and follow up.

PCH-9

Comparison of maximum-intensity projection images with 2-mm axial lung slices for the detection of pulmonary nodules in a pediatric hospital

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Purpose: Based on the reported adult experience we began reconstructing and viewing axial MIPS on pediatric chest CT scans in late 2008. Our purpose was to evaluate whether this practice has added benefit in detecting pulmonary nodules in our population.
Materials and methods: We retrospectively reviewed 39 consecutive low dose multislice spiral chest CT scans from 2008/2009)on patients with 1–15 previously identified pulmonary nodules (age 2–27 years, mean 13.6 years). The axial 2-mm slices (lung algorithm) and axial MIPS (reconstructed 5 or 7 mm thick every 2 mm) were reviewed separately and independently by two blinded pediatric radiologists. The slice, size, location, characteristics and level of confidence of each nodule was recorded. Discrepancies were subsequently resolved by consensus evaluation of both image sets.
Results: A total of 204 nodules were identified ranging in size from 1 to 29.8 mm. The sensitivity of each reviewer in detecting nodules with the axial 2-mm slice was 54.9% and 49%. With MIP, sensitivity increased significantly to 74.5% and 65 % ($P<.05$). In particular smaller (<3 mm) and more centrally located nodules were better discerned on the MIP images. Low density or cystic nodules were better seen on the axial 2 mm images.
Conclusion: More pulmonary nodules are detected on axial MIPS compared with standard axial 2-mm slices, especially when they are small or central in location. Both readers were more confident in identifying nodules when both data sets were available. MIP images were suboptimal in identifying low density or purely cystic lesions. This study did not evaluate the etiology or significance of the nodules found.

PCH-10

Case series: neonatal pulmonary sequestration diagnosed by ultrasound

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Purpose: To highlight the clinical presentations and radiological findings in neonatal pulmonary sequestration.
Material and methods: Three neonates diagnosed as having pulmonary sequestration by ultrasound (US) underwent surgical treatment in 2004. We retrospectively reviewed the clinical presentations and radiological findings. All patients had chest radiographs, two had CT scan of thorax done at referring centres and all had US examination.
Results: All patients presented with respiratory distress and one had cyanosis. The first case had massive left pleural effusion diagnosed by chest radiograph and CT. The second case had a solid mass lesion in the left hemithorax with mediastinal shift diagnosed by chest radiograph and CT. The third case had persistent gross left pleural effusion despite chest tube drainage. In all patients, US showed the presence of homogenous echogenic left basilar chest mass, interrupted only by vascular structures, and the systemic supplying artery was identified arising from the infra-diaphragmatic aorta, confirming the diagnosis of pulmonary sequestration. Surgical resection of extralobar pulmonary sequesration was performed in all 3 cases and the diagnosis was proven histologically.
Conclusion: Pulmonary sequestration should be considered in the differential diagnosis of a left hemithorax mass in a neonate. After chest radiograph, chest sonography should be the investigation of choice in a neonate with opaque left hemithorax and suspicions of pulmonary sequestration. The demonstration of systemic blood supply is in keeping with pulmonary sequestration and may obviate the need for further examination.

PCH-11

Initial chest radiographic findings in pediatric patients with proven H1N1 viral infection

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Purpose: To describe and evaluate the early chest radiographic findings of pediatric patients with H1N1 viral infection.

Materials and methods: We present a retrospective review of patients'chest radiographs in which we describe the initial findings in pediatric patients diagnosed of H1N1 infection proven by PCR. From 240 patients diagnosed of H1N1 infection from August 2009 until February 2010, we searched for those with available chest X-rays for review performed within 7 days after the PCR study. They were divided in 3 groups: non requiring hospitalization, requiring hospitalization and requiring intensive care unit treatment. Further analyses were performed regarding previous medical conditions. Patient outcomes, additional infection with streptococcus pneumoniae and necropsy results (3 patients), were recorded. Radiographs were reviewed separetely by two pediatric radiologists, blinded to all medical information. A systematic approach was used to assess soft tissues, chest wall, pleura, mediastinum and hila anomalies. Pulmonary and airway findings were recorded as peribronchial markings, ground-glass opacities and consolidations. Distribution and any other present abnormality were also registered. Disagreements were decided by consensus.
Results: Final study cohort included 123 patients, 50 without hospitalization, 67 required hospitalization and 6 patients ICU treatment. Mean age was 6 years and 2 months old (42 d–17 yo), 51 girls, 72 boys, no statistically significant different distribution was found between the groups. Chronic pulmonary disease, cardiopathy, neurological disease and prior oncologic malignancies were more common among in-hospital patients.
Conclusion: 40% of out-patients had an abnormal chest X-ray, mainly because of peribronchial thickening and ground-glass opacities, though some also had consolidation. In in-patient hospitals, 61.2% had an abnormal chest X-ray, mostly due to consolidations, ground-glass opacities and peribronchial thickening. Pleural effusion and cavitation were particularly found in ICU patients, although with no statiscally significance.

PCH-12

Chest CT and bronchoscopy correlation in patients with lung collapse

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Purpose: To evaluate the correlation between chest CT and bronchoscopy performed for childen with lung collapse in an intensive care unit.
Materials and methods: Retrospective evaluation of consecutive patients in an intensive care unit where inspiratory and expiratory chest CT were performed to identify a cause of lung collpase. These patients also underwent bronchoscopy as management protocol in our tertiary unit.
Results: 50% correlation was seen.
Conclusion: CT helps to evaluate the cause of lung collapse.

PCH-13

The radiology of complications of fetal endoscopic tracheal occlusion treatment for congenital diaphragmatic hernia

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Purpose: To demonstrate the range of complications relating to fetal endoscopic tracheal occlusion (FETO) treatment for congenital diaphragmatic hernia.

Materials and methods: We reviewed the plain radiographs, bronchograms, and CT examinations of the patients who had previously undergone in utero FETO, who were referred to our tracheal team service.
Results: Seven infants were transferred to our care soon after birth. There were four girls and three boys. Mean age at transfer to our hospital was five weeks (range 1 day-4 months). Three patients died. Five had left diaphragmatic hernias. CT was performed in six patients and bronchography in six. Tracheomegaly was seen in 6/7, and bronchomegaly in 3/7. Three children had the balloon still in situ after birth. One child, who died, had a tracheal perforation, with the balloon in the mediastinum. An external stent cured one child with isolated bronchomegaly and ipsilateral lung overinflation.
Conclusion: Although some of these findings have been reported by our group previously, we present here the imaging of new complications such as isolated bronchomegaly, balloon retention, tracheal perforation, FETO balloon beyond the airways, and the first successful treatment of bronchomegaly by external stent placement.

PCH-14

Chest US in pediatric pneumonia: evaluation of its usefulness

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Purpose: Chest radiograph should be the initial imaging procedure used in cases of suspected pneumonia in children. Chest US is a complementary method and the aim of this study is to evaluate its usefulness in the management of pediatric pneumonia.
Material and methods: Fifty-five children aged from 8 months to 14 years with X-ray proven pneumonia underwent chest US examination. Lung sonography was performed more than one time in 9 of them because of clinical deterioration and X-ray evidence of parapneumonic effusion. Chest US examinations were carried out with a convex probe (5–7 MHZ) and a high-frequency liner probe (8–12 MHZ). Color and power Doppler study was included in all the patients.
Results: Lung ultrasound was positive in all the children of our study. Different sonographic patterns with interesting signs were observed according to the detection of pneumonias with different vascularization. Pleural effusions were also observed in 9 patients with different sonographic patterns that helped to characterize the simple or complicated nature of the fluid.
Conclusion: Lung ultrasound is a simple and reliable tool that can be used in the evaluation of pediatric pneumonia. Radiologist should be aware of its inability to visualize the whole extent of deep lesions. It is a valuable method as it provides additional information to X-ray about lung vascularization and the presence of necrotic areas, or the complicated nature of pleural effusions.

PCH-15

Respiratory-gated CT of the lung using volumetric 320-detector row CT: effects on motion artifacts in free-breathing children

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Purpose: To compare the degree of motion artifacts on 1 mm slice CT images obtained using respiratory-gated volumetric, free-breathing volumetric, and free-breathing helical methods in children.

Materials and methods: Children under the age of 5 years who underwent CT of the chest without breath-hold using a 320-detector row scanner (Aquilion ONE, Toshiba, Otawara, Japan) from April to November 2010 were enrolled in the study. The acquisitions were obtained with configurations of 0.35 sec rotation, slice thickness of 0.5 mm, and tube voltage of 120 kVp with automated exposure control system. Respiratory-gating was conducted to obtain the images on the inspiratory phase using a respiratory gating system (AZ-733V, Anzai Medical, Tokyo, Japan). The degree of motion artifacts was graded at three anatomic levels (upper, middle, and lower lung zones) on 1 mm reconstructed images using the numerical grades representing 0: no artifact to 3: severe artifact. A total motion score for each child was calculated by summing the scores for each of the three lung zones. The scores for the three acquisition methods were compared using Student's t test.
Results: The study cohort consisted of 130 children (ages 5 days to 60`months, median 23 months). Respiratory-gated volumetric, free-breathing volumetric, and free-breathing helical acquisitions were obtained in 26, 59, and 45 children, respectively. The mean value of the total motion scores of respiratory-gated volumetric acquisition was significantly lower (0.6; range 0–2) than that of the other two acquisitions (2.1; range 0–6 , and 3.5; range 1–9 in free-breathing volumetric and free-breathing helical acquisitions, respectively).
Conclusion: Respiratory-gated volumetric CT of the lung has significantly less motion artifacts in free-breathing children.

PCH-16

Radiographic findings of Pneumocystis Jirovecii Pneumonia in early infancy: report of three cases

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Purpose: Pneumocystis Jirovecii Pneumonia (PCP) has been well known opportunistic infection in patients with AIDS, receiving chemotherapy or congenital immunodeficiency. We describe radiographic findings of PCP without known history of immunodeficiency in early infancy.
Materials and methods: 3 infants (2 boys and 1 girl) are included. The Age of PCP developed was one each of 2 months, 3 months, and 4 months. Prior to PCP, 3 infants were doing well. In one infant, underlying severe combined immunodeficiency (SCID) was disclosed with PCP. In another two, no underlying immunodeficiency was detected. Symptoms started with cough, fever, and respiratory distress. ß-D-glucan was elevated in 3. Pneumocystis Jiverocii DNA was confirmed by PCR assays in bronchoalveolar lavage fluid in two infants. In one, the diagnosis was made by in combination with elevated ß-D-glucan, radiographic findings and effectiveness to the treatment. Chest radiography and CT were reviewed.
Results: Initial chest radiography showed diffuse or inhomogeneous infiltration mainly seen in the upper to mid lung zone. Lungs were hyperinflated in two. Chest CT demonstrated patchy inhomogeneous ground-glass opacities with air bronchogram involving most of the lungs. Additional infiltration and linear opacities were noted in one. Some of isolated secondary lobules appeared to be spared. Mosaic pattern of ground-glass opacification was obtained. Lung periphery and lower lobes were relatively spared. No hilar adenopathy or pleural effusion was seen. Two infants without immunodeficiency responded well to treatment and recovered. In the SCID infant, extensive air leak developed, and he died within a month.
Conclusion: We described the radiographic findings of PCP in early infancy. PCP is rare in neonates. However, more than 75% of children are seropositive by the age of 4, suggesting a high background exposure to the organism. Pneumocystis DNA was detected in immunocompetent infants. PCP should therefore be included in the differentials when extensive ground-glass opacities, mosaic pattern with upper lobe predominance, are obtained in chest CT, even in early infancy.

PCH-17

Computation of the tracheal bifurcation angle (TBA) in 3D as a parameter of inspiration

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Purpose: Presentation of an algorithm for semiautomated computation of TBA in 3D.
Material and methods: The proposed algorithm consisted of the following steps:
step 1: reduction of computation by drawing a bounding box of trachea and main stem bronchi and selection of a seed point within trachea,
step 2: segmentation of the airways using fuzzy connectedness, step 3: centerline extraction by skeletonization, step 4: estimate TBA in 3D as expressed by three angles between trachea and mainstem bronchi based on spherical trigonometry. User interaction is only needed in step 1.
step 3 was performed in two ways of 3D transformation of the segmented volume: a) after interpolation of the segmented airwaysand b) simple stretching the segmented volume according to the aspect ratio of voxels . For a) more hardware is needed and for both methods time for computation was stored.
Computations were performed on 10 CT chest CT data sets and for image processing the "Integrated Data Language" (IDL 7.1 Creaso Inc., Boulder, CO, USA) was used. In order to test robustness, TBA was calculated five times in all patients.
Results: Interpolated segmented volume: TBA values: 147.6±5.1°, 135.5±4.3°, and 74.1±6.8°. Stretched segmented volume: TBA values: 147.6±4.9°, 134.±3.4°, and 76.5±7.0°.
Pairwise comparison of TBA based on both methods exhibited no difference for angle 1 ($p<0.95$) and angle 3 Average computation time on interpolated segmented volume was 4.79s, compared to those of the stretched version 1.43s ($p<<0.01$). The full procedure took less than 5 minutes.
Conclusion: TBA can serve as a parameter of inspiration at Chest CT. The low standard deviation underlines the robustness of the method, which is automated, other than in step 1. Due to the significant differences in angle 2 between the methods of 3D transformation and the overall fast procedure of less than 5 minutes, the interpolated segmented volume should be used.

PCH-18

Pulmonary sequestration presenting as tachypnea in the neonate

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Purpose: To describe the common radiological findings of pulmonary sequestration in children especially the newborn child, to explain the common diagnostic pitfalls and the differential diagnosis and to correlate the clinical, radiological and surgical findings. A four year old Bahraini male was referred from a private hospital for tachpnea and suspicion of left congenital lobar

emphysema A chest radiograph on presentation showed a hyperaerated left lung and small irregular retocardiac opacity. The right lung was normal. A post contrast CT scan of the cheat and upper abdomen was performed. The 3D angiographic reconstrution was also performed and this confirmed the diagnosis of pulmonary sequestration. The feeding and draining vessels of the sequestration were assessed, the mosiac pattern of the lung was attributed to hyperaeration and /or air trapping. The plethoric lower lobe segments were evident. Post operatively the child did well and lung vascularity was back to normal again. Follow up chest radiographs showed mild residual hyperaeration of both lungs.

PCH-19

Sonographic contribution to the diagnosis of huge inflammatory myofibroplastic tumor in a child's lung

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Purpose: The purpose of this presentation is to describe the sonographic appearance of huge inflammatory myofibroplastic tumor in a child and discuss its contribution to differential diagnosis.
Materials and methods: A 5 years old child was admitted to our hospital presenting a cough for 10 days and weakness. Low fever was reported and anaemia was found in laboratory exams. A lung radiograph was performed that revealed an extensive round area of opacity with sharp margins in middle and lower area of one lung. In order to determine the cystic or solid nature of the lesion, ultrasound of the thorax was performed using linear and curvilinear transducers. Ultrasound findings showed an extensive solid lesion with sharp regular margins and internal vascularisation. The lesion was mainly homogeneously echoic and internal vasculature was peripheral as well as centripetal with no disruption of the vascular lines. No calcification was found and post obstructive atelectasis in contact with the upper limits of the lesion was apparent. Due to the benign appearance of sonographic findings, an inflammatory myofibroplastic tumor was suggested as the initial diagnosis. CT as well as MRI were also performed, adding little to the diagnosis. CT confirmed the absence of calcifications and pleural erosions and MRI also confirmed the solid composition and the absence of cysts. Enhancement of the lesion was found in both methods with no indicative pattern and their diagnosis was based on the neoplastic nature of the mass. Surgery was planned and histopathologic evaluation confirmed the diagnosis of inflammatory myofibroplastic tumor.
Conclusion: Inflammatory myofibroplastic tumor is a rare benign lung tumor of uncertain etiology, occurring more commonly in young patients and children. Ultrasound was found to be highly diagnostic in our case, even though precise evaluation of the size of the mass and its correlation to thoracic and mediastinum structures could not be fully reached.

PCH-20

Whole-body computed tomography in a fatal dog attack

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This is a case of a girl attacked by four Staffordshire terriers and who then succumbed to her injuries. Post-mortem computed tomography showed extensive defleshing with soft tissue damage and injury to the greater cervical vessels. The cuts also reached the lungs. The diagnosis of exsanguination was made. The result was compared to the forensic autopsy. A good correlation between traditional autopsy and computed tomography could be demonstrated.

PCH-21

Rates of non-diagnostic CT scans versus ventilation/perfusion (V/Q) scans in the diagnosis of pediatric pulmonary emboli

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Purpose: The radiological investigation of pediatric pulmonary emboli has not undergone the type of scrutiny that it has in the adult population. Our objective is to determine the relative rates of non-diagnostic CT examinations when compared with non-diagnostic V/Q scans in the pediatric setting.
Materials and methods: A retrospective review of MDCT examinations, V/Q examinations or both performed on children at a tertiary care pediatric center for the evaulation of pulmonary emboli from January 2000 to January 2010. The studies were blindly reviewed and each investigation was identified as positive, negative or indeterminate for the diagnosis of pulmonary embolism. The rates of indeterminate scans were compared and stratified for age, gender and date of scan.
Results: Statistically significant rates of indeterminate scans were observed when comparing total indeterminate MDCT scans in comparison to total indeterminate V/Q scans. However, when comparing MDCT examinations before 2003, 2003 to 2008 and after 2008 (corresponding to graduation from 4 to 8 and subsequently to 64 slice scanners, respectively) resulted in a significant drop in indeterminate MDCT scans. As a consequence there was no significant difference in the rate of indeterminate scans between the V/Q and MDCT modalities.
Conclusion: The continued improvement in MDCT technology has resulted in equal rates of diagnostic scans when compared to V/Q studies.

PCH-22

Congenital pulmonary causes of mediastinal shift

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Purpose: To review the spectrum of congenital pulmonary disease that cause mediastinal shift.
Materials and methods: A retrospective review of our imaging database was performed to identify studies obtained in neonates and in children with mediastinal shift on radiographs of the chest. Where applicable, concurrent imaging studies—including Ultrasound, CT, and MRI—were reviewed in conjunction with the chest radiograph.
Results: Multiple cases of congenitally-induced mediastinal shift were identified. Causes include: congenital lobar emphysema, congenital pulmonary adenomatoid malformations, congenital diaphragmatic hernia, scimitar syndrome (aka congenital pulmonary venolobar syndrome), pulmonary hypoplasia, and pulmonary aplasia. Some diagnoses were confidently made with chest radiograph, while

others required CT, MR, and ultrasound evaluation. Surgical and pathological correlation was included where available.
Conclusion: Congenitally-induced mediastinal shift in neonates and in children can be caused by many disease processes, some of which have distinctive radiologic appearances and others of which are more difficult to diagnosis with current imaging techniques.

PCH-24

Diffuse lung disease in children older than 2 years

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Purpose: The purpose of this presentation is to emphasize the radiological findings in diffuse lung diseases (DLD, also known as interstitial lung disease) in children older than 2 years. Although DLD are uncommon in pediatric patients, is essential to keep in mind the radiological spectrum of images they can show, because in some cases they have a characteristic appearance. Chest radiographics (CXRs) are usually abnormal, but nonspecific; and a normal CXR does not exclude DLD. High resolution computed tomography (HRCT) is the method of choice to evaluate this group of pathologies.
Materials and methods: We report eleven patients with DLD, in whom HRCT was performed. According with the classification proposed by Fan and Langston, in the group of DLD associated with systemic disease, we present one patient with Langerhans cell histiocytosis (LCH) , one patient with malignancy-related lung disease (lymphoma), one with systemic sclerosis, and two with storage diseases (Niemann Pick and Gaucher). In the group of intrinsic lung disease and idiopathic interstitial pneumonias, we reported one patient with desquamative interstial pneumonia (DIP), and another with lymphocytic interstitial pneumonia (LIP); and in others primary disorders, one with aspiration syndrome, one with lymphangiectasis, and two with alveolar hemorrhage syndromes (hemosiderosis and microscopic polyangiitis). Although bronchiolitis obliterants (BO, postinfectious disease) is included in that classification, we decided to exclude it from this presentation, because in our country we are particularly susceptible to the development of post infectious BO (adenoviruses genome type 7h).
Results: The main findings were ground glass opacities, nodular opacities, centrilobular and lymphangitic nodules, interlobular septal thickness, crazy-paving appearance, irregular lines and honeycombing, cystic change, and consolidation.
Conclusion: HRCT is the modality of choice to evaluate diffuse lung disease. In many cases the tomographic findings allow an accurate diagnosis, and in other cases it serves as a useful roadmap for lung biopsy.

PCV-1

CT angiography can be used to diagnose total anomalous pulmonary venous return in neonates on ECMO when echocardiography is less suited: three cases

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Purpose: Total anomalous pulmonary venous return (TAPVR) is an uncommon cause of cyanosis in neonates. The severity of symptoms depends on the degree of obstruction of the pulmonary drainage. Severe obstruction with respiratory failure may necessitate extracorporeal membrane oxygenation (ECMO). The diagnosis of TAPVR is generally made by echocardiography. However, echocardiographic imaging during ECMO is difficult due to altered flow patterns within the heart and extracardiac vessels.
Materials and methods: We present three neonates with TAPVR and severe pulmonary venous obstruction who were not diagnosed in spite of multiple echocardiograms during the ECMO treatment. The neonates were treated under the presumptive diagnoses of meconium aspiration syndrome, group B streptococcal sepsis and persistent pulmonary hypertension respectively. Two were on veno-arterial (V-A) and one on veno-venous (V-V) ECMO. Infracardiac type of TAPVR was diagnosed in all three cases using CT angiography (CTA) while on ECMO. In two patients the pulmonary veins were draining via a common vertical vein into the portal vein and in one into the inferior vena cava. Contrast delivery was adapted for the type of ECMO circulation and different techniques were used for V-V and V-A circuits. There were no complications associated with the CT examinations or transports. All three neonates underwent successful surgical repair by anastomosis of the pulmonary venous confluence to the left atrium. They could all be decannulated postoperatively, recovered well and were discharged home.
Conclusion: TAPVR is a serious but curable anomaly that can be difficult to diagnose with echocardiography in patients on ECMO. CTA can safely be performed during ECMO with excellent visualization of the venous anatomy if the contrast delivery is adapted to the type of ECMO. We suggest that CTA should be considered in all neonates with pulmonary hypertension and a prolonged need for ECMO without clear cause.

PCV-2

Detection of right ventricular fibrosis by CMR and plasma levels of procollagen type III N-terminal amino peptide in patients with Tetralogy of Fallot

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Purpose: Recently the serum concentration of aminoterminal procollagen type III (PIIIP) was shown to be elevated in patients with congenital heart disease (CHD). Ventricular myocardial fibrosis is also evident in the right ventricle of patients after correction of Tetralogy of Fallot (TOF). The levels of PIIIP are associated with the severity of haemodynamic load or hypoxaemia, both of which might induce myocardial fibrosis. We hypothesized that serum levels of PIIIP would correlate with the amount of fibrosis detected by late gadolinium enhancement (LGE) cardiovascular magnetic resonance (CMR). We also hypothesized that the amount of fibrosis would show correlation with other clinical markers such as pro-BNP and the right ventricular volume.
Materials and methods: Plasma PIIIP levels were measured in two groups: in 50 pediatric patients (mean age 13.1 years, SD 3.1) who had undergone TOF repair and in 43 healthy age and gender matched controls. These groups underwent CMR-study and LGE was scored in the right and left ventricle (RV and LV).
Results: PIIIP levels of TOF patients were significantly higher than those of control subjects (12.4 SD 4.9 vs. 8.3 SD 2.9 $p<$ 0,0001). RV LGE was found in all of the patients but LGE score did not correlate with PIIIP levels ($p=0.16$). LGE score correlated positively with the RV end diastolic volume (EDV ml/m2 $p<$ 0.016) and with pro-BNP ($p<0.015$). No LV LGE was shown in any of the patients and both LGE scores were zero in all control subjects. PIIIP levels did not correlate with EDV or pro-BNP.

Conclusion: RV LGE is a common finding in TOF patients already in pediatric age whereas LV LGE is not present at all. PIIIP levels are elevated but show no correlation with the level of fibrosis of the right ventricle (LGE-score). Cardiac collagen turnover is known to be active in myocardium under pathological conditions. We suggest that the elevated levels of PIIIP reflect an active turnover process in the RV, but the amount fibrosis cannot be estimated by plasma PIIIP levels. Higher LGE score is associated with more dilated right ventricle and suggests that dilatation rather than restriction is common in the right ventricle of TOF patients.

PCV-4

Pretricuspid level shunt: unusual cause of systemic to pulmonary shunting

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Purpose: 1. To illustrate a multimodality approach to the anatomical aspects of unusual causes of left-to-right shunt, emphasizing the increasing importance of Multidetector Computed Tomography (MDCT) and Magnetic Resonance Imaging (MRI) in patient management. 2. To show the appearance on MDCT and MRI of the different types of Atrial Septal Defects (ASD).
Material and methods: Pretricuspid level shunts (PTLS) are one of the most commonly recognized congenital cardiac anomalies presenting in adulthood. Several anomalies during the development may result in this pathologic condition which is a cause of left-to-right shunt, and a proportion will develop pulmonary arterial hypertension if untreated. We reviewed 87 cases of PTLS from our archives, 54 sinus venosus defect in association with partial anomalous pulmonary venous return, 21 partial anomalous pulmonary venous return, 5 scimitar syndrome, 4 total anomalous pulmonary venous return and 3 inferior sinus venosus defect.
Results: The most frequent entity in our series was the superior sinus venosus ASD. This teaching exhibit will illustrate with different techniques (echocardiography, MDCT and MRI) the usual and unusual types of pretricuspid shunts, including samples of ostium secundum defect, coronary sinus ASD, sinus venosus defect, partial anomalous pulmonary venous return and residual shunts in patients in whom PTLS was surgically corrected.
Conclusion: Advances in MDCT and MRI have enabled radiologists and cardiologists to adopt a functional approach to diseases that causes left-to-right shunt, and we must be familiar with these infrequent entities.

PCV-5

Diagnosis of aortic arch malformation using Gd-free MRA—a case report

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Purpose: Demonstration of Gd-free Magnetic Resonance Angiography (MRA) for the diagnosis of an aortic arch malformation.
Material and methods: A two months old girl with congenital inspiratory stridor, decreasing oxygen saturation and feeding problems was referred for evaluation from an outpatient clinic. Chest radiograph and echocardiography were inconclusive, therefore MRA was performed. Due to the young age and in concordance to general guidelines, Arterial Spin Labeling and Time of Flight (TOF) as Gd-free MRA techiques were selected.
Results: Arterial Spin Labeling MRI-technique did not yield diagnostic information, therefore the imaging protocol was switched to TOF MRA. This technique clearly demonstrated the aortic arch malformation consisting of a double of a double aortic arch with hypoplastic left part a Kommerell diverticulum at the confluence of both arches. Supraaortic branches were normally configured.
Conclusion: Several imaging modalities for the diagnosis of aortic arch malformations exist—chest X-ray and echocardiography / mediastinal ultrasound being in the first line. Due to the inconclusive results of the previous and typical clinical presentation, an examination for ruling out / confirmation of the suspected aortic pathology was needed. multidetector row CT would be an option but burdened by considerable radiation exposure and necessary intravenous iodine contrast medium injection. In our institution, Gd-free MRA was therefore chosen—to best of our knowledge the diagnosis of an double aortic arch with hypoplastic left one using Gd-free MRA was not reported. Maybe the hypoplastic part was responsible for inconclusive ultrasound.

PCV-6

Two cases of supracardiac type total anomalous pulmonary venous connection (TAPVC) in neonates with a literature review on TAPVC

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Materials and methods: Case 1. A newborn boy presented with severe cyanosis and respiratory distress immediately after normal delivery. Despite intubation and ventilation with 100% oxygen he remained cyanosed with SaO2 of 60–70%. Supracardiac TAPVC was suspected by echocardiography, therefore CT angiography (CTA) was performed. CTA showed drainage of all pulmonary veins to a common pulmonary vein (CPV). The CPV drained via a severely obstructed vertical vein into the left brachiocephalic vein. Obstruction of the vertical vein led to both filling of thin collateral vessels communicating with the superior vena cava and left brachiocephalic vein, and filling of thin tortous paraesophageal veins extending below the diaphragm. CT showed signs of severe pulmonary interstitial edema. Due to pulmonary venous congestion, extracorporeal membrane oxygenation (ECMO) support was initialized before transportation to pediatric cardiac surgery. The neonate underwent successful surgical repair. Case 2. A newborn boy had tachypnea and cyanosis, initial SaO2 70%. With continuous positive airway pressure and oxygen, SaO2 raised to 80–90%. Supracardiac TAPVC was suspected by echocardiography. CTA showed drainage of all pulmonary veins to a CPV and visualized drainage of the CPV to a moderately obstructed vertical vein communicating via the left brachiocephalic vein with the SVC. This infant also underwent immediate successful surgical repair. TAPVC is categorized into supracardiac, cardiac, infracardiac and mixed forms on the basis of the location of pulmonary venous drainage. The severity of symptoms is dependent on the obstruction of the pulmonary venous return. Obstructed TAPVC is a surgical emergency, awareness of this can help the radiologist with prompt recognition of the condition.

PCV-7

Common and uncommon vascular rings and slings in children: a multi-modality pictorial review

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Purpose: Vascular rings and pulmonary slings are rare congenital anomalies of the aortic arch/great vessels and pulmonary arteries respectively. The purpose of this review is to illustrate radiologic findings of the common and uncommon vascular rings and pulmonary slings in children using a multi-modality imaging approach.
Materials and methods: All pediatric patients (less than 18 years of age) diagnosed with either a vascular sling or pulmonary sling were identified by searching institutional Department of Radiology electronic medical records. Pertinent images from children with common and uncommon vascular rings will be presented using a multi-modality imaging approach, including radiography, esophagography, computed tomography (CT), and magnetic resonance imaging (MRI). A systematic imaging approach to the evaluation of these conditions will be discussed, and three-dimensional CT and MRI renderings will be presented.
Results: We identified numerous common and uncommon and pulmonary slings. Vascular rings to be presented include: double aortic arch (co-dominant, left arch dominant, right arch dominant, and atretic left arch), right aortic arch with aberrant left subclavian artery, right circumflex retroesophageal aortic arch with intact ligamentum arteriosum/patent ductus arteriosus, right cervical aortic arch with left aberrant subclavian artery, right aortic arch with mirror imaging branching and intact retroesophageal left ligamentum arteriosum, and left cervical aortic arch with right descending thoracic aorta and right patent ductus arteriosus. Pulmonary slings to be presented include: classic pulmonary sling (anomalous left pulmonary artery arising from right pulmonary artery), pulmonary sling with diffuse pulmonary arterial hypoplasia, and pulmonary sling with right unilateral pulmonary agenesis.
Conclusion: Vascular rings and pulmonary slings are relatively common causes of airway symptoms in children. It is important for the Pediatric Radiologist to be aware of the various imaging appearances of common and uncommon forms of these vascular anomalies to be able to make a correct diagnosis.

PCV-8

Aortic arch malformations—not just a bunch of rings and slings

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Purpose: The purpose of this poster is to describe the embryology, histology and pre- and post-surgical radiographic findings and surgical correction of discrete coarctation of the aorta, aortic and aortic arch hypoplasia, and aortic interruption.
Materials and methods: After IRB approval, patients with history of aortic arch malformations were identified using imaging and surgical records. Two- and three-dimensional CT and MR images, histological specimens of normal and abnormal aorta and the ductus arteriosus, and surgical photographs were chosen to illustrate each form of aortic malformation and key concepts of each malformation.
Results: Discrete coarctation of the aortic arch hypoplasia, discrete coarctation, and aortic interruption occur when the dorsal aortae or the fourth and sixth aortic arches fail to develop normally. Discrete or simple coarctation of the aorta may be isolated or seen with coarctation of the aorta. Aortic arch hypoplasia, which often accompanies coarctation of the aorta, and aortic interruption, are more often found in patients with complex intracardiac abnormalities. Hypoplastic left heart syndrome (HLHS), a malformation that also results in a small caliber aorta, is the result of an abnormal formation of the entire left side of the heart. Medical management and surgical repair of patients with aortic malformations has improved over the past generation such that 91.5% of patients with aortic coarctation and 38% of patients with HLHS survive five years and 90.9% and 25%, respectively, survive into adolescence.
Conclusion: We have described the embryology, histology, characteristic radiographic findings and the surgical correction of simple coarctation of the aorta, aortic arch hypoplasia and interruption and the aortic malformation associated with HLHS.

PCV-9

Applications of non-Gd contrast angiography using steady-state free precession (SSFP) in children

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Background: There is a need for alternatives to gadolinium or iodine based contrast angiography in children, due to physiologic functional renal immaturity in neonates, the frequent need for vascular imaging in the setting of renal insufficiency, and the increased risk of children to radiation induced carcinogenesis from CT. Non-contrast angiographic techniques like Steady-State Free Precession (SSFP) have the potential to fill this void. They have been widely used in the adult population for imaging of the coronary and renal arteries. They pose formidable technical challenges in children due to high heart rates and small size of the target vasculature.
Purpose: The purpose of this presentation is to review our 9 year experience with the use of 2D and 3D SSFP in over 500 children, with emphasis on essential modifications of technique based on size and clinical indications, potential applications in the chest, abdomen and extremities, and an overview of pitfalls and limitations in pediatric vascular imaging.
Materials and methods: A brief review of the physics and technical aspects of the 3D-SSFP technique will be provided, with focus on essential technique modifications required in pediatric vascular imaging based on size and clinical indication. The presentation will be image rich with demonstration of various applications of SSFP for pediatric vascular imaging, including congenital heart disease, vascular malformations, portal hypertension, vasculitis, renovascular hypertension, systemic venous thrombosis and evaluation of tumor respectability and response to chemotherapy. Comparison to contrast enhanced MRA will be made to highlight benefits, pitfalls and limitations.
Conclusion: The high intrinsic signal to noise ratio, excellent resolution, short imaging time, T2/T1 contrast, and the non-dependence on externally administered contrast makes the SSFP sequence a valuable tool for pediatric vascular imaging.

PED-1

Impact of American Board of Radiology (ABR) changes on pediatric radiology resident training

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Purpose: To assess the impact of ABR changes on pediatric radiology residency training including the number, timing, availability, and funding of pediatric radiology rotations.
Materials and methods: Participants were selected using ACGME accredited USA radiology residency programs list and

data was collected via a survey. Program directors, or designated persons, were asked to fill out the survey.
Results: Of 186 programs, 84(45%) responded to the survey. Three months of pediatric radiology where required in 61.0% of the residency programs, with most completing one rotation in each of the PGY2, PGY3 and PGY4 years. In 46% of radiology residencies, pediatric radiology rotations were completed at the home institution and thus, fully funded. A decrease in the number of pediatric radiology rotations was planned in 7% of the programs, while 75% plan no change. 19% of programs plan to move pediatric rotations to earlier in training, and 52% plan no change. Additional rotations in areas of interest are planned in 82% of programs. Although 53% of programs responded they could provide additional rotations in all 10 subspecialties, 58 % indicated it was "very unlikely" or "impossible" residents could acquire 12 months in one area. Cardiac, OB/Women's imaging and Pediatric radiology were the top three most frequent subspecialty areas that could not be accommodated. While 51% of programs stated that funding limitations were not a barrier for additional pediatric radiology rotations, funding was a limitation in up to 44% of programs.
Conclusion: Residency programs plan to cut back the number of pediatric radiology core rotations and move them to earlier in training. Although 82% of programs say they plan to provide more time in areas of interest, 58% say it is unlikely or impossible residents could accumulate 12 months in their area of interest. Only 53% of programs can provide subspecialty training in all areas, with Cardiac, OB/Women's imaging and pediatric radiology being the most unavailable. Funding may limit access to additional pediatric rotations in up to 44% of programs.

PED-2

Diagnostic errors in pediatric radiology—a pictorial review

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Purpose: Errors in medical decision making is a topic of interest to patients and physicians alike. Much is known about medical errors in procedure-based specialties, and this research and knowledge has led to the development of optimized protocols and changes that improve patient outcomes. Recently, we conducted a study to analyze the pattern and potential etiologies of diagnostic errors as they pertain to the specialty of pediatric radiology. Our goal is to systematically present descriptions and representative examples of cases for each category of these diagnostic errors, with a brief discussion of our observations and recommendations for further investigation.
Materials and methods: We reviewed 265 cases with clinically significant diagnostic errors that occurred over a 10 year period. A diagnostic error was defined as a diagnosis that was delayed, wrong or missed.
Results: Diagnostic errors were systematically analyzed and classified as follows: Perceptual Under-interpretation of finding, Cognitive: Faulty information processing, Faulty interpretation of test Premature closure, Over-interpretation of finding, Faulty context generation, Failure to order follow-up or appropriate test, Faulty data gathering Faulty/incomplete test performance technique, Ineffective review of history/physical exam, Faulty knowledge, Inadequate knowledge base, Inadequate skills, System error, Organizational Clustering, Faulty medical history, Teamwork/communication, Inefficient processes, Management/supervision, Policy and procedures, Technical error, Unavoidable errors
Conclusion: Defining a taxonomy of diagnostic errors represents the first steps towards furthering our understanding of the often multi-factorial etiology. This pictorial essay, highlighting classic examples of each error type, could be used to educate radiology trainees to avoid some of the more common pitfalls in pediatric imaging. This systematic analysis of diagnostic errors may also help define effective strategies for improvement in patient outcomes.

PED-3

Pediatric radiology teaching module: validation of effectiveness in residency training (1-year follow-up)

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Purpose: To create teaching material which can benchmark the progress of residents in pediatric radiology. The goal is to provide a satisfactory knowledge base in pediatric radiology earlier in the training and document continued progress in each pediatric rotation.
Materials and methods: 150 fundamental pediatric radiology entities were compiled with factual information in PowerPoint format. The residents were required to study the material whilst on their pediatric rotation. A pretest and posttest were given in July 2009 and July 2010, before and after the cases were available. 33 individuals were enrolled in the study and separated by levels of training (i.e. R1, R2). The tests consist of 100 single best answer cases tested during a 1 hour session. The fellows who have recently passed the ABR boards, were considered the reference. Changes in mean % score per class and year were tested with ANOVA. Cronbach's alpha coefficient was used to assess test score reliability. Item discrimination and item difficulty statistics were used to evaluate the quality of test questions.
Results: The mean percentages correct on the 2009 pretest by class were: 26.6 (R1); 43.0 (R2), 59.3 (R3); 70.5 (R4); 78.0 (Fellow). In 2010, their posttest scores by class were: 65.3 (R2); 75.4 (R3); 84.0 (R4) and 86.7 (F). In both years, there was a statistically significant ($p<.01$) increase in scores with trainees' level of experience, validating the test. Two-way ANOVA detected statistically significant ($p<.05$) year and class effects, indicating that the 2009 trainees using the pediatric case file improved more than expected based on experience alone. The majority of test questions demonstrated good item discrimination and level of difficulty. Exam scores were highly reliable (Cronbach's alpha=0.985).
Conclusion: Distributing an educational tool covering the basic concepts of pediatric radiology will allow faster acquisition of fundamental imaging pattern recognition, concepts and knowledge. Administering a single best answer imaging test can be a valid and reliable way to evaluate the progress of residents during their training.

PED-4

Pediatric radiology physician assistants: do they alter resident physicians' experience in pediatric fluoroscopy?

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Purpose: Evaluate the effect of a pediatric radiology physician assistant (PA) on radiology resident physicians' experience in pediatric fluoroscopy.
Materials and methods: 63 current and former radiology resident physicians (trainees) received anonymous surveys in November 2010 via email. Questions pertained to the frequency a PA was present during their training in pediatric radiology, the number of voiding

cystourethrograms (VCUG) performed weekly by the trainee, their instructor for VCUG, comfort level with pediatric bladder catheterization and perceptions regarding time spent in pediatric fluoroscopy. Internal review board approval was obtained.
Results: 34 (54%) trainees contacted completed the survey. 27% of trainees never had a PA present. 29% of trainees reported a PA present 50% of the time. 44% of trainees reported a PA present 51–100% of the time. The reported average number of VCUG performed weekly by the trainee was 9–12 or more from trainees reporting a PA never to be present, 5–8 from trainees reporting a PA to be present 50% of the time and 0–4 from trainees reporting a PA present 51–100% of the time. Reported comfort level with pediatric female bladder catheterization was "comfortable" or "very comfortable" for 87% of trainees reporting a PA never present, "comfortable" for 60% of trainees reporting a PA present 50% of the time and "comfortable" for 21% of trainees reporting a PA present 51–100% of the time. None of the trainees reporting the PA as their VCUG instructor were "comfortable" or "very comfortable" with pediatric female bladder catheterization. 62% of the trainees reporting the attending pediatric radiologist as their VCUG instructor were "comfortable" or "very comfortable" with pediatric female bladder catheterization.
Conclusion: A pediatric radiology physician assistant has an adverse effect upon radiology resident physicians' experience in pediatric fluoroscopy. The data indicate that VCUG is better taught to trainees by an attending pediatric radiologist and that radiology trainees should perform nearly 10 VCUG per week while training in pediatric radiology.

PFN-1

State of the art review of the role of ultrasonography in management of necrotising enterocolitis

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Purpose: Necrotising enterocolitis (NEC) is the commonest gastrointestinal emergency in neonates, affecting 12% of babies weighing less than 1500 g, a third of affected babies die. As advances in neonatology result in the survival of smaller babies, and those with lower gestational age, prompt diagnosis and appropriate management of NEC are crucial. We aim to review and illustrate the current and future role of ultrasonography in the diagnosis and management of NEC.
Materials and methods: We searched current literature using search terms "neonates", "sonography", "ultrasound" and "necrotising enterocolitis". We reviewed the role of grey-scale and colour Doppler ultrasonography in diagnosis, assessing severity, determining the need for surgery and in imaging complications of NEC. We compare ultrasonography with plain abdominal radiography (AXR). We use our own images from our tertiary referral neonatal unit to illustrate our findings.
Results: Sonography is more sensitive than AXR in depicting intramural gas, portal venous gas and free intraperitoneal gas. Unlike radiography, sonography can better depict bowel wall thickness, and additionally describe bowel wall perfusion. Thickening and increased perfusion of bowel wall are sonographic indicators of early NEC. Thinning of bowel wall and reduced perfusion may be correlated with clinical deterioration. Absent bowel perfusion in combination with free intraperitoneal gas and focal fluid collections are sonographic indicators of severe NEC.
Conclusion: Ultrasonography is a valuable tool in diagnosing and managing NEC, evaluating the state of the bowel and guiding treatment decisions. It's role is complementary to abdominal radiography, being particularly useful in diagnosing and staging NEC when clinical signs and radiography are equivocal. It has the potential to improve mortality and morbidity associated with NEC. Research as to the optimal timing for surgical intervention is an urgent future priority.

PFN-2

Cytomegalovirus-related brain lesions: pre- and postnatal MRI monitoring (case report)

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Congenital cytomegalovirus (CMV) is the main cause of viral congenital infection and can cause a wide range of brain anomalies. The purpose of our study is to illustrate gradual evolution of intracranial abnormalities in a single patient through the serial imaging from early prenatal period to infancy. A 22 year old woman 24 weeks pregnant was referred to our institution for further characterization of abnormal findings on prenatal ultrasound, interpreted as corpus colossal agenesis. Pelvic MRI was performed on a 1.5 Tesla Magnet using SSh-T2-FSE weighted sequence in addition to sT1-TFE, EPI and DYN-BFFE sequences. The prenatal imaging findings were compared with MRI examinations during the first 5 and 7 months following delivery. Maternal and transplacental fetal CMV infection was serologically proven immediately following fetal imaging. Fetal cerebral MRI revealed normal corpus callosum development, but numerous cerebral abnormalities included: microcephaly, ventricular and subarachnoid spaces dilatation, subependymal cysts, and abnormal irregular gyration, suggestive of polymicrogyria. Moreover, hepatomegaly was noticed. Comparison with postnatal MRI imaging performed on the same scanner revealed progressive cerebral volume loss, numerous periventrical cysts and leukomalacia, and polymicrogyria in occipital and temporal regions. The signs of calcification were evident as line foci of T1/T2 shortening in periventrical white matter. Two months later a follow up MRI demonstrated further cerebral volume loss and delayed pattern of cerebral myelination. The familiarity with imaging appearance of CMV infection in utero is of the great importance for early detection of this potentially devastating entity. The comparison with postnatal imaging will improve our understanding of evolution of cerebral injury over time after birth.

PFN-3

Magnetic resonance evaluation of fetal lower urinary tract obstruction

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Purpose: Lower urinary tract obstruction has a significant impact on neonatal and child health. Accurate detection is possible via ultrasound (US), but the underlying pathology is often unknown. We report four cases of lower urinary tract obstruction detected during the prenatal period with Magnetic Resonance (MR) and examine whether MR is useful not only to confirm the US diagnosis but also to show the underlying pathology and assess the renal prognosis.
Materials and methods: Four fetuses (three boys and one girl) with US-suspected congenital uropathy (pelvicalyceal dilatation, megacystis and large extra-abdominal prevesical pseudo-cyst), underwent prenatal MR. Voiding cystourethrogram were performed during the neonatal period in all cases.

Results: In two fetuses, MR showed the extrarenal character of the urinoma associated with hydronephrosis in a non-functional dysplastic bilateral kidney; in one case bilateral severe hydronephrosis and in one case monolateral pyelocaliceal dilatation. Infravesical obstruction such as posterior urethral valves (PUV) were suspected in three cases on the basis of US and MR, and obstruction of the pyeloureteral junction in the last case. Voiding cystourethrogram performed during the neonatal period revealed PUV in two cases while in one child there were PUV and anterior urethral valves.
Conclusion: Urethral valves are common cause of lower urinary tract obstruction: subvescical obstruction caused pressure build-up in the urinary tract, followed by fetal bladder rupture. The resultant urinoma migrated extra-abdominally. The kidney may be difficult to localize on US if the urinoma is very large. MR may contribute to the diagnosis and reveal the underlying dysplastic kidney.

PFN-4

MRI findings of gastroschisis, omphalocele and cloacal exstrophy in fetus

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Purpose: The purpose of this exibit is to demonstrate the MRI findings of major congenital abdominal wall effects such as gastroschisis, omphalocele, and cloacal exstrophy. We also demonstrate the perils and pitfalls in diagnosing these diseases.
Materials and methods: Balanced steady state free precesion and T1-weighted fast field echo images of whole body (sagittal, coronal and axial directions) were obtained for all 13 cases using a 1.5-tesla scanner. In two cases with gastroschisis, free floating loops of bowels were detected. MRI also revealed dilatation of herniated bowels with wall thickening. Bowel wall thickening might be caused by the "peel" covers of intestinal waste products such as meconium in the amniotic fluid. The bowel usually protrudes through the right side of the normal umbilical cord. Nine cases with omphalocele showed a sac protruding at the center of the anterior abdominal wall. The herniated viscera usually contain the small intestine and liver. Occasionally, the bladder, spleen, stomach and large bowel might also be involved. Our study showed a hernia of the bowel, stomach, liver and bladder in 7 (78%), 2 (22%), 5 (56%), and 1 (11%) cases respectively. Ascites in the sac of omphalocele was detected in 1 (11%) of 9 cases. In 8 cases (89%), the dilatation of bowels was not found, in contrast to that seen in the fetus with gastroschisis. However, 1 case (11%) of ruptured omphalocele showed the floating loops of bowels with dilatation and wall thickening. Because the herniated viscera of gastroschisis do not usually contain the liver, we could diagnose this case as ruptured omphalocele according to the finding of liver herniation.
Conclusion: Cloacal exstrophy is a spectrum of abnormalities resulting from abnormal development of cloacal membrane, associated with omphalocele. On MRI, we could suspect this entity by detecting the defect of the lower abdominal wall and the disappearance of the urinary bladder in our two cases. T1-weighted image were useful to distinguish the bowels from umbilical cord by depicting the high intensity meconium in the bowel.

PFN-5

Neonatal non-neoplastic masses—a pictorial review

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Purpose: 1. To provide a comprehensive pictorial and educational overview of the imaging characteristics of common non-neoplastic neonatal masses. 2. To provide a brief synopsis on the clinical findings and presentation.
Materials and methods: A retrospective review was performed to identify non-neoplastic mass lesions encountered clinically or imaged in the neonatal period. Correlation was made between clinical and radiological findings.
Results: A large proportion of masses encountered in the newborn period will be non-neoplastic. We illustrate the clinical findings and imaging characteristics of a variety of non-neoplastic neonatal masses within the chest, abdomen and soft tissues, including congenital, infective, inflammatory and vascular lesions. Imaging features are demonstrated across multiple modalities including ultrasound, CT and MRI. The contribution of each modality in diagnosis, management and surgical planning is also reviewed.
Conclusion: Information obtained from imaging is critical for the diagnosis and management of neonatal masses, and may provide valuable anatomical information for the surgeon. For these reasons, it is important that radiologists are familiar both with the imaging features that may be encountered and the specific advantages and limitations of each of the imaging modalities used to evaluate this category of abnormalities.

PFN-6

Fetal lobar holoprosencephaly: is a thick corpus callosum the tip of the iceberg?

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Purpose: We report a case of fetal lobar holoprosencephaly associated with an abnormally thickened corpus callosum (CC), which supports recently published results connecting a thick fetal CC to other brain abnormalities. To our knowledge, this is the first time that such an association has been described.
Materials and methods: Antenatal sonography at 31w GA for suspected agenesis of the rostrum of the corpus callosum showed dextrogastria and a left sided facial cleft. Indirect findings associated to fetal lobar holoprosencephaly were found by MRI (absence of the interventricular septum and olfactory bulbs, and rudimentary frontal horns). However, at MRI, the most striking brain abnormality was a diffusely thick corpus callosum, with an abnormal iso-intense signal on T2-weighted-imaging. A subtle brain parenchymal fusion (1 cm long) was then found in the frontobasal and presepto-optic regions. All these findings were confirmed at post-mortem brain MRI and at pathological analysis. At post-mortem CT, gas outlining the whole body arterial vasculature, allowed seeing a single unpaired azygous anterior cerebral artery. We have further investigated the brain fusion by using DTI in order to assess the presence of connecting fibers. The tractography performed antenatally and post-mortem did not demonstrate inter-hemispheric connection by crossing fibers at the level of the frontal parenchymal fusion. The trajectory of fibers of the corpus callosum had no differences with respect to normal fetuses.
Conclusion: This case confirms that a thick fetal "corpus callosum", a rarely reported imaging finding, is frequently associated with other brain abnormalities, and should warn about a possible associated lobar holoprososencephaly, sometimes subtle like in this reported case. The association of holoprosencephaly to other midline and lateralization defects in the present case (facial

cleft, heterotaxy with symmetric liver, intestinal malrotation, polysplenia, bilobed right lung) further support the hypothesis of disturbance of pattern formation during blastogenesis, as previously suggested in the literature.

PFN-7

Cardiovascular structures available at fetal MRI: an anatomical and biometric analysis

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Purpose: To evaluate the cardiovascular structures visible at fetal MRI and their normal values at MRI.
Materials and methods: We reviewed all our fetal MRI studies in order to evaluate the anatomical features of both the fetal cardiac and vascular system. We analyzed: the cardio/thorax ratio, the angulation of the ventricular septum axis to the sagittal midline, the four chambers' diameter and area, the ventricular and atrial septum thickness, the right and left ventricular wall thickness, the great arterious and venous vessels diameter.
Results: A scatterplot by gestational week was obtained for all measurable parameters.
Conclusion: The major teaching points of this educational poster are:
- What are the cardiovascular structures visible at fetal MRI
- What are the expected biometric values of cardiovascular major structures.

PFN-8

Fetus in fetu: a well documented multimodality imaging approach to an unusual abdominal fetal mass with pre- and postnatal correlation

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We report a case of a fetus in fetu followed from pregnancy to birth and surgery with review of the literature. Prenatally US and fetal MRI attempted to define a diagnosis, but only a postnatal multimodality imaging approach consisting of US, X-rays, MRI and CT scan could make a definitive diagnosis. After surgically excising the mass and opening the sac, it showed the presence of a trunk and four limbs with fingers. Histopathology showed the presence of gastrointestinal tract and brain tissue and confirmed the presence of vertebral bodies, four limbs and fingers with nails. Fetus in fetu is a rare congenital anomaly consisting with a parasitic twin of a diamniotic monozygotic twin. However its embryopathogenesis and differentiation from teratoma has not been well established and imaging features may be similar. Although fetus in fetu is a rare condition, correct diagnosis using a multimodality imaging approach can be made before surgery.

PFN-9

Fetal ex-utero 3D CT: 4-year experience

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Purpose: Intra-uterine fetal demise, stillbirth and pregnancy termination are dramatic situations. In order to provide the most precise diagnosis to support a prognosis for future pregnancies, the family is asked to consent to a fetal examination consisting of chromosomal and molecular genetic tests, macro and micro-pathologic studies as well as autopsy. Imaging of the fetus is part of the autopsy process. We have recently added CT and 3D CT into our fetal autopsy imaging protocol.
Materials and methods: After REB approval, from September 2006 to September 2010, 300 consecutives deceased fetuses or stillborn infants were studied with conventionnal Xray and whole body 3D-CT fetograms as part of the autopsy process.
Results: Gestational age ranged from 14 to 41 weeks of gestation (m= 23 weeks 6 days +/− 6 weeks 6 days). A large variety of skeletal anomalies were depicted in 89 cases. They were classified as—skeletal dysplasia (15 pts) representing osteogenesis imperfecta, hypophosphatasia, thanatophoric and campomelic dysplasias, Ellis-van Creveld syndrome;—skeletal dysostosis (34 pts) representing proximal focal femoral deficiency, radial aplasia, limb body all complex, spondylocostal dysostosis, phocomelia, Smith Lemli Opitz syndrome, polydactily, caudal regression syndrome and ribs abnormalities;—and finally, skeletal deformities secondary to underlying non skeletal malformation (40 pts) in case of anencephaly, Meckel Gruber syndrome, abdominal distension, sacrococcygeal teratoma… In every patients the skeletal anomalies were more clearly depicted and more easily recognised on the 3D CT than on the plain films.
Conclusion: Ex-utero 3D CT increases the conspicuity of fetal skeletal anomalies during the fetal autopsy process.

PFN-10

Prenatal diagnosis of intra-abdominal lymphatic malformation in a fetus with Gorlin syndrome

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Case: A 36 year-old G2P0 woman was referred for evaluation of her 37 week 2 day pregnancy. A prior fetal diagnosis of Gorlin syndrome (GS) had been made. Prenatal ultrasound examination demonstrated an anechoic structure in the right lower quadrant with no vascular flow, with a thin anechoic tract of contiguity with a second anechoic component, measuring up to 4.6×3.0 cm. There was mass effect on adjacent bowel loops and contour forming with the liver margin, but no bowel signature. The findings were felt to be most consistent with an intra-abdominal lymphatic malformation, given the known, though rare, association of lymphatic malformation with GS. The baby was born at full term and at one month of age presented for a planned office visit and ultrasound for evaluation of the presumed lymphatic malformation. Postnatal ultrasound demonstrated a complex, mixed microcystic and macrocystic mass measuring approximately 7×6×6 cm, occupying the right lower quadrant, which enveloped the right ovary. Some of the fluid contents were echogenic, suggesting proteinaceous debris. Thick vascularized septations were noted, containing both arterial and venous flow. The findings confirmed the prenatal diagnosis of intra-abdominal lymphatic malformation.
Discussion: GS is a rare autosomal dominant disease manifesting most commonly with multiple basal cell carcinomas of the skin appearing as early 2 years old; recurrent mandibular and maxillary odontogenic keratocysts; calcification of the falx cerebri; skeletal anomalies including bifid ribs and scoliosis; typical facies including frontal bossing, macrocephaly, and pouting lower lip; and palmar and plantar skin pitting. Patients also have an increased risk of a spectrum of benign and malignant neoplasms, most notably ovarian and cardiac fibromas and early onset medulloblastomas (3 to 5% of Gorlin patients). Lymphatic malformations are a rare finding. To our knowledge, this is

the first reported case of an intra-abdominal lymphatic malformation diagnosed prenatally in a fetus with Gorlin syndrome.

PFN-11

The aetiologic spectrum of foetal brain injury

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Purpose: To review our experience of foetal brain anomalies where MRI had been performed as an adjunct to ultrasound, separate out those that were considered destructive rather than malformative, and determine the underlying aetiology for each case.
Materials and methods: A retrospective review of all foetal MRI cases was performed using an established ten year database. Review included pre- and post-natal imaging, laboratory testing, and postnatal follow-up where available.
Results: From a total of 237 cases, 17 cases were identified where the cause was reasonably ascertained to be destructive rather than malformative. These could be grouped into the following categories: haemorrhagic (5 cases), infectious (1 case) metabolic (1 cases) hypoxic-ischaemic (4 cases) and embolic (6 cases). Selected cases from each category, with relevant pre- and post-natal imaging by US, CT and MRI, will be presented, including hydrocephalus, Dandy-Walker spectrum, cytomegalovirus, pyruvate dehydrogenase deficiency, arteriovenous malformation, co-twin demise, twin reversed arterial perfusion, schizencephaly, twin-twin transfusion syndrome and hydranencephaly. Approximately one third of all cases (6) were in monochorionic twin pregnancies.
Conclusion: A spectrum of aetiologies is demonstrated, namely haemorrhagic, infectious, metabolic, hypoxic-ischaemic and embolic. A disproportionate number of cases were associated with monochorionic twin pregnancies. Foetal intraventricular haemorrhage is recognised as a potential cause of Dandy-Walker spectrum.

PFN-12

'Lumps and bumps' around the head and neck on fetal MRI: a pictorial essay

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Purpose: To review and illustrate the fetal MRI imaging findings of various head and neck lesions and to emphasize the role of fetal MRI in the diagnosis, detection of severe complications and management of these lesions.
Materials and methods: A retrospective review of fetal MRI's performed at a tertiary children's hospital over a five year period between 2005 and 2010 was performed. A pictorial essay of the MRI features of cystic and solid lesions around the head and neck is presented.
Results: The various 'lumps and bumps' diagnosed include Cystic hygroma, mixed lymphatic venous malformations, hemangiomas, teratomas and encephaloceles.
Conclusion: Fetal MRI aided in localization and characterization of the lesions and helped plan further management. It is an important tool especially in situations where ultrasound does not provide adequate information.

PFN-13

Intracranial cystic formations in neonates: transfontanellar sonographic findings

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Purpose: Transfontanellar ultrasound is the most commonly used technique to assess the neonatal intracranial structures, with high sensitivity and specificity for the diagnosis of major lesions, which primarily include the intracranial hemorrhage and hypoxic-ischemic injury. The aim of this paper is to show some examples of intracranial cystic formations in newborns, including the subependymal cyst, arachnoid cyst, periventricular leukomalacia, subependymal cysts following intracranial hemorrhage (ICH) grade I, porencephaly post grade IV ICH, encephalomalacia post cerebellar hemorrhage and congenital anomalies such as Dandy-Walker syndrome and cystic formation associated with Chiari II malformation.
Materials and methods: This study is based on transfontanellar sonographic studies performed routinely in our neonatal intensive care unit in preterm and term neonates to intracranial assessment.
Results: Transfontanellar ultrasound is the technique of choice for intracranial evaluation of newborns and infants up to the closure of the fontanelles, by the absence of ionizing radiation, portability, low cost and real-time diagnosis. The technological improvement of new devices and the use of additional sonographic windows, such as the posterior and mastoid fontanelles, allow better assessment of intracranial structures.
Conclusion: Transfontanellar sonography is an important method for intracranial study of preterm and term neonates, allowing differential diagnosis of several neonatal intracranial cystic formations.

PFN-14

Pregnant female anthropometry from computed tomography scan for finite element model development

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Purpose: Approximately 800 fetal losses occur yearly in the United States due to motor vehicle crashes (MVCs). Pregnant occupants incur a variety of injuries, including placental abruption, that lead to maternal and fetal demise. This study introduces methods for translating anthropometric data gathered from computed tomography (CT) scan on a third trimester pregnant female into a finite element model of the female human for use with virtual crash tests.
Materials and methods: Pregnant anthropometry data were collected from CT scan. Masks of the maternal abdominal organs were created by segmentation of the CT slices, and three-dimensional (3D) volume renderings were formed. From these masks, the volume and Hounsfield units for each abdominal organ were recorded, creating a blueprint of the pregnant anatomy. Measurements of the fetal skeleton were compared to literature values, confirming 32 week gestational age stated in the medical records. Uterine volume was calculated, and uterine and placental wall thicknesses were measured for each CT slice.
Results: The total uterine volume in the third trimester of our subject was 3,377 cm3 . Uterine wall and placental thicknesses were measured for each slice, averaging 6.8 mm (+/− 0.7 SD) and 40 mm (+/− 18 SD), respectively. Measurements demonstrated regional variations in thickness of each. Mass effect of the gravid uterus on theaternal abdominal and pelvic organs was modeled as well as uterine rotation to the right.

Conclusion: CT scans offer important information regarding uterine wall thickness, placental thickness, amniotic fluid volume, uterine shape, maternal abdominal and pelvic landmarks, and the mass effect of the gravid uterus that allows the creation of a more accurate finite element female model for use in crash injury analysis. This model is the first step for future study of injury metrics at the placental-uterine interface, of the effect of inompressible fluid within the uterus on the fetus during blunt trauma, and other mechanisms that lead to fetal loss in the setting of trauma. Funding for this project was provided by Ford Motor Company University Research Program.

PFN-15

Microcolon as a transient finding on fetal MRI

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Purpose: Fetal MRI is an important tool for diagnosis of fetal gastrointestinal obstruction. MRI complements ultrasound by accurately demonstrating the size of the rectum and colon, which contain meconium and appear bright on T1 weighted images. Meconium accumulation is retrograde from the rectum, which is routinely visualized on MRI beginning at 18 weeks. A small rectum or distal colon is usually a sign of bowel obstruction in the fetus or newborn. We present a series of fetuses with dilated bowel and microcolon on fetal MRI with normal postnatal outcome and no evidence of bowel pathology.
Materials and methods: We retrospectively reviewed fetal patients referred to our institution for dilated bowel on US in 2009 and 2010, who were subsequently diagnosed with a small rectum or microcolon on MRI. In this study, we included those with microcolon on fetal MRI (1.5T GE, T1-w FGRE or T1-w LAVA-IDEAL), defined as rectal measures more than 1SD less than normal for gestational age on at least 2 different planes. Correlation with follow up MRI and/or postnatal follow up was performed.
Results: Twenty-three patients were initially referred for bowel dilatation to our institution at 22–34 weeks GA. On US, a single loop was dilated in 8/23 patients, echogenic bowel wall in 13/23. 16/23 had fetal MRI. Bowel dilatation was confirmed in 15/16. MRI showed microcolon (measure of the rectum ranged: not seen-3 mm) in 10/16 patients and in 2 patients referred for other abnormalities (CNS abnormality and twin pregnancy with imperforate anus in the other twin). All patients with microcolon had fetal and/or postnatal follow-up at our institution. In 7/12 (58%) patients with microcolon, follow up by MRI (4/7), at 32–34 weeks GA and/or by newborn imaging was normal. All patients with normal outcome had a single dilated loop of bowel with echogenic wall on initial US.
Conclusion: Fetal microcolon is usually a sign of bowel obstruction. Our study shows that this may represent a transient finding associated with normal outcome. Further studies on the physiopathology of fetal bowel may provide the explanation of this phenomenon.

PFN-16

Significance of fetal and neonatal enteroliths

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Purpose: Enteroliths correspond to the rare occurrence of calcified meconium within the bowel lumen, and usually signify severe disease and poor prognosis in the fetus and neonate. The aims of this study are : 1. to recognise enteroliths and differentiate it from other more common fetal or neonatal bowel hyperechogenicities, 2. to understand the significance of this finding in fetuses and neonates, 3. to review the mandatory work-up, and counsel.
Materials and methods: Retrospective review of the imaging and clinical data of fetuses and neonates presenting with enteroliths and or bowel hyperechogenicities in a mother-child institution for 10 years. Correlations with postnatal imaging, surgery and/or pathology.
Results: Presentation of prenatal and postnatal correlations of the various fetal and neonatal entities associated with enteroliths : cloacal and anorectal malformations, extensive aganglionosis (Hirschprung disease), and multiple digestive atresias. Discussion of the differential diagnosis with other more frequent causes of bowel hyperechogenicities such as first trimester bowel hyperechogenicities, second trimester hyperechoic bowel and meconium peritonitis.
Conclusion: Prenatal or perinatal discovery of enteroliths implies complete work-up, and often corresponds to severe diseases such as complex anorectal malformations, extensive aganglionosis or multiple digestive atresia, associated with a poor prognosis. The discovery of enteroliths in a fetus or neonate implies a specific workup, and a careful counselling due to their association with severe underlying entities.

PFN-17

Neonatal hypoxic-ischemic injury: ultrasound and dynamic color Doppler sonography perfusion quantification of the brain and abdomen with pathologic correlation

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Purpose: To illustrate the role of cerebral and abdominal ultrasound (US) including dynamic color Doppler sonography (CDS) perfusion quantification in neonatal Hypoxic ischemic injury (HII) with pathologic correlation.
Material and methods: A pictorial review with illustration and discussion of US and CDS perfusion intensity findings of the brain and abdomen in neonatal HII including pathologic correlation. US technique and demonstration of dynamic CDS perfusion protocol measurements are discussed.
Results: The spectrum of cerebral patterns of injury with special attention to CDS perfusion measurements of the basal ganglia and thalami are demonstrated. The significance of increased cerebral perfusion in HII is discussed. CDS perfusion assessment and US findings of the bowel and kidneys are illustrated. Also adrenal and hepatic abnormalities are described
Conclusion: US and dynamic CDS perfusion of the brain and abdomen provides comprehensive bedside multi-organ imaging information in HII. This pictorial review with pathologic correlation provides an overview of the systemic impact of HII. It also helps understanding the complex pathophysiology of this devastating disease.

PFN-18

Intraventricular hemorrhage (IVH) in term neonates with hypoxic-ischemic encephalopathy (HIE): a comparison study between neonates treated with and without hypothermia

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Purpose: To retrospectively determine the overall prevalence of IVH in full-term neonates with HIE using head ultrasound (HUS) and MRI, and whether there is an association between hypothermia and increase in IVH.
Materials and methods: A total of 65 term neonates with HIE from 2 institutions underwent HUS in their first week of life. The majority (58 survivors) underwent MRI. They were all retrospectively reviewed for IVH. Thirty infants were treated with whole body hypothermia and 35 neonates were treated conventionally.
Results: Four of the 65 infants (6%) were diagnosed with IVH on HUS. Three were confirmed with MRI. The fourth case showed a bilateral enlarged choroid plexus on HUS, but IVH could not be confirmed with MRI, as the infant did not survive. In the group of neonates treated with hypothermia, there were 3 cases (10%) of IVH, whereas in the group not subjected to hypothermia, IVH occurred in one infant (2.9%).
Conclusion: Our study demonstrated that IVH remains uncommon in term infants with HIE. However, it was more prevalent in the group treated with hypothermia. The higher prevalence of IVH in neonates treated with hypothermia may not necessarily be a consequence of the therapy. It might reflect the selection protocol of more clinically severe cases of HIE in the hypothermia group.

PFN-19

Pictures at an exhibition: understanding normal and abnormal fetal development by imaging medical museum specimens

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Background: We have established a collaboration with a unique Medical Museum located close to our institution. The Museum, established for the purpose of collecting material for medical research and education, contains a collection of anatomical and pathological specimens dating back to 1858, including fetuses at many stages of development and with various anomalies.
Materials and methods: For the past two years we have began to perform high resolution CT and MRI on these fetal specimens, 4 specimen with CT scans, and when possible (in 3 of those 4) with MRI at 1.5T and 3T. There are 2 specimens from the 1st trimester (10 and 15 weeks gestation), one from the 2nd trimester (18–20 weeks), and a half specimen (fused leg of sirenomelia, around 25–28 weeks. The purpose of this educational exhibit is to illustrate features of the developing skeleton with images obtained from historical specimens from the Museum's collection and thereby demonstrate the utility of imaging such collections. In order to understand abnormal development, a comprehension of normal features is crucial. Congenital disorders of the skeleton occur with a frequency of 1/3000 births. Much of our understanding of fetal development stems from studies done in other species. Historical fetal specimens provide us with an opportunity to corroborate these findings with current imaging techniques without damaging the specimens. The change in contour of the distal femoral epiphysis from ovoid to bicondylar, visibility of secondary ossification centers, metaphyseal undulation, marrow cavitation, and perichondreal structures such as bone bark will be demonstrated in this exhibit. A description of the histologic changes will accompany the images to further understanding of the developmental processes. Abnormal features, such as fusion in sirenomelia, will also be illustrated with purported explanations for their causation.
Conclusion: Examination of these historical specimens can help to reinforce and possibly to increase our knowledge of development.

PFN-20

Prenatal detection of ovarian cysts: ultrasound features and outcome

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Introduction: Ovarian cysts are the non renal cystic masses detected more frequently in obstetric ultrasound. While their natural history is the spontaneous involution in a significant number of cases, the proper management is still controversial.
Purpose: To determine the pre and postnatal ultrasound characteristics of ovarian cysts, evolution, complications, therapeutic.
Materials and methods: The charts of 25 female patients born from December 2001 to July 2010 with pelvic or abdominal cystic images in prenatal ultrasound were retrospectively reviewed. Gestational age at diagnosis, ultrasound features: shape, size, mobility, echogenicity, evolution in terms of: complications, progression, stability, partial or total involution and treatment were determined.
Results: Out of 25 newborns, 23 had ovarian cysts. The mean gestational age at diagnosis was 32 weeks (r: 24–35 weeks). Fifteen showed limpid cystic aspect, 2 small vesicles daughters, 3 thin walls and 3 had heterogeneous appearance (echogenic content and thick walls). Mean maximum diameter (MD) at diagnosis was 4,1 cm (r: 2.7 to 6.3 cm); 9 had a MD greater than 5 cm, 4 between 4–5 cm and 10 patients 4 cm. Eleven patients (48%), with a mean MD of 3.7 cm (r:2,7-5,1 cm) showed intrauterine involution, 8 postnatal involution in a mean time of 6 months (r:1–13 m), in 6 of them the involution began intrautero;1 grew up to a MD of 7.6 cm and involuted totally at 10 months of life. One patient with a limpid cyst with a MD of 5.5 cm and mobile aspect was complicated in the 10th day of life. The 3 cysts of heterogeneous aspect were surgical.
Conclusion: The 83 % of the ovarian cysts detected by antenatal ultrasound involuted spontaneously. The complications in 3 patients occurred intrautero. No cysts less than 5 cm were complicated. The high percentage of spontaneous involution in newborns with non mobile simple cysts less than 5 cm of MD suggests clinical and ultrasound follow-up. It is necessary to identify the subgroup of patients who may be benefit from intrautero cyst decompression.

PFN-21

Cost effectiveness of a cut-off value of 1.5 cm in the anterior-posterior renal pelvic diameter to define mild antenatal hydronephrosis

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Background: Mild isolated antenatal hydronephrosis (MIAHN) represents half of the urinary tract anomalies detected by antenatal ultrasound (US). No consensus exists on how to measure the hydronephrosis (HN) and on the superior value of the anterior-posterior pelvic diameter (APPD) to define MIAHN. Despite its good prognosis, there are authors who propose extensive protocols: voiding cystourethrography (VCUG), antibiotic prophylaxis (AP) and radioirrenogram (RRG) when the APPD is >1 cm. These aspects have high impact in the postnatal management in terms of cost-effectiveness. Since 1989 we defined MIAHN: APPD ≤1, 5 cm, without calyceal dilatation confirmed by first postnatal US, and AP and VCUG were indicated in all NB. Concerned about the possibility of over-investigation, we reviewed this approach and since 1998, neither VCUG nor AP was indicated except if urinary infection (UI)

occurred. RRG was not performed except if progression was observed. Parents were instructed about signs of UI, and US follow-up was performed.
Purpose: To assess the cost-effectiveness of our current algorithm for MIAHN and the safety of a superior value of 1.5 cm to define MIAHN.
Materials and methods: From 570 NB with prenatal renal abnormalities, 269 (47%) had MIAHN. In 40 NB the APPD was between 1 to 1.5 cm. Direct costs of avoided studies were estimated according to local values: VCUG ($600), RRG ($750), AP ($450 per year) as avoided radiation doses.
Results: In 24 patients (10%) VCUG was performed because they had IU, 3 of them showed mild vesicoureteral reflux. HN involuted in 72% in the 1st year, 4 children showed progression and required RRG, 2 of them were operated. If we had studied all the patients, costs would have been: $120,000, $161,000, $30,000 (40 patients with APPD >1 cm), vs. our real cost : $17,400 (24 VCUG +4 RRG:). Radiation dose and invasiveness were reduced.
Conclusion: An APPD of 1.5 cm was a safe value to define MIAHN and allowed us to reduce costs, invasiveness and radiation dose.

PFN-22

Association between gestational age and occurrence of high grade intraventricular hemorrhage in extreme prematurity

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Purpose: Extremely premature infants, those born before 28 weeks of gestation, are highly susceptible to innumerable complications which may result in mortality or major morbidity. High grade (grade III, IV) intraventricular hemorrhage (IVH) is a leading cause of poor neurological outcome and mortality. While there are numerous studies that focus on IVH, most deal with premature infants that were born after the 28th week of gestation, as survival rate of extremely premature infants was low in the past and has increased only recently due to improved therapy.
Our study evaluates the association between gestational age and occurrence of high grade IVH in extremely premature infants.
Materials and methods: Following Institutional review board approval, patients were identified using the Picture Archiving Communication System (PACS). The study population consisted of 109 premature infants born in Jacobi Medical Center, Bronx, NY, between 2001 and 2010. The patients were divided to 2 groups; Group A: gestational age < =25 weeks (n=54) and group B: gestational age >25, <28 weeks (n=55). Their charts were reviewed and clinical and imaging data were collected. We conducted logistic regression analysis with IVH as the outcome variable to evaluate its association with gestational age.
Results: IVH was diagnosed in 38 (70.4%) of group A and in 29 (52.7%) of group B, while high grade IVH was diagnosed in 17 (44.7%) of group A and 8 (27.6%) of group B. The incidence of high grade IVH was significantly higher in group A (P=0.039). In a multivariable adjusted model, patients in group A were 2.6 times (95% CI: 1.02–6.66) more likely to have high grade IVH, independent of hypotension/bradycardia episodes and surgical patent ductus arteriosus, which were found to be independent risk factors for IVH in this population.
Conclusion: While IVH is common in extremely premature infants, the incidence of high grade IVH, a leading cause of poor neurological outcome and mortality, is significantly lower in those born after the 25th gestational week.

PFN-23

Significance of enlarging ventricular size on neurosonography in predicting abnormal neurodevelopment in newborns followed through infancy

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Background: Infants visiting the N/D clinic are often evaluated with NS. An increasing ventricular size on these exams is often interpreted as a possible predictor of abnormal N/D outcome.
Purpose: To determine the value of both the absolute ventricular size as well as the rate of ventricular enlargement as measured on neurosonography (NS), in predicting neurodevelopmental (N/D) outcome in newborns followed through infancy.
Materials and methods: Greater than 500 NS were obtained on 271 newborns (152 male, 119 female) followed through infancy. Patients underwent N/D testing between 18–24 months of age. Gestational age ranged from 26 weeks to 42 weeks. NS were obtained between day 1 of birth up to ~9 months. Routine NS was performed with frontal horn widths obtained in the coronal plane at the level of the foramen of Monro as previously described.
Results: Patients with an abnormal N/D outcome demonstrated an increased mean ventricular size on early assessment (frontal horn - 7.6 mm vs. 1.8 mm for patients with normal N/D), however the RATE of ventricular growth/enlargement during infancy in these patients was markedly less than that seen in the normal outcome group. The mean ventricular values in late infancy was 9.0 mm for the patients with abnormal N/D outcome compared to 7.5 mm for the normal outcome group.
Conclusion: These findings suggest that increased ventricular size is often present on initial/early NS in patients with subsequent N/D deficiencies. However, the further ventricular system enlargement with aging is less than expected in this population, probably due to an abnormal RATE of brain growth, which may be a better predictor of N/D deficiency than initial ventricular size. Serial NS would facilitate identification of abnormal ventricular growth rate. Ventricular size should be expected to increase with age with the absolute values in normal older infants often greater than what is regarded as abnormal in the neonate.

PFN-24

Prenatal imaging of amniotic band syndrome

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Purpose: To describe the fetal MRI findings in amniotic band syndrome (ABS) and to compare diagnostic accuracy of MRI and Ultrasound (US) with regard to this disorder.
Materials and methods: Prenatal MRI and US studies were retrospectively reviewed in 14 pregnancies with confirmed ABS via fetal surgery (11 patients) or postnatally (3 patients). The US and MRI studies of each fetus were performed on the same day and fetal gestational age ranged from 18 to 27 weeks. Both imaging modalities were evaluated for their ability to visualize amniotic bands (AB), the body part affected, the type of deformity, umbilical cord involvement, and vascular abnormality.

Results: AB were confidently identified with MRI in 8 fetuses (57%) and suggested in 3 fetuses (21%) but were confidently seen by US in 13 fetuses (93 %). Both techniques were equally able to define the body part affected, the type of deformity, and umbilical cord involvement. At least one limb abnormality was visualized in all cases with the most common findings being restricted motion (11), focal constriction (8) and distal edema(7). Truncal involvement included severe spinal deformity and constriction of the lower chest. Cord involvement was suspected in 7 cases and confirmed during fetal surgery. Cord abnormalities included unusual course, entanglement, segmental edema, and fixed position adjacent to AB or affected limb. Doppler US also allowed assessment of the affected limb for preservation of distal blood flow (present in all the constricting bands) and assessment of fetal distress in cases of suspected cord involvement (with abnormal Doppler present in 5 cases).
Conclusion: Fetal MRI findings in ABS reproduce those of US (including limb and truncal deformities and cord involvement). US was superior in detecting amniotic bands and equally reliable as MRI for detection of limb and cord abnormalities (with the additional benefit of blood flow analysis). In the absence of complex deformities or technical limitations, it appears that US alone provides sufficient information for the confident prenatal diagnosis and evaluation of ABS.

PFN-25

Training in infants with neonatal stroke

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Purpose: The literature on adult, human and animal models suggests early and intensive experiences can advance motor skills. The purpose of this project is to provide intervention for reaching and grasping in infants with neonatal stroke order to take advantage of the plasticity of the developing brain. DTI analysis of the brain with emphasis on the cerebellum at stroke diagnosis and post-intervention are discussed.
Materials and methods: Twenty infants with neonatal stroke were randomly assigned into an experimental group (intervention) and a control group. MRI scans were acquired from 17 infants at birth. To date, DTI scans have been processed from 5 subjects post intervention. The Magnetic Resonance scanning was performed on a 3.0 Tesla imager. DTI acquisition parameters were: TE=76 ms; TR=10 s; flip angle=90° single-shot; full k-space; 128×128 acquisition matrix interpolated to 256×256 with a field of view (FOV)=30 cm, generating an in-plane resolution of 1.72 mm2 with full head coverage. Slice thickness=5 mm; slice gap=1.5 mm. Diffusion MR Images were obtained from 25 directions with a b-value of 1000 s/mm2 along with a b=0 image with no diffusion gradients. TrackVis diffusion toolkit was used for the tractography and the region of interest for quantifying and comparing the number of tracks in the cerebellum.
Results: Infants in the experimental group showed earlier and better reaching and grasping behavior than infants in the control group. The number of fiber tracks in the cerebellum increased from birth to 6 months of age. At 6 months of age, and post intervention, infants in the experimental group demonstrated a slightly higher number of fiber tracks in the cerebellum (9487) compared to the control (8758).
Conclusion: Preliminary results suggest that intervention advances week of reach onset, improves grasping behaviors and the fine motor subset of the Bayley Scale. Interestingly, the cerebellum may play a role in the development of coordinated reaching and grasping behaviors in infants with neonatal stroke.

PFN-26

Distinguishing imaging features of fetal cervical teratomas: the utility of fetal magnetic resonance imaging and ultrasound

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Purpose: The purpose of this study is to provide a detailed description of the clinically relevant imaging findings of fetal cervical teratomas, as depicted by fetal ultrasound (US) and fetal magnetic resonance imaging (MRI). It is our hope that providing a comprehensive description will assist others in the fetal imaging community with providing a complete and appropriate imaging workup in fetuses carrying this diagnosis.
Materials and methods: To date, approximately 1800 fetal MRI cases have been performed and/or interpreted at our institution since 2004. After obtaining IRB approval for this retrospective study, we reviewed 11 cases of fetal cervical teratoma evaluated by the fetal imaging team from January 2004 through October 2010. Subjects were identified through the Med Notes word search program. The available fetal MR images and reports, ultrasound images and reports, and prenatal echocardiography reports were reviewed by the authors. In addition, the postnatal images, operative reports and pathology reports (where available) were also reviewed for this study. The patients' existing Fetal Care Center charts were also accessed for the study.
Results: Data regarding gestational age at evaluation, lesional size, location, internal architecture, MRI and ultrasound imaging features, vascularity, amniotic fluid volumes, lung volumes, airway delineation, and regional invasion were collected. Postnatal information was obtained in 9 of 11 cases, including but not limited to, intra-operative findings, pathologic characterization and infant outcomes. Fetal US generally renders a correct diagnosis, and is well known for demonstrating vascularity, calcifications and amniotic fluid volumes. Fetal MRI is an important adjunct modality for delineating the fetal airway and carina, calculating lung volumes and for detecting mediastinal and intracranial invasion which occurs in a small percentage of cases.
Conclusion: Complete prenatal evaluation of fetal cervical teratomas should be carried out utilizing both US and MRI for optimal surgical planning and parental counseling, as both modalities provide unique and important information.

PFN-27

Predicting gestational age and weight in premature infants admitted to the neonatal intensive care unit (NICU) by chest radiograph

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Purpose: Before digital radiographs, the pediatric radiologist could guess the weight and gestational age of premature infants admitted to the NICU by their size on an analog film. In digital imaging, magnification at the desktop by the radiologist or by the technologist during processing can mask the difference between a very small 26 week premature infant and a larger 35 week infant. We hypothesized that the transverse diameter of the chest in a premature infant would correlate with its weight and possibly with gestational age. The pediatric radiologist uses gestational age and weight to adjust their differential diagnosis, normal values for renal size, or the expected degree of sulcal development in the brain, when they interpret images.

Since gestational age and weight are not always provided by our NICU or PACS to the radiologist at the time of dictation, a reliable desktop estimate of gestational age would be useful to a pediatric radiologist.
Materials and methods: The gestational age, weight, and sex of 310 infants admitted to the NICU over an 8-month period in 2010 were obtained from admission records. Their chest diameter was then measured on admission chest radiograph and compared with both their gestational age and admission weight.
Results: It has been previously established that there is a linear correlation between gestational age and weight, which we confirmed with a Pearson coefficient of 0.87. As hypothesized there was also a linear correlation between both gestational age and weight with chest diameter, Pearson coefficients of 0.82 and 0.90 respectively. Clinically useful chest diameters were divided into categories (<80, 80–89, 90–99, 100–110, >110 mm) and the average gestational ages and weights for each of these categories was calculated, each of which were found to be statistically different from each other in a pairwise fashion.
Conclusion: An infant's gestational age and weight can be estimated by a simple measurement of the transverse chest diameter. This is not only useful in interpreting the chest X-ray, but also in additional studies that the patient may undergo while they are in the NICU.

PFN-28

Evaluating discordant lesions in fetal brain US and MRI

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Purpose: There is increased use of fetal MRI to further probe abnormalities identified by routine fetal ultrasound. The goal of this study was to evaluate efficacy of fetal MRI brain as compared to fetal ultrasound and identify areas of discordance.
Materials and methods: Fetal MRI since 2009 referred for suspected brain abnormalities by ultrasound were retrospectively identified. Subjects without prenatal ultrasound were excluded. Standard ultrafast T2 single shot spin echo sequences of the fetal brain were obtained on 1.5T MRI. If available, fetal brain MRI was compared to postnatal brain MRI. 3 pediatric radiologists reviewed the studies independently.
Results: We identified 54 fetal MRI with suspected abnormal brain findings by ultrasound. Mean gestational age (GA) was 27 wks and 28 wks at the time of fetal ultrasound and MRI, respectively. Postnatal MRI was obtained in 14 subjects (mean age 3.6 days). Suspected abnormal brain findings included: neural tube defects (7), ventriculomegaly (26), absent corpus callosum/cavum septum pellucidum (4), intracranial cyst/mass (4), posterior fossa malformations (9) or cerebral malformations (3). MRI was performed for polyhydramnios in 1 case. New lesions were seen in 24 of 54 cases of fetal MRI, in addition to those identified by ultrasound. Furthermore, in 22 cases, there were discordant ventricular measurements (>2 mm); in 8 cases, the measurement shifted to above or below 10 mm. Fetal and postnatal MRI correlated well, with no additional findings on postnatal MRI in 12 subjects. One subject showed no abnormality on postnatal MRI; 1 case showed an additional finding on postnatal MRI.
Conclusion: Fetal MRI detected additional lesions compared to prenatal US in 44% of cases. Furthermore, discordance in ventricular measurement was found in 41%. In 8 cases, this change in measurement challenged definition of ventriculomegaly, which has important clinical implications. Postnatal MRI correlated well with fetal MRI. Larger studies are needed to further identify significance of discordant ventricular measurements by fetal ultrasound and MRI.

PFU-1

[11C]-L-Methionine positron emission tomography/computed tomography in the management of children with brain tumors

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Purpose: To evaluate the clinical value of [11C]-L-Methionine(Met) positron emission tomography/computed tomography (PET/CT) in the management of children (under 20 year-old) with brain tumors.
Materials and methods: 16 Met PET/CT scan from 13 patients aged from 5 to 20 years (median 16 years) were analysed. All PET/CT studies were performed on Discovery ST-Elite (GE HealthCare). 3 MBq/kg body weight Met were injected intravenously. 20 minutes after Met injection , tracer accumulation was recorded. After recording Met accumulation, 3 MBq/kg body weight FDG were simultaneuously injected.40 minutes later,FDG accumulation was recorded. Each PET tracer accumulation was recorded over 15 minutes and reconstructed into a 128×128 matrix. Each voxel sizes were 3.27 mm(isovoxel).
Results: 8 patients were operated and 5 were closely observed. Histology of the operated patients was as follows: 1 pilocystic astrocytoma, 1 ganglioglioma grade 3, 2 diffuse astrocytoma grade 2, 1 chordoid meningioma, 1 glioblastoma, 2 germinoma. Evaluable images could not be obtained for 1 patient because of her body motion. SUV max ratio of the tumors and normal tissues were calculated as T/N ratio in Met PET/CT studies and FDG PET/CT studies.Using a threshold of 1.4 in Met PET/CT studies, all patients who showed Met T/N ratio over 1.4 had grade 2 or more tumors.On the other hand, all patients showed FDG T/N ratio over 1.0 were malignant tumors (grade3 and 4) except 1 patient with chordoid meningioma.
Conclusion: All previously reported studies were conducted by using PET scanner,not PET/CT scanner.Although small number of patients is our limitation , this is the first report that Met PET/CT in children is feasible and could provide useful imformation for differentiating low grade from high grade tumors.Met PET/CT might be a useful tool for providing additional clinical information when a decision for therapeutic strategy is difficult from routine structural imaging procedures alone.

PFU-2

PET-CT in the evaluation of FUO

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Purpose: To describe the utility of PET/CT in the evaluation of fever of unknown origin (FUO) and to review the limitations of PET/CT for imaging infection and inflammation in children. In this educational exhibit, a review of the challenges in diagnosing children with FUO will be provided. The mechanism of accumulation of radiotracer at sites of infection or neoplasia will be discussed to further understanding of why this modality may be helpful in this clinical situation. Guidelines provided by regional organizations will be listed. Recent literature regarding the advances made with PET/CT and the specific populations in the pediatric age range which may benefit from this study will be described. Limitations ranging from technical issues to difficulties obtaining a diagnosis will be reviewed. Alternative imaging strategies will also be discussed with supporting

published research. Finally, issues regarding dose and the importance of imaging gently will be emphasized.

PFU-3

Beyond lymphoma: PET imaging of pediatric solid malignancies

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Purpose: 18F-fluorodeoxyglucose (18F-FDG) positron emission tomography (PET) is an established imaging modality in the evaluation of many types of cancer in the adult population and is being used with increased frequency in the diagnosis, staging and monitoring of pediatric malignancies. The use of combined PET-CT imaging has become the routine standard of care in the staging and response assessment of pediatric patients with lymphoma. With the exception of certain sarcomas, the scientific literature regarding the use of PET in evaluating the wide variety of non-central nervous system (CNS) pediatric solid malignancies is anecdotal, consisting mostly of scattered case reports or small series largely used to answer clinical questions on a case-by-case basis.
Materials and methods: As a first step toward expanding the indications for PET in the evaluation of pediatric malignancies, we have reviewed our institutional results in which PET imaging was performed on a large number of patients encompassing the spectrum of non-CNS pediatric solid tumors. In this pictorial survey we present our findings, along with the relevant cross-sectional imaging correlation.
Conclusion: Our review indicates that PET can be used effectively in the majority of pediatric solid tumors and can increase sensitivity of detection at the time of diagnosis, offer early signs of treatment response and may also be useful in detecting sites of disease relapse that are otherwise occult. Multi-institutional clinical trials of larger numbers of patients together with outcome data are needed to establish the precise role PET will play in evaluating the majority of pediatric solid tumors.

PGI-1

Ultrasound guided saline hydrostatic reduction: a non surgical procedure for the management of intussusception in children

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Background: Intussusception is the most common cause of intestinal obstruction in the infant and toddler age group. Intussusception is the telescoping of one segment of bowel into the contiguous distal segment. Peak age incidence is between 2 months to 3 years of life.
Purpose: To prove the efficacy of Ultrasound guided saline hydrostatic reduction, a non surgical, non radiation method in the management of intussusception in children.
Materials and methods: US guided hydrostatic reduction with normal saline was attempted on thirty two children in the age group of 2 months to 3 years with clinical diagnosis of intussusception. 500–1000 ml of normal saline was used for reduction. High resolution USG (7.5 M Hz) was used to assess the progress of reduction during the procedure.
Results: Our initial experience in the last three years from April 2007 to May 2010 showed a successful reduction in 26 children out of 32 attempted reductions.

PGI-2

What is the normal superior mesenteric artery (SMA) angle in children?

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Purpose: Nutcracker syndrome is a rare condition in which an abnormally acute angle between the aorta SMA is believed to compress the left renal vein, causing haematuria or proteinuria. The normal SMA angle has been clearly defined in adults, and may relate to visceral fat volume. In this study, we measured the SMA angle and abdominal fat distribution in asymptomatic children undergoing abdominal CT in order to define the normal range.
Materials and methods: We retrospectively identified all childhood abdominal CT examinations in our department over a 4 year period (2005–2008). SMA angle was measured on 3D reconstructed sagittal/oblique slices. Total and visceral fat volumes were measured at the level of the umbilicus using automated software based on −190 to −30 Hounsfield Units.
Results: We measured SMA angle and body fat in 205 consecutive paediatric abdominal CT examinations (120 male, 85 female). Mean age was 9.9±5.5 years. None had unexplained abdominal symptoms, haematuria or proteinuria. The mean SMA angle was 45.6±19.6° (range 10.6–112.9°). There was a weak but significant correlation between visceral fat volume and SMA angle (Y=0.09 X+2.3; R=0.30; p<0.001).
Conclusion: There is a wide range of normal SMA angle in children, which correlates weakly with visceral fat volume. Using a definition of <25° would diagnose 19 (9.3%) asymptomatic children with nutcracker syndrome. Our findings suggest that the SMA angle is not the sole contributor to this rare syndrome.

PGI-3

MRI vs endoscopy in paediatric inflammatory bowel disease

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Purpose: To assess diagnostic accuracy of MRI in paediatric patients with suspected Inflammatory Bowel Disease; compared to endoscopic findings (gold standard) in patients at Sheffield Children's Hospital. Literature suggests MRI compared with endoscopy has a diagnostic accuracy of 90% indicating a good degree of concordance.
Materials and methods: 13 patients who were investigated over a 12 month period between Oct '08 and Nov '09 with small bowel MRI for inflammatory bowel disease were identified using PACS software. Endoscopic findings were collected from patient's clinical notes. The radiological findings were compared to endoscopic findings (gold standard) and the diagnostic accuracy of MRI was calculated.
Results: Out of 13 patients who had a bowel MRI, 11 also had an endoscopy (OGD/Colonoscopy). 2 patients had no endoscopy and therefore findings could not be compared. The average patient age was 14.6 years (range 9–16).There were 8 males and 5 females. None of the 13 patients developed any serious side effects from the MRI investigation. 9 out of 11 (81%) had endoscopic findings which were concordant with MRI findings (of these 5 had active disease and 3 were normal). 2 out of 11 (19 %) had endoscopic findings which were different to MRI findings (1 reported disease on MRI and normal colonoscopy, 1

reported normal on MRI, but ulcers on colonoscopy). The diagnostic accuracy of MRI in this series was 81%.
Conclusion:
• MRI small bowel is a new technique in paediatric inflammatory bowel disease.
• Only 11 patients were included in our study.
• Diagnostic accuracy is 81%, involves no radiation and is a less invasive procedure than endoscopy.
• Should MRI small bowel replace small bowel follow through? MRI is a valuable tool for surveillance and monitoring effects of treatment in inflammatory bowel disease in combination with clinical signs and markers of inflammation.

PGI-4

The application of small bowel magnetic resonance enterography to the paediatric population

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Purpose: MR enterography is a relatively new technique that is now firmly established in the adult population; however its uptake in paediatrics has so far been limited in UK district general hospitals. This is despite the obvious benefits in radiation reduction over traditional imaging methods, which is particularly beneficial in a relapsing remitting disease process such as inflammatory bowel disease where repeated examinations are likely. We have found that in many district general hospitals in our region of the UK there is confusion regarding protocols and application of this technique in children. We aim to provide a well established protocol for this technique and a full discussion of its role in the imaging pathway. A pictorial review of the key signs to recognise in MR enterography of inflammatory bowel disease, imaged using our protocol, will also be included.
Materials and methods: Our institution has a number of years experience in this technique with a robust and well established protocol that leads to reproducible, diagnostic quality imaging in paediatric patients. We present our protocol along with a full discussion of the indications for small bowel MR enterography and the benefits and limitations of the procedure. We outline its use in the investigation of inflammatory bowel disease and consider its role with other imaging, including ultrasound, supported by a literature review.
Results: We present images from a number of different cases to highlight the key findings that should be recognised in MR enterography of inflammatory bowel disease.
Conclusion: Given the correct technique, MR enterography can be a valuable tool in the investigation of inflammatory bowel disease in the paediatric population in the majority of district general hospitals.

PGI-5

The use of contrast enhanced ultrasound (CEUS) in the diagnosis and management of post-traumatic splenic pseudoaneurysms in children

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Background: The liver and spleen are the two most commonly damaged viscera following pediatric abdominal trauma and suspected splenic injury. Computerized tomography (CT) is the primary imaging modality used to evaluate the extent of damage both in the acute and subacute settings. With splenic injury, a concern is the development of splenic pseudoaneurysms with the risk of rupture, which often necessitates repeated CT imaging, with an increase in radiation burden.
Materials and methods: We present two cases of blunt abdominal trauma in children aged 9 and 6 years (male and female), which resulted in splenic pseudoaneurysms. In both cases the initial diagnosis was made during a follow up ultrasound examination after a pseudoaneurysm had not been identified on CT imaging. The CEUS were performed by experienced operators using a Siemens (Mountain View CA) S2000 machine, a 4C1 probe, and 1.2 mls of SonoVue (Bracco SpA Milan).
Results: Using CEUS, the pseudoaneurysm could be clearly identified in both cases and in one a vascular nidus could be seen to progressively diminish in size as thrombosis occurred with repeat examinations. Clear characterization on CEUS allowed for further follow up to be performed on an outpatient basis with B-mode and colour Doppler ultrasound until the lesions 'healed'. This allowed for confident, conservative management of the patients without recourse to CT imaging.
Conclusion: At this tertiary referral centre for pediatric trauma, we have found that with variations in the timing of the arterial and venous phases of CT imaging, the presence of intraparenchymal splenic pseudoaneurysms can be difficult to identify, but can be clearly seen with CEUS examinations. Furthermore, when a pseudoaneurysm can be clearly characterized, follow up may be performed with both repeated CEUS and non-contrast enhanced ultrasound, reducing a potentially high cumulative radiation dose in this young population.

PGI-6

The position of the sigmoid colon in right iliac fossa in children: a retrospective study

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Purpose: To evaluate the incidence of the position of sigmoid colon in the right iliac fossa in children.
Materials and methods: This retrospective analysis was done to assess the frequency of the sigmoid colon in the right iliac fossa on contrast enema study in children in the settings of a tertiary care centre of a developing country. The study was approved by the ethics committee of our department. Images of 91 studies were used, of which 15 were done in the post operative period. The position of the sigmoid colon was evaluated on an antero-posterior view of the abdomen and categorized as follows: Left lower quadrant: if most or all of the loops of the sigmoid colon were to the left of the lumbar vertebral bodies, Right lower quadrant: if one or more complete loops of the sigmoid colon were to the right of the lumbar vertebral bodies, Midline: if the sigmoid colon extended superiorly in a vertical orientation, overlying the midline to the level of the second lumbar vertebrae before entering the right or left side of the abdomen, Indeterminate: if the position of the sigmoid colon could not be ascertained from available images.
Results: The age range varied from 2 days to 13 years. The position of sigmoid colon in left lower quadrant, right lower quadrant, midline and indeterminate was 32 (35.16%), 33 (36.26%), 12 (13.19%), and 14 (15.38%) respectively.
Conclusion: The sigmoid colon occupies the right lower quadrant in a large number of children. Awareness of this finding can reduce the likelihood of misinterpreting air in sigmoid colon as air within the caecum in children suspected of having abnormalities such as intestinal obstruction, intussusception and malrotation.

PGI-7

Role of multidetector CT (MDCT) in the diagnosis of mechanical intestinal obstruction in children

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Purpose: To evaluate the role of multidetector CT (MDCT) in the diagnosis of mechanical intestinal obstruction in children.
Materials and methods: This was a prospective study which was approved by our institute ethics board. Thirty two children underwent MDCT scans for clinically suspected mechanical intestinal obstruction. Twenty two of these patients were subsequently operated upon and included in the study. Of the 22 children included, there were 16 males and 6 females. Median age was 3.5 years (range 4 months to 12 years). 14 MDCT scans were performed on 16 detector scanner while 8 MDCT scans were done on 4 detector scanner. The scans were evaluated for presence and level of intestinal obstruction, any possible cause and viability of bowel.
Results: There were 19 true positive, 2 false negative, 1 true negative and no false positive cases of mechanical intestinal obstruction on MDCT scan. Thus, MDCT had 90.48% sensitivity, 100% specificity, 100% positive predictive value and 33.33% negative predictive value in diagnosing mechanical intestinal obstruction. MDCT scan could correctly predict level of obstruction in all (19 out of 19) true positive cases. MDCT scan could predict the cause of intestinal obstruction completely in 11/21 (52.38%) patients and partially in 5 out of 21(23.81%) patients. MDCT could detect bowel wall ischemia in patients with mechanical intestinal obstruction with a sensitivity of 75%, specificity of 88.24%, positive predictive value of 60%, negative predictive value of 93.75% and overall accuracy of 85.71%.
Conclusion: MDCT scan is useful in management of pediatric patients with intestinal obstruction.

PGI-8

Esophagography: a pictoral review

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Purpose: Esophagography is the primary radiographic examination of esophagus with opaque contrast media.
Materials and methods: In the review all three phases of esophagagraphy are described as well as modifications or shortening of the procedure according to the clinical question, the child's clinical condition and degree of compromise. The selection of most appropriate contrast medium used for examination is discussed. Esophagography remains the method of choice for demonstration of many anatomical abnormalities, both congenital and acquired, and for assessing the peristalsis of the esophagus and the function of gastroesophageal junction.
Results: We present a pictorial review of various esophageal morphological and functional abnormalities shown by esophagography. The most common pathological findings in oral and pharyngeal phases wee nasopharyngeal reflux and the aspiration of contrast medium in the tracheobronchial system. In esophageal phase we assessed the esophageal peristalsis and lumen. The assessment of peristalsis and peristaltic waves was conducted under fluoroscopic control and many motility disorders could be found. The esophageal lumen was evaluated in order to exclude stenosis and strictures of the esophagus of various causes (congenital or acquired), esophageal indentations (aberrant vessels and anomalies of aorta, tumors, duplication cysts), tracheoseophageal fistulas and changes according to inflammations (infective and non-infective). Special attention should be paid to the gastroesophageal junction disorders, such as gastroesophageal reflux with or without complications (inflammation, stenosis), different types of the hiatal hernia, and achalasia. Esophagography is also an important method for evaluation the esophagus after surgical and endoscopic procedures.
Conclusion: Despite modern bi- or three-dimensional techniques in radiology (CT, MRI), esophagography remains the primary imaging method in evaluating the esophagus. It is simple, quickly performed, with a low radiation dose, there is no need for sedation and it provides us with a lot of important and useful clinical information.

PGI-9

Post-operative ultrasound features in pediatric liver surgery: normal appearaces and the features of common complications

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Purpose: To review the ultrasound imaging findings and complications of two of the most common paediatric liver operations: the Kasai portoenterostomy and liver transplantation. We shall illustrate the ultrasound appearances of normal anatomy in the post-operative period. Immediate and long-term complications will also be considered.
Materials and methods: Ultrasound images of the normal post-operative liver transplant will be presented alongside images of the common complications arising in the early and late stages of paediatric liver transplantation. A concise summary of the key findings will be presented with the images.
Results: Conditions will include normal anatomy, normal post-operative findings, Kasai procedure, liver transplantation—split and whole cadaveric grafts; common complications: hepatic artery stenosis, portal venous stenosis, bile duct obstruction, post-operative fluid collections.
Conclusion: Paediatric liver operations are rare surgical procedures performed in specialist tertiary referral centres. However, follow-up imaging may not always be performed in these centres and patients may present acutely to non-specialist centres. All radiologists performing paediatric ultrasound should be aware of the post-operative appearances of liver surgery and be able to recognise the common complications.

PGI-10

Post-operative appearances of esophageal atresia repair: pictorial spectrum

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Purpose: Participants should be able to identify various post-operative oesophagographic appearances, following repair for oesophageal atresia with or without tracheo-oesophageal fistula.
Materials and methods: Hospital records and upper gastrointestinal contrast studies of 152 patients following repair for oesophageal atresia with or without a tracheo-oesophageal fistula were reviewed by two pediatric radiologists.
Results: Images from upper gastrointestinal contrast studies of 152 patients were evaluated and recorded. Findings were recorded as

normal post operative appearances and complications, which included minor and major leaks, fistulous tract, strictures, persistent fistula, reflux ,incidental and pseudodiverticulae formation.
Conclusion: We present a pictorial spectrum of post-operative appearances of esophageal atresia repair in children with oesophageal atresia with or without a tracheo-oesophageal fistula. Pediatric radiologists should be aware of spectrum of these findings including complications, following an esophageal repair.

PGI-11

Ultrasound imaging of the hollow gastrointestinal tract in the paediatric population

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Purpose: The advent of high-resolution linear probes, real-time scanners, power doppler, harmonic and panoramic imaging has resulted in the increasing use of ultrasound in the investigation of the hollow gastrointestinal tract (GIT). Although contrast studies are superior for assessing the lumen and mucosa of hollow viscera, ultrasound provides a dynamic assessment of the bowel wall and it's motion, as well as allowing the identification of any extra-luminal masses. Abdominal ultrasound is particularly suitable for children as it is non-invasive, non-ionising, portable when necessary and repeatable. It plays an important first-line diagnostic role in acute abdominal pain, gastrointestinal inflammation, congenital anomalies, and in monitoring patients with chronic abdominal disease. A sound knowledge of the typical imaging appearances of conditions affecting the GIT in the paediatric population is required of any radiologist involved in the imaging of children.
Materials and methods: We review the optimum ultrasound technique for imaging the hollow GIT. A variety of pathologies are illustrated with cases encountered in a busy tertiary paediatric radiology department. Where relevant we include the findings of other complementary imaging modalities and correlating pathology.
Results: The optimum ultrasound technique for imaging the bowel is described, and an illustrated review of hollow GIT pathologies encountered in children is presented.
Conclusion: Ultrasound should always be considered as a first line investigation to evaluate the hollow GIT in children, in order to establish a diagnosis and facilitate further imaging or management.

PGI-12

The difficulty in radiographic diagnosis of total colonic aganglionosis

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Purpose: The purpose of this study is to describe and analyze the findings on contrast enema of total colonic aganglionosis (TCA).
Materials and methods: From 2001 to 2009, 14 patients (11 males and 3 females, aged from 1 day to 6 months) with pathologically proved TCA were reviewed for clinical data and findings on contrast enema.
Results: Among the 14 patients, the caliber of the colon was normal in 8 (57%), the microcolon in 3 (21%) and the small left side colon in 3 (21%). There were 13 patients (93%) with a shortened and rigid colon, 10 patients (71%) with poor rectal distensibility and 8 patients (57%) with colonic wall irregularity. The radiographic transition zone was located at the terminal ileum in 12 patients (86%), at the transverse colon in 1 patient (7%) and was not available in 1 patient. Among the 10 patients with available delayed films, delayed evacuation of contrast medium was noted in 6 patients (60%). The initial imaging diagnoses were TCA in 8 patients (57%), meconium plug syndrome in 3 patients (21%), small bowel atresia in 1 patient (7%), long segment Hirschsprung's disease in 1 patient (7%), and ileal atresia with post operative anastomosis stricture in 1 patient (7%).
Conclusion: Through the wide-range radiological features of TCA, when contrast enema presenting small bowel dilatation is accompanied by a shortened and rigid colon, poor rectal distensibility, colonic wall irregularity and delayed evacuation of contrast medium, it should raise the suspicion of TCA. Further rectal suction biopsy or full thickness biopsy by laparotomy may confirm the diagnosis of TCA.

PGI-13

Abdominal B-mode and Doppler ultrasonographic findings of Wilson's disease: a review of 33 cases

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Purpose: To determine the prevalence and describe abdominal B-mode and Doppler-ultrasonographic (US) findings in Wilson's disease (WD), in one of the largest series published. To illustrate liver disease presentations at symptoms' onset.
Materials and methods: US scans of 33 patients (18 males, 15 females; 28–2 years, 17 years mean) with WD were retrospectively evaluated. US were performed at the moment of diagnosis. Clinic onset (fulminant hepatic failure, abnormal liver function tests [LFT], acute or chronic hepatitis, cirrhosis) was also assessed. Hepatobiliary abnormalities, hepatic Doppler study and splenomegaly were recorded, paying attention to thickened perihepatic fat layer, an uncommon feature recently described.
Results: Six fulminant hepatic failures, one acute hepatitis, two chronic hepatitis, and three abnormal LFT were found at diagnosis. Diffuse hepatic hyperechogenicity was observed in eight patients (24%) and increased periportal thickness in two (6%), as a coexisting finding. Hepatomegaly was assessed in five cases (15%). Perihepatic fat layer was clearly thickened only in one patient, whereas multiple hypoechoic nodules were present in another. Portal diameter was increased in 2 patients and spleen size in five (15%) (according to their ages). Portal flow was hepatopetal in all cases, with decreased flow in 6.
Conclusion: Most frequent US findings in WD are increased hepatic echogenicity and hepatosplenomegaly, and may be undistinguishable from other liver diseases. Hepatic nodules are uncommon in our series. Although thickened perihepatic fat layer is seldom described and probably not pathognomonic, it seems to be an important imaging key to reaching a correct diagnosis in a proper clinical context.

PGI-14

Current classification of hepatic hemangioma and ongoing therapeutic strategies

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Purpose: To illustrate the spectrum of imaging findings of infantile hepatic hemangiomas, with emphasis on key diagnostic features and differential diagnoses with vascular malformations and true neoplasms. To expose the current classification and clinical management algorithm of vascular anomalies affecting the liver.
Materials and methods: Hemangiomas are the most common hepatic vascular tumors of infancy. Most are asymptomatic, incidentally discovered, but some are associated with severe symptoms (cardiac failure, hepatic dysfunction, compartment syndrome). The literature is confusing regarding the natural history and therapy options. This fact may lead to an incorrect diagnosis and, therefore, inappropriate treatment. We reviewed pediatric patients with hepatic vascular tumors from our database, recording the main imaging features.
Results: Hepatic hemangiomas are classified into three types on the basis of imaging findings: focal, multifocal, and diffuse. Each type demonstrates different imaging appearances, pathologic features and clinical behaviour, and may respond differently to various pharmacologic and invasive treatments. Sonography is the most common and the first imaging technique used. MR, including dynamic contrast-enhanced sequences is probably the best technique for diagnosis. CT may also be performed although radiation is a drawback. Angiography should be reserved in cases of symptomatic shunts and when endovascular therapy isanticipated. Rapidly involuting congenital hemangiomas, venous malformations, arteriovenous malformations, and true vascular neoplasms will also be discussed, stressing their differential imaging features.
Conclusion: This exhibit will provide a comprehensive overview of the imaging appearance of hepatic hemangiomas and help to distinguish hemangiomas from other lesions whose natural history and therapy differ dramatically. We also give a subtype classification and therapeutic algorithm that will contribute greatly to the understanding of these potentially fatal tumors.

PGI-15

Role of intravenous contrast-enhanced multidetector computed tomographic colonoscopy (CTC) in diagnosis of clinically suspected colorectal polyps in children

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Purpose: To evaluate the diagnostic performance of intravenous contrast enhanced multidetector computed tomographic colonoscopy in diagnosis of clinically suspected colorectal polyps in children
Materials and methods: This was a prospective analytical study which was approved by our institute's ethics committee. Thirty pediatric patients with a history of rectal bleeding and suspected to have colorectal polyps were enrolled. All the patients underwent IVCTC on a 64 detector scanner followed by conventional colonoscopy (CC) within 14 days of IVCTC. The diagnostic performance of IVCTC for detection of colorectal polyps was evaluated using CC as gold standard.
Results: The age range of patients was 2.5 years to 14 years. There were 19 males and 11 females. 30 IVCTC and 31 CC procedures were performed in 30 patients of which 8 CC procedures were incomplete. 63 polyps were detected on IVCTC in 28 patients of which 53 polyps in 27 patients were eligible for inclusion in statistical analysis. 60 polyps were detected on CC in 28 patients of which 50 polyps in 27 patients were eligible for inclusion in statistical analysis. IVCTC detected six false positive and three false negative polyps. True negative polyps could not be evaluated as this corresponds to normal colonic mucosa. It was estimated that if intravenous contrast was not injected, four patients would have had false negative CTC examination while the number of polyps would have been underestimated in another patient. IVCTC had sensitivity of 94% and positive predictive value of 88.6%. Specificity and negative predictive value could not be calculated because of non availability of number of true negative polyps. No complications were encountered during the IVCTC.
Conclusion: IVCTC is a safe study capable of serving as an efficient non invasive screening tool for evaluating children with clinically suspected colorectal polyps.

PGI-16

Hydrostatic reduction under US guidance—our first choice method of intussusception treatment

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Purpose: To review intussusception epidemiology and diagnostic and treatment methods, to present our algorythm of intussusception management and the procedure of reduction under US guidance to emphasise adventages of ultrasonography.
Materials and methods: Intussusception is a common abdominal emergency in children but there are still considerable differences in the approach to diagnosis and treatment of this entity. The nonoperative technique of invagination treatment has gained acceptance only in some parts of the world. US-guided hydrostatic reduction is one of the preferred nonoperative techniques and its major advantage is the lack of ionized radiation. We present our algorithm of intussusception management and the pictorial review of the procedure of hydrostatic reduction under US guidance. Since 2006 we use US-guided hydrostatic reduction as a first choice method of invagination treatment in children admitted to our university hospital. We would like to discuss advantages, disadvantages and costs of the procedure.
Conclusion: Hydrostatic reduction under US guidance is safe and effective method. Our algorithm of intussusception management allows for substantial reduction of the radiation in the children population and also decreases the costs of intussusception treatment. It has gained acceptance among surgeons and pediatricians in our university hospital.

PGI-17

Pancreatic pseudotumor: case report

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Purpose: An inflammatory pseudotumor is a benign, solid lesion of unclear etiology. It is considered by some authors as true neoplasm, by others as post-infectious or post-traumatic lesion. Inflammatory pseudotumor most commonly involves the lung and the orbit, but has been reported to occur in nearly every site in the body. For making a definite diagnosis, a biopsy is often essential. Location of the tumor in the pancreas is very rare.
Materials and methods: A 6.5-month-old boy was admitted to our hospital because of jaundice, pruritus and aholic stool. His abdomen was clinically normal. A serum conjugated bilirubin was elevated (52 μmol/l). Ultrasound (US) showed a 4 cm large mass in the head of the pancreas, which was homogeneous and hipoechogenic with

regard to pancreas. A moderate hyperemia was seen on color Doppler. Additionally dilated extra hepatic bile duct and a large gallbladder with a normal wall were found. US guided cytological puncture defined the mass as benign. MRI confirmed an unenhanced mass in the dorsal part of the head of the pancreas; it involved the bile duct, but not the great vessels. Surgical resection of the mass together with resection of gallbladder, distal part of the stomach and duodenum was carried out. Histological sample made a diagnosis of inflammatory myofibroblastic tumor (IMT) and some tumor cells were found on the edge of the resected pancreas. Therefore close follow up with US and MRI was recommended. The control US examination two months after surgery was normal. Control MRI has not yet been performed. The boy is doing well, his stool and color of the skin are normal.
Conclusion: IMT is a rare tumor, especially in the pancreas, as was confirmed by a review of the literature which showed the limited number of cases. Despite the fact that IMT is considered as benign, it could be locally invasive and also a malignant degeneration or transformation to lymphoma in the recurrent or residual tumor is possible. Careful follow up is therefore mandatory.

PGI-18

Development of a carbon dioxide pneumatic reduction device for intussusception—problems, techniques and applications over 6 years

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Purpose: 1. Review the evolution of a new CO2 reduction device, from conception through development to validation. 2. Analyse the management of patients presenting with intussusception at our institution over this 6 year period, specifically evaluating the outcome and complications of intussusception reduction procedures performed using the device.
Materials and methods: Progression of the device design features and functions was reviewed. Retrospective analysis of imaging and reduction procedures carried out over the device development period was performed, using computerised and departmental records.
Results: Of all patients with intussusception, 67 proceeded to CO2 pneumatic reduction procedure using the device, with successful reduction in 61%, and a 4% complication rate.
Conclusion: We will review the evolution of a CO2 reduction device through its prototype stages, including overcoming practical problems and difficulties in development, as well as technical specification and utililty over this 6 year period.

PGI-19

Interstinal obstruction in newborns—a prompt way to diagnose

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Purpose: To show that plain film and contrast studies are the first line for diagnosing interstinal obstructions in newborns and pinpointing their value.
Materials and methods: We reviewed 71 newborns seen in our hospital over a 6-year period and suspected by a neonatal surgeon of interstinal obstruction. Diagnosis was confirmed on plain film and contrast upper GI examination and defined ro criteria of broad spectrum of patological conditions which leads in interstinal obstruction.
Results: The source of IO were duplication cysts (14), atresia (24), meconium ileus(10), Hirschsprung disease (7), malrotation (11) and partial occlusions-stenosis (7). Level and source of obstruction were correctly anticipated and recognised in 87%.
Conclusion: Plain film of the abdomen is the first course of action for pinpointing the right contrast study to perform, and both give us crucial diagnostic information on interstinal obstruction—source and level.

PGI-20

Monitoring of pediatric liver transplantation—follow-up of 99 consecutive patients with biliary atresia using Doppler ultrasound

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Purpose: Doppler ultrasound is a first line tool for the monitoring of vascular patency in liver transplantation (LTX). Despite the methods widely use, little quantitative data have been published regarding follow-up of pediatric patients. The aim of this study was to provide a quantitative description of the development of Doppler measurements in a large pediatric population after LTX.
Materials and methods: 99 consecutive paediatric patients with biliary atresia and progressive liver failure, who were liver transplanted at our university hospital, were included. Serial Doppler measurements of the central and peripheral vessels were performed pre-, intra-operatively and at follow-up. Doppler results were prospectively documented and retrospectively re-evaluated until 12 months after transplantation.
Results: Peak systolic hepatic artery (HA) velocity decreased on comparing preoperative and early postoperative measurements (central HA velocity 64.9±27.0 to 56.3±23.7 cm/sec). A further decline of values was noted during later follow-up measurements. The HA resistance index (HARI) decreased postoperatively to normal values (central 0.91±0.14 to 0.7±0.12) and remained stable at follow-up. Portal venous velocity increased after LTX (central 6.2±15.2 to 36.6±19.9 cm/sec). A backward flow in the central and peripheral portal veins was noted in 28 and 19 patients, respectively, and in none of the postoperative controls. The splenic vein velocity slightly increased after transplantation (15.8±6.3 to 21.8±9.0 cm/sec).
Conclusion: The study describes a range of Doppler abnormalities in pediatric patients with progressive liver failure due to biliary atresia. After LTX, early normalization of Doppler measurements was noted, which remained stable during follow-up.

PGI-21

The difficulties in diagnosing duodenal duplications: a case report

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Purpose: Gastrointestinal duplication cysts are rare congenital malformations. The infrequency of presentation combined with the varied clinical picture renders the diagnosis of these cysts difficult. As a result, the pertinent and timely use of radiology is paramount in establishing the correct diagnosis and monitoring progression.
Materials and methods: We report a case in which a 4 year old boy presented to his local hospital with copious bilious vomiting, peri-umbilical pain and right flank fullness. Clinically, an

appendix mass was suspected. Imaging with ultrasound (US) demonstrated a large cystic structure with incomplete septae arising from the right side of the abdomen. On subsequent computerized tomography (CT), this mass could be seen to cross the midline and was resulting in duodenal obstruction by direct compression. The diagnosis remained uncertain and arrangements were made for transfer to the tertiary hospital. During his transfer, the symptoms suddenly subsided and the patient felt hungry for the first time in five days. A subsequent US showed free fluid within the abdomen and a collapsed, peristalsing, trilaminar walled structure that was separate to but resembled bowel. A ruptured small bowel duplication cyst was suspected. This was confirmed histologically following elective surgery.
Results: The sequence of imaging obtained combined with the progression of clinical symptoms result in an interesting chain of events.
Conclusion: Although this particular scenario is rather unusual, the principle that these congenital anomalies can present with a variety of symptoms which may change during the course of an acute admission is an important concept to embrace. We reflect on the different ways in which an enteric duplication cyst may present and discuss the differential diagnoses of the typical imaging appearances illustrated by the CT and US images we obtained.

PGI-22

Pancreatitis in a pediatric population—it's not just gallstones

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Purpose: With the prevalence of documented pancreatitis increasing in the pediatric population, we aimed to characterize the spectrum of new cases of pancreatitis managed over the course of 12 months within a pediatric population at a specialist tertiary referral centre.
Materials and methods: The radiological departmental records were analyzed to quantify the total number of new cases of pancreatitis that had been managed in a 12 month period. Of these, those that had been referred as opposed to those presenting through the hospital accident and emergency department were calculated. The underlying cause for the pancreatitis was documented and for those that had been discharged at the time of analysis, the average length of stay, the mortality rate and average number of radiological investigations was calculated.
Results: A total of 19 children (Female=13, Male=6, mean age 7.8 years, range 20 months to 17 years) were identified as having been managed for pancreatitis within this period. 12 had been referred from another institution. The underlying causes for the development of pancreatitis included: choledochal abnormalities (n=5), gallstones (n=2), pancreas divisum (n=1), hyperlipidaemia (n=1), non-accidental injury (n=1), autoimmune pancreatitis (n=1), drug-induced (n=1), sepsis-induced (n=1), trauma (n=1), post endoscopic retrograde cholangio-pancreatography (n=1), pancreatic duct stricture (n=1) and unknown/idiopathic (n=3). 17 of the 19 inpatients had been discharged at the time of analysis. No patients had died in hospital and the average length of stay was 15 days. The average number of radiological investigations was 2.1 ultrasounds, 0.65 computerized tomography and 0.7 magnetic resonance imaging scans per inpatient.
Conclusion: In the pediatric population the causes of pancreatitis are diverse and numerous potential etiologies need to be considered. Patients in our institution had an average length of stay of 15 days but no cases died in our cohort, in keeping with the better prognosis for this disease in the pediatric age group.

PGI-23

Duodenal atresia in neonates: imaging findings

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Duodenal atresia represents complete obstruction of the duodenal lumen. It often occurs distal to ampulla of Vater. Infants present bilious vomiting in the neonatal period and a radiograph of the abdomen demonstrates the "double bubble" sign without air in the peripheral small bowel. We present two newborn girls (GA: 37w &32w) born with normal childbirth. In the first 24h the babies presented transient tachypnea and a delay in passing meconium. A plain radiograph demonstrated a dilated stomach and a dilated proximal duodenum with no gas distal to the proximal duodenum referred to as a "double-bubble" sign. A nasogastric tube was passed and bilious secretions were aspirated. The diagnosis was duodenal atresia needing operation. Both cases required surgical treatment based on Kimura's diamond-shaped-duodenoduodenostomy (DSD). Surgery exposed a duodenal diaphragm in both cases. Recovery for the two babies was uneventful. Duodenal obstruction in the neonate may be partial or complete. The prevalence of duodenal atresia stands at 1/ 6000 new-borns and is caused by a failure of canalization of the bowel lumen. The incidence is equal in males and females. Duodenal atresia is associated with Down syndrome (30%) , with a complex of congenital abnormalities known as VACTERL (vertebral, anorectal, cardiac, tra-cheo-esophagal, renal and limb anomalies). When the classic sign of a double bubble is presented on the plain film, additional contrast-enhanced investigation is unnecessary and one should consider both intrinsic and extrinsic causes of obstruction requiring surgery. The intrinsic causes are duodenal atresia(40–60%), duodenal stenosis(7–20%) and duodenal webs(35–45%). The extrinsic causes include annular pancreas(10–30%), malrotation of the gut with obstruction produced by midgut volvulus or Ladd bands and the preduodenal position of the portal vein. The presence of distal bowel gas indicates stenosis, incomplete membrane or a hepatopancreatic ductal anomaly.

PGI-24

Pediatric liver transplantation: relevance of preoperative MDCT evaluation in the diagnosis of portosystemic collaterals in biliary atresia

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Background: Chronic liver diseases increase portal vein pressure and modify splanchnic circulation. This is particularly significant in infants with biliary atresia. Large collaterals steal portal flow and increase the risk of posttransplant portal vein thrombosis.
Purpose: To evaluate different types of portosystemic collaterals prior to liver transplantation with low-dose multidetector CT (MDCT) in patients with biliary atresia and their relevance in the preoperative evaluation.
Materials and methods: 13 patients with biliary atresia underwent low-dose 64-MDCT before liver transplantation (effective tube current ranged from 20 to 120 mAs depending on weight and kilovoltage was 80–120 for all CT). Hepatic arterial and portal venous phases was performed after IV contrast administration [1–1.5 mg/kg]. The mean age of the study group was 1 year (range, 4 months to 3.6 years). Two radiologists reviewed the CT images to determine the grade and types of the portosystemic collaterals.

Results: A total of 16 CT scans were obtained from the 13 patients preoperatively; within 6 days to 12 months of liver transplantation. The mean interval between transplantation and preoperative CT was 115 days. Portosystemic collaterals were found: esophageal (11), paraesophageal (2), gastric submucosal (8), gastric adventitial (7), splenic (7), hemorrhoidal (10), intrahepatic portosystemic shunt (4), mesenteric [mesocaval shunt (0), dilated or tortuous branches of superior (1) or inferior mesenteric vein (8)], retroperitoneal varices [gastrorenal shunt (10), splenorenal shunt (4)] and dilated or tortuous of left gastric (13), internal thoracic (5), paraumbilical (3), interior abdominal (8) and intercostal veins (4).
Conclusion: CT is a useful tool in determining clinically relevant information such as patency of the venous system, presence of varices and position of venous shunts. Detection of collaterals that are not evident on a routine US study are of releveant due to the steal phenomenon that may be related to portail vein thrombosis.

PGI-25

Hereditary spherocytosis with splenic infarction, an unusual entity: atypical ultrasound features with histopathological correlation

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We describe the ultrasound findings in a nine year old girl, known to have hereditary spherocytosis and possible alpha thalassaemia trait, who presented with left upper abdominal pain, exacerbated on inspiration. She had a tender spleen, palpable to the umbilicus. Ultrasound demonstrated massive splenomegaly with unusual focal areas of abnormalities; a large well defined echogenic area in the lower pole, which appeared to have blood flow within it and an avascular septated heterogeneous area at the splenic hilum, adjoining a wedge-shaped superficial hypoechoic area. The abnormal areas mimicked solid neoplasia on ultrasound, creating a dilemma regarding surgery (laparoscopic or open?). Laparoscopic surgery would have been accomplished by crushing the spleen, potentially crushing a tumour which would have made later histological assessment very difficult. She underwent an open splenectomy. The histopathology confirmed these abnormalities as areas of infarction in varying stages of evolution. Hereditary spherocytosis (HS) is a common cause of haemolysis and the commonest haemolytic anaemia resulting from a red cell membrane defect. Children with HS are susceptible to aplastic or hypoplastic crises. Splenic infarction is extremely rare in HS. Coexistent sickle cell disease / trait and Epstein-Barr virus infection have been reported to be associated with splenic infarction in HS. Sonographic-histopathologic correlation of splenic infarction in HS has not been previously reported. Splenic infarction is typically seen as a peripheral wedge-shaped hypoechoic lesion. Radiologists need to be aware that splenic infarctions may have a mass-like atypical appearance with confusing preserved vascularity. Splenic infarcts of varying ages with differing appearances may coexist on a background of long standing splenomegaly, as illustrated in this case.

PGI-26

Preoperative 64MDCT in pediatric liver transplantation: review of protocol and technical parameters

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Background: Chronic liver diseases increases portal vein pressure. In our Department US is the preferred imaging tool in these patients. For the last four years we have included a systematic pretransplant evaluation of collateral veins with MDCT. Large collaterals steal portal flow and increase the risk of posttransplant portal vein thrombosis. *Purpose:* To describe our Imaging protocol in pediatric patients candidates for liver transplants, including indications and technical parameters of MDCT.
Materials and methods: 22 patients underwent low-dose 64-MDCT before liver transplantation (effective tube current ranged from 20 to 120 mAs depending on weight and Kilovoltage was 80–120 in all CT). Hepatic arterial phase was obtained with bolus tracking technique and Portal venous phase was obtained 15 to 25 seconds after the bolus of IV contrast [1–1.5 mg/kg]. The mean age of the study group was 2,6 years (range, 4 months to 10 years). The primary liver disease was biliary atresia in 13 patients, progressive familial intrahepatic cholestasis (PFIC) in 2, alagille syndrome in 1, hepatoblastoma in 1, hepatocellular carcinoma in 2 and Caroli'syndrome in 3.
Results: 26 CT scans were obtained of the 22 patients preoperatively; within 2 days to 12 months of liver transplantation. The mean interval between transplantation and preoperative CT was 112 days. Arterial phase was obtained in all patients and easily depicted the presence of normal variants in the liver arterial branches. Portal phase demonstrated the presence or absence of portal vein enhancement, its caliber and the presence of portosystemic collaterals. Special relevance in the preoperative planning was the detection of retroperitoneal varices [gastrorenal shunt an >(12), splenorenal shunt (6)] that were not detected on the US study.
Conclusion: CT is a useful tool in determining clinically relevant information for the planning of liver transplantation in children. The use of low dose protocols is mandatory.

PGI-27

Possible indicators of intussusception post-rotavirus vaccine

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Purpose: To report and describe clinical and US findings of intussusception in the setting of rotavirus vaccination.
Materials and methods: Demographics and US findings of 23 intussusceptions were reviewed in 2010. There were two cases of 4 month old children with intussusception and previous rotavirus vaccination. US findings were compared with the 21 ileocolic intussusception control group according US-pathologic correlation previously published. Dedicated images of atypical features of intussusception are shown.
Results: In the two cases post-vaccination, the vaccine was previously administrated (6h and 4 days before respectively) and early hematochezia (1 and 5 hours after pain began) occurred. Unusual US finding in the 2 cases post-vaccination as ilecolocolic and cecocolic intussusception were depicted by US: At the apex of the intussusception, the terminal ileum (identified with its characteristic lymphoid tissue) was just seen at the centre of the intussusception forming the entering limb of the intussusceptum. As opposed to regular ileocolic intussusception (21 cases), in both cases post-vaccination the terminal ileum did not participate in the returning limb of the intussusceptum at the apex and after US/ hydrostatic successfull reduction an unusual thickening of the

cecum and ascending colon was shown and fluid did not freely pass through the ileocecal valve, supporting the participation of the colic wall in the intussuscepted bowel. The vaccine was retired for unrelated causes.
Conclusion: Our results suggest a possible relationship between unusual US findings of intussusception and rotavirus vaccination. Further reports and studies should undertaken to draw any conclusions.

PGI-28

Secondary intussusception in children: US diagnosis in five patients

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Purpose: To demonstrate the value of US in the evaluation of the secondary intussusception in five patients.
Materials and methods: US studies performed in five patients with intermitent abdominal pain revealed secondary intussusception. We reviewed the US examinations of patients. Special attention was paid to the intraluminal mass as a lead point for intussusceptions, its shape and echostructure. The findings of the US studies were compared with clinical and pathological data.
Results: Two jejuno-jejunal and three ileo-colic intussusception were found by US. In all patients leading points were hypoechoic, solid masses. Surgery confirmed the presence of intraluminal masses at the apex of the intussusceptions. Histopatology shown various causis.
Conclusion: US should be used to look for secondary intestinal intussusception in patients with appropriate clinical findings.

PGI-29

Omental torsion secondary to left inguinal hernia in a 3-year-old boy: an ultrasound diagnosis

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Purpose: We report a case of surgically proved torsion of the greater omentum secondary to left-sided inguinal hernia that was preoperatively diagnosed with ultrasound. A 3-year old boy was referred to our department for ultrasound evaluation of acute scrotum. Ultrasound demonstrated the presence of an avascular, hyperechoic, tubular structure within the inguinal canal that was attributed to infarcted omental segment. The left testicle and epididymis appeared hypervascular and enlarged. A complicated hydrocele was also noticed. The right hemiscrotum was unremarkable. Surgical exploration revealed torsion of the greater omentum with laceration of the hernial sac into the scrotum. An omentectomy with a repair of left inguinal hernia was performed. The resected omentum was submitted for pathological examination which showed hemorrhagic infarction. Post-operative course was uneventful. Left-side omental torsion is extremely rare. The greater susceptibility to torsion of the right side is due to its greater length and size in relation to the left side and its greater mobility. Preoperative diagnosis is often difficult and most often set with CT. Our case shows that diagnosis can also be set with ultrasound as long as the degree of suspicion is high.

PGI-30

Predicting the insertion length for gastric tube placement in neonates: a randomized controlled trial

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Purpose: Studies in children show that between 5% and 55% of nasogastric/orogastric (NG/OG) tubes are placed incorrectly. Malpositioned tubes can seriously harm children. This NIH-funded randomized controlled trial compared error rates of three existing methods of predicting the gastric tube insertion length in a series of neonates <1 month corrected age (if premature). The three methods of estimating the correct tube length were the age-related, height-based equation (ARHB); direct distance nose-ear-xiphoid (NEX); and direct distance nose-ear-mid-umbilicus (NEMU) measurements.
Materials and methods: The sample was 173 hospitalized neonates who were randomly assigned to one of three groups ARHB, NEX, or NEMU. For our primary analysis, tubes placed too high with the tube tip in the esophagus or at the gastro-esophageal junction were considered to be placed incorrectly. For our secondary analysis, a stricter definition was used with tube tips being placed only in the stomach (and not in the esophagus or the duodenum) being considered correctly placed.
Results: The differences in percentages of tube tips placed below the gastro-esophageal junction among the three methods was highly statistically significant (chi-square=34.45; $p<0.0001$), with both NEMU and ARHB being more accurate than NEX (NEMU chi-square=18.59, $p<0.0001$; ARHB chi-square=21.34, $p<0.0001$). Using the stricter definition for placement, with the tube tip in the stomach, and not in the esophagus or the duodenum, ARHB was not significantly different from NEX ($p=0.0615$).
Conclusion: NEX should no longer be used as an NG/OG tube insertion-length predictor in neonates. Either NEMU or the existing ARHB methods are equally good predicting tip location below the gastro-esophageal junction. If ARHB is used there is a greater likelihood of the tube tip entering the duodenum.

PGI-31

Different patterns of reporting the location of nasogastric tubes: An analysis of different methods of describing the tube tip location and the influence of the content of the clinical history on the radiology report

Mervyn Cohen, Marsha Ellett
Indiana University, Indianapolis (United States)

Purpose: As part of a prospective NIH funded study evaluating three different methods for estimating the optimal length for placement of a new nasogastric (NG) tube, abdomen radiographs were required to determine the location of the tube tip. Our objective was to analyze different methods by which the tube location was described in the radiology report, and the influence of the presence or absence of a relevant clinical history.
Materials and methods: We reviewed the imaging reports obtained following placement of a new nasogastric tube in patients enrolled in the study. After the tube placement the research nurse was required to write a requisition indicating that the radiograph was being performed to identify NG tube position.
Results: There were 188 studies. The X-ray report contained separate description and impression sections in 154. In 24 they were combined. When the history on the requisition indicated "tube placement" as the reason for the study, the location of the tube tip

was given in the impression on 134/141 (95%) times. When the requisition failed to mention "tube placement" as the study indication, the impression only mentioned the tube tip location 4/13 (31%) times. The report provided a specific location for the tube tip in 115 cases; in 73 cases the report stated that the tube tip "overlies/is in the region of" the stomach. On 29 occasions the report stated that the tube, not the tube tip, was in the stomach!
Conclusion: There is variation in the manner of reporting the location of NG tube tips. When the requisition fails to indicate "tube placement" as the study indication, the report impression often fails to mention the tube location.

PGI-32

Accurate localization of the position of the tip of a nasogastric tube: where is the gastro-esophageal junction

Mervyn Cohen, Marsha Ellett, Kathleen Lane, Susan Perkins
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Purpose: There are risks associated with malpositioning of the tip of a nasogastric (NG) tube. The plain film radiograph is the gold standard, but the final decision regarding positioning of the tip, made by the radiologist, is often subjective. In many publications, the landmarks used to determine the NG tube tip position are poorly defined or not defined at all. Our objective was to improve interpretation of radiographs taken to evaluate the location of the tip of an NG tube. Using UGI barium studies we determined the anatomical location and variability of the position of the gastro-esophageal (GE) junction.
Materials and methods: We reviewed consecutive upper gastrointestinal barium studies done at one hospital from July 2009 to obtain a group of 200 study patients (50 in each of 4 age groups). Exclusion criteria were absence of a true frontal view, inability to verify the presence of 12 ribs on each side, scoliosis, malrotation, or previous surgery on the esophagus, stomach or small bowel. For purposes of the study the gastro-esophageal junction was defined as the point at which the right inferior margin of the esophagus joined the lesser curvature of the stomach. We measured the distance of the gastro-esophageal junction from the left side of the spine and its vertebral level. These were compared between the age groups using one-way analysis of variance models.
Results: There is a very constant location of the GE junction with no significant variation between between age groups.
Mean ± SD for distance (mm) of the GE junction from left side of spine for ages <12 months, 13–60 months, 61–120 months and 120–180 months were 4.6±5.6, 5.4±4.8, 5.0±4.2 and 7.1±4.7 mm (p=0.065).
Mean ± SD for vertebral level of the GE junction for ages <12 months, 13–60 months, 61–120 months and 120–180 months were 10.5±0.6, 10.4±0.5, 10.5±0.5, and 10.5±0.5 (p=0.74).
Conclusion: The lower esophagus passes through a hole in the left diaphragm crus, so that it is not surprising that the GE junction location is very constant. This knowledge should aid in more accurate reporting of the position of NG tube tips.

PGI-33

Is gastro-esophageal reflux due to variations in the position of gastric anatomical landmarks?

Mervyn Cohen, Marsha Ellett, Susan Perkins, Kathleen Lane
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Purpose: Gastro-esophageal (GE) reflux is common. Although there are many theories, the precise etiology of GE reflux is not known. The objective of our study was determine whether there were any differences in the lower esophageal and gastric anatomy landmarks that might be part of the cause of GE reflux.
Materials and methods: Using UGI barium studies we determined the anatomical location and variability of the position of six gastro-esophageal anatomical landmarks. We reviewed consecutive upper gastrointestinal barium studies performed in 1 hospital from July 2009, to obtain a study group of 200 study children <18 years old. Exclusion criteria were absence of a true frontal view of the upper abdomen, inability to verify the presence of 12 ribs, scoliosis, malrotation, or previous surgery on the esophagus, stomach or small bowel. For purposes of the study the gastro-esophageal junction was defined as the point at which the right inferior margin of the esophagus joined the lesser curvature of the stomach. We made 6 different measurements and compared results between those children who had any GE reflux during the study and those who did not using separate one-way analysis of variance models.
Results: 36 children had GE reflux and 164 did not.
Mean ± SD for the distance (mm) of the GE junction from left side of spine: No reflux, 5.8±5.2; Reflux, 4.1±3.1 (p=0.0523). Mean ± SD for the vertebral level of the GE junction: No reflux, 10.5±0.5; Reflux, 10.5±0.5 (p=0.72). Mean ± SD for the vertical distance (mm) from the apex of the left hemi diaphragm to the level of the GE junction: No reflux, 32.9±14.5; Reflux, 28.6±10.8 (p=0.09). Mean ± SD for the vertebral level of the pylorus: No reflux,12.6±0.7; Reflux, 12.7±0.4 (p=0.50). Mean ± SD for the distance (mm) of the pylorus from the right margin of the spine: No reflux, 4.3±8.5; Reflux, 3.4±5.1 (p=0.52). Distance from the GE junction to the pylorus (mm): No reflux, 78.6±31.9, Reflux, 73.0±28.6 (p=0.33).
Conclusion: We found no anatomical differences between children with GE reflux and those without GE reflux.

PGI-34

Congenital and acquired disease of the portal vein in children

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Purpose: To present common and uncommon congenital and acquired abnormalities of the portal vein in the pediatric population.
Materials and methods: Imaging findings in children and adolescents with congenital and acquired abnormalities of the portal vein (PV) are presented and the entities are discussed. Normal anatomy and common variants of the portal venous system are also described. Imaging modalities include ultrasound, CT, MRI, and angiography.
Results: Congenital anomalies of the PV presented include congenital absence (Abernathy malformation types I and II), intrahepatic portosystemic shunt, and preduodenal configuration. Acquired abnormalities of the PV include thrombosis, pylephlebitis, cavernous transformation, varix, intravenous gas and calcification, and post-transplantation stenosis.
Conclusion: Abnormalities of the PV may be congenital or acquired. While some of the entities presented are commonly encountered and have little or no clinical significance, others are rare and may have significant clinical implications. Ultrasound is effective in defining these abnormalities and is the optimal initial exam in evaluating the portal vein. MR may be beneficial in challenging cases.

PGI-35

Multifocal liver lesions in children—a cross-sectional pictorial review

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Purpose: It is relatively common to encounter multifocal liver lesions in cross-sectional imaging in children. It is important for Pediatric Radiologists to be aware of the vast differential diagnosis for this finding. The purpose of this pictorial review is to illustrate the ultrasound, computed tomography (CT), and magnetic resonance imaging (MRI) appearances of a wide variety of benign and malignant causes of multifocal liver lesions in children.
Materials and methods: Pediatric patients (less than 18 years of age) with multifocal liver lesions were identified by searching Department of Radiology electronic medical records. Numerous causes of benign and malignant multifocal liver lesions were documented and pertinent ultrasound, CT, and MRI images were selected for presentation. Relevant patient demographic and clinical information were also reviewed and recorded.
Results: We identified numerous benign (for example, developmental cysts, hamartomas, adenomas, focal nodular hyperplasias [both typical and atypical], regenerative nodules, abscesses [fungal and bacterial], and vascular lesions) and malignant (for example, hepatoblastoma, hepatocellular carcinoma, intrahepatic cholangiocarcinoma, epithelioid hemangioendothelioma, lymphoma, and metastatic disease) causes of multifocal liver lesions in children. The ultrasound, CT, and MRI appearances will be illustrated and both clinically and histopathologically correlated.
Conclusion: There are numerous causes of multifocal liver lesions in children.While imaging features of certain lesions are unique allowing an exact diagnosis, the appearances of other lesions may overlap. The constellation of imaging findings when correlated with pertinent clinical data should allow the Pediatric Radiologist to considerably narrow the differential diagnosis.

PGI-36

"It's not easy being green": the imaging spectrum of pediatric biliary anomalies

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Purpose: Pediatric disorders involving the biliary tree include benign anatomic variants, congenital abnormalities of bile duct formation, inflammatory conditions, and rare neoplasms. In children, biliary disorders can exhibit a wide range of clinical presentations. Imaging plays a key role in distinguishing these disorders from pathologic conditions of the liver which may have similar presentations, and it is necessary for early diagnosis and guidance of clinical management. This presentation reviews the imaging findings of the broad spectrum of biliary anomalies encountered by the pediatric radiologist.
Materials and methods: Abdominal imaging in children, ranging from neonates to teenagers, with a variety of biliary anomalies is reviewed. For each case, the pertinent anatomy and embryology is examined, and the key clinical and imaging features are described. Findings on ultrasound, CT, MRCP, and nuclear scintigraphy are demonstrated. Correlation with ERCP and histopathology is provided.
Results: The entities presented in this exhibit include, but are not limited to: anatomic variants of the bile ducts, gallbladder variants such as agenesis and duplication, choledochal cysts, biliary atresia, congenital hepatic fibrosis, benign recurrent intrahepatic cholestasis, primary sclerosing cholangitis, choledocholithiasis, bile plug syndrome, biliary hamartomas, and bile duct neoplasms.
Conclusion: Upon completing this presentation, the reader will have learned the extensive range of anomalies that involve the biliary tract in children.

PGI-37

Pyloric stenosis: to image (after hours) or not to image: a survey of regional practices

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Purpose: The diagnosis of pyloric stenosis (PS) is a non emergent indication for imaging as patients are typically stable. When a diagnosis of PS is made after routine hours, surgery is typically deferred until the following work day. In Europe, there has been a trend towards a "watch and wait" approach, with the majority of patients demonstrating resolution of the PS over time with simple conservative management. Given the potential for false positive/negative results or inadequate studies due to less experienced staff after hours, the objective was to determine the practice management protocols for PS of other regional institutions and determine regional practice patterns to make recommendations for appropriate imaging utilization in the era of high imaging demand
Materials and methods: A survey questionnaire was created. Regional hospitals in the state of Massachusetts, USA, were then contacted by telephone. Responses came from radiologists, sonographers, or practice managers. The responses were then recorded and followed by data analysis looking for key trends.
Results: A total of 67 hospitals responded. 81% were community hospitals, and 19% were teaching hospitals. Of these 67 hospitals, 37 centers (55%) perform PS studies. Only 15 (40%; 9 community, 5 teaching) of these centers do these studies after hours. The ultrasound scan is done by the technologist at all of these hospitals. Interpretation by a dedicated pediatric radiologist is seen at only 3 (20%) centers. Of all the centers that perform PS ultrasounds, only 7 centers use only a pediatric radiologist for interpretation (18%).
Conclusion: Of the regional centers that perform PS studies, most do not image for this indication after hours and do not rely on pediatric radiologists for interpretation. Pediatric radiologist interpretation is seen mostly at teaching centers. PS being a non emergent study, it is our recommendation that these studies not be done after hours when staffing and experience are typically lower than during routine work hours. Triaging of resources allows for improved imaging utilization and patient throughput.

PGI-38

What's that atresia?—a simplified approach to bowel atresias

Abdullah Shaikh, Grace Mitchell, Tara Catanzano
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Purpose: This is an educational poster designed for senior radiologists who are involved in teaching trainees that will give

them a structured design in how to describe the clinical presentations of the various small bowel atresias (duodenal, jejunal, and ileal) and to discuss the radiological findings. For trainees, this will teach this important entity in an easy to remember manner.
Materials and methods: The structure of the poster will have multiple headings as follows:
• Pathophysiology and Epidemiology of the atresias
• Anatomy
• Image findings–radiographic findings from prenatal to postnatal for each atresia, and what the surgeon wants to know.
• Pitfalls in the diagnosis of the various atresias
• Management
Conclusion:
• The ability to recognize and discuss the various atresias.
• The ability for a senior radiologist to take this knowledge in the presented manner and teach it effectively in a structured manner.

PGI-39

Multifocal hepatic lesions in children: a pictorial overview

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Multifocal hepatic lesions often present a challenging diagnostic dilemma for the pediatric radiologist. While metastatic disease is a common etiology for multifocal liver lesions, less common benign and malignant entities can also present with a similar appearance. Recognizing characteristic imaging features which can help to differentiate between malignant and benign multifocal hepatic lesions can help to narrow the differential diagnosis. This poster presents varied cases illustrative of malignant and benign multifocal hepatic lesions in pediatric patients including entities such as infantile hemangioendothelioma, focal nodular hyperplasia, cat scratch disease, nodular regenerative hyperplasia, angiomyolipoma, peliosis, Langerhans cell histiocytosis, tuberculosis, cholangiocarcinoma, lymphoproliferative disorders, embryonal sarcoma, and metastatic disease. The presentation of these varied cases outlines the key imaging features to help narrow a differential diagnosis.

PGI-40

Intussusception: spectrum of clinical presentations and assessment by sonography in pediatric patients

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Purpose: Intestinal intussusception is the second leading cause of acute abdomen in children. Their most frequent localization is in the ileocolic segment, from six-month-old to two-years-old. The etiology is idiopathic in most cases. Sonography is the first choice imaging method for initial assessment with high sensitivity and specificity. The aim of this paper is to demonstrate different clinical presentations and evolutions of intussusception, assessed by sonography.
Materials and methods: Sonographic studies were performed in our service in five pediatric patients in the investigation of abdominal pain, diagnosed as intermittent intussusception of small bowel, ileocolic intussusception complicated with pneumatosis intestinalis and portal vein air, ileocolic intussusception with sonography-guided hydrostatic reduction and ileocolic intussusception complicated with vascular suffering.
Results: In abdominal sonography, several signs and findings are related to intussusception under B-mode and color doppler sonography, predicting ischemia and irreducibility during the procedure of hydrostatic reduction. Evolution of intussusception is varied, ranging from intermittent episodes, fixed intussusceptions, even catastrophic clinical evolutions to intestinal perforation with peritonitis and shock. Sonography-guided saline enema is presented as an alternative to surgical approach with high efficacy, low cost and lack of ionizing radiation.
Conclusion: The abdominal ultrasound is an important method in the evaluation of abdominal pain in children, enabling differential diagnosis and use as guide for procedures. Early assessment is crucial, preventing complications.

PGI-42

Sonographic UGI in the vomiting infant: how we do it

Thaddeus Herliczek, Deepak Raghavan, Kathleen McCarten, Michael Wallach
Warren Alpert Medical School of Brown University, Westport (United States)

Purpose: To review the indications, technique and images from the sonographic UGI with an emphasis on technique and assessment of normal midgut fixation.
Materials and methods: A. Background and Anatomy B. Indications for Sonographic UGI C. Imaging Technique—patient preparation—sonographic technique and windows—enteric contrast medium D. Normal and Abnormal Findings—gastroespophageal junction—gastroesophageal reflux—pylorus—hypertrophic pyloric stenosis—midgut fixation—duodenal obstruction
Conclusion: This educational exhibit will review sonographic UGI in the vomiting infant. Viewer will obtain the following; 1. Indications for sonographic UGI 2. Technique for sonographic UGI 3. Examples of normal anatomy and several pathologic conditions on sonographic UGI

PGI-43

The pediatric appendix: imaging gently

Thaddeus Herliczek, David Swenson
Warren Alpert Medical School of Brown University, Westport (United States)

Purpose: Review the indications, imaging methods, and techniques imaging the pediatric appendix. Particular focus will be promotion of an imaging algorithm without ionizing radiation in which US is the first line modality and MRI is used for inconclusive cases. Correlative images from US, CT and MRI will be demonstrated.
Materials and methods: A. Background of Pediatric Appendicitis B. Indications for Imaging C. Imaging Options D. Imaging Techniques E. Review Findings of Normal and abnormal appendix in each modality. F. Provide Imaging Algorithm without Ionizing Radiation for Pediatric appendicitis
Conclusion: This exhibit will review imaging of pediatric appendicitis and promote an imaging algorithm without ionizing radiation. The viewer will obtain the following; Techniques for US, CT and MRI with examples of the normal and abnormal appendix. Correlative imaging from CT and MRI will be

demonstrated. Imaging algorithm without ionizing radiation will be provided.

PGI-44

Biliary atresia from diagnosis to treatment with correlative pathology

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Purpose: The goal of this educational exhibit is to illustrate the imaging criteria to diagnose biliary atresia (BA), to demonstrate the relevant imaging during the course of treatment, and to correlate with the pathologic findings. BA is a significant gastrointestinal abnormality which can result in death if untreated. Distinction from neonatal hepatitis is a common reason for imaging. Sonography and nuclear medicine imaging are central in the evaluation of neonates being evaluated for BA, but MRCP can be helpful in equivocal cases.
Materials and methods: This exhibit will discuss the clinical presentation, epidemiology, classification, patient preparation and imaging findings in BA; illustrative examples will be provided. The triangular cord sign, absent or abnormal gallbladder, absent common bile duct, hypertrophic hepatic artery and increased subcapsular flow of the liver are among the sonographic findings that will be discussed. The use of Phenobarbital prior to hepatobiliary scan and SPECT imaging as well as potential pitfalls will be included in the discussion of scintigraphic studies. Recent guidelines regarding the consensus for the appropriate dose in pediatric patients will be outlined with emphasis on the importance of ongoing efforts to limit radiation exposure. Images will be correlated with pathologic slides demonstrating BA. Pathology will include use of frozen section in assessing diameter of bile ducts in the portal area, and changes in the intrahepatic bile ducts and hepatic parenchyma. The role of infection/inflammation in progression of the disease will be discussed. A description of surgical treatment of BA and potential complications will be discussed with both imaging and pathologic correlation. The use of PET for patients with resultant biliary cirrhosis will be discussed.

PGI-45

Emergent sonographic diagnostic possibilities beyond intussusception, appendicitis and pyloric stenosis

Alicia Roman-Colon, Philip Dydynski, Martha Munden
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Ultrasound is the modality of choice in examination for hypertrohic pyloric stenosis, intussusception, and is considered the first line examination for appendicitis. It can also be useful in the acute presentation of inflammatory bowel disease, other forms of enterocolitis and in the setting of bilious emesis for evaluation of malrotation or midgut volvulus. Five unusual pathologies were encountered and diagnosed sonographically, including a surgically proven small bowel obstruction due to an ileal duplication cyst, a large trichobezoar causing weight loss presenting as an epigastric mass, a hernia containing a torsed ovary, splenic sequestration in sickle cell disease and an intrathoracic stomach presented for suspected pyloric stenosis. These cases will be presented with a review of the literature to illustrate some additional diagnoses that can be made sonographically in the emergency setting.

PGI-46

Pictorial essay in performing upper GI studies

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Baystate Medical Center / Tufts University, Springfield (United States)

Purpose: This is an educational poster designed for senior and junior radiologists who are involved in teaching trainees that will give them a structured design in how to describe the various maneuvers and images that need to be obtained in various fluoroscopic Upper GI studies. For trainees, this will teach this important procedure in an easy to remember manner. Another aim will be to create easy to remember visual cues with a mannequin in various positions side by side with the corresponding fluoroscopic image.
Materials and methods: The structure of the poster will have multiple headings as follows: Anatomy, Common uses for this type of exam, The Fluroscopic Study Room Safety Step 1-Left Lateral Decubitus Step 2-AP Step 3-Right Lateral Decubitus Step 4-Rolling from Right Lateral Decubitus to AP, Tip and Tricks on getting the most out of the study by avoiding pitfalls, Coning and positioning and What the clinician wants to know
Conclusion: Learning how to perform Upper GI studies in an easy to remember fashion by using visual cues by using a mannequin model. Provide teaching faculty a visual aid to teach this important study.

PGI-47

"Handlebar hernia"- CT findings and associated visceral injuries

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Purpose: Blunt abdominal trauma in children due to bicycle accident is relatively common, often with significant intrabdominal injuries, but associated abdominal wall hernias are rare. The literature is sparse with about 25 reported cases in children less than 16 years old and virtually all describe abdominal wall defects only.
Materials and methods: We present 2 cases of post-traumatic abdominal wall hernias with associated visceral injuries. Patient 1 is an 11 year old girl that presented to the emergency room after falling from her bicycle and striking the handlebar. Clinical examination of her abdomen demonstrated mild tenderness and a semi-lunar ecchymosis resembling the handlebar with intact skin surface. US imaging demonstrated a small hematoma of the abdominal wall, and suggested possible abdominal wall disruption. The patient had progressively worsening abdominal pain; a CT scan of the abdomen and pelvis 2 hours later showed disruption of the musculature and fascia in the right lower anterior abdominal wall with herniation of small bowel contents, pneumoperitoneum, and free air in the subcutaneous fat. Exploratory laparotomy confirmed the presence of a mid-jejunal perforation. Patient 2 is an 8 year old girl presenting with significant abdominal pain and vomiting following a fall from her bicycle and hitting the handlebars. An oval-shaped ecchymosis was seen in the right upper quadrant with intact skin surface, associated with severe tenderness. A CT scan of the abdomen and pelvis was ordered due to severe pain. Imaging showed disruption of the anterior abdominal wall musculature and stranding of the subcutaneous fat underneath the ecchymosis. Laceration of Segment 4 of the liver with associated periportal fluid and a laceration of the pancreas at the junction of the head and body

were seen."Handlebar hernias" are a recognized subset of pediatric injuries resulting from bicycle accidents. Our cases illustrate how clinical history and physical examination (the focused impact of the handlebar; the localized bruising, swelling and pain with progressive abdominal pain) can appropriately initiate cross-sectional imaging to fully evaluate the full extent of occult injury.

PGI-48

Preoperative diagnosis of acute ovarian torsion with concurrent appendicitis by ultrasound-case report

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Purpose: Acute ovarian torsion is an uncommon cause of lower abdominal pain in female children. Clinically it is often difficult to differentiate from other conditions such as appendicitis. Ultrasound plays an important role in the evaluation of children with lower quadrant pain, specifically to differentiate adnexal pathology including ovarian torsion from appendicitis in female children. Acute ovarian torsion with concurrent appendicitis is exceedingly rare, with only a handful of cases reported in the literature. Preoperative imaging diagnosis of ovarian torsion with concurrent appendicitis has not been reported in the literature.
Materials and methods: We present a case of right ovarian torsion with concurrent appendicitis, diagnosed by ultrasound preoperatively. An 11 yo female presented to ER with RLQ pain for 36 hours. The pain became significantly worse, with multiple episodes of nausea and vomiting for the last 12 hours. On presentation, the abdomen was soft but tender to palpation in the RLQ over McBurney's point with rebound. WBC was19.5×103 with left shift. Ultrasound was requested to evaluate for appendicitis. Ultrasound showed a mildly enlarged fluid-filled appendix, with focal tenderness over the appendix, compatible with appendicitis. There was also a 5 cm hypoechoic structure containing small cystic spaces in the right adnexal region, with no flow on Doppler imaging. Therefore right ovarian torsion was also considered. The patient was taken to OR for an exploratory laparoscopy. At surgery, the right ovary twisted 360° and appeared hemorrhagic and distended. The fallopian tube was also entrapped in the torsion. Both the right ovary and tube were detorsed and returned to normal pink color, and ovariopexy was performed. The appendix was edematous, and appendectomy was performed.
Results: The previously reported cases of ovarian torsion with concurrent appendicitis in the literature require both appendectomy and oophorectomy with or without salpingectomy. In our case, we made the diagnosis of both ovarian torsion and appendicitis by ultrasound preoperatively, and the torsed right ovary and fallopian tube were detorsed and salvaged at surgery.

PGI-49

Manifestations of Meckel's diverticulum: a pictorial review

Alexander Kowal
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Purpose: The Meckel's diverticulum is a vestigial remnant of the omphalomesenteric duct. The purpose of this exhibit is to demonstrate the imaging findings of several diverse manifestations of Meckel's diverticulum in the emergent and nonemergent pediatric setting.
Materials and methods: 15 cases of Meckel's diverticulum with varying presentations were compiled over a 3 year period at two pediatric children's hospitals.
Results: Meckel's diverticulum may present with small bowel obstruction secondary to volvulus, inversion with bowel intussusception, isolated infection and ischemia, a giant diverticulum, and gastrointestinal hemorrhage. Images with discussion of each presentation is provided.
Conclusion: Pediatric imagers play a crucial role in identifying Meckel's diverticulum as an underlying etiology in several diverse clinical presentations, which in turn is vital to surgical planning.

PGI-50

State-of-the-art: a multimodality imaging evaluation of focal hepatic masses in children with an emphasis on clinical, imaging, and pathological correlation

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Purpose: The overarching goal of our presentation is to review the clinical aspects, characteristic multimodality imaging features with pathological correlation, and key points that can confirm and also allow differentiation among various common and uncommon focal hepatic masses in pediatric patients.
Materials and methods: We used our hospital information system to identify focal hepatic masses in pediatric patients (<18 years of age) who had both imaging studies and subsequently underwent surgical resection with available pathological diagnosis from July 2004 to November 2010.
Results: This pictorial presentation addresses the advantages and disadvantages of currently available imaging modalities such as US, CT, and MRI for evaluating common and uncommon focal hepatic masses in pediatric patients. The State-of-the-Art imaging techniques for evaluating these hepatic masses with an emphasis on 2D / 3D imaging and pathological correlation will be highlighted. Our review includes focal hepatic masses in children which occur in a diverse spectrum of conditions including congenital anomalies, neoplasms, infections, and conditions that can mimic focal hepatic masses. For congenital focal hepatic lesions, hepatic cyst and choledochal cyst will be presented. Focal hepatic masses from both primary and metastatic disease that are included in this pictorial review are infantile hemangioma, rapidly involuting congenital hemangioma, hepatic adenoma, focal nodular hyperplasia, mesenchymal hamartoma, regenerative nodule, hepatoblastoma, hepatocellular carcinoma, fibrolamellar hepatocellular carcinoma, undifferentiated (embryonal) sarcoma, angiosarcoma, lymphoma and hepatic metastasis. For infectious focal hepatic masses, bacterial infection, fungal infection, and parasitic infection are included. In addition, conditions that can mimic focal hepatic masses in children such as focal fatty proliferation, hepatic infarction, and extrahepatic masses are also addressed.
Conclusion: Familiarity with the state-of-the-art optimal imaging techniques and characteristic imaging appearance of various focal hepatic masses in children can avoid delay in diagnosis and optimize patient care.

PGI-51

MRE in the assessment of inflammatory bowel disease (IBD) in pediatric population including diffusion-weighted imaging (DWI), cine MR and post gadolinium dynamic MR

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Purpose: MRE is broadly used in the assessment of IBD. MRE without nasojejunal intubation and radiation exposure offers similar results to MR enteroclysis and should therefore be the preferred method. Sensitivity and specificity are comparable to those of CT enterography. Capsule endoscopy is obviously superior to MRE in detecting superficial lesions, but this is limited to the mucosa and stenosis has to be excluded before examination using imaging, like MRE. The advantages of MRE are: Non use of radiation; assessment for extension and severity of the disease; evaluation for penetrating disease and complications related to IBD like intestinal obstruction, fistula, abscess and fibrostenosing disease. The purpose is to describe the MRE findings that accurately evaluate active inflammation in IBD including DWI, cine MR and post contrast dynamic MR.
Material and methods: MRE protocol in our service includes 3 planes in T2 SSFSE, cine MR, axial and coronal DWI (b1000), administration of glucagon, dynamic volumetric fat/sat post gadolinium at approximately 8, 30, 52, 74, 96 and 118sec and axial 3D post contrast. Wall bowel thickening, early (arterial phase) post gadolinium mucosal enhancement, parenchymal and delayed phase post gadolinium enhancement and comb sign are findings that correlate with active IBD. Marked diffusion restriction is seen in the segments of bowel involved with active IBD. Diffusion restriction, but in less degree, is also seen with poor bowel distension; however, these segments of bowel show preserved peristalsis on cine MRE which helps to differentiate between both entities.
Conclusion: Bowel wall thickening, early post gadolinium enhancement, diffusion restriction and lack of normal peristalsis are findings described in active inflammatory bowel disease. MRE allows making diagnosis of new patients, assessing for active inflammation, detecting penetrating disease, assessing complications related to IBD, monitoring activity and response to therapy in clinical trials.

PGI-52

Your patient has an acute abdomen of unusual cause? Don't miss these diagnoses!

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Purpose: We will present our experience in the diagnostic imaging of some very unusual causes of acute abdomen in children, in order to increase the awareness of their existence and hence facilitate their correct diagnosis.
Materials and methods: From our data base, we selected 10 cases of acute abdomen secondary to unusual causes. We analyzed their clinical presentation, imaging characteristics, and surgical findings when applicable.
Results: Selected cases include complicated mesenteric cysts, omental torsion, apendagitis, mesenteric ischemia, internal hernia, complicated urachal cyst, and splenic torsion. The key imaging findings that lead to the correct diagnoses are presented.
Conclusion: A child with acute abdomen is always a diagnostic challenge, both for the clinician and the radiologist. Appendicitis and ileo-colonic invagination are the most common causes in children, however, the differential diagnosis is wide and includes some very infrequent causes. Many of these unusual causes are not consistently described in paediatric radiology textbooks and have only been scarcely reported in the literature. Awareness of these diagnostic possibilities and their imaging characteristics is the key factor that enables correct diagnosis and optimal patient management, which can either be medical or surgical.

PGI-53

Radiographic findings of ultra-long gap esophageal atresia before and after the Foker staged lengthening technique for surgical repair

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Purpose: Typically esophageal atresia is treated with primary surgical repair, however there is a subset of patients with longer gap lengths that are more difficult to repair. Classically these have been treated surgically by interposition grafts or gastric transposition, however with significant long term morbidity. In 1983 the Foker technique was first used in treating ultralong-gap esophageal atresia (defined as >3.5 cm) using a growth induction procedure. Placing the esophagus on traction induces growth in a very short time (weeks) allowing for an anastamosis with reasonable tension. This has required a team approach including Surgery, Gastroenterology, Radiology, Pediatric Intensivist, Anesthesiology, ENT, and Speech Pathology. This technique is gaining acceptance internationally and is now being used as an alternative method for repair in this set of patients. The imaging and procedures for patients treated with the Foker technique is unique and requires active involvement by pediatric and pediatric interventional radiology. Management includes numerous fluoroscopy examinations, serial esophageal dilatations, intraoperative assessment and management of complications. It is important in the care of these patients that both the general pediatric radiologist and pediatric interventional radiologist have knowledge regarding both the lengthening technique and postoperative findings and complications.
Materials and methods: We have had the opportunity to follow a large number of patients, 70 patients in total from 1990–2007 in our Pediatric Radiology Department.
Results: Our goal is to inform and educate pediatric radiologists regarding the Foker procedure including the imaging and intervention involved. We will discuss the initial work-up of patients with ultra long-gap esophageal atresia, findings encountered during the growth procedure, and follow-up after repair, including those complications which occur most frequently.

PGI-54

Interesting clinical presentation of newborn with gastroschisis

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A 36 week infant with abnormal prenatal ultrasound presented to NICU staff after delivery by cesarean section with a closed, normal appearing abdominal wall, except for a narrow caliber tubular structure adhered to the umbilical cord. Clinically, the infant was stable. Abdominal ultrasound demonstrated a large, fluid filled structure with fluid-fluid level, and gut wall signature occupying most of the upper abdomen and free fluid. Differential diagnosis included small bowel atresia, meconium pseudocyst, and enteric duplication cyst. Upper GI and enema studies were recommended. Enteric tube was placed after ultrasound. Upper GI

showed normal stomach and proximal duodenum. The third portion of the duodenum tapered to a point and the distal duodenum to the left of midline would not fill with contrast. Gastrograffin enema showed small caliber rectum, sigmoid, descending and distal transverse colon. The transverse colon coiled and terminated at a point at the midline abdomen. The colon to the right of midline would not fill with contrast and the abdomen was largely gasless. Differential diagnosis included in utero volvulus or multiple atresias. The patient was taken to the operating room. At surgery, a chronic-appearing small bowel volvulus, with 6–8 cm of viable duodenum was noted; otherwise, no viable small bowel was present. The ileocecal valve, cecum, appendix, and ascending colon were not present. Nonviable small bowel was resected and a duodenal colostomy was formed. Considering prenatal ultrasound later acquired, which showed an abdominal wall defect with abdominal contents external to the abdomen and the clinical examination and surgical findings, the gastroschisis closed intrauterinely and resulted in the volvulus and necrosis of proximal colon and small bowel. At present, the infant is on TPN, Omegavan and the family is considering small bowel transplant. Case presentation details the case; prenatal imaging diagnosis of the condition; the appearances on neonatal radiograph, ultrasound, upper GI, and enema studies; the role of radiologist; and clinical management.

PGI-56

Pre- and post-operative imaging of adolescents undergoing Lap-Band surgery

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Purpose: To examine pre- and post-operative imaging utilization in adolescents undergoing Lap-Band® surgery, describe the most common abnormal imaging findings, and illustrate the typical appearance on post-operative upper GI studies.
Materials and methods: A total of 27 morbidly obese adolescents (22 girls and 5 boys, mean age 16.9 years) who underwent Lap-Band® surgery at a single tertiary-care pediatric hospital from 2007 to 2009 were studied retrospectively. A hospital database was queried for all imaging studies performed on these patients, ranging 6 months prior to and all dates after the procedure. Post-operative Upper GI studies were analyzed for common imaging patterns.
Results: Twenty-five of 27 patients (92.7%) had pre-operative imaging, most commonly an upper GI study (22/27, 81.5%). Of these, 8 upper GI studies were abnormal (3/8 with gastroesophageal reflux, 2/8 with hiatal hernia, 1/8 each with esophagitis, gastritis or malrotation). Pre-operative chest X-rays were obtained in 18/27 patients (66.7%), with 1 showing hyperaeration. Pre-operative soft tissue neck X-rays were also common, revealing adenoid and tonsillar enlargement in 5 of 8 patients studied. Post-operatively, 23/27 patients (85.2%) had upper GI studies. Six patients had 1 post-operative study, while 17 had multiple studies (range 2–12) for Lap-Band® evaluation and adjustment. Most commonly, the Lap-Band® was positioned at a 45° angle at the gastroesophageal junction, as seen on an erect AP view. Barium promptly passed through the narrow Lap-Band® channel, flowed leftward on a shelf along the lesser curve of the stomach, and then filled the collapsed distal body and antrum. No complications were observed. Other post-operative imaging studies were uncommon.
Conclusion: Upper GI studies are the most common pre- and post-operative imaging studies obtained in adolescents undergoing Lap-Band® surgery. Pre-operative chest and neck X-rays are also common. Post-operatively, patients often undergo multiple upper GI studies for Lap-Band® adjustment.

PGI-57

A single center's experience with the radiographic assessment of pediatric patients undergoing evaluation for intestinal transplantation

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Purpose: Radiographic testing is an integral part of the comprehensive evaluation of candidates for intestinal transplantation (ITx). These studies outline preoperative anatomy and elucidate intra-abdominal pathology and potential complications such as vascular thrombosis, items which are essential for operative planning. As one of five centers worldwide to offer pediatric ITx, this study retrospectively reviews our experience in the preoperative radiographic evaluation of pediatric ITx candidates.
Materials and methods: A retrospective, IRB-approved study involved review of an institutional database. 45 pediatric patients receiving 50 ITx between 11/91–04/07 are included in the analysis. The medical records for all children (<18 yr) who underwent primary ITx were reviewed. The total number of radiographic tests, common findings during the preoperative planning imaging evaluation, and clinical significance are reported.
Results: Major causes of intestinal failure were gastroschisis and NEC; median age at ITx was 2.2 years old. 734 radiographic exams were performed in the pre-ITx period. The mean number of diagnostic procedures per pt was 16.0 +/−15.9. The most commonly utilized test was conventional plain radiography (n= 394). Studies utilized: abdominal UTZ (100%), nuclear medicine GFRs (82%), UGI/SBFT (82%), contrast enhanced CT (73%), MRI/MRA/MRV (60% overall, 0% pre-2000 listing vs. 79% post-2000), and Barium Enema (43%). Common imaging findings: hepatosplenomegaly/cirrhosis=90% (UTZ and CT), abnormal length, caliber or motility of bowel=76% (UGI/SBFT), absent Ileo-cecal valve=79% (BE), mean CrCl on GFR=102+/− 43 (vs. Schwartz formula calculated CrCl, p=0.79).
Conclusion: A systematic approach to the radiological evaluation of children undergoing ITx is an integral part of the preoperative evaluation. Consolidating the workup can potentially minimize the risks of radiation exposure and anesthesia. As a result of our experience, we now routinely use MR en lieu of CT and abdominal UTZ, in most patients.

PGI-58

Inflammatory bowel disease in children: assessing the diagnostic performance and inter-reader agreement of magnetic resonance enterography compared to ileocolonoscopy

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Purpose: The purpose of this study is to assess the accuracy and inter-reader reliability of MR enterography in pediatric

inflammatory bowel disease (IBD) evaluation when compared to ileocolonoscopy.
Materials and methods: All MR enterographies performed at our institution between July 2009 and July 2010 were retrospectively reviewed in a blinded fashion by two pediatric radiologists. Studies were performed for known or suspected IBD. Exams were evaluated for multiple signs of enteric inflammation and extra-enteric disease. Each reviewer assessed the overall likelihood of disease using a 5 point Likert scale with scores of 3 or higher considered positive. Cohen's kappa coefficient was calculated to assess inter-reader agreement. A subset of patients having undergone ileocolonoscopy or surgery with confirmed histopathology within 45 days of the MRE were used to calculate the sensitivity and specificity of MRE for detecting active IBD in small and large bowel.
Results: A total of 90 MR enterographies were reviewed. Cohen's kappa coefficient was 0.79, indicating substantial agreement between the readers. 45 patients underwent endoscopy or surgery within 45 days of the MRE. In this subset, the sensitivity for detecting active disease was 92% for both readers. Specificity was 88% for reader 1 and 75% for reader 2.
Conclusion: MR enterography is sensitive for detecting signs of bowel inflammation with good inter-reader agreement in children with known or suspected IBD. The lower specificity, indicates that ileocolonoscopy remains useful and MRE is a complementary modality in the overall evaluation of IBD.

PGI-59

Magnetic resonance enterography (MRE) and wireless capsule endoscopy (WCE) in the evaluation of patients with inflammatory bowel disease (IBD)

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Purpose: To determine the performance of MRE, MRI findings were compared to WCE and endoscopy/histology (E/H) results in 12 patients who underwent MRE for suspected IBD.
Materials and methods: WCE and E/H findings of the terminal ileum were retrospectively reviewed in 12 patients (8F/4M; age range: 11–23 years; mean age=17 years) who had MRE between 3/09 and 3/10. 12 patients had E/H and 7 had WCE results available. Imaging was reviewed by 2 radiologists in consensus without knowledge of WCE and E/H findings. The study was approved by the IRB. The E/H and MRI findings were scored with regards to the terminal ileum. WCE findings were scored with regards to the small bowel.
Results: Of the 12 patients included, 10 had Crohn's disease and 2 had ulcerative colitis. A statistically significant correlation was found between MRE and E/H scores (Pearson correlation coefficient=0.71, P=0.01). Correlation coefficients ranged from −1 to +1, with values close to +1 indicating a strong positive linear correlation. An ROC analysis was performed for MRE and E/H scores (dichotomized as 1–6 vs 8–10) with area under the curve= 77.1% (ie, predictive accuracy of MR score in relation to binary pathology score; P=0.12). The correlations between WCE and E/H scores (Spearman-rank correlation coefficient=0.52, P=0.23) and WCE and MRE scores (Spearman-rank correlation coefficient =0.54, P=0.22) were fairly good. Although not statistically significant, the correlations are still considered fair to moderate. Sensitivity and specificity for E/H score (dichotomized as 1–6 vs 8–10) based on MRE score (dichotomized as >3 vs <3) was calculated as 100% and 71.4%, respectively.
Conclusion: MRE has a better correlation with E/H (r=0.71) as compared to WCE (r=0.52) with a sensitivity and specificity of 100% and 71.4%, respectively. The lack of significance between WCE and MRE and E/H may be due to small sample size, with only 7 patients contributing usable capsule scores. MR should be recognized as a reliable tool in diagnosing IBD.

PGI-61

Imaging patterns for the evaluation of appendicitis among pediatric hospitals in the United States, 2005–2010

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Purpose: The aim of this study is to characterize national patterns in imaging utilization for pediatric patients with acute appendicitis.
Materials and methods: The Pediatric Health Information System (PHIS) was interrogated from 2005 to 2010. All patients were classified as either uncomplicated appendicitis (ICD codes 540.0, 540.9), or complicated appendicitis (ICD code 540.1, appendicitis with abscess).The demographics, imaging utilization, and imaging costs among these groups were analyzed and compared.
Results: There were 69,764 cases of appendicitis treated at 40 pediatric hospitals. 86.6% of the cases represented uncomplicated appendicitis while 13.4% of cases represented complicated appendicitis. Imaging utilization and charges varied significantly between cases of uncomplicated appendicitis (1.9 imaging exams/case, average charge $1,557 USD) and complicated appendicitis (4.8 imaging studies/ case; average charge $4,193 USD). Imaging utilization and charges also varied widely among member hospitals, even when normalized for case mix index. Charges ranged from $309.40 to $3,818.70 (average: $1323.20) with a low CMI score, from $1,261.10 to $4,477.10 (average: $2593.20) with an intermediate CMI score, and from $3402.10 to $34,987.80 (average: $13,461.00) with a high CMI score. During the study period, there was progressive increase in the use of ultrasound for evaluating appendicitis (31.4% of patients in 2010 compared to 19.3% of patients in 2005). Concurrently, the use of CT decreased (47.3% of patients at the peak of CT usage in 2006 to 39.7% of patients in 2010).
Conclusion: Among pediatric hospitals within the United States, there is significant variability in utilization of and charges for imaging resources for the diagnosis of appendicitis. Both use of and charge for imaging is significantly higher in patients with complicated appendicitis. National trends favoring ultrasound over CT appear to be slowly emerging.

PGI-62

Comparison of MR enterography and endoscopy in the assessment of terminal ileal inflammation in inflammatory bowel disease in the pediatric age group

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Purpose: To compare accuracy of MR enterography (MRE) and endoscopy in assessing active terminal ileal inflammation in children with inflammatory bowel disease (IBD).
Materials and methods: Pediatric patients with clinically suspected or proven IBD with MREs performed from November 2008 to March 2010, and colonoscopies within 3 months prior or

after MRE were retrospectively evaluated. Nineteen patients were included (12 males, 7 females; 4–17 years (mean=13.3 years)). Imaging protocol included oral administration of 450–900 ml of VoLumen, and these sequences: coronal and axial single-shot FSE T2, axial FIESTA, coronal LAVA pre- and dynamic post-contrast and axial post-contrast LAVA. MRE findings for inflammation were compared with endoscopy and biopsy using a binary classification test. Sensitivities of MRE and endoscopy were compared using the McNemar test.
Results: Eleven (58%) patients showed no inflammation on MRE, confirmed on endoscopy. Eight (42%) patients showed inflammation on MRE, with 3 showing inflammation on endoscopy, and 5 showing no inflammation on endoscopy. The MRE criteria of inflammation were wall thickening (n=7), wall enhancement (n=4), mucosal hyperenhancement (n=1) and wall edema (n=1). The following were estimated for MRE at 95% confidence interval (95%CI): sensitivity=1(0.31–1), specificity=0.69(0.41–0.88), positive predictive value (PPV)=0.38(0.10–0.74), negative predictive value (NPV)=1(0.68–1). The following were estimated for endoscopy at 95%CI: sensitivity=1(0.31–1), specificity=0.88(0.60–0.88), PPV=0.6(0.17–0.93), NPV=1(0.73–1). Utilizing McNemar's test, there is no statistically significant difference in MRE and endoscopy for detection of terminal ileum inflammation (p=0.4497).
Conclusion: MRE and endoscopy show high sensitivity for terminal ileum inflammation, but endoscopy is more specific. Diagnostic effectiveness of MRE is comparable to endoscopy. MRE has potential as a non-invasive screening or follow-up test for ileal inflammation in pediatric IBD.

PGI-63

3% sorbitol as oral contrast and IV hyoscine butylbromide are well tolerated in children undergoing MR enterography

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Background: Many institutions worldwide use 0.1% barium sulfate/3% sorbitol suspension (VoLumen ®) as oral contrast and IV Glucagon or IV hyoscine butylbromide as anastaltic medication when performing magnet resonance enterography (MRE). IV hyoscine butylbromide is far less costly compared to IV Glucagon, resulting in it being most frequently used worldwide. Health Canada has not approved the use of VoLumen® as oral contrast. Therefore, we decided to use oral 3% sorbitol suspension and IV hyoscine butylbromide in children referred for MRE. To our knowledge, no study in children undergoing MRE with use of oral 3% sorbitol and IV hyoscine butylbromide has been published.
Purpose: To evaluate tolerance of oral 3% sorbitol and IV hyoscine butylbromide in children undergoing MR enterography.
Materials and methods: We collected questionnaires from 50 children (36 m, 14 f, mean age 13.4 years) referred for contrast enhanced MRE with oral 3% sorbitol and IV hyoscine butylbromide (Sandoz, Boucherville, Canada). Participation in filling out the questionnaire after the MR exam was on a voluntary basis. Patients ranked flavor, texture and speed of drinking on a Likert scale (1–10) and they commented on adverse events, e.g. vomiting, diarrhea, blurred vision, dry mouth, tachycardia, and allergic skin reaction.
Results: Tolerance of flavor (n=48), texture (n=48) and speed of drinking (n=50) was very good with an average score of 2.6, 2.0 and 1.5 (1.0 being the highest score). Two children could not comment on flavor and texture because 3% sorbitol was administered by nasogastric tube. Out of 50 patients, 14 experienced blurred vision, 10 tachycardia, 9 dry mouth, 5 diarrhea, 5 vomiting, 1 allergic skin reaction, and 1 headache. All of these symptoms resolved within 60 min after completion of MRE.
Conclusion: Oral 3% sorbitol and IV hyoscine butylbromide are well tolerated and cost effective in children undergoing MRE and we implemented this as standard protocol at our institution.

PGI-64

Pediatric blunt splenic trauma: changing etiopathogenesis

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Purpose: 1. To compare and review the spectrum and severity of blunt splenic trauma in children associated with motor vehicle accidents and sports and related activities 2. To assess severity of associated intra-abdominal injuries in both categories. 3. To compare the AAST trauma grading scores and review image based severity grading of blunt pediatric splenic trauma.
Materials and methods: 220 consecutive cases of blunt pediatric splenic trauma cases were analysed in a retrospective study. Patients presented to our Level 1 trauma center over a period of 4 years (2004–2008). Splenic Injury was graded according to AAST grading on CECT in all patients.Associated intra and extraabdominal injuries were categorized. Patients were categorized according to mechanism of injury into Motor vehicle related trauma, Outdoor Sports related trauma and biking related trauma.
Results: All grades and severity of splenic injuries were seen in all three categories in our population. However the severity of associated intra and extraabdominal injuries was highest in the motor vehicle group as expected. Biking related injuries were found to be more severe in grade than other outdoor sports. Handle bar injuries to spleen are a serious hazard and constitute a whopping 22% of all blunt splenic trauma. Frequency of associated abdominal solid visceral trauma is low with sports related trauma.
Conclusion: Traditionally motor vehicle trauma is considered as the major culprit in pediatric splenic trauma, however in our study we found a far exceeding number of sports related and biking related trauma to the spleen. This is cause for concern and calls for a need for improved safety measures during pediatric recreational activities.

PGI-65

Pictorial review of AAST grading of pediatric blunt splenic trauma

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Purpose: 1. To familiarize radiologists with Organ Injury Scale for blunt pediatric splenic injuries. 2. To present challenging cases for review. 3. To emphasize the importance of reporting additional findings that determine prognosis and are not a part of the AAST grading per se. 4. To highlight the use of low dose CT with optimal contrast enhancement to avoid caveats in appropriate grading of splenic injury.
Materials and methods: MDCT images from 220 patients of splenic injury who presented between 2004 and 2008 to our level I trauma center were analyzed retrospectively. All cases were reviewed by two radiologists to arrive at a single grade of injury as per AAST guidelines. Causes of blunt trauma were varied and representive samples from all etiologies were taken.

Results: All grades of splenic injury were seen with varied etiopathologies. The most representative images were presented. Additional findings like contrast blush, splenic fracture, extravasation, splenic ateriovenous fistulas and splenic artery aneurysms which are not part of AAST grading per se were also evaluated. Challenging cases with difficult grading are presented for review as well. Laceration, hematoma, infarcts and vascular pedicle injury and their differentiation with respect to imaging in pediatric size spleen is presented as well. Contrast administration and optimal phase of imaging is central to adequately grading splenic injuries. Low dose CT with iterative reconstruction can further markedly reduce radiation dose and provide optimal diagnostic images.
Conclusion: Though many authors have debated its usefulness, Organ Injury Scale /AAST grading still remains widely used for categorizing blunt abdominal injuries in adults as well as children. Hence knowledge of the grading and its correct reproduction is necessary to ensure interobserver agreement. We provide a comprehensive review of the grading as it applies to pediatric blunt splenic trauma. Pediatric cases present a special challenge as this patient category necessitates the need for low dose CT and imaging challenges in the form of motion artifact.

PGI-66

Prevalence of biliary atresia in children with choledochal cysts

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Purpose: To determine the prevalence of biliary atresia in children with choledochal cysts.
Materials and methods: This study was HIPAA compliant and IRB approved. We retrospectively reviewed the medical records of all pediatric patients referred to our hospital from August 1987 to August 2010 for the possible diagnosis of choledochal cyst. The diagnosis of choledochal cyst with or without biliary atresia was made on the basis of information obtained from sonography (US), computed tomography (CT), magnetic resonance imaging (MRI), HIDA scan and surgery.
Results: A total of 58 patients with the initial diagnosis of choledochal cyst were identified. There were 25 males and 33 females. Of these 58 patients, 28 patients (48%, 13 male, 15 female) had a definitive diagnosis of choledochal cyst, 1 patient had an equivocal diagnosis of choledochal cyst, 7 patients were lost to follow-up, 22 patients (38%) had alternative diagnoses including duplication cyst, hepatic cyst, ovarian cyst or obstructive biliary dilatation. Of the 28 patients with a definitive diagnosis of choledochal cyst, 6 patients (21%) had associated biliary atresia and underwent a Kasai procedure. The six patients with both biliary atresia and choledochal cyst were all female.
Conclusion: Of patients with the suspected diagnosis of a choledochal cyst on an initial imaging study, approximately half will have a final diagnosis of choledochal cyst (48%). For those patients with a definitive diagnosis of a choledochal cyst, there is a significant risk of associated biliary atresia (21%).

PGI-67

Effect of conversion to gastrojejunal (GJ) feedings on reflux-related visits (RRV) and resource utilisation in neurologically impaired (NI) children

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Purpose: To determine whether the use of GJ in children with NI and gastroesophageal reflux disease (GERD) reduces RRV and costs for children with NI and GERD.
Materials and methods: Children with NI and GERD who had a primary GJ tube placed between 12/99–10/06 at a tertiary children's hospital formed the retrospective cohort. Patients' courses were reviewed from birth until GJ placement (Pre) and one year following GJ placement (Post). RRV was defined as an emergency department visit, radiology visit, or hospitalization due to pneumonia, respiratory distress, GERD diagnostic study or feeding tube problem using strict clinical criteria to assure precision. Visits were summarized and costs were obtained from the hospital database. Pre and post rates are reported and were compared using a paired t-test.
Results: Thirty three children with NI underwent GJ tube placement to manage GERD. Twenty five patients were male, and median age at initial conversion to GJ was 14 months. Four patients died less than a year following GJ placement; two related to the GJ tube (ischemic bowel and intestinal perforation). Prior to GJ placement the total visits were 6.8 per child-year which was unchanged after placement of the GJ tube (7.0, $p=0.89$). RRV increased after placement of the GJ tube (Pre 2.4 visits per child per year: Post 4.3 visits per child per year, $p=0.04$). Major reasons for RRV (Pre, Post) were pneumonias (22%, 9%), respiratory distress (30%, 6%), GERD diagnostic procedures (6%, 3%), and feeding tube problems (42%, 82%). Total Pre costs were $3.78 million, RRV Pre costs were $1.42 million. Total Post costs were $2.17 million, RRV Post costs were $1.63 million.
Conclusion: GJ feedings increase reflux related visits in children with NI and GERD; this increase appears to be related to mechanical tube problems. These are cumulatively expensive health care visits. The impact of these frequent visits on the child and caregiver health related quality of life is unknown.

PGI-68

Button battery ingestion in children: what the radiologist must know

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Purpose: Published studies in the literature have shown an increasing morbidity and mortality from button battery ingestion in children. Button batteries lodged in the esophagus or nose are a true surgical emergency, unlike other foreign bodies. The radiologist may be the first to suggest the diagnosis from the radiographic appearance of the foreign object. The purpose of this study is to review the imaging findings of button battery ingestion in children including the radiographic appearance of button batteries, means of differentiating batteries from other foreign bodies, and the complications that can occur as a result of ingestion.
Materials and methods: Our database was searched to identify patients with a button (or disc) battery ingestion between January 1998 and November 2010. Patient charts were reviewed to determine the age of the patient at diagnosis, if the ingestion was witnessed, symptoms at presentation, and complications.

Images and reports were reviewed to determine the location of the battery and complications.
Results: 33 children who ingested button batteries were identified (mean age 3 years, range 0.7–11 years). On frontal radiographs, the batteries had a double contour while the lateral view demonstrated a beveled edge or step off. 21 (63%) ingested batteries had passed into the stomach or small or large bowel, 9 (27 %) were lodged in the esophagus and 3 (10 %) in the nose. Patients with witnessed ingestion presented immediately after ingestion without significant symptoms. The ingestion was unwitnessed in 9 patients and their clinical symptoms were nonspecific ranging from 1–6 days. Complications occurred with batteries lodged in the esophagus or nose and included tissue necrosis ($n=7$), tracheoesophageal fistula formation ($n=2$), esophageal stricture ($n=2$), and vocal cord paralysis ($n=1$). In 4 cases, the outside radiologist or resident did not correctly identify the object as a button battery.
Conclusion: The radiologist must be aware of the appearance of button batteries. When there is suspicion for button battery ingestion, prompt removal is necessary to avoid complications.

PGI-69

Evaluation of the role of fluoroscopic enema diagnosis of Hirschsprung disease, clinical considerations and determining need for radiographic evaluation

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Purpose: To evaluate the need for and effectiveness of radiologic evaluation of suspected cases of Hirschsprung's disease and cases not initially suspected to have Hirschsprung's, but for which patient's abdominal symptoms could be caused by Hirschsprung's disease.
Materials and methods: Initially, retrospective analysis of rectal biopsies for a period of 5 years was performed. Enema studies were reviewed independently by 2 radiologists. As discrepancy between biopsy and Gastrografin enema results were noted, it was felt there was value in reviewing all pediatric contrast enemas performed on a retrospective basis for a 10 year period and correlating with clinical history and rectal biopsy. A total of 103 cases were reviewed.
Results: As cases were reviewed, it was noted there was significant discrepancy between fluoroscopic enema results and rectal biopsy results. Prevalence of Hirschsprung's disease among patient's with the reported positive contrast enema was 0.5 (CI 0.4–0.6). The sensitivity of the enema study for abnormal rectosigmoid (RS) ratio was 0.94, (CI 0.8–0.9) and the specificity was low at 0.04 (CI 0.006–0.15).
Conclusion: Contrast enema had a high report of abnormal RS ratios, but negative biopsies. In addition, the retrospective analysis of all enema studies identified population of patient's with described clinical symptoms of Hirschsprung's disease with abnormal RS ratio, but never went on to biopsy. In addition, some patients with negative enema studies went on to biopsy, a number of which were positive for Hirschsprung's. Questions are raised regarding the accuracy of the enema study, whether it is needed in evaluation of patient's suspected of having Hirschsprung's disease given the patient's with negative enema studies who went on for biopsy if there is high clinical suspicion. There is also a role for a larger multi-institutionl study to gather more data was this particular analytic approach.

PGI-70

Imaging features of non-hematological splenic lesions in infants and children

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Purpose: We present briefly the ultrasound (US), Magnetic Resonance Imaging (MRI) and/or computed tomography (CT) imaging spectrum of non haematological lesions occurring in the spleen and discuss differential diagnosis and nosological status of selected lesions.
Materials and methods: We reviewed records of 16 benign splenic lesions in pediatric patients(6 months–14 years), including two hamartomas, two lymphangiomas, four solitary cysts, tree splenic infarcts, one splenomegaly by leishmaniasis and four hemangiomas.
Results: The imaging appearance of splenic hemangiomas may be complex, echogenic solid or complex cystic mass, and differentiation of these lesions from malignant disease may not be possible. The diagnosis of splenic hamartoma may be suggested when findings of increased blood flow on color Doppler images are seen in association with a homogeneous solid echogenic mass. A large subcapsular solitary cystic abnormality discovered incidentally in a child in association with internal septations and tiny mural nodules favors the diagnosis of lymphangioma. Splenic infarcts may be seen with localized processes such as portal hypertension or pancreatitis, or may arise from an embolic source. Evaluation of a focal splenic abnormality identified on sonograms should be followed up with CT or MRI with and without contrast material enhancement. Splenectomy may be required for definitive evaluation of a splenic mass with atypical features.
Conclusion: Although solitary splenic lesions are uncommon, their importance lies in that they must be differentiated from the more common neoplastic disorders of the spleen, such as lymphoma and metastasis.

PGI-71

Gastrointestinal congenital abnormalities in neonatal period: radiological-surgical comparison

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Purpose: The purpose of this educational exhibit is to illustrate comparative images of radiological examination and surgical findings in gastrointestinal congenital abnormalities in neonatal period (<= 1 month)
Materials and methods: We reviewed medical records of neonates born between November 2006 and December 2009 at our neonatological center (45cases in the 9000 birth/year) who underwent surgical intervention during their first month of life because of gastrointestinal congenital abnormalities. We reevaluated radiological examinations (plain radiographs and contrast examinations) performed before surgery to correlate them with surgical findings
Results: Congenital abnormalities can occur in every part of the gastrointestinal tract and concern defect of canalization (oesophageal atresia, duodenal atresia or stenosis, small bowel atresia, meconium peritonitis), defect of rotation (malrotation and volvulus) or defect of innervation (Hirschprung disease).

Conclusion: While most of congenital abnormalities are now discovered in the prenatal period, radiological confirmation still has a relevant role in the early postnatal period and sometimes remains the first diagnostic tools to detect the abnormality. Radiological images are of real help to plan surgical intervention because of the good imaging correlation with intraoperative findings, and the safe and fast procedure.

PGI-72

Does ultrasound (US) imaging for acute appendicitis in children influence surgical management and correlate with histological findings? Our experience in a tertiary paediatric radiology department

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Purpose: Right iliac fossa pain in children can present a difficult diagnostic dilemma, with acute appendicitis often being difficult to diagnose on clinical and biochemical assessment alone. US imaging can play an important role in patient management.
Materials and methods: From June 2007 through November 2010, we retrospectively reviewed all reports for US imaging requested in children presenting acutely with suspected appendicitis. Based on US findings, patients were assigned to 1 of 4 categories; A) appendicitis, B) normal appendix visualised, C) appendix not visualised but secondary signs seen, D) appendix not visualised and no secondary signs seen. Histological correlation was performed for patients who underwent surgery, whilst casenote review was undertaken for those patients who did not undergo appendicectomy to establish their clinical outcome.
Results: 403 patients (F=286, M=117, age range 3–19 yrs) underwent US imaging for suspected appendicitis. 61 patients had an US diagnosis of appendicitis (category A). Of these, 49 were confirmed at histology, 4 had faecolith with dilated appendix, 1 had appendiceal carcinoid, 1 had normal histology and 6 did not undergo surgery. The majority of patients in category A underwent prompt surgery within 12–24 hours of imaging. 21 patients had a normal appendix visualised (category B). This correlated with clinical improvement and prompt discharge in 18, whilst 3 patients underwent appendicectomy, 2 of which were negative on histology whereas 1 demonstrated appendicitis. 23 patients fell into category C, with over half revealing appendicitis on histology. 298 patients fell into category D.
Conclusion: US appendix is a valuable assessment tool in children with suspected acute appendicitis. Of particular benefit is the lack of associated ionising radiation to the growing child. An US diagnosis of a normal or abnormal visualised appendix has a significant influence on the surgical management of these patients.

PGI-73

Ultrasound in acute abdominal pain in pediatric emergency department: what use?

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Purpose: Acute abdominal conditions are a common reason for admission of children in emergency department. The aim of this study was to present our experience in pediatric radiology department in the management of acute abdominal pain and investigate the range of emergency abdominal conditions and ultrasound (US) usefulness
Materials and methods: We retrospectively reviewed US examinations of 825 children (age ranged from 20 dies to14 years) admitted with acute abdominal pain (non traumatic) in the emergency department between January and December 2009.
Results: US scan revealed 52 appedicitis, 16 intussusceptions, 6 hypertrophic pylorus syndrome, 19 ovarian lesions (9 corpus luteum cyst, 6 simple cysts, 4, ovarian torsion), 5 tumours (3 teratomi, 2 mesenteric lymphangiomas), 3 simple renal cysts, 2 multicystic kidney, 6 renal calculi, 3 double renal districts, 10 hydronephrosis, 1 pyelitis, 2 enlarged and hyperechoic kidney, 4 splenomegaly, 6 gallbladder lithiasis, 2 choledochus cyst, 9 bladder thickening, 5 umbilical hernia, 3 splenic cyst, 2 hepatic angiomas, 4 urachus persistence.
Conclusion: Our results suggest that acute abdominal pain does not always require US scanning to come to a reasonable diagnosis. A detailed history, meticulous examination and basic stool, urine and hematological investigations, often are sufficient to exclude organic pathology in most children with abdominal pain. It is also important to realize that the presence of an abnormal US result alone does not pinpoint to a diagnosis unless it is clinically relevant.

PGU-1

Ultrasonography versus helical computed tomography in the diagnosis of stone-free rate after extracorporeal shock wave lithotripsy in children

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Purpose: The purpose of a successful extracorporeal shock wave lithotripsy (SWL) is the complete fragmentation of stones leading to the diagnosis of stone-free. The aim of this study is to compare the diagnostic accuracy of ultrasonography (USG) and helical non-contrast computed tomography (NCT) in children with urolithiasis who believed to be stone-free after extracorporeal shock wave lithotripsy (SWL) with plain abdominal X-ray, by evaluating the same patients with both radiologic modalities
Materials and methods: Between March 2007 and August 2010, a prospective study of 116 consecutive patients who were treated with SWL and considered to be stone-free with plain abdominal X-ray, underwent both USG and helical NCT. The results were compared for the accuracy of the stone-free diagnosis.
Results: Residual stones were detected in 7 (8.13 %) with USG and in 18 (20.9 %) with CT of 86 patients who were thought to be stone-free with plain abdominal X-ray alone.
Conclusion: Although plain abdominal X-ray has been accepted as the first line diagnostic tool in evaluation of post SWL status with its cheap and practical use, helical CT was found to be more accurate and superior to USG in diagnosis of residual stone fragments which has not been found in plain abdominal X-ray. We believe that helical NCT is the imaging modality of choice for patient follow up after SWL, especially in pediatric patients in whom detection of residual stones can change our clinical approach, however, cost and risk of radiation exposure is a concern still to be resolved.

PGU-2

Long-term effect of varicocele repair in adolescents using ultrasonography

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Purpose: The treatment of the adolescent varicocele raises several interesting clinical and ethical dilemmas. The aim of this study is to investigate the long-term effect of varicocele repair on ipsilateral testicular size and intratesticular arterial resistance index (RI) using color Doppler sonography (CDS).
Materials and methods: A total of 52 boys, age 9 years to 16 years varicocele who underwent a testicular artery and lymphatic-sparing subinguinal varicocelectomy were examined with CDS for testicular size and intratesticular flow parameters before and at least one year after surgery.
Results: Repair of the varicocele resulted in catch-up growth of the affected testicle in 37 % of boys; this was more common in younger boys and those with smaller varicoceles. The mean values of RI, end-diastolic velocity and pulsatility index decreased significantly after surgery ($p>0.05$), whereas no significant change was observed in peak systolic velocity.
Conclusion: Our data show that a significant improvement occurs in testicular volume and blood supply after surgical varicocele repair in adolescents. Varicocelectomy at a younger age offer a better chance for preserved testicular function.

PGU-3

Neonatal scrotal disorder: sonographic finding and anatomical consideration

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Purpose: Ultrasonogrphy is usually the initial imaging modality for evaluation of scrotal disorder. It provides excellent information regarding, without radiation exposure, is easily accessible, and relatively rapidly. We review scrotal anatomy and present the sonographic findings of scrotal disorder in the neonate.
Materials and methods: We review sonogram and medical records of neonate who present acute scrotal disorder, scrotal masses or enlargement, and cryptorchidism. We describe the scrotal development, anatomy and characteristics of scrotum in the neonate. We illustrate the sonographic findings of various scrotal disease in the neonate and the correlation with anantomy.
Results: Acute scrotal disorders include extravaginal testicular torsion, epididymitis, and scrotal cellulitis. Scrotal masses or enlargement are hydrocele, spermatic cord hydrocele, inguinal hernia, and congenital testicular tumors. In cases of suspected cryptorchidism, sonogram is useful to detect a nonpalpable cryptorchid testis.
Conclusion: Recognizing characteristic sonographic findings of neonatal scrotal disorder can be used to help diagnosis of various scrotal disease and appropriate strategies for management.

PGU-4

Ultrasonographic measurement of diuretic-induced renal length change: does it correlate with renal function?

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Purpose: To prospectively identify the renal length change with diuretic and to determine whether the percentages of the renal length change allow an estimation of the split renal function.
Materials and methods: Approval for this prospective study was obtained from the institutional review board. 23 children (14 boys and nine girls), who were undergoing 99mTc-diethylenetriamine pentaacetic acid (DTPA) diuretic renography, were included in this study. Their ages ranged from 10 months to 15 years (mean, 7.83± 4.08 years). Renal lengths were measured prior to and 15 minutes after diuretic injection by ultrasonography.
Kolmogorov-Smirnov test was used to evaluate the normal distribution. Paired sample Student's t test was used to evaluate the difference between the mean values of renal lengths before and after diuretic injection. Spearman's test was used to assess the correlation between renal length increases due to diuretic injection and split renal functions.
Results: The mean renal lengths measured before and after diuretic administration were 91.52±20.87 mm and 95.38±21.46 mm, respectively. We found that the increase in renal length after diuretic administration is statistically significant ($P<0.001$, $t=10.630$). There was a positive correlation between renal length change and functional status ($p=0.006$; $r=0.401$).
Conclusion: Renal length measurements may change after diuretic injection, and these changes may be used in estimation of the renal function.

PGU-5

Role of diagnostic imaging in evaluation of precocious puberty

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Purpose: To review and summarize the role of diagnostic imaging in the evaluation of precocious puberty in children, with emphasis on clinical presentations and radiological findings in assessment of various causes of precocious puberty.
Materials and methods: The role of imaging would include:hand radiographs for bone age, pelvic ultrasound for assessment of uterine and ovarian size, ultrasound of testes for evaluation of testicular tumors, ultrasound or MRI studies for evaluation of adrenal and intracranial masses, imaging of other soft tissue tumors which may cause pseudo-precocious puberty
Results: Diagnostic Imaging plays an important role in the assessement and evaluation of precocious puberty and is used in diagnosis, follow up and managment of the condition. Most importantly, it can differentiate between the different causes of precocious puberty, hence helping with patient management.
Conclusion: Although hormonal assessment is the mainstay in evaluation of precocious puberty, radiology plays a major role in diagnosis, follow up and management of the condition. Various causes of precocious puberty would include intracranial and adrenal tumors, ovarian or testicular masses, and certain paraneoplastic syndromes which may cause pseudo-precocious puberty.We provide an overview of some common and rare causes of precocious puberty in children, with their imaging findings and screening protocol

PGU-6

Should ultrasound study of the renal tract be performed routinely in hypospadias?

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Purpose: At present our current practice is not to investigate the urinary tract in patients with hypospadias. We wished to clarify whether renal tract ultrasound scan is a useful and necessary investigation in the management of hypospadias.
Material and methods: A retrospective case notes review of 223 consecutive patients with hypospadias was undertaken. Patients were classified into two groups, proximal and distal hypospadias. The medical records were examined to find the patients who had

undergone USS of the renal tract. The results and indications of USS were recorded.
Results: A total of 223 patients were identified from our hypospadias database. 179 patients were classified as having distal hypospadias and 44 with proximal hypospadias. 30 patients with hypospadias had undergone USS for a variety of clinical indications. Among the group with distal hypospadias only 1 patient had a significant upper tract abnormality (consistent with PUJ dysfunction, which was not obstructed on radionuclide imaging). In patients with proximal hypospadias, 6 patients had significant upper tract abnormalities (2 ectopic kidneys, 1 urachal sinus, 1 hydroureteronephrosis with ureterocoele, 1 hydronephrosis) and 1 patient had epididimo-orchitis. A further four patients with proximal hypospadias had internal genital abnormalities consistent with disorders of sexual differentiation.
Conclusion: Current evidence suggests that USS of the renal tract is not indicated in patients with distal hypospadias, but no clear guidelines exist for screening patients with proximal hypospadias. There was a high incidence of upper tract abnormalities in our population and therefore we would recommend routine USS of the renal tract in patients with proximal hypospadias, to avoid any unnecessary morbidity.

PGU-7

Discontinuous spleno-gonadal fusion interpreted as a possible testicular malignancy—an important consideration in testicular imaging

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A 14 yr old boy was referred from his GP with a left sided hydrocoele. He was previously fit and well with no medical problems. On examination, he had a left sided testicular swelling, which the patient felt had always been present. An ultrasound study was requested for further evaluation. The ultrasound showed a normal right testis and epididymis with two ovoid homogeneous structures in the left hemiscrotum with the sonographic appearances of conjoined testes. The superior one was highly vascular and appeared to distort the vasculature of the inferior. Due to the intense vascularity, further imaging was advised. A MRI study was performed which showed a normal left testis inferiorly. Superior to the normal left testis was a 2.2×2.9×2.8 cm lesion, which was of slightly increased signal intensity on the T1 weighted image and decreased signal intensity on the T2 weighted image, in comparison to the normal testes. There was concern that this could represent a malignancy so he was then admitted for a radical left orchidectomy. The pathology specimen consisted of the left testis, and a separate encapsulated tissue mass with no identifiable structures over the superior testicular pole and the spermatic cord. The encapsulated mass was identified as a mature spleen.
Conclusion: It is important to consider splenogondal fusion in the differential diagnosis for testicular lesions. On review of the imaging, it presents as a vascular, but well-defined mass. The US and MRI findings are presented here as an important teaching point.

PGU-8

PIC cystography—positional installation of contrast cystography: missing link in the diagnosis of vesicoureteral reflux?

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Purpose: Positional installation of contrast cystography (PIC cystography) is a method to identify vesicoureteral reflux (VUR) that is unrevealed by standard diagnostic procedures. We studied the significance of PIC cystography to demonstrate VUR that failed to be revealed by standard VCUG, as well as the correlation of such a finding with endoscopic appearance of the ureteral orifice (UO).
Materials and methods: PIC was performed by radiological examination of the vesicoureteral junction and upper urotract during cystoscopic installation of the contrast medium at the ureteral orifice. Installation of the contrast at the ureteral oriffice was performed by all pressure standards of classical VCUG. We analyzed 10 children (8 girls and 2 boys), aged 6–15 years (mean 9.8 years) with recurrent febrile urotract infections, complicated with scarring of the renal parenchyma and normal findings on VCUG. The grade of VUR by PIC was classified using the standard hydrodistensional scale.
Results: All 10 patients had VUR by PIC cystography. In 8 it was unilateral and in 2 bilateral. 8 had VUR grade I and one grade II. All with VUR detected by PIC cystography had evident cystoscopic abnormalities in the position and/or configuration of the ureteral orifice at the same side, while at the side with normal finding on PIC cystography, the endoscopic finding was within normal limits.
Conclusion: PIC cystography is the method of choice in the confirmation of VUR as the cause of recurrent urotract infection and its complications in children with a normal finding on standard VCUG. In all our patients with VUR verified by PIC cystography, at the same side we also revealed endoscopic changes in the position and/or configuration of UO.

PGU-9

Ovary containing inguinal hernia in female infants: sonographic findings

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Purpose: To described the imaging findings of ovary containing inguinal herniation.
Materials and methods: From June 2005 to June 2010, we retrospectively reviewed the US images of inguinal hernia in female infants. 9 infants were diagnosed with an ovary containing an inguinal hernia, confirmed with surgery. The mean age was 3.57 months (range : 22 day–19 months). And the 5 of 9 infants were premature babies (mean gestational age 30 weeks). We assessed the presence of the inguinal hernia, the contents of the hernia sac, vascularity and uterus location.
Results: In all 10 cases of 9 infants (bilateral hernia in one patient), sonography revealed an oval shaped heterogeneously hypoechoic lesion with internal small cysts, representing follicular cysts. In 4 cases, there was associated herniation of the uterus and fallopian tube. Blood flow was observed in all cases. In 6 cases, uterus was displaced and stretched to the ipsilateral side of the hernia. In 2 cases, uterus was displaced anteriorly. In one case, ovary incarceration was confirmed surgically.
Conclusion: Inguinal herniation of pelvic viscera can occur in female infants. Sonographic findings of an heterogeneous hypoechoic mass with small cysts in the inguinal area indicate inguinal hernia of ovary. Displacement and stretching of the uterus is also a useful associated finding.

PGU-10

Comparing 3D renal ultrasonography and 99m-Tc DMSA renal scintigraphy in detecting renal scarring and calculating differential renal volume in children with a urinary tract infection

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Purpose: To evaluate the potential of 3D renal ultrasonography in detecting renal scarring and its value in calculating differential renal volume to predict differential renal function in children with urinary tract infection, comparing with DMSA renal scintigraphy.
Materials and methods: 24 patients who were scheduled for DMSA scintigraphy underwent 2D and 3D ultrasound examination within a one month period. The ultrasound examinations were performed by 2 operators and the images interpreted by two radiologists independently. Comparison was made between the ultrasonographic findings of scar detection with the gold standard, DMSA scintigraphy. Volume calculations by 3D ultrasound was also performed to obtain differential renal volumes and these were correlated with differential renal function by DMSA scintigraphy.
Results: The sensitivity, specificity, positive and negative predictive values for renal scar detection were 45.4%, 72.1%, 32.6%, 81.6% for 3D ultrasound. These values were not significantly different from 2D ultrasound, which were 36.4%, 80.2%, 32.6% and 81.6% respectively. The correlation between differential renal volume by 3D ultrasonography and differential renal function by DMSA scintigraphy was significant (r= 0.935) and better than 2D ultrasound (r=0.773) with narrow limit of agreement.
Conclusion: 3D and 2D ultrasonography are not sensitive in detecting renal scarring and should not substitute DMSA scintigraphy. However, they are useful in the calculation of differential renal volume which can be used as a predictor of differential renal function.

PGU-11

Sonographic findings of kidneys in acute phase of dehydration in infants with cystic fibrosis

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Purpose: Infants with cystic fibrosis can develop episodes of hyponatremic hypochloremic dehydration with metabolic alkalosis because of external factors such as rise in environmental temperature, fever, loss and /or inadequate intake of salt and fluids.In infants dehydration may be the initial presentation of cystic fibrosis. As dehydration progresses, hypovolemic shock ultimately ensues with a detrimental effect on the vital organs. The purpose of this study is to present the ultrasound findings of kidneys in infants with cystic fibrosis after an episode of severe dehydration.
Materials and methods: 12 infants, 6 boys and 6 girls (mean age 17 months) with cystic fibrosis were admitted to the hospital with dehydration over the last year during the summer months (June to August). For 4 infants, dehydration was the presenting symptom of cystic fibrosis. All children were investigated with renal ultrasound at the time of dehydration by the same radiologist.
Results: 4 infants with severe dehydration had increased renal reflectivity with preserved corticomedullary differentiation. The volume of the kidneys was increased in two of the infants and normal in the others.The kidneys were equally involved. All 4 children had markedly abnormal electrolytes with chloride below 70 mmol/l and urea above 100 mg/l. In 8 infants with no severe dehydration (chloride above 70 mmol/l), the kidneys were of a normal size and parenchymal reflectivity.
Conclusion: Severe dehydration causes renal changes as detected by an ultrasound scan. Although increased renal reflectivity is not a specific sonographic finding, cystic fibrosis should be considered in differential diagnosis of any child presenting with unexplained hypochloremic dehydration. It is also important information for referral to avoid concomitant use of nephrotoxic drugs, which may have an add-on effect on vulnerable kidneys and cause irreversible damage.

PGU-12

MR urography in the evaluation of UPJ obstruction in children–preliminary results

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Background: Ureteropelvic junction (UPJ) obstruction is the most common cause of hydronephrosis in children and continues to present a challenge to radiologists and urologists, who are unable to accurately predict which children will benefit from surgery. Previous studies have shown that dynamic contrast-enhanced MR urography has several advantages in the evaluation of hydronephrosis in children because it combines both anatomic and functional information in a single test that does not use ionizing radiation. The purpose of our study is to review our experience with MR urography in children with UPJ obstruction and to identify anatomic or functional parameters that may predict which children will benefit from surgery.
Purpose: The purpose of our study was to retrospectively review our experience using MR urography in the diagnosis of ureteropelvic junction (UPJ) obstruction in children.
Materials and methods: The study included 60 children with hydronephrosis but with no dilatation of the ureter (28 females and 32 males) aged from 3 month–21 years (average age 7.4 years). The anatomic criteria assessed included the degree of hydronephrosis, the morphology of the renal pelvis, the atrophy of medulla, and the presence of crossing vessels. Functional criteria included renal transit time, differential renal function, and time-intensity curves when available.
Results: 54 children had stenosis of UPJ, and thirty-one kidneys were classified as obstructed, 7w as equivocal, and 16 as non-obstructed. Obstructed systems had more marked hydronephrosis and more extensive medullary atrophy. Crossing vessels were seen in all groups (7 in nonobstructed and 2 in obstructed). Obstructed systems also showed greater functional derangement, decreased split renal function, and abnormal time-intensity curves.
Conclusion: MR urography is a single-technique approach to pediatric UPJ obstruction that offers both anatomic and functional insights. Anatomic evaluation combined with renal transit time classification provides a reliable parameter for the identification of obstruction

PGU-13

Renal fungal ball in neonate

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Fungal infection of urinary tract occur mainly in immunocompromised patients and the most common cause is candida albicans. In pediatric patients, the premature neonate is vulnerable to fungal infection of the kidney. We describe a case of a premature baby with extremely low birth weight who presents with a fever. Sonographic examination shows enlargement of the left kidney with diffuse increased echogenecity and mild dilatation of pelvicaliceal system. A well defined wedge shaped, echogenic mass without posterior acoustic shadowing was visualized in the pelvis of left kidney. After 7 days, sonographic examination showed aggravation of hydronephrosis in the left kidney and no change of well defined echogenic mass in the renal pelvis. A urine culture revealed candida albicans. The patient received systemic antifungal therapy with fluconazone for 2 weeks. Follow-up sonographic examination was performed, with no change of marked hydronephrosis and echogenic mass in the renal pelvis of the left kidney. Percutaneous nephrostomy with antifungal agent irrigation was performed. Follow-up sonography showed a complete resolution of the echogenic mass(fungal ball) with residual mild hydronephrosis.

PGU-14

Post traumatic urinoma in a child: a clinical and imaging experience highlighting the role of MR urography

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Urinoma, which is a collection of chronically extravasated urine, is uncommon in children and when it does occur in the pediatric age group, is usually secondary to urinary obstruction such as posterior urethral valves. Post traumatic urinomas are rare and are only sporadically reported in children. We report a case of post traumatic urinoma in a 3 year old boy who was clinically suspected to have a perirenal hematoma after a fall. Ultrasound examination revealed a large urinoma encasing the right kidney, displacing it anteriorly and causing hydronephrosis. CT examination confirmed a enhancing urinoma but did not demonstrate the site of injury / leak. However, MR Urography using heavily T2W sequences, exquisitely demonstrated the site of injury and leak in the upper right ureter. The child was treated with ultrasound guided drainage and recovered well. Our experience not only highlights the importance of considering the diagnosis of urinoma following trauma, but also documents the invaluable role of MR Urography in similar clinical situations.

PGU-16

MRI features of congenital mullerian duct anomalies in children and adolescents

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Purpose: To illustrate the MRI spectrum of pediatric congenital Mullerian duct anomalies using a high-field open magnet (1.0T). Technicalities in performing the pelvic MRI and imaging findings of these conditions are outlined.
Materials and methods: Children and adolescents with congenital Mullerian duct anomalies referred to our department the past 3 years for MRI of the pelvis are included.
Results: Cases of hematometrocolpos with a background of common urogenital sinus, uterus didelphys, hypoplastic uterus, Gartner cyst, persistent mullerian duct syndrome and their associated anomalies are demonstrated.
Conclusion: The high strength and sensitivity of this modality which contributes to an accurate diagnosis is outlined. An overview of congenital Mulllerian duct abnormalities and the criteria which lead to their diagnosis is attempted.

PGU-17

Posterior urethral valves—identifying mimics on MCUG

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Purpose: In the light of technological advances in antenatal and postnatal ultrasound techniques, we reviewed the added value of the micturating cystourethrogram (MCUG) in the assessment of male infants with bilateral antenatal hydronephrosis and suspected posterior urethral valves (PUV). Ultrasonography (US) reliably demonstrates features of bladder outflow obstruction, including hydronephrosis, bladder trabeculation, and a dilated bladder neck or posterior urethra (keyhole sign), with some authors relying on voiding US to identify posterior urethral valves. However, US is less reliable than MCUG at demonstrating other essential information such as the presence or absence of vesicoureteric reflux (VUR) and intrarenal rupture, and cannot characterise fully other bladder and urethral abnormalities which may mimic PUV. We present five cases from St Georges Hospital, London to illustrate the value of MCUG.
Materials and methods: We retrospectively reviewed all MCUGs performed in infants under the age of 3 months at St Georges Hospital, London between May 2002 and August 2010. Case notes, electronic patient records and PACS records of 141 patients were reviewed. The male to female ratio was 4:1 and median age at MCUG was 6 weeks.
Results: Diagnoses included 68 normal studies, 30 cases of VUR, 18 cases of PUV, 11 bladder neck anomalies, 8 urethral anomalies, 4 duplex systems with ureterocoele and 1 patient with megaureter. We have selected 5 cases to illustrate the value of MCUG over US in the assessment of bladder outflow obstruction.
Case 1—Posterior urethral valve (classic example)
Case 2—Posterior urethral folds (plicae colliculi)
Case 3—Anterior urethral diverticulum
Case 4—Trigonal ridge
Case 5—Intrarenal rupture secondary to bladder outflow obstruction.
Conclusion: MCUG remains the gold standard investigation for the assessment of bladder outflow obstruction and suspected PUV. In addition to identifying the complications of obstruction such as VUR and less frequently, intrarenal rupture, there are rare anomalies of the bladder and urethra that cannot be excluded on US alone.

PGU-18

Testicular torsion: Are we looking at the right place?

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Purpose: The diagnosis of cord torsion is currently based on the absence of testicular flow as well as in the evaluation of the spermatic vessels at the inguinal channel. Recently the whirlpool sing has been described as the most reliable US sign of testicular torsion. Our aim is to determine the usual location of the twisted cord vessels.
Materials and methods: We review 21 charts and US records in 21 patients with proved testicular torsion. Videos and color Doppler images when available were specifically analysed.
Results: In 17 cases the images were just focused on testicular vascularization and in 11 cases the inguinal canal was also checked. Dedicated US of spermatic cord and its vascularization was only found in 4 cases. In 2 cases a complete and in 2 cases an incomplete (peak sign) whirlpool sign was depicted in a laterocaudal position to the teste (intravaginal location). Only in one case did the testicular flow remained normal. Although vessels appeared straight at the inguinal ring, demonstrative videos showed a whirlpool sign or spiral twist of the spermatic cord caudal to the teste.
Conclusion: In our series the spiral twist of the spermatic cord was found laterocaudal to the testis. The vessels at the inguinal ring showed a normal position. A detailed study of the cord at the paratesticular area, especially caudal to the testis, might increase the detection of the whirlpool sign and make the diagnosis of spermatic cord torsion before ischemic changes are established.

PGU-19

Virtual MR vaginoscopy/cystoscopy in management of duplex collecting system with ectopic ureter draining into vagina

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Background: A 4-month-old girl with a history of persistent urinary tract infection and duplex collecting system was referred to our hospital.
Materials and methods: Abdominal ultrasonography confirmed a bilateral duplex collecting system. Conventional cystoscopy detected a left-sided ureteral orifice and two right-sided ureteral orifices with a ureterocele originating from the ectopic orifice. The genitourinary system was examined with magnetic resonance urography. Gadopentetate dimeglumine (0.2 ml/kg, iv) was administrated. She lay in a supine position after achieving adequate bladder distention. Sedation was performed based on standard protocols. Images were obtained with 3D T1 scanner using pulse sequences (TR=30–50ms,TE=2–8ms, echo train length=8, flip angle=40 degrees). MR images confirmed previous detected abnormalities with an ectopic ureter draining into left side of vagina. Using multiplanar reformation from source images, virtual MR cystoscopy was performed to determine ureteral orifices and ureterocele anatomy in the bladder. The same sequences were obtained from vagina to find the orifice of the ectopic ureter draining into the vagina and any concurrent abnormality. Virtual MR vaginoscopy showed the left-sided ectopic ureter draining into the vagina and an ectopic ureterocele originating from that orifice (which was not detected in previous studies). Using all data, the girl underwent a ureterocele double puncture of bladder ureterocele and reimplantation of the vaginal ectopic ureterocele.
Conclusion: Virtual imaging provides a promising technique in detection of ureteral orifices and ureterocele anatomy prior to management of a duplex collecting system. It permits a whole evaluation of concurrent genitourinary abnormalities. Patients receive no radiation, no general anesthesia is required, and complications would be rare. It is probably the most valuable method in follow-up of surgical techniques, being minimally invasive and reliable. It may be indicated as a clinical routine for ureterocele double puncture. It may be considered as an alternative method when conventional cystoscopy is contraindicated.

PGU-20

Retrospective analysis of the demographics, radiological and clinical characteristics of females showing signs of early puberty at University Hospital Coventry and Warwickshire

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Purpose:
1)To assess the referral pattern to and demographics of the early puberty population in a large secondary care centre
2)To assess the radiological and clinical characteristics of this population
Materials and methods: The study group was collated by identifying all female patients under 10 years of age who had a bone age radiograph or a pelvic ultrasound. Data were retrieved from the radiology information system from 01/01/2006 to 30/07/2010. Clinical data were retrieved from clinic letters on the hospital information system.
Results: 132 patients were identified; 24 patients with full datasets had ultrasound features in advance of their chronological age. Following LHRH test and pelvic ultrasound, the diagnosis changed in 41.7% of these patients at the second clinic appointment. The precocious puberty group presented with early breast development (90.9%), pubic hair growth (81.8%) and axillary hair growth (27.3%). Final diagnoses were precocious puberty (45.8%), thelarche (16.7%), adrenarche (16.7%), early onset of normal puberty (12.5%), vulvovaginitis (4.2%), and concerns of precocious puberty (4.2%). Chronological age at presentation in the precocious puberty group was 7.57 years, the thelarche group 5.25 years, the adrenarche group 7.13 years, and in the early puberty group 8.72 years. The difference between chronological and bone age, measured in standard deviations was 2.23 in the precocious puberty group, 2.46 in the thelarche group, 1.18 in the adrenarche group, and 0.92 in the early puberty group. Pelvic ultrasound uterine appearances were pubertal in 45.5% of precocious puberty cases. In 66.7% of the early puberty cases a cavitary echo was identified. Ovarian appearances were advanced in 54.5% of the precocious puberty cases, 50% of thelarche cases, 75% of adrenarche cases and 100% of the early puberty cases.
Conclusion: 1) An average of 28.8 patients per year are referred to our secondary care centre to exclude precocious puberty, with a prevalence of 8.33%. 2) 81.1% of our population have a pelvic ultrasound, the role of which is mostly to confirm clinical diagnosis, however if appearances are pubertal then further tests are instigated.

PGU-21

Is renal transverse pelvic diameter measured accurately? Audit of referrals to a tertiary paediatric centre

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Purpose: The measurement of renal transverse pelvic diameter (TPD) forms an important part of the sonographic assessment of the paediatric renal tract. Accurate and reproducible measurements are used to guide appropriate management. The TPD should be measured on a true midportion transverse image across the renal hilum. Inaccurate measurement may result from the inability to obtain a true midportion transverse image of the renal pelvis and/or not measuring in the correct location. The purpose of this study was to assess whether TPD was being measured accurately in hospitals within our region, to review the reasons for inaccurate measurement and to assess whether this had any implications on management.
Materials and methods: We audited all ultrasound scans reviewed at out tertiary paediatric centre nephro-urology meetings over a 3 month period (from 23rd August 2010 to 29th November 2010). The scans were available either on our PACS system, via electronic links to other departments or on CDs brought to the meetings by the clinical teams. We documented whether an appropriate transverse renal image was recorded, if the TPD was measured and whether it was measured correctly. In inaccurately measured cases, we were able to retrospectively measure the renal pelvis in cases where appropriate images were available. We also documented whether there had been a change in management as a result.
Results: During our audit period 125 kidneys were reviewed. In 11 no transverse image was saved, therefore making retrospective measurement impossible. In a further 42 the measurement was incorrect, mainly due to measurement of extra-renal pelvis or oblique measurements. In 3 cases this resulted in a change of management.
Conclusion: This audit demonstrates that overall TPD measurements are performed unsatisfactorily in 42% of cases and highlights the need to accurately measure the renal pelvis to ensure patients receive appropriate management. We would also recommend that all patients have a documented TPD measurement whether the scan is considered normal or not.

PGU-22

Hemorrhage in a scrotal cystic lymphangioma: a rare cause of acute scrotum

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Hemorrhage in a scrotal cystic lymphangioma: a rare cause of acute scrotum. Lymphangiomas are hamartomatous, congenital malformations of the lymphatic system. In children scrotum is an unusual location for this otherwise common lesion. We present a case of a 13-year old boy who was referred for scrotal ultrasound because of scrotal left-sided pain of sudden origin. Physical examination showed a swelling that was separate from the left testis and spermatic cord that felt normal. Ultrasound showed a complex septated cystic mass. Moving internal echoes were observed in some spaces whereas in the same spaces hyperechoic structures attributed to blood clots were also noticed. Color Doppler demonstrated the presence of blood flow in the septa. The boy underwent surgery and the tumor was excised completely. Although rare, scrotal cystic lymphangioma complicated by haemorrhage is a cause of acute scrotum and must always be included in the differential diagnosis.

PGU-23

Neuroblastoma mimics Wilms tumor

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We present a case of neuroblastoma who presented with a primary tumor that appeared to arise from the kidney and multiple, well defined, nodular lung metastasis. Either of these two features alone is rare for neuroblastoma. The presence of these two features together is extremely unusual for neuroblastoma, creating a radiographic appearance very suggestive of Wilms tumor. Neuroblastoma may invade the kidney but it very rarely appears as if the origin is actually from the kidney. Neuroblastoma metastasizes to lymph nodes, liver and commonly to bone. Nodular lung metastases are rare. Wilms tumors are usually easily identified as arising from the kidney. By far the most common site of metastasis is the lung. Abdominal neuroblastoma and Wilms tumor need to be differentiated on their initial abdominal imaging as the subsequent imaging and the initial treatment may be different. If the initial abdominal CT suggests neuroblastoma the next imaging test may be a isotope bone scan with diagnosis possibly made from bone marrow aspiration. If initial abdominal CT suggests Wilms tumor, the next steps will usually be a chest CT scan and resection of the abdominal tumor (in the USA) or initial chemotherapy (in Europe), often without initial biopsy. Stage 4 neuroblastoma is treated with initial chemotherapy and possible later resection of residual primary tumor. In the USA, stage 4 Wilms tumor is treated with initial surgical resection of the primary tumor and then chemotherapy. Differentiation of these two tumors is thus important. A report from the International Neuroblastoma Risk Group (INRG) found lung metastasis in only 3.6% of 2,808 patients with Stage 4 neuroblastoma. In contrast, over 80% of children with metastatic Wilms tumor will have lung metastasis. Our patient is especially unusual as both the local renal findings and the nodular lung metastases suggested the incorrect diagnosis of Wilms tumor.

PGU-24

Ambiguous genitalia in the neonate: A case based review of imaging findings

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Purpose: To review the role of radiology in evaluating neonates with ambiguous genitalia.
Materials and methods: We present 4 cases evaluated by the department of Pediatric Radiology with the finding of ambiguous genitalia. These cases were worked up by utilization of various imaging modalities in our department, including ultrasound, fluoroscopy studies and MRI. Correlation with laboratory findings and when available, surgery and pathology findings would be discussed, along with review of the relevant literature.
Results: The cases we encountered included a case of a female with congenital adrenal hyperplasia due to 21-hydroxylase deficiency, a case of a male with 5-alpha-reductase deficiency, a 46XX true hermaphrodite, and a case of clitoromegaly possibly due to transiently elevated maternal androgens of undetermined etiology.
Conclusion: Determining the etiology of ambiguous genitalia involves a multi-disciplinary approach including pediatric radiology, endocrinology, surgery and pathology utilizing physical examinations, chromosomal analysis, endocrine screening, serum

chemistries, ultrasound, fluoroscopy, and possibly CT and MRI. Diagnostic protocol may then expand to more invasive exploration with laparotomy/laparoscopy and gonadal biopsy. Using our representative cases as a benchmark, we present a standard rubric for radiologic evaluation of ambiguous genitalia.

PGU-25

A multi-modality pictorial review of pelvic masses in young females

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Purpose: To review the imaging spectrum of pelvic masses seen in young females.
Materials and methods: A retrospective review of our imaging database was performed to identify studies obtained in young females presenting with pelvic pain or fullness.
Results: Multiple pelvic masses were elucidated primarily by ultrasound, with cross-sectional imaging included where clinically necessary. Ovarian masses include: torsed ovaries, dermoids, hemorrhagic cysts, tubo-ovarian abscesses, and herniation of an ovary into the ipsilateral inguinal canal. Uterine masses include: hydrometrocolpos and mullerian duct anomalies. In addition, pelvic inflammatory disease and rhabdomyosarcoma were seen. Surgical correlation was included where available.
Conclusion: Pelvic masses are relatively common entities in young females. While sonography remains the preferred method to initially characterize pelvic masses, cross-sectional imaging can be utilized to further delineate otherwise confusing disease processes.

PGU-26

Adnexal pathology in the pediatric female pelvis

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Purpose: 1) Review appearance of the normal female pelvis. 2) Illustrate the range of adnexal lesions in pre- and post-pubertal girls (ovarian and paraovarian cysts, torsion, tubo-ovarian abscess, and neoplasms). 3) Discuss imaging features and vascular flow patterns that help differentiate surgical from nonsurgical and malignant from benign lesions.
Materials and methods: 1) Overview and epidemiology of ovarian pathology in children and adolescents. 2) Review of the normal parameters of the pediatric female pelvis. 3) Visual presentation of the range of adnexal lesions in the pediatric population.
Results:
1) Review of distinguishers applied to the range of adnexal pathologies.
2) Discussion of the clinical questions brought to the imager when presented with a patient with pelvic pain or mass.
Conclusion:
1) Ovarian pathology should be considered in girls with abdominal pain.
2) Ultrasound is ideal for initial imaging of the female pelvis.
3) CT and MRI, with benefit of contrast enhancement, provide excellent characterization of adnexal lesions and help excluded mimickers of adnexal pathology.
4) Certain imaging features are important in distinguishing benign from malignant adnexal lesions.
5) Accurate imaging characterization of adnexal lesions is important for appropriate surgical decision-making and planning.

PGU-27

Precocious atrophy or multicystic dysplastic kidney (MDK)—a case report

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Background: MDK appears sonographically as echo—free areas of cysts of varying size and number, of which the largest cyst has a noncentral location, scattered throughout the renal parenchyma. The kidneys may be mildly or severely enlarged, or reduced in size, when the diagnosis is formed. MDK can be bilateral (incompatible with life), unilateral or limited to a localizated portion of a kidney. The more frequent type is unilateral. The male to female ratio is 2:1 in unilateral MDK. The more common form of presentaton in a newborn is a severely enlarged kidney, being the second cause of palpable abdominal mass in a newborn; the first is hydronephrosis. In our experience, according to world literature, it becomes progressively smaller after birth, reaching until complete atrophy. In most cases, in a child around 2 to 3 years old, MDK and normal kidneys are similar in size and then MDK become smaller and normal kidneys increase in size, because of the compensatory function. The velocity of evaluation to atrophy depends on the vessels supply.
Materials and methods: We present a case of very precocious atrophy, at the beginning of the prenatal period. A diagnosis was formed on the fetus around 29º week of gestation when the sizes of the kidneys were: Right (normal): 3.7×2.2×1.9 cm; Left (MDK): 4.4×2.8×2.1 cm. In 32º week: RK: 3.6×2.2×2.1 cm; LK: 5.9×2.8×2.7 cm; in 36º: RK: 4.4×2.2×2.4 cm, LK: 3.8×2.4×2.1 cm and in 38º week: RK: 4.7×2.3×2.7 cm; LK: 2.7×2.3×1.9 cm. In the neonatal period: RK: 5.1×2.7×3.1 cm; LK:2.2×1.6×1.1 cm; with 4 months old: RK: 6.0×2.9×2.8 cm, LK: 1.4×0.9×1.0 cm and when the child was 1 year old, the left kidney were not visible and the RK size was: 6.8×3.2×3.1 cm. The colour Doppler of renal artery show normal flow in the right side and undetectable on the left, even in the first fetus evaluation which explains the precocious atrophy.

PGU-28

Ultrasonography of the pediatric scrotum: An emphasis on the T's—Torsion, Trauma and Tumors

Edward Sung, Bindu N Setty, Ilse Castro-Aragon
Boston Medical Center, Boston (United States)

Ultrasonography is the imaging modality of choice for diagnosing scrotal disorders. This is due to the excellent anatomic detail it offers, as well as the relative ease and speed of acquiring images. The approach to scrotal imaging in the pediatric population is unique and more challenging given the greater anatomic variance with development, disease spectra and reduced cooperativeness of patients. Knowledge of the common pathologic entities and their variable sonographic appearances and clinical presentations are necessary for accurate interpretation. This educational poster reviews techniques suited to image the pediatric population, normal anatomy of the pediatric scrotum, and different sonographic appearances of various pediatric scrotal disorders. Em-

phasis will be placed on entities such as torsion of the testicle and appendages, trauma, and tumors. Other processes such as infection, infarcts especially in patients with sickle cell, undescended testes, adrenal rests, microcalcifications and idiopathic scrotal edema will also be discussed.

PGU-29

Testicular appendageal torsion—a sonographic panorama
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The most important role of ultrasound in the evaluation of the acute scrotum in children is to rule out testicular torsion. Once this has been ruled out, other causes of an acute scrotum must be sought. Testicular appendageal torsion is the leading cause of acute scrotum in children. The appendix testis and the appendix epididymis are identified based on their spatial relation to the testis and epididymis on ultrasound. Knowledge of the clinical and radiologic appearances of these entities is important to make the correct diagnosis. Careful scanning of the epididymal head and upper pole of the testicle is necessary since the findings are often subtle and easily confused with other entities such as epididymitis, orchitis, or complex hydroceles. The appearances of the torsed appendage also vary depending on the timing of the exam in relation to the occurrence of the torsion. Color doppler examination is often very useful in further characterization. In this exhibit, we will illustrate a case series of appendigeal torsions highlighting their different appearances and associated complications on ultrasound. We will also have a brief review of the literature, and discuss technical pearls of scotal ultrasonography.

PGU-30

Pictorial essay of performing VCUGs
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Purpose: This is an educational poster designed for senior and junior radiologists involved in teaching trainees; it will provide them with a structured design in how to describe the various maneuvers and images required from VCUG studies. For trainees, this will teach this important procedure in an easy to remember manner. Another aim will be to create easy to remember visual cues with a mannequin in various positions side by side with the corresponding fluoroscopic image.
Materials and methods: The structure of the poster will have multiple headings as follows:
Anatomy,
Common reasons for this type of exam,
The Fluoroscopic Study Room Safety
Step 1-Catherization and bladder volume
Step 2-Early filling
Step 3-The Kidneys
Step 4-Voiding
Tip and Tricks on getting the most out of the study by avoiding pitfalls,
Coning and positioning,
To obtain oblique views or not Grading of reflux
What the clinician wants to know
Conclusion: Learning how to perform VCUG studies in an easy to remember fashion by using visual cues by using a mannequin model. Provide teaching faculty a visual aid to teach this important study.

PGU-31

Pictorial essay: ultrasound—pediatric testicular mass lesions
Amelie Damphousse, Douglas Jamieson, Ashley Robinson, Claire Lloyd
BC Children's Hospital, Vancouver, Canada

This exhibit presents and reviews our experience with pediatric testicular mass lesions. A testicular mass in a post pubertal or adult patient has a very high likelihood of malignancy and is approached as such with orchiectomy being the standard management. Pre pubertal testicular mass lesions have a more optimistic outcome characterized by teratomas being largely benign and by a higher incidence of epidermoid cysts. Enucleation and testicular sparing surgery are more common as these benign lesions constitute about half the pre pubertal mass lesions. We specifically highlight our epidermoid experience, which includes an unusual follow up of an infant testicular cyst converting to a cystic solid and calcified mass lesion, surgically removed at 9 years of age. Yolk sac tumor, teratoma and seminoma further illustrate germ cell mass lesions. Interstitial/stromal tumors are illustrated and it is emphasized that the diagnosis rests largely with histology. A collection of non malignant testicular mass lesions including trauma, vascular malformation, adrenal rests, cystic dyslasia testis, leukemia and crossed ectopic testicle complete the pictorial essay.

PGU-32
Comparative anatomy of the exstrophy pelvic floor utilizing three-dimensional MRI analysis
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Purpose: Magnetic resonance imaging (MRI) was utilized to provide a model of the pelvic floor in classic bladder exstrophy (CBE), specifically focusing on the levator ani muscle complex and its pelvic interrelationships.
Materials and methods: Infants with CBE, prior to primary closure, and control patients underwent pelvic MRI. Imaging protocol included axial, coronal and sagittal T1-weighted and T2- weighted images of the pelvis without fat suppression. Contours of the levator ani muscle group were drawn in a virtual reality type system (dextroscope). This system fuses 3D stereoscopic visualization with full six degree freedom of interaction using 3D input devices, thereby providing a more natural and intuitive hand eye coordination for exploring three dimensional datasets and co-registration of intra and inter modality MR exams.
Results: There was an apparent pubic diastasis and lateral deviation of the anterior compartment in children with CBE. Additionally, the iliac wings had a more flattened orientation in the CBE child. In the axial plane, the puborectalis muscle is more obtusely shaped, forming a looser sling around the rectum and anterior compartment compared to controls. The ileococcygeus muscle forms a flatter arc on either side of the rectum in the exstrophy child in the coronal plane. In the sagittal view, the pubococcygeus muscle extends in a flatter, less bowl shaped manner than in the controls pelvic floor.
Conclusion: Advanced definition of the levator ani muscle complex utilizing 3D models illustrates the flattening of the exstrophy pelvic floor, lack of conical shape, and overall minimal anterior genitourinary organ support. This data provides a baseline for ongoing studies on the effects of osteotomy and pelvic ring closure on pelvic muscular anatomy and muscular pelvic biomechanics effecting eventual continence outcomes.

PGU-33

Pediatric extratesticular masses with rad-path correlation

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Purpose: High frequency scrotal sonography is an unrivalled technique in evaluating both solid and cystic extratesticular masses. This poster aims to show the ultrasound features of the pathology-confirmed atypical extratesticular masses encountered in a large children's hospital
Materials and methods: A 10 year retrospective chart review of solid and cystic extratesticular masses identified on pediatric scrotal sonography was performed. Inclusion criteria were age less than 18 years and pathological correlation. Commonly encountered extratesticular pathologies (defined as greater than 15 cases per annum) namely appendage torsion, epididymitis, paratesticular rhabdomyosarcomas, varicoceles and hydroceles were excluded.
Results: 24 patients fulfilled the inclusion and exclusion criteria. The pathology-proven extratesticular solid-appearing masses were adrenocortical tumor in an adrenal rest, splenogonadal fusion, adenomatoid tumor, acute lymphoblastic leukemia in the epididymis, spermatic granuloma, incarcerated omental fat and incarcerated bowel (mixed cystic-solid). The pathology-proven cystic masses were vascular malformations (lymphatic, veno-lymphatic and arterio-venous), Fournier's gangrene, perforated appendicitis, and pseudocyst along the spermatic cord.
Conclusion: While these extratesticular pathologies are encountered relatively uncommonly, recognition of their distinguishing manifestations enables appropriate management and interventions.

PGU-34

Sclerosing encapsulating peritonitis secondary to peritoneal dialysis in children

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Background: Peritoneal Dialysis (PD) is now a standard therapeutic modality of end-stage renal disease (ESRD). Sclerosing encapsulating peritonitis (SEP) is a rare and serious long-term complication of PD with high morbidity and mortality rates and the inability to continue this renal replacement therapy. SEP is a clinical entity with symptoms of persistent, intermittent or recurrent bowel obstruction with gross thickening of the peritoneum enclosing the small intestine.
Purpose: The present study aimed to report the imaging findings (abdominal radiograph, US and CT scan) of 5 cases of SEP.
Materials and methods: Among 80 patients receiving PD, from November 1994 to March 2009, 5 cases of SEP were diagnosed (6,25%). All of them were transferred to haemodialysis and 3 patients died. The aetiology of ESRD was: 3 cases of haemolytic uremic syndrome, one cystic renal disease of unknown origin and one cystinosis. The most important factors contributing to the development of SEP were long term on PD, ultrafiltration failure, need of high dialysis solution glucose concentrations and refractory peritonitis.
Results: Radiological findings visualized on abdominal films included scattered calcifications in the bowel wall with dilated loops of proximal small bowel in 4 out of 5 patients. One patient showed no abnormalities in imaging studies. US and CT scans showed thickening of peritoneum in 3 cases. Typical histological features were found in 3, including the case with normal imaging.
Conclusion: SEP is a severe PD complication. Radiological findings include encapsulating peritoneal thickening, small bowel obstruction signs and extensive peritoneal calcifications.

PGU-35

Ureteroceles in pediatric patients: management controversies

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Hospital Interzonal Dr. Jose Penna, Bahia Blanca (Argentina)

Introduction: Ureteroceles are cystic dilatations of the terminal portion of the ureter. The broad-spectrum of the clinical and radiological manifestations make diagnosis and treatment a real challenge. Historically they were diagnosed by their complications and treated surgically. Currently prenatal diagnosis allows us to know the natural history and identify a select group of patients that could be managed conservatively.
Purpose: To analyze the clinical manifestations and outcome of pediatric patients with ureteroceles.
Materials and methods: The charts of 32 patients with a diagnosis of ureteroceles assisted from1993–2010 were retrospectively reviewed. Pre or postnatal diagnosis, anatomical variants, methods of study, sex, complicatios,treatment and outcome were determined. We compared ureteroceles in single system (SS) and duplex system (DS). Fisher's test was applied.
Results: Nineteen (60%) were diagnosed by prenatal ultrasound and the other 13: 8 (62%) by urinary tract infection and 5 incidentally. Twenty-nine were unilateral, 17 DS and 12 SS and 3 bilateral were small ureteroceles in SS. Ultrasound was the main method of diagnosis and follow-up. Ten of the 15 patients with SS were boys vs. 7/17 with DS (p=0, 13). Mean follow-up time was 27 month (r: 2–134 m) in both groups. Eleven of the SS (73%) were treated conservatively (antibiotic prophylaxis and ultrasound follow-up), total involution of the hydronephrosis and ureterocele was observed in 4 and 2 other patients showed involution of the hydronephrosis. Seven patients with DS were managed conservatively, in 3 of them hydronephrosis and ureterocele involuted (p=0,06). Of those resolved surgically, 9 of 14 had recurrent urinary tract infections, 3 vesicoureteral reflux of high grade and 6 abnormal renal scintigraphy.
Conclusion: Ureteroceles in SU predominated in males and had better prognosis, with total involution in approximately in the 50% of patients. High-grade reflux, recurrent urinary tract infections and signs of ureter or bladder outlet obstruction would be surgical indications.

PGU-36

Cyclic voiding cystourethrography: How many cycles? Preliminary report

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Introduction: The voiding cystourethrography (VCUG) is a specialized radiological procedure, invasive, with a considerable dose of radiation and with difficulties in its implementation. In spite of being one of the most commonly used fluoroscopic examinations in children, indicated for the detection of vesicoureteral reflux (VUR) and the study of the lower urinary tract, there are controversies about its technique. In everyday practice we observe personal

adaptations according to the operator's experience. One of the points of debate is the number of voiding to take. Our original protocol dates from 1987 and includes three voiding cycles, the first two with catheter. This protocol emphasises the need to be extensive.
Purpose: To determine if the diagnosis of the lower urinary tract pathology changes by adding the second and/or the third cycle voiding.
Materials and methods: The results of 63 VCUG performed between May–July of 2010 were analized. The VCUG were practiced by medical pediatric radiologist or a fellow in pediatric radiology. Twenty seven patients were males and 36 females, mean age 11.5 month (r:2–72 m).Fifty-eight were indicated by urinary tract infection, 3 by urinary tract infection and prenatal hydronephrosis and 2 by prenatal hydronephrosis. The numbers of voiding cycles and the diagnosis during the 1st, 2nd and 3rd cycle voiding were determined. The VUR was graded according to the International Reflux Study Comittee's classification.
Results: Eighteen patients (28%) showed reflux, bliteral in 12. Among 30 renal units with reflux, 5 were grade IV-V, 6 III and 19 grade I and II. All became apparent during the 1st cycle void.
Conclusion: In our group the diagnosis, after having an adequate filling of the bladder and obtained a complete voiding, did not change with a 2nd and 3rd cycle void. Since the literature reports an increase of 20% in the detection of VUR with a second cycle void, a larger sample should be evaluated before chaging the protocol definitively.

PGU-37

Acquired polycystic kidneys in neuroblastoma survivors

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Polycystic kidney disease [PKD] is a common cause of chronic kidney disease in childhood. PKD can be classified in two main groups—inherited and acquired. Inherited causes of PKD include autosomal dominant polycystic kidney diseases PKD1 and PKD2, tuberous sclerosis, and other less common syndromes. Acquired PKD occurs in patients on chronic hemo- or peritoneal dialysis, and has also been reported in children after liver transplantation. With neuroblastoma, acute renal failure can occur, usually as a result of a thrombotic microangiopathy associated with bone marrow transplantation. In addition, end-stage renal disease has been reported in long-term survivors of neuroblastoma although the appearance of PKD in these patients has not been previously reported. This poster exhibit describes and illustrates the first case series of five long-term survivors of neuroblastoma in whom the imaging features of polycystic kidney disease occurred. None of the patients had a family history of PKD or had previously undergone dialysis. Three patients progressed to end-stage kidney disease.

PGU-38

Accuracy and pitfalls of MRI and US in the diagnosis of mullerian anomalies in children

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Purpose: The purpose of this study was to evaluate the accuracy and pitfalls of ultrasound and MRI in the evaluation of MA using the American Fertility Society (AFS) classification.
Materials and methods: A retrospective review was performed of patients with mullerian anomalies who had undergone an MRI, US or both. The radiological findings were correlated to surgical pathology.
Results: 38 female patients with MA who underwent a dedicated pelvic MRI were included in our study. 31/38 (81.6%) had a dedicated pelvic ultrasound. 26/38 (68.4%) underwent subsequent surgical intervention and confirmation of diagnosis. The remaining cases did not warrant surgery. Ultrasound findings correlated with MRI findings in only 51.5% of cases, and with surgical findings in 54.5% of cases. Missed ultrasound diagnoses included two AFS I (1 vaginal and 1 cervical atresia), seven AFS III (didelphys), one AFS VI (arcuate). 9/10 missed diagnoses had imaging only with curved low frequency transducers without any linear high resolution imaging. 3/10 misses had prepubertal morphology of the internal pelvic organs, resulting in difficult visualization of the endometrium. MRI findings correlated with surgical findings in 92.3% (24/26) of cases. Discordant MRI diagnoses included cervical duplication, isolated cervical atresia, and a rudimentary uterine horn in didelphys. However, there was inadequate visualization at surgery to render a precise diagnosis in these cases, and the confidence of MRI diagnosis was considered superior to surgery in these discordant cases. MR sequences that contributed most to the diagnosis included T1, T2, and high resolution single shot FSE T2. Gadolinium enhanced sequences were not helpful for uterovaginal morphology, but provided delineation of associated adnexal pathology like retrograde menstruation, hydrosalpinx and tuboovarian masses.
Conclusion: MRI is the preferred imaging modality for identifying mullerian anomalies in children, and is the only study needed for therapeutic decision making. Ultrasound is an excellent screening modality, but is prone to errors related to suboptimal technique and prepubertal morphology of the internal pelvic organs.

PGU-39

Pelvic magnetic resonance imaging (MRI) of patients with Mayer Rokitansky Kuster Hauser syndrome (MRKHS) provides accurate definition of gynecologic anatomy

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Purpose: Available data suggest that imaging does not accurately define gynecologic anatomy in patients with the spectrum of vaginal and uterine agenesis, termed MRKHS. We aim to systematically analyze MRI images and correlate these data with laparoscopic findings to determine the degree of concordance.
Materials and methods: Girls who underwent both pelvic MRI for a suspected diagnosis of MRKHS and subsequent laparoscopy were identified. A blinded pediatric radiologist retrospectively analyzed pelvic MRI images for the presence or absence of vaginal and uterine structures. In addition, the following characteristics were assessed: ovarian number and position, ovarian location within the pelvis and with respect to uterine tissue, evidence for endometrial differentiation, evidence for endometriosis, location and number of kidneys. Subsequent to MRI analysis, laparoscopy and pathology reports were reviewed.
Results: 86 patients had a pelvic MRI during an 8 year period in a tertiary pediatric hospital where the report made reference to MRKHS and 82/86 met criteria for MRKHS. Of these, 9 have had laparoscopy, at a median age of 16.1 years, with an average

period of 80 days between MRI and surgery. On MRI, 8/9 had vaginal agenesis, 9/9 had absence of a normal midline uterus, 9/9 had bilateral, rudimentary hemiuteri in direct continuity with the ipsilateral ovary, 8/18 hemiuteri had evidence for endometrial differentiation, 5/9 patients had free pelvic fluid, but no direct imaging evidence for endometriosis, 8/9 had two orthotopic kidneys, 1/9 had fused pelvic kidneys. Laparoscopic findings were identical in all, with one exception: 8/9 had endometrial implants at surgery.
Conclusion: In experienced hands, there is a high degree of concordance between gynecologic anatomy on pelvic MRI and findings on direct laparoscopic inspection in patients with MRKHS. It is hoped that knowledge of patterns of malformation in this condition may contribute to the care of patients with this life-changing diagnosis.

PIR-1

Mid-aortic syndrome: a case report

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Mid-aortic syndrome (MAS) is an acquired or developmental vascular anomaly that can involve the midthoracic and/or abdominal segments of the aorta and is accompanied by a narrowing of major visceral and renal arteries (RA), which can result in secondary artery hypertension (AH).
A 3 year-old girl was admitted to the hospital because of proteinuria, hemoglobinuria and a high blood pressure (>200/100 mmHg). An abdominal bruit was heard. Ultrasonographicaly the kidneys looked normal. Tardus parvus wave in both kidneys and narrowed aorta at the level of visceral and RA were seen by Doppler examination. Digital subtraction angiography showed typical MAS changes of abdominal aorta with visceral and RA involvement. In order to exclude vasculitis and to estimate the extent of total body vascular changes, MRI and MRA of the whole body were done. Isolated abdominal aorta pathology was confirmed. Laboratory parameters for vasculitis were normal, therefore the diagnosis of idiopathic MAS was most probable. AH remained refractory to the antihypertensive drugs, therefore the percutaneus transluminal angioplasty (PTA) was performed, however the stenoses of the aorta and left RA were resistant to dilatation due to the elastic recoil of narrowed parts and only resulted in a minimal angiographic improvement. The right RA was occluded. Due to unsuccessful PTA and sustained AH the subdiafragmal aorto-aortic bypass with resection and neoimplantation of both RA was done. After surgery the girl developed multiorgan failure, due to a massive bleeding from the right RA anastomosis. Over some time the girl recover completely. Her blood pressure is currently under control with only one antihypertensive drug. MRA showed patent aorto-aortic bypass and left RA, while right RA is partially narrowed but passable. MAS is an uncommon, but an important cause of malignant AH in children. The diagnosis is established by using different imaging modalities. Due to a great variability in the extent of vessels involvement and pathophysiology, management needs to be individualized.

PIR-2

Ultrasound guided insertion of pigtail catheter in the management of empyema thoracis

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Purpose: To describe the single centre experience and results of radiologically inserted pigtail catheter under ultrasound guidance for the management of empyema thoracis in children.
Materials and methods: A 9 year retrospective analysis of the radiologically inserted pigtail catheter between January 1st 2001 and December 31st 2009 identfied 158 patients (mean age 6.4, range 0.7–15.9 years).
Results: 147 had a single drain inserted, while 11 required a second drain. 114 patients had a drain inserted under general anaesthetic and 44 under sedation. There were no major complications to drain insertion—2 patients had minor complication of very blood stained aspirates. Eleven patients required a second drain insertion—nearly all for inadequate drainage, while 1 child with learning difficulties had a second drain after the first was removed. The number of drains required per child decreased significantly with experience over time, with only 2 patients requiring more than 1 drain in the last 3 years (Chi square $p=0.001$). Mean (SD) length of hospitalisation was 7.8 (3.6) days, while mean (SD) length of drain insertion was 4.6 (1.6) days. Seven patients were hospitalised for greater than 14 days—the majority had complicating factors—Sanfilippo syndrome, liver abscess, septic arthritis or bronchiectasis. Two of these patients required a second drain. Three patients had a surgical decortication but there have been none required since 2003. Chest drain removal was uncomplicated in all but 1 child, who had a clinically insignificant pneumothorax.
Conclusion: Chest drain insertion under ultrasound guidance is safe and well tolerated. With experience the need for a second drain insertion or surgical decortication decreased significantly.

PIR-3

Common bile duct injury after blunt abdominal trauma in children: diagnosis and intervention

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Purpose: Common bile duct (CBD) injury after blunt abdominal trauma is uncommon. This exhibit will illustrate our recent experience of two pediatric patients with CBD injury focusing on imaging findings and intervention.
Materials and methods: Case 1 is a 12-year old boy who fell and hit his abdomen against the horizontal bar when he was standing on the bar. Abdominal ultrasound followed by contrast enhanced CT showed swelling and decreased attenuation of the pancreatic head. A small amount of retroperitoneal effusion was recognized surrounding the pancreatic head. Gradual development of biliary tract dilatation led the patient to have percutaneous transhepatic biliary drainage (PTBD) at 3 weeks from trauma. PTBD was effective and subsequently balloon dilatation for the stenotic portion of CBD was performed with 5mm balloon catheter. Tube stent was left in place through the stenosis with 12F for 8 weeks followed by 8F for 6 weeks. The patient has been symtom-free for 1 year since the removal of the tube. Case 2 is a 7-year old boy who crushed his abdomen under the bar of a futsal goal. Contrast enhanced CT of the abdomen performed at local hospital revealed swelling and decreased attenuation of the pancreatic head in addition to the hepatic laceration involving caudate lobe and medial segment of the left lobe of the liver. Periportal low attenuation was recognized at the hepatic hilum. A small amount of retroperitoneal effusion was recognized surrounding the pancreatic head. Follow up

CT performed at 2 weeks from the trauma showed biliary dilatation and bile cyst at the hepatic hilum. Because of biliary dilatation, the patient was referred to our facility for further treatment. PTBD was performed and was effective to relieve jaundice. Contrast study from a drainage catheter showed complete obstruction at CBD. The patient was operated upon for hepatojejunostomy. The patient has been symtom-free for 9 months since surgery.
Conclusion: Although early recognition of CBD injury is often difficult, evidence of pancreatic head injury may suggest the future development of biliary obstruction. In case of biliary obstruction, PTBD is a promising therapeutic adjunct.

PIR-4

Venous malformations in infants and children

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Purpose: Venous malformations are the most frequent type of vascular malformation seen in children attending specialist clinics. Despite this, their diagnosis remains confusing to many physicians and some children continue to receive inappropriate treatments. The variable clinical phenotypes, their natural history, the long-term morbidity and mortality, imaging characteristics (emphasizing particularly the role of non-ionising diagnostic imaging) and treatment options including interventional radiology are presented.
Materials and methods: A review of patients from our large Vascular Anomalies Clinic and Interventional Radiology database was undertaken.
Results: Illustrative cases throughout all paediatric age groups will be presented to describe the above features, demonstrating the conjoint role of diagnostic and interventional radiology.
Conclusion: This presentation describing salient features of venous malformations illustrates how the radiologist armed with knowledge of such lesions is essential to the multi-professional team caring for such children. Improvements in understanding these lesions can expedite appropriate treatment when required, prevent inappropriate treatments being undertaken and in doing so improve the standard of patient care.

PIR-5

A case of thrombolysis and thrombectomy with TIPS for treatment of extensive portal and mesenteric venous thrombosis

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Purpose: The use of chemical and/or mechanical thrombolysis is not common in pediatrics. In addition to the risk of bleeding, another obstacle is the lack of research and recommendations for the use of thrombolysis in children. There are, however, instances when thrombolysis is necessary and potentially life-saving, despite the associated risks. Our objective is to describe a case of thrombolysis and thrombectomy handled by our Interventional Radiology department for the treatment of extensive portal and mesenteric venous thrombosis
Materials and methods: We reviewed the medical records and imaging studies for this patient and have performed a literature review related to thrombolysis in pediatrics, with special attention to portal and mesenteric venous thrombosis.
Results: A 17-year-old girl was found to have portal and mesenteric vein thrombosis. She was diagnosed with antiphospholipid antibody syndrome and treated with enoxaparin, however her extensive portal and mesenteric venous thrombosis progressed despite anticoagulation. Over four days, she was treated with mechanical thrombolysis, chemical thrombolysis, including overnight t-PA infusion, thrombectomy, balloon angioplasty, and placement of a transjugular portosystemic shunt to improve venous outflow.
Conclusion: There is no standard therapy for treatment of extensive portal and mesenteric venous thrombosis. We describe one case of extensive thrombolysis and thrombectomy, however further studies are needed to evaluate appropriate dosage, duration, and timing of thrombolysis treatment. Descriptions of thrombectomy in pediatric cases other than following liver transplantation are also lacking. In addition, few prior reports describe the use of TIPS to improve the results of thrombolysis and thrombectomy in children. Though further studies are necessary, for this life-threatening case, we used chemical and mechanical thrombolysis as well as thrombectomy, angioplasty, and placement of a TIPS to treat the venous obstruction caused by this patient's antiphospholipid antibody syndrome.

PIR-6

Percutaneous drainage of intraabdominal abscess in children with perforated appendicitis: safety, efficacy, and prediction of outcome

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Purpose: The aim of this study is to retrospectively determine the safety and efficacy of percutaneous drainage of intraabdominal abscess in children with perforated appendicitis. Secondary goals are to identify any imaging findings or clinical variables with predictive value for technical or clinical outcomes.
Materials and methods: All percutaneous drainage procedures performed for periappendiceal abscess from April, 2003 to February, 2010 were identified within departmental procedure logs. Patients were assigned to one of three risk categories based on imaging features at presentation. Medical records then were reviewed to determine technical and clinical outcomes, including any procedural complications. Technical success was defined as abscess drainage without complication or recurrence. Clinical success was defined as thirty-day postponement of appendectomy. Finally, logistic regression was used to analyze demographic, radiologic, and procedural variables with regard to clinical and technical outcomes.
Results: Thirty two patients underwent percutaneous drainage for primary management of periappendiceal abscess during the study period. Our clinical success rate was 100%, with all patients undergoing delayed elective appendectomy. Our technical success rate was 87.5%, in that two patients required repeat drainage, one patient developed a recurrent abscess which was managed conservatively, and one patient developed an enterocutaneous fistula which may have been a consequence of his procedure. Patients with ill-defined abscesses extending beyond the immediate periappendiceal area had a statistically significant increase in the probability of technical failure. Other candidate variables were not reliable predictors of technical outcome.
Conclusion: Percutaneous drainage is a safe and effective means of managing periappendiceal abscess in children, with high rates of clinical and technical success. Pre-procedure imaging may be useful for identifying patients at increased risk for suboptimal technical outcomes.

PIR-7

CT angiography in acute bleeding in children: preliminary experience

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Purpose: Acute bleeding is a medical emergency with a significant mortality. Its traditional initial approach has been conventional angiography; however this technique has its own morbidity in pediatric patients. Computed tomography angiography (CTA) has shown to be a useful tool in the diagnosis of acute bleeding in adults, mainly in the gastrointestinal tract.
Materials and methods: From January 2010 till November 2010, we retrospectively reviewed patients in which interventional radiology was consulted due to history of acute bleeding from different sources and that after a multidisciplinary discussion, a CTA was performed to define the specific source of bleeding and to decide the management.
Results: We collected a total of 3 patients. All of them were hemodinamically stable and the CTA was performed uneventfully. The cases were: a teenager with a previously resected pelvic sarcoma in whom the CTA demonstrated a pseudoaneurysm of the surgical bed which was successfully treated from an endovascular approach; a newborn with lower GI bleed in whom the CTA demonstrated a large vascular anomaly of the distal small bowel which was treated surgically and that transpired to be a small bowel Hemangioma; and a case of a patient with diffuse PTLD of the small bowel in which the CTA showed an arterial bleed from an ostomy site with was successfully managed endoscopically. In all the patients the CTA provided very valuable information to direct the treatment.
Conclusion: In our recent experience, CTA is a valuable tool in pediatric patients with acute bleeding to define the site of bleeding and to decide the best treatment approach. Conventional angiography should be the initial diagnostic/therapeutic approach in hemodynamically unstable patients.

PIR-8

Percutaneous sclerotherapy in neonatal and infant head and neck lymphatic malformations: a single-center experience

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Purpose: To evaluate the clinical outcomes of percutaneous sclerotherapy for congenital head and neck lymphatic malformations at our institution.
Materials and methods: Over a 7 year period 16 children (10 m, 6f), mean age 5 months (5 days–13 months), underwent 48 sclerotherapy procedures for congenital head and neck malformations. The imaging and clinical records were reviewed for each patient. 9/16 had macrocystic disease, 7/16 had microcystic disease. Imaging response was categorized by volume reductions of 0–25%, 25–50%, 50–75% or 75%–100%. A concentration of 10 mg/ml Doxycycline was used routinely via catheter in 3 instillations with a dose range of 50–500 mg per session as per our standard protocol in 16/16 patients. In more recent patients, systemic doxycycline levels were obtained after instillations. Additional treatments included direct injection doxycycline (8/16), instillation of absolute ethanol (6/16) or sodium tetradecyl sulfate (4/16) or a combination of these methods.
Results: 15/16 children had adequate follow up imaging. ≥76% imaging improvement was noted in 9/15. Of these 7/9 had macrocystic disease. 5/15 had 51%–75% resolution of which 4/5 were mixed. 1/15 children had 6/48 major peri-procedural complications: hemolytic anemia in 2 infants, hypoglycemic and metabolic acidosis in 3 neonates aged 7–10 days and transient hypotension during absolute alcohol instillation in one neonate. Neonates prone to these systemic complications had doxycycline doses of greater than 250 mg and resulted in serum levels of >5 μg/ml but as high as 21 μg/ml. Delayed neural complications occurred in 6/48 procedures; Horner's syndromes in 4/48 procedures, transient left lip weakness in 1/48 procedures and transient left hemidiaphragm paralysis in 1/48 procedures.
Conclusion: Our experience with catheter directed doxycycline sclerotherapy provides excellent results for large macrocystic head and neck lymphatic malformations. Microcystic and mixed lesions continue to provide a therapeutic challenge.

PMI-1

Postmortem fetal imaging: a pictorial essay

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Purpose: The purpose of this poster is to familiarize the radiologist with the role that postmortem fetal imaging can play as an adjunct to autopsy. He/She will see a wide range of cases in which plain radiography, CT and MRI played complementary roles in helping the pathologist arrive at the diagnosis using conventional, non-research equipment. Optimal imaging techniques on 64-slice CT and 1.5T MRI will be discussed.
Materials and methods: Fetal autopsy rates have been declining worldwide and more emphasis has been placed on imaging techniques to help provide pathological information that may not have been demonstrated antenatally. Plain radiography is still unsurpassed in providing a panoramic evaluation of the skeletal system. Recently multi-slice CT has added an additional dimension to the imaging of the skeletal system by using thin cross-sectional slices, MIP and 3D reconstructions allowing depiction in fine detail. MRI provides excellent soft-tissue depiction, and has been shown to be as good as autopsy for identifying gross abnormalities of the CNS, muscles and heart. Therefore MRI is playing an increasingly important role in postmortem imaging. This poster will illustrate cases seen in our department in the last decade.
Results: A wide variety of cases such as osteogenesis imperfecta, thanatophoric dwarfism, absent cervical vertabra, trisomy 13 with semi-lobar holoprosencephaly, absence of corpus callosum, ectrodactyly of the hand, dysplastic renal disease and others will be illustrated. Correlation with autopsy images will be shown.
Conclusion: Imaging will play an increasingly important role in postmortem fetal evaluation. This poster will show how this can be achieved in a radiological department using conventional, non-research equipment.

PMI-2

Sedation for paediatric MR: what is the evidence for the alternatives?

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Purpose: MR is now the imaging modality of choice in many paediatric diseases, such as neurological and musculoskeletal imaging, and is becoming more widely used for thoracic and

abdominal imaging. In order to achieve diagnostic images during MRI examinations, small children need to lie still to avoid movement artefact. A variety of methods have been developed to overcome this hurdle with young children, and the conventional approach is to use patient sedation or anaesthesia, but this is not without risk and expense. However, many other techniques are available for preparing children for MRI, which have not been fully evaluated.
Materials and methods: Here, we review the evidence to justify the use of sedation and anaesthesia, including the current advantages and disadvantages. We evaluate the alternatives, which include neonatal comforting techniques (non-nutritive sucking, sucrose, swaddling, feeding), sleep manipulation (sleep deprivation, melatonin), and appropriate adaptation of the physical environment (play therapy, mock scanners and parental factors). We summarise the evidence for their use according to an established hierarchy. Lastly, we discuss several factors which will influence the choice of imaging preparation, including patient factors (age and airway management), imaging factors (body part, duration of imaging) and service provision.
Conclusion: The choice of approach to paediatric MR imaging is multi-factorial, with limited scientific evidence for many of the current approaches. These considerations may enable others to image children using MRI under different circumstances.

PMI-3

The paranasal sinuses in kids

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Background: The air-filled spaces of the facial and skull bones are dynamic and evolving structures in growing kids. A number of normal variations have been mentioned in the literature, and these are well demonstrated with imaging. The importance of these normal variants increases with more endoscopic surgery being performed in kids and increased imaging in children. The paediatric paranasal sinuses are affected by a wide spectrum of conditions including congenital abnormalities, inflammatory, traumatic and neoplastic diseases.
Purpose: There is a lack of current literature on this subject. The purpose of this review is to highlight some salient features regarding the anatomy, development of the sinuses in children, and also some of the more common normal anatomical variations encountered. A spectrum of pathologies affecting the paranasal sinuses in the paediatric population will also be covered. Finally, mention will also be made of suggested imaging guidelines in our vulnerable paediatric patients.
Conclusion: This is primarily a pictorial review with the emphasis on imaging features and findings. Cross sectional imaging provides exceptional detail of the anatomy and variations seen in the paranasal sinuses. It is also an essential tool to assess disease extent and assists in determining diagnoses and planning surgery. The diagnostic algorithm for sinus disease continues to evolve along with the advances in imaging modalities

PMI-4

Incidental abnormalities identified on MRI of the spine in Children

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Purpose: We aim to present a pictorial review of incidental findings on MRI of the spine in children. Magnetic resonance imaging (MRI) is the modality of choice for the investigation of disorders of the spine. The use of spinal MRI imaging has increased over the last few years, with improvements in hardware such as magnets, coils as well as imaging techniques. With these improvements come the additional responsibilities on the radiologist's part of accurately reporting these examinations, including the identification of abnormalities on the scans that are not related to the spine and central nervous system. It is important to identify these incidental abnormalities as some of them may potentially have significant clinical implications requiring further imaging, clinical or biochemical evaluation. There is also benefit in picking up these abnormalities early to prevent adverse outcomes in the future.
Materials and methods: 700 paediatric MRI examinations of the spine performed at our tertiary level paediatric hospital were retrospectively reviewed for incidental abnormalities unrelated to the spine and central nervous system.
Results: This poster will illustrate the various incidental abnormalities identified on paediatric MRI of the spine. The cases will be presented under the following categories based on anatomical location: head and neck, mediastinum, abdomen and pelvis. Information regarding subsequent management and outcome in these children will be provided.
Conclusion: It is important to identify and report incidental abnormalities on paediatric spine MRI scans as these may have significant clinical implications. A methodical approach in evaluation of the scan will be useful in identifying these incidental abnormalities.

PMI-5

Associated vascular anomalies syndromes: clinical and imaging evaluation

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Purpose: To become familiar with the current classification of vascular anomalies (VA). To provide a comprehensive overview of the most important associated vascular anomalies' syndromes. To illustrate clinical and imaging findings of these entities, emphasizing key imaging features and differential diagnoses.
Materials and methods: Different specialists are involved in VA management, including radiologists. Terms are confusing, especially in radiological papers. This fact may lead to an incorrect diagnosis and inappropriate treatment. Associated VA syndromes are infrequent entities (some of them extremely rare), and the radiologist, especially pediatric one, must be familiar with their broad spectrum of clinical and imaging features. Musculoskeletal findings are the most frequent features, but not the unique ones, because many organ systems may be affected. We review patients with associated VA syndromes from our database, recording VA and other associated features.
Results: In this exhibit, the most important syndromes will be discussed: Klippel-Trenaunay, Parkes-Weber, Servelle, Proteus, Cloves, blue rubber bleb nevus, Gorham, Maffucci, Bannayan-Riley-Ruvalcaba, Cobb, Rendu-Osler-Weber, Sturge-Weber syndromes and Bockenheimer's disease. Clinical data and plain radiograph, US, CT, MR and angiographic features will also be shown, highlighting which techniques are the most useful in each clinical scenario.
Conclusion: This exhibit will provide a comprehensive overview of associated VA syndromes and their clinical and imaging data.

Knowledge of the wide spectrum of manifestations of these conditions is essential for an accurate diagnosis and for adequate patient management.

PMI-6

Radiologists' perspective to paediatric sedation during MRI scan in Turkey

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Purpose: MRI is a sensitive to motion artifacts. Sedation is indispensable for children under 6 years and mentally retarded adults during MRI scanning. Our purpose is to reveal the rate of radiologists practising paediatric sedation during MRI scans in Turkey.
Materials and methods: We have prepared a questionnaire for standardization of the answers. We asked 10 detailed multiple-choice questions. We have conducted the survey face to face or by e-mail survey, fax or telephone.
Results: The 165 radiologists from 28 different cities in Turkey answered the questionnaire. 123 of 165 radiologists (74,5%) stated paediatric sedation was performed at their institution, however 42 stated there was no sedation facility at their institution (25.5%). Only 9 (7%) declared that paediatric sedation was performed by radiologists, however 77 (64%) said it was performed by anesthesiologists, 10 (8%) that it was performed by paediatricians and 27 (21%) that the sedation was carried out by a group of doctors from different specializations e.g. anesthesiology and radiology or paediatry and radiology.
Conclusion: The rate of radiologists performing paediatric sedation is relatively low in Turkey. Anesthesiology take up most of the sedation practice during MRI in the majority of hospitals. It is an indisputable fact that radiologists are specialists in MRI physics and managers of radiology departments, rendering them particularly responsible for image quality. They decide if a particular radiological examination is necessary or not for a patient in accordance with his/her well being, or they can opt for an alternative imaging method. The active presence of radiologists in MRI scan rooms is always preferable. But anesthesiologists are also experts in sedation medication and if necessary, CPR practice. For paediatric sedation during an MRI scan, the scheduling must be well-organized, and each specialist should take their part in sedation practice.

PMI-7

The painless pediatric groin mass: ultrasound spectrum of benign pathology

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Purpose: To illustrate the various benign causes of painless groin mass in infants and children and describe their sonographic findings.
Materials and methods: We retrospectively reviewed ultrasound findings in children aged 1 day to 15 years during a 5 year period (2005–2009). Bilateral inguinal canal gray scale and Doppler ultrasound examination was performed using a 7–11 MHz linear array transducer. Pathologic findings were identified in 404 children.
Results: The most common finding was undescended testis (n= 198) usually located adjacent to the internal inguinal ring. A boy with triorchidism had an undescended supernumerary testicle and 66 boys had retractile testes. Inguinal hernias (n=101) were found in both sexes but predominantly in boys, containing intestinal loops and/or omental fat. An ovary was identified in 10 girls and additionally the uterus in 1 infant. Hydrocele of the cord (cyst non-communicating or inguinoscrotal communicating) was revealed in 54 boys. Cyst of the canal of Nuck was identified in 2 girls. A cavernous hemangioma of the soft tissues was diagnosed in a female infant. Inguinal lymphadenopathy was an incidental finding in both sexes usually bilaterally (n= 36).
Conclusion: Ultrasound is a low-cost, non-invasive, ionizing radiation free diagnostic tool for the study of the inguinal region in children. The information obtained with this modality is usually sufficient to enable accurate diagnosis in most cases aiding the pediatrician or pediatric surgeon in the management of the child, avoiding unnecessary surgical exploration.

PMI-8

Benchmarking a paediatric radiology department for the 21st century

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Purpose: In late 2007, a government decision was announced to build a tertiary paediatric hospital for a city of 1.5 million to be completed within 5 years. It rapidly became apparent there was a paucity of resources, including limited literature, on staffing and equipment requirements of a dedicated paediatric radiology department. A benchmarking exercise was undertaken to determine existing equipment and staffing levels within paediatric radiology departments in Australia, North America and the United Kingdom, given their similarities in medical care if not medical systems.
Materials and methods: A facility questionnaire was developed and emailed to 16 children's hospitals in Australia, New Zealand, the United States of America, Canada and the United Kingdom, following personal communication with their radiology directors to obtain their consent to participate. Due to the short timeframe imposed by the hospital planners, the survey was intentionally kept brief to maximize response rate and minimize response time. Hospital bed and total radiology examination numbers were evaluated but clinical services were not. The responses were collated and de-identified.
Results: Of the 16 hospitals, one withdrew as equipment was integrated with an adult facility. A response rate of 67% was achieved from 10 of 15 sites. The average number of examinations per modality unit per year was: general X-ray 9,468, ultrasound 2,174, fluoroscopy 1,523, computerised tomography 3,095, magnetic resonance imaging 2,663, digital subtraction angiography 831, and cardiac angiography 558. The average number of examinations per occupation per year was: radiologist 8,802, radiology fellow 28,456, radiology registrar (resident) 19,098, radiographer (medical imaging technologist) 2,341, nurse 11,607 and administration 7,472.
Conclusion: Useful data were obtained for paediatric medical imaging equipment and staffing levels to inform planning and development for a new children's hospital, incorporated with projected growth, anticipated technological advancement and a streamlined service delivery model.

PMI-9

Chickenpox—a pictoral review of complications

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Purpose: Varicella infection is a common childhood illness from which most children make a rapid recovery but a significant minority will experience a range of complications. The aim of this study is to highlight the presentation of these complications in the acute setting and how the radiologist can assist with early diagnosis.
Materials and methods: A review of the clinical presentation, subsequent imaging, management and outcome of the cases presenting to our institution (a referral centre for paediatric infectious disease) are demonstrated to highlight the life-threatening complications.
Results: Representive high quality plain film, US, CT and MRI images have been used to promote a greater awareness of the radiological complications of childhood chickenpox. Despite adequate treatment, unfortunately some patients went on to have long term morbidity.
Conclusion: It is rare for childhood chickenpox to present with complications in an immunologically competent child. It is therefore important for radiologists to be familiar with the imaging signs of acute complications when they do occur to prevent a delay in diagnosis and treatment initiation. This will have a positive impact on the subsequent lifetime morbidity.

PMI-10

Extrapulmonary TB and the importance of developing new concepts in diagnostic imaging

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Purpose: TB is one of the most common fatal infections in the world with approximately 2 billion people infected and almost 2 million deaths a year. Extrapulmonary TB is an increasing problem accounting for more than 20% of cases. Children appear to have a higher risk of contracting extrapulmonary TB involving any organ. TB is difficult to diagnose and the standard established diagnostic tests (including indirect signs of low epidemiological specificity, symptoms, a chest radiograph and an intracutaneous tuberculin test) are often inconclusive and microbiology tests are time consuming. The purpose of this study is to highlight the necessity of using new imaging concepts and utilising different imaging modalities and to review the characteristic imaging findings of various forms of extrapulmonary TB.
Materials and methods: We reviewed the paediatric extrapulmonary TB cases in our hospital (a referral centre for paediatric infectious disease) in the last 3 years. Subsequently we evaluated the diagnostic value of different imaging modalities including US, CT and MRI and correlated these with the disease activity.
Results: From a total of 81 paediatric TB cases, 15 had extrapulmonary TB in the last 3 years in our hospital (including abdominal, musculoskeletal, lymphatic, middle ear, CNS and miliary spread). All of the patients survived after adequate treatment with some unfortunately having long term morbidity.
Conclusion: Extrapulmonary TB in children is increasing in prevalence and severity partially due to their immature immunity, social and economic dependency with adults and also from the increasing number of HIV infections. Reaching an early diagnosis is imperative to reduce childhood mortality and morbidity and improve prognosis. Our study shows the need for using new imaging concepts using different modalities (US, MRI and CT) to improve the diagnosis of extrapulmonary TB.

PMI-11

Clinical history is critical for radiological imaging

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Background: We present an illustrated case in which radiological imaging was needed to diagnose a rare complication of bone marrow biopsy. The case reinforces the importance of accurate clinical history. Bone marrow biopsy, is considered a valuable diagnostic tool in evaluating haematological disorders. Recognised complications include haemorrhage and infections. Radiology plays an important role in the diagnosis of any complications, with the modality of imaging used dependent on the individual case.
Case report: An 8 month old male presented with hepato-splenomegaly. Investigations revealed pancytopaenia with a leucoerythroblastic picture on blood film. Investigation included a liver and bone marrow biopsy. Following discharge he was re-admitted with irritability, poor feeding and a haemoglobin (Hb) of 5.6. An ultrasound scan was requested by the admitting clinical team who suspected haemorrhage post liver biopsy. They were unaware of the bone marrow biopsy and it was not mentioned on the imaging request card. Initial abdominal ultrasound scan was normal. Despite blood transfusion the Hb continued to fall. Repeat ultrasound scan 4 days later revealed a 3×3 cm collection in the pelvis. A CT scan confirmed a non enhancing mass, which was diagnosed as a haematoma. Review of the medical notes confirmed a bone marrow biopsy from the right posterior superior iliac spine. An MRI scan confirmed the haematoma and a pseudoaneurysm from the right superior gluteal artery was shown on CT angiography. The complication of haematoma and pseudoaneurysm post bone marrow biopsy is rare. Bains et al reported adverse events in 0.05% of 54890 bone marrow biopsies, the commonest being post operative haemorrhage [1]. The lack of comprehensive clinical details resulted in the initial ultrasound being dedicated to the liver and not the pelvis.
Conclusion: Knowledge of the bone marrow biopsy would have resulted in an CT scan of the abdomen/pelvis to assess for complications of both procedures. This case report reinforces that it is imperative the correct clinical details are presented prior to each investigation undertaken.

PMI-12

Gate keeping and practice management of paediatric CT: a tertiary hospital model

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Purpose: To achieve a multi-profession approach to gate keeping and to propose a best practice model in paediatric patients referred for Computed Tomography (CT) in a tertiary hospital.
Materials and methods: The process of gate keeping CT requests was reviewed within the Medical Imaging Department (MID) at a large paediatric teaching hospital in 2010. Justification of each request by a consultant paediatric radiologist was analysed. A

tailored approach to individual patient requirements prior to their CT appointment was performed by a combination of professions: receptionist, radiographer, nurses and play therapist (PT). A flow diagram demonstrating the pathway to best practice per patient was brought into practice.
Results: The number of unnecessary CT scans was reduced. The number of CT scans performed under General Anaesthetic (GA) decreased due to the involvement of PT. This is more desirable for the patient, their parents and the department financially. There are fewer instances of incorrectly prepared patients.
Conclusion: Overall workflow is more efficient by ensuring the patient's are thoroughly planned in advance rather than as each appointment arises. A departmental approach to gate keeping and practice management in paediatric CT is essential when taking into account all possible considerations. Patients received the correct CT scan for their given medical situation using the additional services of PT or anaesthetics if required.

PMI-13

Medicolegal issues shrouding digital radiographs

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Purpose: 1. To highlight the various new medico-legal concerns cropping up with digital radiography which were not present with conventional radiography. 2. To review the pre-existing legal guidelines and provisions under law, regarding acceptability of a digital image as evidence in a court of law. 3. To bring about the set of lacunae and inconsistencies in different nations' state laws and to propose universal legal guidelines. 4. To provide a set of recommendations for the radiologists in archiving the digital records to safeguard him/her against potential legal pitfalls.
Materials and methods: A comprehensive search for pre existing medico legal guidelines regarding the production, storage and transmission of a digital image and its acceptability as evidence in a court of law was conducted. Various state laws of different nations were reviewed. Pre-existing national and international guidelines and legal provisions were analyzed. A proposed set of recommendations primarily to standardize the legal provisions regarding digital radiographs the world over was suggested.
Results: There is a complete lack of standardization of different state laws regarding this issue. Standard national and international guidelines need to be laid down regarding digital archiving. Vendors and radiologists need to become aware of the various "tamper proofing" provisions in the existing software in order to bring the digital image at a par with conventional image, in terms of authenticity and reliability.
Conclusion: 1. There is a lack of universal guidelines regarding legal significance of digital radiographs.
2. Standard guidelines need to be established to define the role of digital radiographs in court of law.
3. Vendors and radiologists need to be alert about misuse of software and take precautions to prevent the same.

PMI-14

Changing from general anaesthesia to feed and wrap method in neonatal MRI, impact on the daily routines

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Background: MRI is an important diagnostic tool in neonatal imaging. The major draw back with MRI is the need for sedation in these non-cooperative patients. Sedation or general anaesthetics (GA) should be avoided when possible and is even contra-indicated in some patients. In 2005 we introduced a systematic feed-and wrap (FW)-technique using natural sleep and no sedation for MRI-examinations of infants. From 2005–2008 the infants were wrapped with elastic bands and from 2008 we started to use a VacFix bean-bag to ease the process. The aim of this retrospective study is to evaluate the FW- technique as an alternative to GA in MRI-examinations in infants.
Materials and methods: Data available on RIS were used to include all patients aged 3 months or younger who underwent an MRI-examination between 01.10.2005-present in this analyses. We assessed the number of scans performed under sedation or GA and the scans performed by using the FW-technique. The diagnostic quality of the examination was evaluated retrospectively by one paediatric radiologist based on the images and the report available on PACS and RIS. Patient complications were also recorded.
Results: Since January 2005, 137 neonates under 3 months were examined with MRI and thus included in the study. The number of patients who underwent GA decreased from 17 in 2005 to 9 in 2010. The use of FW-technique increased from 1 in 2005 to 20 in 2010. A total of 84 examinations under FW and 53 under GA were performed. No complications were recorded. We experienced an increase from 1 patient in the FW group in 2005 to 20 patients in 2009 and 2010 with a maximum of 25 in 2008, meanwhile there is a reduction in the GA group from about 17 patients in 2005 to 9 in 2010 with the lowest number in 2008, when 1 patient was in the GA group. Just 3 examinations of the FW had to be repeated, 1 patient under general anaesthesia and 2 with a new FW because of an unacceptable result.
Conclusion: The feed and wrap method is a safe alternative to general anaesthetics and facilitates MRI as the method of choice in the neonatal period.

PMI-15

Audit on the use of sedation in paediatric patients—how effective is it?

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Purpose: Magnetic Resonance Imaging has become one of the most important imaging modalities for paediatric patients. Due to the relatively long examination time and the possibility of image quality reduction by motion artefacts, effective sedation for paediatric patients is therefore essential. Our study is designed to evaluate the safety and effectiveness of sedation procedures for paediatric patients undergoing magnetic resonance imaging in our locality.
Materials and methods: 323 consecutive paediatric patients who underwent sedation for magnetic resonance imaging in a twenty-three-month study period were evaluated prospectively. The types of sedation, sedation outcome and presence of complications were recorded.
Results: 310 patients (96%) were successfully sedated. 205 of these patients (66.1%) were being successfully sedated with chloral hydrate alone. 90 patients (29%) were being successfully sedated with chloral hydrate followed by intravenous midazolam. Up to the age of 12 yrs, the rate of successful sedation with chloral hydrate alone was >50%. Failure of sedation was observed in 13 patients (4%). Younger patients had a higher rate of being successfully sedated ($p<0.05$). Complications were seen in three

patients (0.9%) after the administration of sedation agents. Two of them developed vomiting and the other developed seizure. None of the patients developed respiratory depression. There was no significant association between the dosage of sedation agents and the development of complications.
Conclusion: The use of oral chloral hydrate and intravenous midazolam as first and second line sedation agents in paediatric patients yielded a high rate of successful sedation (96%) and is safe with a low complication rate (0.9%).

PMI-16

Should children with cervical lymphadenopathy routinely have ultrasound scans?

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Purpose: Paediatric cervical lymphadenopathy is a very common condition encountered by all clinicians. Most of these lymphadenopathies are reactive and managed conservatively. The aim of this study was to question the routine practice of performing ultrasound examination of these nodes without sound clinical reasons.
Materials and methods: A retrospective analysis of 62 patients was carried out; all the patients had had an ultrasound examination for cervical lymphadenopathy. Age, gender, clinical presentation and origin of referral were assessed. The impact of ultrasound examination in the management of these patients was evaluated.
Results: 42 patients (67%) had bilateral cervical reactive lymphadenopathy. 7 patients (4.6%) had unilateral reactive lymph nodes. 12 patients (20%) had normal lymph nodes. 1 patient (0.62%) had a single necrotic lymph node. 61 patients (98.4%) were managed conservatively.
Conclusion: Almost all patients with cervical lymphadenopathy were managed conservatively and ultrasound examination did not add any useful information which changed the management in any way. We therefore recommend that the practice of routine ultrasound for cervical lymphadenopathy in childhood should not be performed unless there are other mitigating clinical reasons.

PMI-17

Pictorial essay of CT and MRI findings of pediatric head and neck infections

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Purpose: To demonstrate the imaging spectrum of head and neck infections in children and infants by means of cross-sectional imaging. To emphasize the additional value of cross-sectional imaging in detecting associated complications and underlying congenital anomalies.
Materials and methods: CT and MRI examinations of head and neck in children with infection performed in our institution during the past 3 years.
Results: Cross sectional imaging in neonates and children with head and neck infection becomes invaluable in suspected complications and in cases where sonographic results do not justify the clinical appearance of the child. The additional value of MRI in demonstrating early vascular and brain complications and in early detection of skull osteomyelitis with no radiation burden is also illustrated.
Conclusion: Prompt detection of complications of head and neck pediatric infections is essential in avoiding potential life threatening sequels. Cross sectional imaging is ideal in verifying the presence of these complications.

PMI-18

A safe and economical alternative to sedation in the paediatric population

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Purpose: We are a busy Paediatric Radiology department and perform regular DMSA, MAG-3, bone scans and Meckel's scans. However motion artifact is a significant issue in paedatric nuclear medicine procedures particularly in patients under the age of four who may find a hospital environment intimidating. Traditionally sedation with chloral hydrate has been used to address this. Chloral Hydrate carries the risk of respiratory depression due to over sedation, which needs to be balanced with the risk of waking during the procedure.The financial cost of a Day Ward bed and nursing observation for several hours is significant. The longer preparation time and post procedure recovery time inevitably leads to longer waiting lists. Parent anxiety is a further concern.
Materials and methods: An alternative distraction technique, using recorded children's TV entertainment on an iPod Touch, is used when patients under four years are deemed suitable. Any child under four years is prospectively reviewed by our radiology nursery nurse and assessed for suitability.
Results: For the 8 months from Jan–Aug 2010 47 patients under four years of age were assessed as suitable for a non-sedated scan. A further six patients woke from sedation during the scan and the distraction technique was used rather than abandoning the scan altogether. One further candidate, initially found not suitable, was subsequently successful when sedation failed. The 54 patients completed a diagnostic scan in all cases with no motion artefact. Our non-sedation waiting list is now 4–6 weeks for all routine nuclear medicine examinations whereas our sedation list is 4–5 months.
Conclusion: Considerable savings can be made in term of manpower, waiting lists, patient anxiety and time. The "wasted" exposure to a radioisotope that occurs when sedation is not successful is also avoided. The benefit for clinicians elsewhere in the hospital is two fold—faster access to scans for their patients but also an increase availability of day ward beds for other procedures. With such a successful study period we now plan to introduce the same technique for our Paediatric CT department.

PMI-19

Oral sedation in radiology: can we reduce dose without compromising efficacy?

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Purpose: Chloral hydrate (CH) sedation provides a safe and effective alternative to general anaesthesia for suitable children undergoing medical imaging. We use reduced doses of CH in selected patients in an effort to minimise complications including prolonged post-procedure sedation. Our aims were to assess whether reduced CH doses are successful and if so, when and how would we advocate their use.

Materials and methods: We retrospectively reviewed outpatient CH sedations over one year including: gender, age, weight, dose (initial, augmentation), outcome and time to sedation where successful. We defined standard initial doses of CH as: 50 mg/kg(infants) and 75 mg/kg (children above one year). A reduced dose was defined as a dose 80% or less than the standard dose.
Results: 653 outpatients received CH sedation (one month to three years and ten months). 42% received a reduced initial dose. An augmentation dose was needed in 11.5%. An augmentation dose was more commonly needed in those above one year (15.7%) compared to infants(6.8%)[p=0.00003]. Sedation was successful in 96.6% overall. Sedation was more likely to be successful in infants (98%) than in children above one year (95%)[p=0.03]. Use of reduced initial dose CH had no negative effect on sedation outcome[p=0.19] or time to sedation [p=0.1]. No prolonged post-procedure sedation or significant post-sedation complications were seen in our patients.
Conclusion: Reduced doses of CH are safe and effective for sedation of infants and young children. In suitable patients we suggest the following initial doses: 40 mg/kg in infants and 60mg/kg in children.

PMI-20

Whose line is it anyway? The essential imaging guide to paediatric lines and tubes

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Purpose: Unwell paediatric patients commonly have multiple lines and tubes in situ to aid their management. Line positions must be assessed when reviewing their imaging, as the complications of ectopic line position and line fracture can have very serious consequences. Our aims are:
- To review the correct position of paediatric lines and tubes on plain film.
- To evaluate abnormal line and tube positions, and common reporting pitfalls.
- To demonstrate the complications of line and tube insertion, and their imaging appearances.
Materials and methods: A series of plain films relating to a number of different cases have been acquired over several years in our institution. These highlight both the common and rarely seen complications of paediatric line and tube insertion from abnormal position to line fracture and migration.
Results: We offer several case reviews of line complications that were repeatedly missed by both Paediatricians and Radiologists. We offer comprehensive background information and a pictorial review of correctly sited neonatal lines and tubes.
Conclusion: Assessing the correct position of paediatric lines and tubes on plain film is crucial to avoid unnecessary and potentially serious complications for the patient. Our comprehensive pictorial review of normal and abnormal line and tube positions with associated complications is an essential guide to ensure safe neonatal management.

PMI-21

A rare case of panniculitis in a child

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Purpose: Cytophagic histiocytic panniculitis (CHP) is a rare form of panniculitis histologically characterized by an infiltration of subcutaneous adipose tissue by benign-appearing cytophagic macrophages. The clinical course is various, often rapidly fatal. CHP is not a common disease in children but we must suspect it when we find a rapid onset of a panniculitis, especially if it seems "primary". This work aims to improve knowledge in this respect.
Case report: We observed a 13-year-old boy presenting with thigh subcutaneous plaques up to 20 cm in diameter, developed over the previous two weeks. Lesions were raised and well circumscribed, their consistency was quite indurated and the overlying skin colour was normal. The child had recurrent fever and local pain, but laboratory findings were poor. One month later he had a hepatosplenomegaly and a massive pleural effusion. We performed a US exam for the first, MRI to complete the imaging feature and CT for the last, looking for systemic expressions. The involvement of a infectious disease specialist, rheumatologist and haematologist was activated for diagnostic workup and treatment plan. Biopsies of lesions and bone marrow cytology and histology were carried out, and a macrophage activation syndrome (MAS) was found. The disorder has responded to non- aggressive care and we have begun a close follow-up.
Conclusion: CHP represents a reactive histiocytic disease within the spectrum of histiocytic disorders and may be associated with infections, connective tissue disorders, limphomas and leukemia. The malignant cases don't respond well to treatment; benign cases show no evidence of malignancies and cytotossic therapy isn't necessary. But the term "benign" is relative because in the clinical spectrum a progression may occur. So, we haven't to understate subcutaneous "idiopathic" fat tissue lesions to search rapidly for associated diseases because the mortality rate may be so high that comprehensive work up and starting treatment are crucial.

PMI-22

Labeling of contrast agent containers—a potential source of confusion and error

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*Purpose:*To describe potential errors that can occur as a result of confusing labeling on contrast agent containers.
Materials and methods: We looked at the labels on the containers of a large variety of different contrast agents to determine the manner in which the concentration of the agent was expressed. We looked at labels of containers of barium, gadolinium and iodine. We wished to evaluate any potential ambiguity that could result from this labeling.
Results: We found that the methods by which contrast concentration is expressed is potentially very confusing for all three types of agent. The label of barium agents displays the barium concentration by two different methods. These are weight per weight, (w/w) i.e. grams of barium per 100 g of final solution and weight per volume (w/v), i.e. grams of barium per 100 ml of final solution. Because a variety of different materials are added to barium solutions by different manufacturers, the relationship between the w/w and the w/v concentrations is also highly variable. Gadolinium-based contrast agents have a gadolinium concentration of 0.5 mmol/ml, which is 0.1 mmol/0.2 ml. The dose can be expressed as millimoles per kilogram body weight or as ml/ kg body weight. The conventional dose (often termed a single dose) is 0.1 mmol/kg, which translates to 0.2 cc of contrast per kilogram body weight. It is easy to see how miscommunication can occur. Each bottle of iodinated contrast agent may display two different concentrations on the label; namely the concentration of iodine and the concentration

of the chemical compound. When the radiologist prescribes the contrast to be used, this could result in miscommunication between the radiologist and the technologist.
Conclusion: Errors in the concentration and volume of administered contrast agents can occur if careful attention is not paid to potentially confusing labeling on the bottles of some agents.

PMI-23

Interesting infections in Arkansas
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Our institution is a tertiary care referral hospital that services the entire state of Arkansas. Because of this, we see many rare or extreme cases, especially infections. I will present a series of cases, all of which are infectious in etiology. Organisms include PCP in a non-HIV patient, aspergillus, mucormycosis, naegleria, and MRSA.

PMI-24

Pictorial review of tuberous sclerosis and imaging algorithms for surveillance: a spectrum of radiologic findings in children
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Purpose: Tuberous sclerosis is a multi-organ autosomal dominant neurocutaneous syndrome which is usually diagnosed in childhood between the ages of 2 and 6. Recognition of the common and uncommon manifestations of tuberous sclerosis is important in order to diagnose this disorder in a timely manner and to help prevent complications resulting from delayed diagnosis. Knowledge of the appropriate surveillance guidelines and optimized protocols for imaging patients with diagnosed tuberous sclerosis is necessary to follow these patients.
Materials and methods: As well as depicting the spectrum of both common and uncommon radiologic findings in pediatric patients with tuberous sclerosis, this pictorial review will provide surveillance guidelines in the form of imaging algorithms. The MRI techniques/protocols for the best detection and surveillance of the intracranial and intra-abdominal manifestations of tuberous sclerosis will also be thoroughly reviewed. Critical imaging features that are important to consider when monitoring patients with TS will also be outlined and illustrated. These include angiomyolipoma size and rate of growth as well as complications resulting from the neurological, pulmonary, and abdominal manifestations of tuberous sclerosis.
Conclusion: After viewing this pictorial review, readers will know which imaging protocol to use and what surveillance algorithm should be followed to best image patients with tuberous sclerosis. They will be able to recognize the common and more esoteric imaging findings of tuberous sclerosis and the complications of tuberous sclerosis.

PMI-25

Pediatric cat scratch disease from head to toe: a pictorial essay
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[1]University of Missouri Kansas-City, Kansas City [2]Scott and White Memorial Hospital/Texas A&M Health Sciences Center Temple, [5]Children's Mercy Hospitals and Clinics, Kansas-City (United States)

Cat scratch disease is generally a benign and self-limiting condition but may imitate more serious disease due to its variable presentations. This poster will illustrate findings including lymphadenopathy, hepatosplenic lesions, osteomyelitis, discitis, encephalitis, meningitis, opthalmitis, and cranial nerve neuritis. While many of these individual findings are nonspecific, it is important for the radiologist to be aware of and recognize the imaging findings of cat scratch disease to help guide an appropriate workup. This poster will illustrate pediatric cat scratch disease including multiple cases demonstrating the wide spectrum of imaging findings. Specific emphasis on key imaging findings suggesting this diagnosis will be discussed.

PMI-26

Virtual neonatal autopsy—developing a clinically useful CT protocol
Nathan Dobbs, Kamran Ali, Charles McGuire, Debbie Desilet-Dobbs, Curt Dorn, William Palko
Kansas University- Wichta, Wichita (United States)

Purpose: Determining the cause of death of a neonate can be medically challenging as well as taxing to the infants family. CT is proposed as useful in determining a cause of death. Due to physiologic differences of neonates compared to other pediatric and adult cases, a specific protocol was developed
Materials and methods: From 4/1/10–10/31/10, 17 CTs were completed. Helical CT was performed on a 64slice GE unit: slice thickness-5 mm; pitch-0.5. Scans were obtained at 120 kV and mA from 80 to 600. Gestational age ranged from 23 wks to term. Correlation with standard autopsy was made in 4 cases.
Results: Post-mortem CT scanning was initially protocoled using standard pediatric settings. This low mA returned images of low diagnostic value. As dose reduction is no longer an issue, mA was increased to 600 and auto-mA was disabled. Time after death is important in post mortem CT. As the time interval increases, so does the density of static blood, leading to potential confusion of intravascular blood for pathology. This was most noticeable in the dural sinuses and the cardiac atria. Thus, scans are most useful when obtained soon after death. Other findings were initially concerning for hemorrhage, then were determined as normal for neonates. These included increased attenuation of the germinal matrix and dense meconium within the bowel. CT demonstrated renal calculi in patients requiring frequent Lasix, and in other cases showed increased liver density, correlating with multiple transfusions. CT was also effective in the evaluation of support line placement. Limitations of CT included lack of microscopic evaluation of solid organs and fluid collections. Illustrating the need for a non-invasive post-mortem evaluation, consent was given for only 4 autopsies in the 17 cases. CT correlated with many of the findings made on autopsy and provided detail of intracranial contents that would not have otherwise been available.
Conclusion: Post-mortem CT virtual autopsy is a non-invasive method to aid in determination of the cause of death in neonates.

PMI-27

Radiology family-centered care committee—improving communication and collaboration between families and staff members
Bernadette Koch, Dianne Hater, Katherine Nees, Lane Donnelly , Neil Johnson
Cincinnati Children's Hospital Medical Center, Cincinnati (United States)

Purpose: Growing evidence suggests that family-centered care provides improved patient and family experience, better health outcomes and reduced costs. Most family-centered care committees or patient-family advisory councils have been created within clinical divisions of hospitals. We formed a committee within the radiology department of our pediatric institution, to promote the highest standard of family-centered care through communication and collaboration between families and staff members.
Materials and methods: A committee of 15 radiology department staff and 5 family members was formed. The department staff includes child life specialists, registered nurses, technologists, division managers, physicians, administrative assistants, patient-family advocates and customer service representatives. Our family members were recruited through the hospital Family Advisory Council and all have children who have had variable frequency and type of visits to the radiology department. In addition, many of our staff members have children who have been cared for in various sections of the radiology department.
Results: Routine meetings involving both department staff and family members have resulted in many family centered improvements, in many areas of our department. These include improving our radiology website for families, changing our "way-finding" in the department, improving our current scheduling process, and updating our imaging prep books for children. In addition, the families have had input into the development's resource guide used by the inpatient units (to facilitate more thorough and accurate information sharing about radiology procedures for patients and families), and they had many good ideas that were incorporated into a guideline for delivering difficult news to families in radiology.
Conclusion: The collaboration between family members and staff in the department has been very well received. The outcome has been one of open communication and idea sharing to improve the patient and family experience in the department of Radiology, from the time of scheduling to the time of departure.

PMI-28

Delivering difficult news to families in radiology—developing a communication guideline

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Purpose: When an unexpected, significant diagnosis is made while imaging a child, the pediatric radiologist and support staff are placed in the middle of a life-changing event for a family with which the radiologist has a limited prior relationship. The process by which this has historically been done has been variable. Therefore we developed a guideline to improve effective communication between staff, faculty and family members, and improve patient safety, confidentiality, and overall family experience during these difficult times
Materials and methods: A task force composed of 20 pediatric radiology department employees (radiologists, technologists, child life specialists, registered nurses, patient-family-advocate, patient care assistants, and parents of children cared for in our system) met multiple times to review current practices and try to understand what each person's role might be during the time in which a family will need to be given bad news. Questions that arise include: Where should the family wait while we are gathering additional information? Who will tell the family and where will they be told?
Results: A written difficult news communication guideline was developed to define steps in the process (Initial Discovery, Evaluation, Alert, Communication and Debriefing Stages), define roles for individuals and to identify a point person to support the families. Huddles between the caregivers and the point person coordinate and optimize communication. Checklists, lists of helpful phone numbers and privacy signs to place on the door where the family is waiting are included. The pediatric radiologist's roles include talking with the referring physician and deciding who will be the person to talk to the family (radiologist, referring physician or consulting surgeon). The guideline has been communicated to all radiology department caregivers and pediatric residents in the institution, and is available in paper and electronic format to all divisions of the department.
Conclusion: By defining and coordinating roles, the guideline improves communication between caregivers and families and optimizes patient family experience during a very difficult time.

PMI-30

Current trends in use of immobilizing devices and techniques used during pediatric imaging studies

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Purpose: To establish current trends in the use of immobilizing devices and techniques used during pediatric imaging studies (fluoroscopy). Given the recent trend toward distraction techniques and supportive team approaches utilizing child life specialists, we hypothesize that current trends in use are decreasing. Continued use of immobilizing devices and techniques may be multifactorial- dependent on region, training, perception of image quality, access to child life services and hospital policy.
Results: A 20-question survey distributed to members of the SPR will be used to assess current trends in use. The questions will assess demographic information including location of practice and general/higher training, hospital policy regarding restraint use, availability of child life specialist programs, and reasons for restraint use. We anticipate a 25% or better responser rate. Results will be analyzed and reported after complete data collection.
Conclusion: We hypothesize that immobilizing devices and techniques may be falling out of favor as focus on child and family centered care increases, and with the development and increased use of trained child life specialists in the last 10 years.

PMI-31

Feasibility of non-sedation MRI scans

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Purpose: Unequivocally, MRI is the gold standard for anatomical and functional imaging of the brain. Clinical protocol mandates

imaging of the brain for all infants born under 32 weeks gestational age yet only a handful of hospitals in the United States routinely use MRI for patients in the NICU. One challenge is the necessity to keep the infants' head still during the MRI scan, and subsequently clinicians sedate the infant. Recent work at the University of Washington has established a safe and successful protocol for transport and MRI scans in unsedated neonates. Therefore, the purpose of this study is to examine the feasibility of non sedation MRI scans of the infant brain in inpatient and outpatient clinical setting in infants less than 6 months.
Materials and methods: Thirty seven infants have been enrolled in this project. Seven infants were outpatients; two of the seven were typically developing. The remaining participants were inpatients in a NICU with risk factors for brain injury. For outpatients, MRI sounds were provided to familiarize the participant with the sounds an MRI scanner makes. In addition, participants received practice materials such as earplugs and a hat to try on at home. Parents were instructed to familiarize their baby for 1 week before the scheduled scan. Participants came to the MRI facility at night time, 8 pm or after. Infants were swaddled, outfitted with earphones, and placed in the extremity (knee) coil of a 3 Tesla MR scanner. All infants were monitored by electrocardiography, pulse oximetry and a pediatric nurse.
Results: The success rate for these scans was 33/37 on the first attempt and 36/37 on the second attempt. These success rates are higher than reported in the literature for the few leading programs in the country that routinely use non-sedation MRIs. In addition, the presence of motion artifact as reported by a neuroradiologists was noted in less than 5% of all sequences.
Conclusion: These results join others in suggesting that a non sedation protocol for MRI scans of the brains is feasible in both research and clinical settings. Training for the staff and participants is essential for success.

PMI-32

Tuberous sclerosis complex (TEC) and aortic aneurysm: a rare association

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Tuberous sclerosis is a rare autosomal dominant syndrome in which aortic aneurysm is a classic but little known cause of sudden death. We report a 5 month-old boy, with TEC and aortic aneurysms. 18 cases were reported in Medline ours was the smallest. The pathogenesis of aortic aneurysms is not well known but is probably caused by connective tissue disorders. Aortic aneurysms in children are rare and usually associated with Marfan syndrome, Ehlers-Danlos syndrome, tuberous sclerosis, congenital heart disease, Kawasaki disease, Turner syndrome and in newborn infants secondary to umbilical artery catheterization. Idiopathic abdominal aneurysm is exceptionally rare.
Conclusion: This case supports previous observations of ET in children and young adults, who are associated with the development of aortic aneurysms. This case highlights the importance of systematic screening for such vascular complications. Therefore patients should undergo ultrasound diagnosis of ET and then at regular intervals because of the high risk of breakage. Once detected, MDCT or MRI should be performed to assess extent, vessels involved and possible surgery.

PMI-33

Spectrums of radiographic findings of congenital hypothyroidism

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Purpose: To show a variety of ultrasound (US) and nuclear medicine (NM) findings in patients with congenital hypothyroidism and to suggest an algorithm for using ultrasound as the primary imaging modality for congenital hypothyroidism.
Materials and methods: Using the radiology archives, the hospital information systems (including ICD-9 coding for congenital hypothyroidism), and a data registration maintained by the Indiana Congenital Hypothyroidism Follow up Program, we identified 123 patients who had been diagnosed with congenital hypothyroidism from 2003–2010. Of these 123 patients, 121 patients had US studies; 60 also had a Tc-99m pertechnetate study.
Results: The imaging variations of congenital hypothyroidism include agenesis, sublingual thyroid, organification defect, and hemiagenesis with or without sublingual thyroid. From the 123 patients included in our study, 15% had agenesis, 40% had sublingual thyroid, 37% had an organification defect, 6% had hypoplasia and 2% had hemiagenesis with or without sublingual thyroid. Compared to NM, US had a high specificity (100%) and low sensitivity (45%) for the detection of sublingual thyroid. We suggest that US can be used as the primary imaging modality for congenital hypothyroidism, while NM studies should be performed only when US results are equivocal, such as in agenesis or hypoplasia.
Conclusion: Radiologists should become familiar with the US findings of congenital hypothyroidism. We suggest using US as the primary imaging for congenital hypothyroidism and reserving NM studies for equivocal cases.

PMI-34

Case reports from Kilimanjaro Christian Medical Center in Moshi, Tanzania

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We had the opportunity to spend several months of elective time during our Radiology Residency in the Department of Radiology at the Kilimanjaro Christian Medical Center in Moshi, Tanzania. There was opportunity to particularly focus on the pediatric population, which has a unique diversity of medical conditions as well as typical conditions made unique due to lack of accessible medical care or the funds to pay for medical care when a problem may first arise. Evaluation was performed using modalities including ultrasound, plain film, and older generation CT. Interesting cases included trauma specific to their way of life including falls from coconut and banana trees as well as animal attacks; late presentation of classic pediatric malignancies that had progressed at the time of diagnosis much further than typically seen in the United States; complications of sickle cell anemia; complications of hemophilia, infectious diseases such as Tuberculosis and advanced osteomyelitis; rheumatic heart disease; and complications related to pediatric HIV/AIDS. Not only did the experience offer interesting cases, but also challenged us to extract as much diagnostic information as is typically attempted from modalities such as ultrasound. It also encouraged us to become more directly involved in the clinical management of patients. In addition, concepts

learned can be applied to the growing African immigrant population in the United States which makes this type of experience valuable. Multiple examples will be displayed in this case series.

PMI-35

Pediatric occupants in motor vehicle crashes: crash type, injury assessment, and restraint use

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Purpose: CIREN (Crash Injury Research Engineering Network) is a multi-center project that gathers data on motor vehicle crashes (MVCs) from 6 level-1 trauma centers across the U.S. This presentation investigates pediatric occupants in MVCs, particularly evaluating injuries and outcomes with incorrect application of NHTSA (National Highway Traffic Safety Administration) guidelines for child safety restraints.
Materials and methods: Biomedical engineers analyzed crashes enrolled in CIREN to determine causation, kinematics, mechanism of injury, and effectiveness of safety systems. This data was paired with medical records, radiographic studies, and patient photos. Pertinent information was catalogued in a national searchable data base. The compiled pediatric data from all sites was then analyzed statistically by type of crash (frontal, side, rear, or rollover), patient location in the vehicle, injured body region, and abbreviated injury scale (AIS) score with further stratification based on use of restraint devices.
Results: Many pediatric patients sustaining significant injuries in MVCs are not properly restrained. Over 100 patients of 607 in our study group were children under 13 years of age seated in the front seat. Over 200 CIREN pediatric patients were under 4′9″ tall and not seated in a child safety seat (CSS). Ninety-three percent of crashes were frontal or side impact. The most frequently injured body region was the face, followed by the head and the lower extremities. Eighty-six percent of head injuries and 82% of spinal injuries were AIS 2 or greater.
Conclusion: Efforts to improve child safety restraints is and should be an ongoing focus of research. However, statistics show that inattention to NHTSA guidelines and improper use of existing CSS are significant causes of morbidity and mortality in the pediatric population. Enhanced public awareness of the value of the guidelines is crucial. Additionally, development of more user-friendly CSS may increase restraint use. Funding has come from Childress Institute for Pediatric Trauma, Toyota, and NHTSA

PMI-36

Optimization of iterative reconstruction technique (iDose) in pediatric abdominal CT scans

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Purpose: Iterative reconstruction (iDose) is a new method of creating CT images. Images created with iDose may be non diagnostic. It has been suggested that traditional filtered back projection (FBP) images be combined with iDose to improve image quality. Our purpose was to determine if iDose improves CT scan quality in children, and to find the optimized percentage of combined iDose and FBP in each image, based on the child's age, body weight and maximal body diameter.
Materials and methods: Fifty-three body CT scans were evaluated. Seven image series were generated: FBP only and 6 different iDose levels (20%, 30%, 40%, 50%, 60% and 70%). Two pediatric radiologists independently chose the optimal images from those studies containing between 20% and 70% iDose. This study was then compared to the FBP only study. The quality of each of the 2 studies (FBP only and best iDose level) was graded using a Likert scale of 1 (non-diagnostic) to 5 (excellent).
The patient's age, body weight and maximal body diameter, as measured from the scout view, were recorded.
The quality of the CT scans for FBP only and scans with iDose was evaluated using two-tailed t-test. The correlation between the average optimal level of iDose and patients' age, body weight and maximal body diameter was performed using Spearman rank-order correlation test.
Results: Patient ages ranged from 50 days to 18 years, body weights ranged from 5 kg to 80 kg, and maximal body diameters ranged from 15 cm to 35 cm. The 2 radiologists concurred on optimal iDose level (within 10% of difference) in 48/53 (92%) studies. In all studies, iDose improved image quality with an average quality grade of 4 as compared to 3.2 in FBP ($P<0.01$). The optimal average level iDose in the image ranged from 35% to 65% and significantly correlated with age, body weight and maximal body diameter, ($p<0.01$). Maximal body diameter and body weight better correlated with optimal level of iDose ($r=0.42$ and 0.41, respectively) as compared to age ($r=0.35$).
Conclusion: Adding iDose to an FBP image results in significant improvement in image quality. There is a significant linear relationship between optimal level of iDose and patient age, body weight and maximal body diameter.

PMS-1

Osteofibrous dysplasia in children—a pictorial essay

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Purpose: The aim of this pictorial essay is to illustrate the characteristic but wide ranging radiological features of osteofibrous dysplasia (OFD) in children. Recognition of the radiological appearances is important because unnecessary surgery can be avoided.
Materials and methods: OFD is a rare benign fibro-osseous process occurring most commonly in the tibial diaphysis of children under the age of 10 years. It is commonly misdiagnosed as fibrous dysplasia. A minority of patients may have ipsilateral fibula involvement. Lesions have occasionally been reported in the ulna and the radius. Pain and swelling is the commonest presenting complaint.
Results: Radiographically, these lesions appear as intra-cortical, radiolucent, well-defined lesions with marginal sclerosis. A "ground-glass" appearance may be present. Bowing and pseudoarthrosis may develop in some cases. The process undergoes spontaneous resolution in most cases during adolescence. Surgery is only recommended for extensive, symptomatic and persistent cases after puberty because there is a local recurrence rate of about 25% following curettage or local resection.
Conclusion: This pictorial essay will illustrate the distinct multimodality features of OFD and their evolution over time. Histological specimens will also be shown. Lesions mimicking the appearance of OFD such as fibrous dysplasia, non-ossifying

fibroma, chronic osteomyelytis and bone cysts will be presented. Emphasis will be placed on the imaging features which enable these lesions to be distinguished from OFD.

PMS-2

Developmental dysplasia of the hip: do we know what we're doing?

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Purpose: Developmental Dysplasia of the Hip (DDH) is a poorly defined entity which overlaps with normal physiological hip changes which improve with age. The diagnosis and treatment of DDH varies between countries, institutions and medical practitioners. We review the definition, epidemiology, pathology, diagnosis, management and follow-up of DDH described in the literature.
Materials and methods: We searched PubMed for articles published on DDH over the past 30 years (1980–2010) using MeSH terms "hip dysplasia", "hip dislocation" and "congenital". The variety of definitions, classifications, diagnostic methods and treatments used were recorded and an attempted assessment of the relative merit of these determined.
Results: Literature on screening and interventions for DDH has significant methodological shortcomings. No published trials directly link screening and the use of ultrasound with improved outcomes. The precise definition of DDH remains controversial. Different methods are used to diagnose DDH including clinical history (including risk factors), examination and either hip ultrasound (US) or pelvic radiography depending on the age of the patient. Hip US is subject to both intra- and inter-observer differences and its reliability, especially outside of dedicated paediatric centres, is variable. Treatment options range from conservative observation to harness application and open surgical correction. Active treatment is not without risk, in particular that of avascular necrosis of the femoral head. Universal screening for DDH and the appropriate timing of such screening remain controversial. Screening is standard practice for example in some European countries (Germany and Switzerland) but not in the United Kingdom, the United States or Scandinavia.
Conclusion: Diagnosis and management of DDH remains an important issue in paediatric radiology. The most reliable means of diagnosis and whether or not routine screening is appropriate and when and how DDH should be treated remain largely unresolved as indicated by the broad spectrum of practice demonstrated in the literature.

PMS-3

Ganglion cysts seen at MR imaging of the paediatric wrist: prevalence and characteristics

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Purpose: The majority of published literature on ganglion cysts in the paediatric wrist has been from a surgical perspective. Magnetic resonance (MR) imaging has the ability to detect ganglion cysts from 2 mm and to yield information regarding the relationship of the cyst to various structures within the wrist and may indicate the likely aetiology of the cyst. Our aim was to determine the prevalence of ganglion cysts involving the wrist in the paediatric population.
Materials and methods: We retrospectively reviewed 80 consecutive paediatric MR wrist examinations. Each study was reviewed by a paediatric radiology fellow and a consultant paediatric musculoskeletal radiologist. Images from additional modalities (plain radiography, ultrasound, computed tomography and nuclear medicine) were reviewed where available. Ganglion cysts were assessed for their location, size, signal characteristics, relationship to and effect on adjacent structures. Radiologic findings were correlated with the clinical presentation in each case.
Results: We found 32 ganglion cysts in 28 MR wrist examinations. Twelve cysts were dorsal in location, 20 were palmar. Relationship to adjacent structures was as follows: intercarpal joints (12), intercarpal ligaments (10), triangular fibrocartilage (5), ulnar styloid process (3) radial styloid process (1) and radiocarpal joint (1). The size of the cysts ranged from 3 to 32 mm in maximum dimension. The majority of cysts were simple in appearance although two showed internal septations. In 2 out of 5 cases where gadolinium had been administered, the cyst showed wall enhancement. Mass effect on surrounding structures was seen in 5 cases: displacement of the extensor tendons in 3 cases and stretching of the TFC in a further 2 cases.
Conclusion: Our results demonstrate that ganglion cysts are relatively commonly seen on MR imaging of the paediatric wrist, with an incidence of 35%. MR imaging has the ability to detect even small ganglion cysts and to provide detailed information regarding the relationship of the cyst to surrounding anatomical structures.

PMS-4

Magnetic resonance imaging of the paediatric wrist: a review of 80 cases

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Purpose: The majority of published literature on wrist pathology in the paediatric population has been from a surgical perspective. Advances in magnetic resonance (MR) imaging quality have resulted in increased observation of bone, joint, tendon and ligament abnormalities. Our aim was to review the spectrum of abnormalities seen on MR imaging of the paediatric wrist.
Materials and methods: A retrospective review was performed of 80 consecutive paediatric MR wrist examinations. Each study was reviewed by a paediatric radiology fellow and a consultant paediatric musculoskeletal radiologist. Images from additional modalities (plain radiography, ultrasound, computed tomography and nuclear medicine) were reviewed where available. Correlation was made between imaging findings and clinical presentation.
Results: The majority of studies (72) were abnormal. Abnormalities included in order of prevalence: ganglion cyst (32 cysts in 28 patients), joint effusion (21), bone marrow oedema/fracture (14), negative ulnar variance and impingement (7), triangular fibrocartilage degeneration (6)/stretching(6)/tear(7), partial/complete physeal fusion (7), Madelung deformity (3), congenital hypoplasia/absence of one or more carpal bones (2), extensor carpi ulnaris tendinopathy (2), positive ulnar variance and impaction (1), intraosseous cyst (1), bone island (1), alignment abnormalities related to arthrogryposis (1), physeal stress reaction (1), osteomyelitis (2). The radiologic findings were felt likely to directly account for the patients symptoms in 56 cases.
Conclusion: MR imaging of the paediatric wrist has the ability to identify numerous abnormalities including those involving bone (including physis), joint, tendon, ligament and triangular fibrocartilage.

PMS-5

Venous-malformation-related arthropathy: a childhood disease with significant morbidity

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Purpose: 1) to characterize extremity venous malformation (EVM) related joint involvement /arthropathy on MR, 2) identify changes on longitudinal follow-up, 3) describe challenges in patient care and 4) recommend improvements in identifying early VM-related arthropathy
Materials and methods: A retrospective review of consecutive patients(pts) with EVM undergoing at least one MR scan over 8 yrs from Jan 2000 was undertaken. Pts with joint involvement were analyzed. MR scans were reviewed for: extra-articular disease, joint involvement by VM, joint effusion and osteo-articular disease (OAD). OAD was defined as changes affecting menisci, articular cartilage, subchondral bone and ligaments together with hemosiderin deposition assessed on gradient echo (GE) sequences.
Results: 272 pts were identified, 21 pts (8%; aged 6 mo-16 yrs) had EVM joint involvement affecting 24 joints (knee joint in 19/24). 18/21 pts had diffuse EVM, 20/21 pts were clinically symptomatic. 9 joints showed intra-articular VM alone, 7 (all with diffuse EVM disease) showed intra-articular VM + OAD and 6 had intra-articular VM + effusion. Hemosiderin deposition occurred in 10/11 joints on GE MR (all pts had diffuse extremity VM), 8/10 of these showing OAD. The mean pt age for hemosiderin detection was 10.5 yrs, and OAD detection was 11.5 yrs
Conclusion: 8% of children with EVM had MR evidence of EVM joint involvement, OAD was seen in 38% of joints affected by VM (without hemosiderin deposition) and in 80% in those with VM and hemosiderin deposition on GE MR. Extra-articular disease clinically masks the intra-articular involvement with OAD, hence appropriate joint specific MR imaging should be done in addition to that done for a general evaluation of the venous malformation.

PMS-6

Juvenile idiopathic arthritis—a pictorial review of a multimodality approach

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Juvenile Idiopathic arthritis (JIA) is the most common rheumatic disorder of childhood and a major cause of morbidity. It is characterised by chronic inflammatory lesions in the soft tissues of the joints. Radiology has an important role in the management of JIA, monitoring disease progression and detecting complications. Imaging of JIA requires a multimodality approach. In our pictorial review we present the wide variety of radiographic features seen in JIA at different stages of the disease at different anatomical locations. These include the classic plain radiographic changes of soft tissue swelling and periarticular osteopenia progressing to joint space narrowing, erosive changes and bony ankylosis. Ultrasound features of synovial thickening and joint effusion are demonstrated. Doppler imaging is used to assess vascularity and response to treatment. MR can be used to assess articular cartilage, as well as depicting bone erosions, synovial proliferation and joint effusion: we present example at the ankle, hip, knee, sacroiliac joints, cervical spine and temporomandibular joints. We also demonstrate the MR findings of enthesitis which can be another feature of JIA. We aim to highlight the advantages and disadvantages of these different imaging modalities used, and in which situations each imaging modality is appropriate. In particular we draw attention to the importance of contrast enhanced MR imaging in differentiating active synovial thickening from joint effusion.

PMS-7

State of the art: evaluation of uncommon pediatric benign lipomatous lesions with an emphasis on clinical, imaging, and pathologic correlation

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Variable types of benign lipomatous lesions can occur in children. Due to their often non-specific physical examination findings, imaging studies play a crucial role for the early and correct diagnosis, which in turn, can lead to proper patient management. This presentation addresses advantages and disadvantages of currently available imaging modalities, including plain radiography, ultrasound, computed tomography, and magnetic resonance imaging, for evaluating benign lipomatous lesions in children. The state-of-the-art imaging techniques for evaluating benign lipomatous lesions in pediatric patients will be highlighted. We will also review the classification system for benign lipomatous lesions by Weiss and Goldblum including: 1) lipoma (i.e., a tumor containing mature fat); 2) variants of lipoma (i.e., fatty tumors with specific clinical and histologic findings including angio/myo or chondroid lipoma, lipoblastoma and spindle-cell/pleomorphic lipoma); 3) lipomatous tumor (i.e., lesions associated with non-adipose tissue including intra/intermuscular lipoma and lipomatous of nerve); 4) infiltrating lipoma (i.e., proliferative fatty lesion including diffuse lipomatosis and adioposis dolorosa); and 5) hibernoma (i.e., a benign tumor of brown fat). Our review includes various benign lipomatous lesions such as parotid lipoma, head / neck lipoma, mediastinal lipoma, mediastinal thymolipoma, intra-abdominal lipoma, lipoblastomas of the retropharynx, mesentery, and extremities, intramuscular lipoblastoma, and infantile lipofibromatosis in pediatric patients. The overarching goals of our presentation are to understand the clinical aspects, characteristic imaging features, and key points that can confirm and also allow differentiation among various benign lipomatous lesions in pediatric patients. Familiarity with this new classification system, optimal imaging techniques and characteristic imaging appearance of various uncommon lipomatous lesions in children can avoid delay in diagnosis and optimize pediatric patient care.

PMS-8

Skeletal surveys in suspected NAI: interpretation obscured by artefacts

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Purpose: We perform many skeletal surveys on young children who are suspected of suffering non-accidental injury (NAI), some of whom are recently deceased. These are difficult to perform, for a variety of reasons, and are frequently compounded by radiographic artefacts which can obscure vital areas such as the metaphyses. Here, we evaluate the extent of this problem at our institution
Materials and methods: We retrospectively reviewed skeletal surveys performed on children for suspected NAI under the age of 3 years, between 2004 and 2008. We identified the number and type of artefacts on each radiograph. We divided artefacts into 4 different types : Lines (e.g. intravenous cannula, intra/osseous needle, endotracheal tube), Patient identification labels or wrist bands, radiographic (side) markers, and others (e.g. the hands of the person holding the child, or clothing artefact). Artefacts were deemed "significant" if they impaired the reporter's ability to interpret the image. We used Fisher's exact test to compare between groups.
Results: Of 99 skeletal surveys in our cohort, 38% were in live children and 61% in deceased. Overall, 863 (36%) out of a total of 2408 radiographs had artefacts, of which 566 (66%) were judged to be significant. There were significantly more artefacts on radiographs performed in deceased children (597/150; 40%) compared to live children (266/904; 29%; $p<0.001$). Moreover, more artefacts were judged to be significant in deceased children (426 / 597: 71%) compared to live children (140 / 266 : 53%; $p<0.001$). There were significantly fewer "patient identification label" artefacts in the live (22%) vs deceased (55%; $p<0.001$) radiographs, but significantly more "other" artefacts in the live (49%) vs deceased (10%; $p<0.001$). There was no significant different in the proportion of LINES artefacts (22% vs 27%; ns) or radiographic marker artefacts (8% vs 8%; ns).
Conclusion: Judging by the number and nature of overlying artefacts, skeletal surveys are more difficult to perform in deceased than live children. Paying careful attention to radiographic technique, in particular the location of patient identification labels in deceased children, and artefacts such as parents' hands in live children, could increase the diagnostic yield in skeletal surveys in the setting of non-accidental injury.

PMS-9

Osteonecrosis in children following chemotherapy for acute leukaemia

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Purpose: Advances in intensive multi-agent chemotherapy regimes has led to an improvement in the long term survival of children with acute lymphoblastic leukaemia (ALL). However as a consequence, side effects of treatment are becoming more apparent. Of particular concern, modern chemotherapy for acute leukaemia in childhood involves high dose dexamethasone (up to 10 mg/m2/day), which puts patients at significant risk of osteonecrosis. In this study we evaluate the extent of this problem.
Materials and methods: We performed a retrospective analysis of our hospital's Serious Adverse Events database over a 12 month period.
Results: We identified 8 patients (4.6%) with a new diagnosis of osteonecrosis, from a total of 174 children currently receiving the UK ALL 2003 treatment regime. All 8 patients had osteonecrosis of the hip, 3 had osteonecrosis of the knee, 2 at the shoulder and 2 in the spine. 3 out of the 8 patients showed severe multifocal necrosis, with at least 3 separate joints involved. We present the radiographic and MR imaging findings of AVN in this cohort, demonstrating some of the early changes that are detectable only using MR when the corresponding plain films are normal. We highlight the importance of early detection of osteonecrosis as 2 of our patients eventually required surgical intervention resulting in a hip prosthesis.
Conclusion: At our institution, 5% of children currently treated for ALL developed severe osteonecrosis, almost half of whom demonstrated multifocal disease. The use of higher cumulative doses of steroids may be responsible for the increased incidence, but the exact causation is poorly understood. Early detection is vital to prevent disease progress and its complications.

PMS-11

Imaging the infant cervical spine—case report of an infant with 6p deletion syndrome

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Purpose: Analysis of an abnormal cervical spine in infants with plain radiographs is limited. This case illustrates the use of MRI and CT in evaluating complex abnormalities of the infant cervical spine. Case Report: A term female infant was born to non-consanguinous parents with the antenatal diagnosis of Dandy Walker malformation with agenesis of the corpus callosum. The child was noted to be dysmorphic at birth, prompting investigations which revealed a 6p chromosome deletion. A shunt was inserted to decompress the posterior fossa. The baby had enterobacter meningitis in the 2nd month of life, subsequent to which the infected ventriculoperitoneal shunt was removed and a new shunt placed. A follow up limited MR carried out in the 3rd month of life showed stable ventriculomegaly with shunt in situ but abnormal kyphosis of the cervical spine. This resulted in dedicated imaging of the cervical spine. Lateral plain radiograph of the cervical spine shows few ossified cervical vertebrae with abnormally shaped ossication centers of the upper cervical vertebrae and suggestion of platyspondyly of the lower cervical vertebrae. MRI shows kyphosis at C4/6 occurs on flexion, minimal in neutral position and extension. The non-ossified cervical vertebral bodies are well visualised on MRI. The C3 and C4 vertebrae are slightly hypoplastic and partially fused. Normal signal is seen in the distorted cervical cord. CT of the spine shows greater bony detail with absent ossification of the C3 vertebral body, a rudimentary ossification center for the C4 vertebral body, an absent C5 vertebral body yet the presence of bony posterior elements at this level which are partially fused to the left C4 lamina and partially fused to the right C5 lamina. There is also fusion of the posterior elements of C2 and C3. A C8 vertebrae bears cervical ribs.
Conclusion: This case illustrates the superiority of MRI in demonstrating the unossified vertebra in an infant with the complementary use of CT to detect subtle abnormalities of bony fusion. Diagnosis of such abnormalities is important for presurgical planning.

PMS-12

Surgically treated patients with brachial plexus birth injury: an MRI study

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Purpose: The outcome of shoulder operations of brachial plexus birth injury (BPBI) was assessed clinically and with MRI.
Materials and methods: 31 BPBI patients who had undergone a shoulder operation (relocation of the humeral head, external osteotomy of the humerus, subscapular tendon lengthening or teres major transposition) in our hospital between March 2002 and December 2005 were included in this study. Shoulder range of motion (ROM) was measured. Magnetic resonance imaging (MRI) was performed pre- and postoperatively: glenoscapular angle (GSA) and percentage of humeral head anterior to the middle of the glenoid fossa (PHHA) were measured. Congruency of the glenohumeral joint (GHJ) was assessed. Wilcoxon test was used to compare pre- and postoperative GSA-values in different operation groups. P value<0.05 was considered significant.
Results: Relocation of the humeral head was performed for 13 patients, external rotation osteotomy of the humerus for 5 patients, subscapular tendon lengthening for 5 patients and teres major transposition for 8 patients. After relocation of the humeral head, external rotation increased in 10/13 patients (median increase 37.5°). The corresponding values after external rotation osteotomy of the humerus or subscapular tendon lengthening were 5/5 (median 25°) and 4/5 (median 20°) and after teres major transposition 5/8 (median 40°). Congruency of the shoulder joint improved in 10/13 patients who had undergone relocation operation under the age of 5 years, with mean GSA improvement of 33º and mean PHHA increase of 25%. Congruency of GHJ did not change significantly in patients treated with other operation types.
Conclusion: Malposition of the GHJ can be improved surgically in BPBI. Remodeling of the glenohumeral joint can be achieved with a relocation operation in young patients.

PMS-13

How old is this fracture?

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Background: The first evidence of persiosteal new bone related to a fracture is one of the most useful signs in dating fractures, as the 'window of uncertainty' is narrower for the early radiological signs of healing than those occurring later. It had been our view that most radiologists would be reluctant to date such changes as less than 7 days, except perhaps in newborns. Standard texts repeat this message, although we have been unable to find original research, particularly in relation to digital imaging, which confirms this. This is of great importance in the field of non-accidental injury where dating of the injury may determine the pool of potential perpetrators.
Materials and methods: Our case relates to an accidental injury in a 3- year old girl. She had a 4-day history of limping, partial weight bearing and dragging of her left foot. The presenting radiograph was considered to be normal. A second radiograph 11 days later showed established periosteal reaction together with sclerosis around a visible fracture line across the mid left fibular shaft. Critical retrospective review of the presenting radiograph showed subtle periosteal reaction at the same site. We emailed both sets of images to 8 consultant paediatric radiologists experienced in child protection work. Brief details of patient age, ethnicity and clinical scenario were provided. We asked:- Do you agree that periosteal reaction was present on the original film? In your opinion, what is the age of the fracture of the first film? Their responses will be presented and discussed, but demonstrate a range of opinions.
Conclusion: We believe that our case demonstrates that occasionally subtle periosteal reaction can be identified as early as day 4 post injury in a child as old as the fourth year of life. As far as we are aware, there has been no published data documenting periosteal reaction at 4 days post injury. This case has important implications for those working in the radiology of NAI.

PMS-14

The types of fractures and modes of presentation in children under 2, presenting to a paediatric teaching hospital Accident and Emergency Department over a 15 month period

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Purpose: Differentiating between accidental and non accidental injury (NAI) is difficult in all children presenting with evidence of trauma, but particularly in those under the age of 2 years. It is generally accepted that no fracture is pathognomonic of either type of injury, but there is very little published evidence on the types of injuries sustained in children under 2 years presenting to Accident and Emergency Departments (A+E) following accepted episodes of trauma. The aim of our study was to provide local statistics regarding the most commonly seen accidental fractures and their modes of presentation in children under 2 years. We also intend to relate our findings to the fractures commonly associated with non accidental injury, such as metaphyseal fractures and rib fractures
Materials and methods: We retrospectively reviewed the modes of presentation, injuries and imaging in over 600 children under the age of 2 years presenting to our A+E from 01/01/2008 to 01/03/2009. We followed up the cases to see whether any subsequent investigations for NAI took place over the next 18 months. We searched for the data from the A+E history and for the radiology imaging on local PCAS.
Results: The study included all children under 2 years presenting to the A+E during the allotted time frame who had had some form of imaging. Our results included 612 children of which 156 had sustained a fracture; of these there were 52 lower limb, 83 upper limb and 21 skull fractures.
Conclusion: We aim to present our findings schematically including the types of fractures, the modes of presentation, the clinical symptoms, the average time interval and demonstrate the rarity of the types of fractures more commonly associated with non accidental injury i.e. metaphyseal fractures and rib fractures. With our data collection we hope to add weight to the generally accepted patterns of accidental injury in children under 2 years.

PMS-15

Contrast-enhanced MRI and MRA of two patients with purpura fulminans—guiding surgical resection

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Purpura fulminans is a serious and life-threatening complication of childhood infection, especially in those with Neisseria meningitides as the causative pathogen. Surgical treatment depends on the extent of damage to soft tissue and bone. It ranges from decompression in the form of fasciotomy in the acute phase to more extensive tissue debridement and ultimately amputation. The

range of surgical treatments available means that planning is crucial to ensure a balance between removing abnormal tissue and leaving enough tissue to maximise function. Technetium bone scanning has been advocated as a useful adjunct in the management of purpura fulminans for this purpose. However MRI can give an accurate delineation of tissue necrosis with the addition of gadolinium and with angiography allows evaluation of the lower limb vasculature patency for prognostic information. It is crucial for the Paediatric radiologist to delineate as accurately as possible the border between necrotic and normal tissue. Contrast-enhanced MRI plays an important role in this. We present the contrast-enhanced MRI findings in two female patients under 5 years of age. Both presented with severe meningococcal infection and subsequently developed extensive lower limb purpura fulminans. This warranted surgical intervention and an MRI was performed prior to operation, which demonstrated a clear border between enhancing and non-enhancing tissue. MRA demonstrated patent lower limb vasculature in one case which enabled the surgeon to perform a more limited tissue resection and in the other case it demonstrated extensive destruction of the lower limb vessels which resulted in amputation. We will demonstrate the benefit gadolinium-enhanced sequences and MR angiography gave in the assessment of tissue necrosis versus standard sequences alone. We will correlate this with the intra-operative findings and show the value of MRI in pre-operative planning.

PMS-16

Pattern of ultrasound and colour Doppler indices in synovial inflammation of juvenile idiopathic arthritis: preliminary results from an ongoing study in North India

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Purpose: To study the pattern of ultrasound and colour Doppler indices in synovial inflammation of juvenile idiopathic arthritis.
Materials and methods: A cross sectional study was conducted in the paediatric rheumatology clinic of a teaching hospital in North India. We studied 19 patients- 12 males and 7 females. A total of 60 joints diagnosed clinically as juvenile idiopathic arthritis were included in our sample. Of these, 50% were knee joints, 23% wrists, 20% ankle and 7% were MCP joints. Ultrasound evaluation by high frequency transducer was done for presence of synovial thickening, joint effusion and bone erosions. The synovial vascularization was determined by color Doppler and spectral doppler, estimating the color fraction (the number of color pixels inside the synovium) and resistive index.
Results: The mean age was 9.5 years with 3 patients in 0–5 yrs, 8 patients each in 6–10 and 11–16 yrs age group. Sonography showed synovial thickening in all the joints as hypoechoic intra-articular tissue which is poorly compressible, exhibiting Doppler signal with color flow. Joint effusion, seen in 75% joints, was anechoic and could be displaced by compression with no evidence of flow on Doppler imaging. Erosions seen as intra-articular discontinuity of bone were found in 2 wrist joints (3%). Quantitative evaluation of degree of synovial inflammation by colour fraction revealed a mean value of 0.29 and a standard deviation of 0.82. The resistive index had a mean of 0.62 and a standard deviation of 0.08.
Conclusion: Ultrasound with color Doppler is a valuable tool for assessing the abnormal changes in juvenile idiopathic arthritis and determining the extent and severity of synovial inflammation. Being inexpensive, non invasive and non radiating procedure, it can play a useful role in monitoring disease activity and therapeutic response.

PMS-17

Are EOS imaging 3D reconstructions reliable in adolescent idiopathic scoliosis treated by posterior instrumentation?

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Purpose: To assess the reliability of pre and postoperative 3D reconstructions using EOS imaging in patients operated for adolescent idiopathic scoliosis (AIS). To evaluate the impact of two different thoracic implants on the reproducibility of postoperative measurements.
Materials and methods: This series included 24 paediatric patients (mean: 15 years±2), operated for thoracic AIS, using either all-pedicle screw constructs (group 1, $n=12$) or hybrid constructs with Universal Clamps at thoracic levels (group 2, $n=12$). In each group, the preoperative Cobb angle was less than 50° (moderate curves) in 4 patients, between 50° and 65° (medium curves) in 4 patients and greater than 65° (severe curves) in 4 patients. All patients underwent EOS biplanar radiographs before and after surgery. Three operators performed the 3D reconstruction process two times before and two times after surgery. Intra and interobserver reproducibility were calculated and compared between groups.
Results: The reproducibility for scoliosis parameters (Cobb and Apical Vertebral Rotation) was between 4–6° before and 5–10° after surgery. Pre and post operative reproducibility were not significantly different for kyphosis and lordosis (4–7°) and for pelvic measurements (1–5°). The intra and interobserver reproducibility concerning scoliosis parameters were better in group 2, but without significant difference. No difference was found between groups for reproducibility of the other parameters.
Conclusion: Post operative 3D reconstructions are as reproducible as the preoperative ones. Their precision is not influenced by the type of implant used for correction. The mean difference between observers was higher than previously reported for the apical rotation measurement, but can be explained by the severity of the curves and the poor visibility of the anatomical landmarks with the implants.

PMS-18

The role of advanced MRI techniques as the definitive diagnostic tool in the differentiation between osteomyelitis and osteonecrosis in children with sickle cell disease

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Purpose: Microvascular thrombosis in sickle cell disease can damage a variety of tissues, including bone marrow with acute musculoskeletal pain and spleen, which increases the risk of infection in particular osteomyelitis. Acute musculosceletal pain due to marrow infarction is by far the most frequent clinical presentation for sickle cell, but clinical symptoms of acute painful events can also be caused by osteomyelitis. MRI has the highest sensitivity and specificity in the detection of marrow and extraosseous changes in both infarction and infection. Although

musculoskeletal changes are confidently detectable with MRI, they can be very similar. The purpose of this study was to illustrate the importance of MRI and to introduce our highly developed protocol including unenhanced, dynamic enhanced, subtraction and whole body DWI sequences.
Materials and methods: We examined 17 children with sickle cell disease, acute musculoskeletal pain and noncharacteristic clinical symptoms with our completed MRI protocol, and correlated our results with the clinical and surgical details in order to determine the diagnostic value of our sequences in comparison to routinely used protocols in other hospitals.
Results: There was a significant correlation between our MRI results and the clinical and surgical outcome.
Conclusion: Whole body DWI sequences are the most effective sequences for the detection of the hot spots in a multifocal musculoskeletal process, which is the nature of sickle cell disease. Although unenhanced sequences are helpful to determine the extent of a local process, in most of the cases the musculoskeletal abnormalities are either in osteomyelities or in marrow infarction, similar and dynamic post contrast and subtraction sequences are required for the definite differentiation. The results of our study showed that our advanced MRI protocol is a single ultimate diagnostic tool for confidently differentiating between marrow infarction and infection in children with sickle cell disease.

PMS-19

The role of MRI in the diagnosis of severe Panton-Valentine leucocidin-positive Staphylococcus aureus infection of the growing skelet

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Purpose: PVL is a cytotoxin that makes Staphylococcus aureus more virulent. It was discoverd by Van de Velde in 1894 and named after Philip Panton and Francis Valentine who associated it with skin infections in 1932. PVL-SA causes necrotising pneumonia and severe soft tissue and skelet infections with poor outcome. Early diagnosis helps lessen the risk of complications. Early osteomyelitis is rarely diagnosed with radiography or scintigraphy, because ossesous manifestations are not evident with these modalities in the first days after symptom onset, and ultrasound cannot evaluate intraosseous abnormalities. MRI shows marrow oedema, abscesses and with the use of Gadolinium, hyperemia in an infected bone within 24 hours of symptom onset. Through designated MRI sequences, a whole body detection of infectious foci is possible without radiation. The aim of this study was to describe MRI features of PVL-SA of growing skelet, their correlation with the clinical results and to compare MRI with other imaging modalities.
Materials and methods: In this retrospective study we reviewed the imaging studies and medical records of 14 children ranging in age from 7 to 156 months who were diagnosed with severe PVL-SA infection of the skelet since 2006. Subsequently we assesed the correlation of the clinical data with the common MRI features and compared different imaging modalities.
Results: 14 patients all with severe PVL-SA of the skelet were treated in our hospital since 2006. Possible risk factors were identified in12 children. Collections were detected in all 14 children. 10 patients were admited to PICU with acute sepsis. The majority of the initial radiographs and ultrasounds were normal. The most comprehensive imaging procedure was MRI.
Conclusion: Invasive PVL–SA infection of the growing skelet is a severe infection associated with sepsis and high morbidity. Early diagnosis and adequate therapy is therefore crucial. Our study showed that MRI is the most advanced imaging procedure with the highest sensitivity and specificity without radiation.

PMS-20

Ultrasound examination of neonatal hip dysplasia: comparison of interobserver variation when classifying using Graf method and femoral head position

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Purpose: Classification of neonatal hip dysplasia is often performed according to Graf, but interobserver variation compared with other methods is unknown. I aimed to compare interobserver variation for Graf classification and femoral head position
Materials and methods: At a consensus meeting of the Scottish Hip Screening Group meeting 12 experienced observers (sonographers, orthopaedic surgeons physiotherapists and radioloogists with an interest in neonatal hips) classified 25 anonymised static images by Graf type and femoral head position (normal, decentered or eccentric). Images were selected form recent hip clinics and were projected for 1 minute each. Video of spontaneous instability and/or stress testing was presented where available.
Results: There was significantly greater agreement of observers using femoral head position than Graf type whether agreement was defined as unanimous ($p<0.001$), 11:1 ($p<0.001$), 10:2 $p<0.001$) or 9:3 ($p<0.001$). It was not possible to improve agreement by combining Graf types during analysis of results.
Conclusion: Graf classification results in greater inter-observer variation than assessment of femoral head position. There appeared to be differing understandings of terminology and use of the Graf classification. Treatment decisions based on Graf classification are less likely to be consistent than those based on femoral head position. It is suggested that treatment decisions should be performed on stability rather than Graf classification.

PMS-21

Radiological features of osteogenesis imperfecta type V—a report of two cases

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Purpose: Osteogenesis imperfecta type (OI) V is a distinct clinical entity with its unique clinical, radiological and histological features.
Materials and methods: We reported OI type V in two Chinese patients. Both presented with repeated episode of bony fractures since early childhood and were referred to orthopaedic surgeons and paediatricians for management. They had an absence of blue sclera, normal hearing and normal dentition. Radiologically, typical features for OI type 5 are seen, including interosseous membrane calcification in forearms which are present in both patients. Both of them developed radial head dislocation. One of the patients developed painful hypertrophic callus 3 months after anterior closing wedge osteotomy on his right distal femur at the age of 13 years, which is one of the most debilitating feature of the disease. The patients are currently receiving treatment including

intravenous pamidronate. This is the first case report of OI type V in Chinese patients.
Conclusion: Osteogenesis imperfecta (OI) comprises a heterogeneous group of diseases. OI type V is a distinct entity from other subtypes of OI with its unique clinical, radiological and histological features. Radiologically, it is distinguished from other subtypes by calcification of interosseous membranes, hypertrophic callus formation, and a high incidence of radial head dislocation.

PMS-22

MR features of musculoskeletal TB in the pediatric population: an illustrated review
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Purpose: 1. To illustrate the typical and atypical MRI features of musculoskeletal tuberculosis (TB). 2. To describe the pathophysiology of TB and its status as a disease entity in the current era. 3. To identify key imaging features of tuberculous lesions and to provide a differential diagnosis.
Materials and methods: A retrospective analysis of clinically suspected cases of musculoskeletal TB was done. Radiological studies including plain radiographs and MRI of the patients were reviewed. These were correlated with the final diagnosis confirmed on histopathology.
Results: TB is widely prevalent and difficult to diagnose only on the basis of clinical features. Musculoskeletal TB, including spondylitis, osteomyelitis and arthritis has characteristic imaging features. It also has atypical manifestations and mimics other disease processes.
Conclusion:
1. The diagnosis of musculoskeletal TB in the pediatric population requires a high degree of suspicion.
2. With the resurgence of tuberculosis in immunocompromised patients, recognition of the MRI features of tuberculosis, can aid in the timely management of these patients.

PMS-24

Chest radiographic findings in constitutional disorders of the bone
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Purpose: Constitutional disorders of the bone (bone dysplasias, dysostoses and inherited metabolic bone disorders), although uncommon, make up a large group of conditions that can be difficult to recognise and diagnose. We aim to review and present the spectrum of musculoskeletal findings on chest radiograph that suggests the presence of a constitutional disorder of the bone.
Materials and methods: Chest radiographs are the most common pediatric radiological examination, performed for both acute and routine indications. The chest radiographs from a database of more than 400 children with known or suspected constitutional disorders of the bone were retrospectively reviewed with clinical correlation where possible. We describe the abnormalities of the chest wall, thoracic spine, scapula and shoulder girdle which can help guide a systematic approach to further assessment of the patient.
Results: A wide spectrum of findings are displayed, discussed and classified. They range from severe life-threatening rib shortening seen in thanatatophoric dysplasia to the more subtle rib findings in metaphyseal chondrodysplasias, abnormalities of the clavicle in cleidocranial dysplasia to the generalized increased bone density in osteopetrosis and pyknodysostosis.
Conclusion: Although uncommon, constitutional disorders of the bone have many features which may be evident on a chest radiograph, providing the first clue that a dysplasia or osteodystrophy is present. These diverse findings can assist the radiologist to recognise these entities and guide their further investigation and treatment.

PMS-25

Pelvic radiographic findings in constitutional disorders of the bone
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Purpose: Constitutional disorders of the bone (bone dysplasias, dysostoses and inherited metabolic bone disorders), although uncommon, make up a large group of conditions that can be difficult to recognise and diagnose. We aim to review and present the spectrum of musculoskeletal findings on pelvic radiographs that suggest the presence of a constitutional disorder of bone.
Materials and methods: Conventional radiographic examination remains the most useful means of studying the dysplastic skeleton. The pelvic radiographs from a database of more than 400 children with known or suspected constitutional disorders of the bone were retrospectively reviewed with clinical correlation where possible. We describe the abnormalities of the ilia, ischia and pubic bones, together with additional information gained from the lower spine and proximal femora, which can help guide a systematic approach to a further assessment of the patient. This multiplicity of different bones allows for a fairly thorough evaluation of skeletal modelling on this single view.
Results: A wide spectrum of findings are displayed, discussed and classified. The iliac bones may be flared (as in trisomy 21) or narrowed (as in achondroplasia). The acetabulum may be shallow (in mucopolysaccharidoses) or almost horizontal (in the achondroplasia group, in Jeune's and related disorders). There may also be characteristic features of the iliac bones such as horns (in nail-patella syndrome) or a snail shape (Schneckenbecken dysplasia). The pubic and ischial bones may show delayed or abnormal ossification (in some type 2 collagenopathies and in multiple epiphyseal dysplasia). Upper femoral modelling is often a useful indicator of epiphyseal and metaphyseal development and may give further clues.
Conclusion: Many constitutional disorders of the bone have characteristic features seen on a pelvic radiograph. These findings, which vary from subtle to pathognomonic, often occur in key areas within the pelvis, with a number of positive findings evident on a single view. These elements can assist the radiologist to recognise the abnormality and guide their further investigation and treatment.

PMS-26

Paediatric sports overuse injuries and their eponymous names
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Purpose: Imaging review of different types of paediatric sports overuse injuries. Brief exploration of the origin of their eponymous names.
Materials and methods: Competitive sports and high level exercise can lead to repetitive stress to the growing skeleton which can lead to various conditions like bursitis, tendonitis, apophysitis, stress fractures and osteochondral injuries. Common sites of overuse injury include tibial tubercle, patella, calcaneous, navicular, olecranon, lunate, thoracic spine and the metatarsals. Historically, many of these overuse injuries have been described and assigned eponymous names.
Results: We present relevant cases and imaging features which encompass the spectrum of diseases due to overuse injuries.
Conclusion: Overuse injuries are not uncommon in young sporting athletes and many of these diseases often been described on eponymous names.These conditions may be readily imaged using a number of modalities and the appropriate choice of modality coupled with accurate interpretation of the findings will aid prompt diagnosis and treatment.

PMS-27

MRI screening for idiopathic scoliosis in children—can we bend the rules?
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Purpose: To review the MR scans performed for Idiopathic Scoliosis at a tertiary children's hospital . To determine the standard recommendations by a review of the current literature. To compare our practice with any available standard practice and/or recommendations. To optimise imaging based on these findings
Materials and methods: This was a retrospective review of the MR spine examinations performed in the hospital over a year (Oct 09–Oct 10) for investigation of scoliosis. All the abnormalities seen on these scans were noted.
Results: Total number of scans for evaluation of scoliosis: 100. Of these, 63 were screening requests for idiopathic scoliosis with no other symptoms (78% overall). No abnormality was seen in 80.6%. The abnormalities detected included Spinal cord syrinx, Chiari malformation and tethered cord/filar lipoma.
Conclusion: Screening for Idiopathic Scoliosis did not reveal a significant number of abnormal pathologies. The pathologies found did not have an immediate impact on patient management. We have since optimised the imaging protocol of screening MR scans for Idiopathic scoliosis to only include limited sequences—this will minimise scanning time with no adverse impact on detection of abnormalities.

PMS-28

Imaging features of slipped capital femoral epiphysis
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Purpose: Slipped capital femoral epiphysis (SCFE) is the commonest hip abnormality in adolescence and an important cause of early osteoarthritis. Imaging is important as early diagnosis can lead to a better outcome. We aim to provide a comprehensive review of the imaging features of the condition to include diagnosis, a range of surgical treatment options and complications.
Materials and methods: A literature review was performed and imaging of relevant cases from our tertiary referral centre were studied. Selected examples are presented in this poster.
Results: The epidemiology and presentation of the condition are described. We illustrate a range of imaging findings in plain radiography and Computed Tomography. The range of surgical options including pinning, bilateral pinning, reduction and Dunn's procedure are presented. Complications of SCFE are also discussed and illustrated including pseudo-arthrosis, continuing slip, avascular necrosis and impingement.
Conclusion: SCFE is the leading cause of hip pain and morbidity in adolescence. Imaging plays an important role in the diagnosis and follow up of this condition

PMS-29

Taking the first step in paediatric foot alignment disorders: a pictorial review
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Background: Radiographic evaluation of alignment disorders in the paediatric foot can be challenging. It requires an understanding of normal foot alignment, recognition of disorders of malalignment and use of appropriate terminology.
Purpose: To describe normal foot alignment on radiograph examination. To summarise the key terms used in relation to foot alignment. To provide a pictorial review of the common disorders of paediatric foot alignment and their characteristic radiographic findings.
Materials and methods: We outline the assessment of alignment, including hindoot, midfoot and forefoot, in the normal foot on standard radiographs. Alignment can be assessed understanding the relationship of the foot bones to one another and by drawing axial lines through individual bones on anteroposterior and lateral views. We summarise the terminology commonly used to describe abnormalities in foot alignment. We present a pictorial review of the main alignment disorders and summarise their key radiographic findings, including Congenital clubfoot (Talipes Equinovarus), Hindfoot valgus and varus deformities, Congenital Vertical Talus Forefoot adduction, abduction, varus and valgus Skewfoot Pes planus, pes cavus and rockerbottom foot Congenital tarsal coalition.
Conclusion: We have compiled a pictorial review of the paediatric foot including normal alignment, key terminology of congenital abnormalities and the radiographic findings of the main alignment disorders.

PMS-30

Newborn compartment syndrome—an infrequent and not well known diagnosis
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Purpose: We report on a rare disease of newborn infants which is usually not diagnosed on time, despite the fact that sufficient therapeutic management can only be applied if the affection is recognized in the acute phase. Typically sequelae develop resulting in Volkmann – contracture.

Materials and methods: In the department of hand surgery in our hospital, the team has specific experience with the treatment of these infants and children. The imaging findings of these children are demonstrated and the specific changes on epiphysis, metaphysis and position of hands and forearm bones are illustrated. The history and pathophysiology as well as the evolution of the appearance are discussed and early findings are shown. The therapeutic efforts cannot result in a restitution ad integrum if therapy starts in the state of contracture.
Results: The aim is improvement of function and therefore examinations are necessary to detect which muscle groups are damaged to show a useful way of operating. A further goal of the paper is to render more pediatric radiologists familiar with the entity so as to increase the chances of recognizing the forearm compartment syndrome in a newborn in the acute phase and induce early operative treatment with the possibility of complete recovery.
Conclusion: If the entity of newborn compartment syndrome is more widely known, there will be a chance to treat affected patients with more success.

PMS-31

Diagnostic imaging in suspected child abuse in Germany—preliminary results

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Purpose: In the event of suspected child abuse, diagnostic imaging plays a major role to substantiate the conjectures. In the event of skeletal injuries, an X-ray survey serves as the gold standard. National guidelines issues by the scientific societies describe the process of producing a usable survey. From recent scientific publications it is known that the standard is not always adhered to. This prospective study assesses the quality of X-ray surveys with regard to recommendations of the Society of Paediatric Radiology (GPR) of Germany.
Materials and methods: The prospective study analysed data from October 2009 to October 2010, including patients aged 0–3 years for whom child abuse was suspected and X-ray examinations were produced. Data were collected from university and community hospitals located in Germany. The quality of the X-ray examinations were judged on recommendations issued by the Society of Paediatric Radiology (Germany), the American College of Radiology (USA), and the Royal College of Radiologists and Royal College of Paediatrics and Child Health (UK).
Results: 32 cases were included. 1 case did not meet the inclusion criterion (DICOM conformity). 211 single-shot exposures from 31 patients were evaluated. Only 3 cases were in complete accordance with the GPR guidelines. In 4 cases a full body exposure ("babygram") was obtained. In 90 exposures (42,65%) the assessment was hampered by overlaying obstacles, e. g. fixating hands, diapers. Only in 60% of the male patients gonadal shielding was used. In 14 of the 31 cases at least one fracture was proven. The total number of fractures was 63.
Conclusion: Diagnostic imaging in compliance to national guidelines in cases of suspected child abuse is not guaranteed in hospitals in Germany. Although the recommendations of the scientific societies are known, X-ray surveys show minor and major deviations from the guidelines. Continuing education with regard to obtaining the highest standards in imaging seems to be necessary. Transnational research on the topic is deemed crucial to achieve a better quality of medical care in this sensitive field of medicine.

PMS-32

Ultrasound assessment of lumps and bumps in the paediatric extremities

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Background: Ultrasound is our modality of choice for the initial assessment of superficial lesions of the upper and lower limbs in paediatric patients. It is quick, non-invasive, with no radiation dose or requirement for general anaesthetic. Interaction with child and carer allows the operator to gain a detailed history, provide reassurance and alleviate anxiety. Our department is receiving an increasing number of requests, mainly from GPs, Orthopaedic surgeons and Paediatricians for evaluation of extremity lumps and bumps. The purpose of this pictorial essay is to raise awareness amongst radiologists to the wide spectrum of lesions encountered in children in a general hospital setting. Many extremity lesions also occur in adults, whilst others are more common in children. We will provide examples of traumatic, infective and inflammatory lesions; vascular and lymphatic malformations; developmental and acquired cysts and pathologies such as neural tumours, pilomatrixoma, osteochondroma and giant cell tumour of the tendon sheath. Where educationally appropriate, correlation with other imaging modalities, such as MRI, will be included. In our experience, there is a time effective triage element to ultrasonic assessment of these peripheral lesions. The dynamic scan allows us to ascertain the presence of a lesion, its location and morphological characteristics. The radiologist is well placed to guide the referrer towards the most appropriate future management of the patient, be it: reassurance from the GP; more complex imaging investigations; referral for surgical opinion or evaluation by a paediatric tertiary referral centre.

PMS-33

Imaging of growing joints using synchrotron light

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Purpose: This project aims to demonstrate the utility of diffraction enhanced imaging (DEI), using a synchrotron light source, as a non-invasive method to demonstrate bone, cartilage and soft tissue detail in healthy and inflamed joints during growth. By establishing technical and imaging protocols for joint DEI, this project will guide the development of new research tools to improve understanding and management of inflammatory and degenerative joint diseases.
Materials and methods: Imaging was performed at the Canadian Light Source Biomedical Imaging and Therapy (BMIT) beamline. Medial oblique views of a 4 week old explanted piglet knee were captured using the Diffraction Enhanced Imaging technique at an X-ray energy of 40keV. These images were acquired using a Photonic Science detector with field of view 74.9 G 49.9 mm and effective pixel size of 18.7 mm. In addition, a 3 mm diameter articular cartilage-through-to-bone core from 1 joint was studied in CT mode at 20 keV photon energy. The CT imaging was done with AA-40 beam monitor coupled to Hamamatsu C9300-124 CCD camera which resulted in field of view 14′ 5 mm and effective pixel size of ~4.5 mm.
Results: DEI on the intact 4 week old piglet knee joint generated clear images of bone and of cartilage. CT of the cartilage-through-

to-bone core yielded detailed images of bone and of articular and growth plate cartilage (Figure).
Conclusion: This preliminary study supports that synchrotron technology has potential as an innovative tool to improve understanding, diagnosis, monitoring and management of inflammatory arthritis during growth. Our results are particularly significant in that growth plate cartilage has never before been identified with X-rays. The results will guide refinements to the imaging protocol and the future development of synchrotron technology to clarify pathogeneses and to evaluate pharmacotherapeutic and bioengineering technologies relevant to inflammatory and degenerative joint diseases.

PMS-34

Digital stitching of scoliosis films—the importance of evaluating the source images prior to making a final diagnosis

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Purpose: We wish to describe diagnostic mistakes that can be made because of errors in the digital stitching of source images to create a single image to evaluate scoliosis. We also measured the incidence of such errors.
Materials and methods: At our institution, Philips software is used to stitch the source chest and abdomen images together into a single scoliosis spine image. 86 consecutive recent digitally stitched frontal and lateral scoliosis films were reviewed and compared to the source images to differentiate stitching artifact from true pathology. The incidence of a stitching error resulting in an abnormality which could not be confirmed on the source images was calculated. Subgroups were analyzed based on the presence/absence of spinal surgical hardware and standing/supine technique.
Results: 14 exams (16%) had stitching errors that could result in a false diagnosis if not correlated with the source images. The false diagnosis included vertebral subluxation and structural vertebral abnormality. Nine errors (64%) occurred on the lateral projection, 4 (29%) on the frontal projection and 1 (7%) had an error on both projections. 2 (14%) of the errors occurred in patients with spinal hardware, 8 (57%) occurred on an upright exam and the remaining 6 (43%) were supine. There was no significant difference in error rate with the presence or absence of hardware (p=0.73) or patient positioning (p=0.34).
Conclusion: Errors occur from stitching two source images. 16% of our digital scoliosis exams have stitching errors that could result in a false diagnosis of spinal pathology. The error rate is not influenced by the presence or absence of spinal hardware (p=0.73), nor is it affected by patient positioning (p=0.34). Our results stress the importance of correlating abnormalities on the stitched views with the exam's source images.

PMS-35

Supracondylar fractures of the pediatric elbow—a simplified approach

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Purpose: This is an educational exhibit designed for senior radiologists who are involved in teaching trainees that will give them a structured design in how to describe the relevant anatomy and focus on this common fracture. For trainees, this will teach this important entity in a easy to remember manner.
Materials and methods: The structure of the poster will have multiple headings as follows:
- Anatomy-this will be focused on the elbow
- Epidemiology of this fracture
- How old?-this section will focus on the ability to determine patient ages based on ossification centers development
- The Gartland Sytem-a description of the various types with associated examples in describing supracondylar fractures
- Common Lines-this is a review of common lines including the Anterior Humeral Line, Radiocapitellar line, and the Baumann angle
- The Fat Pad-What is it? How to use it? The pitfalls of the Fat Pad sign.
- Management-understand the surgical management based on whether it's a flexion or extension injury.

Conclusion:
- The ability to recognize supracondylar fractures and how to appropriately grade them for the surgeon
- The ability to understand secondary signs to aid in the diagnosis
- The ability for a senior radiologist to take this knowledge in the presented manner and teach it effectively in a structured manner.

PMS-36

Pediatric foot alignment

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Purpose: The purpose of this educational exhibit is to teach the audience how to evaluate the pediatric foot for normal and abnormal alignment. Abnormalities discussed include, but are not limited to, talipes equinovarus (congenital clubfoot), planovalgus, and vertical talus.
Materials and methods: Clinical scenarios and radiographs will be used to orient the learner to the evaluation of pediatric foot alignment. Practice questions are included at the end of the presentation to assess understanding of the subject matter.
Results: Radiographs are a useful tool for assessing alignment disorders of the pediatric foot. After viewing this educational exhibit, the learner will be able to clarify the description and assessment of alignment disorders of the foot and characterize and describe anomalies of the foot.
Conclusion: Malalignment of the bones of the foot may present a complex diagnostic problem for radiologists. In this exhibit, multiple cases illustrating common and a few uncommon abnormalities will be presented. Before more advanced imaging such as ultrasound, CT, and MRI are considered, conventional radiographs are initially obtained in a variety of acquired and congenital disorders of the foot.

PMS-37

Pediatric cartilage imaging

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Purpose: Cartilage development has a profound impact on musculoskeletal growth. The objective of this exhibit is to offer insight into the maturation of hyaline cartilage through magnetic resonance imaging.
Materials and methods: We will begin by briefly describing the molecular make up of hyaline cartilage. We will then follow with basic principles to optimize hyaline cartilage imaging. The remainder of the exhibit will focus on the MR appearance of distinct histological types of hyaline cartilage, normal variations in cartilage development, and the sequela of cartilage injury on normal skeletal development.
Results: The developing cartilage has distinct and characteristic MR appearance. This educational exhibit will teach the viewer about normal and abnormal pediatric cartilage appearance.
Conclusion: Identifying the normal and abnormal appearance of hyaline cartilage will offer a more complete understanding of skeletal maturation, and will help us avoid mistakes in image interpretation.

PMS-38

Pediatric musculoskeletal infectious and inflammatory conditions

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Purpose: The purpose of this educational exhibit is to discuss and present radiologic images of pediatric infections and inflammatory conditions such as osteomyelitis, chronic recurrent multifocal osteomyelitis, juvenile idiopathic arthritis, and senronegative spondyloarthropathies.
Materials and methods: This exhibit will present multiple examples of infectious and inflammatory musculoskeletal conditions in the pediatric population. Also discussed will be important clinical findings, appropriate imaging methods, and helpful diagnostic clues.
Results: By viewing this educational exhibit, the audience will gain a more thorough understanding of pediatric musculoskeletal infections and inflammatory conditions.
Conclusion: MSK infections & inflammatory disorders in the pediatric population are commonly encountered, affecting the bones, cartilage, muscle, soft tissues and joints. Imaging plays a key role in the evaluation of patients with known or suspected musculoskeletal infection or inflammation. After thorough clinical examination and biochemical assessment, the imaging evaluation traditionally begins with plain radiography. Though neither very specific nor sensitive, plain films still play a crucial role in narrowing the differential diagnosis and helping us to select the next most appropriate imaging study. Moreover, they are readily available and relatively inexpensive to perform. Additional imaging studies include ultrasound (US), computed tomography (CT), Nuclear medicine, and MRI. Arguably, magnetic resonance imaging is often the best imaging modality to diagnose both early and chronic infectious/inflammatory conditions.

PMS-39

Essentials of pediatric elbow trauma

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Background: Pediatric elbow trauma is challenging due to the complex nature of the growing skeleton. The objective of this exhibit is to present the essential anatomy and pathology needed for radiographic evaluation of pediatric elbow trauma. We will begin by reviewing basic anatomy including the development of secondary ossification centers. We will then follow with description of radiographic landmarks needed for orientation. The remainder of the presentation will focus on discussing acute and chronic elbow injuries sustained, including mechanisms, imaging manifestations, and treatment. Modalities depicted include radiographs, MRI and ultrasound.
Purpose: After viewing this educational exhibit, the participant will be able to:
1. Describe the normal developmental anatomy of the pediatric elbow.
2. Utilize key radiographic landmarks and relationships needed for systematic interpretation in the trauma setting.
3. Characterize the common acute injuries to the pediatric elbow.
4. Characterize the common chronic overuse injuries to the pediatric elbow.
Results: The proposed exhibit will address
1. Normal developmental anatomy of the pediatric elbow, including the sequential appearance of secondary ossification centers.
2. Radiographic relationships and landmarks including the anterior humeral line, radial head-capitellum line, Baumann angle, and the "fat pad" sign.
3. Common acute injuries including supracondylar humerus fracture, lateral condylar fracture, medial epicondylar fracture, posterior dislocation and radial head subluxation.
4. Common chronic injuries including "little leaguer's elbow," osteochondritis dissecans and Panner's disease.
Conclusion: Radiographic evaluation in the acute setting requires firm understanding of developmental anatomy, radiographic landmarks, and the common injury patterns. Both radiographs and MRI are vital tools for diagnosing chronic overuse injuries in adolescent athletes.

PMS-40

Beyond the supracondylar fracture: a pictorial review of pediatric elbow pathology

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Purpose: We present a pictorial review of less common conditions involving the pediatric elbow, with particular emphasis on magnetic resonance imaging (MRI).
Materials and methods: We reviewed imaging studies of the elbow in pediatric patients, aged 1–18 years. Images included plain radiography, computed tomography, magnetic resonance imaging (MRI) as well as MR arthrography. The myriad of interesting conditions imaged included infective, neoplastic, post-traumatic conditions, as well as congenital abnormalities. These included acute lymphoblastic leukemia (ALL), eosinophilic granuloma, lymphoma, osteomyelitis, cat scratch disease, post traumatic myositis ossificans, UCL tear, trapped medial epicondyle, non accidental injury, osteochondritis dissecans, hemangioma, manifestation of renal rickets, TAR (thrombocytopenia absent radius syndrome), Morquio's syndrome, and osteochondroma. Some of these conditions were demonstrated on multiple imaging modalities.
Conclusion: We present a pictorial review of less common conditions involving the pediatric elbow, with particular emphasis on MR imaging.

PMS-41

MRI of the pediatric hindfoot—a pictorial review

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Purpose: Hindfoot pathology is common in the pediatric population.While many hindfoot abnormalities can be diagnosed by conventional radiography, MRI is frequently required to either confirm the radiographic diagnosis or demonstrate radiograph-occult abnormalities. The purpose of this pictorial review is to illustrate the MRI appearances of various hindfoot abnormalities in children for the Pediatric Radiologist.
Materials and methods: MRI examinations of the hindfoot in children (less than 18 years of age) were identified by searching institutional Department of Radiology electronic medical records. A variety of hindfoot abnormalities were documented and pertinent images were selected for presentation. Relevant patient demographic and clinical information were also reviewed and recorded.
Results: We identified numerous pediatric hindfoot abnormalities by MRI. These hindfoot abnormalities will be organized and presented as follows:
1) congenital/developmental (for example, calcaneonavicular coalition, talocalcaneal coalition, and accessory soleus muscle);
2) infection/inflammatory conditions (for example, osteomyelitis, septic arthritis, hemophiliac arthropathy, juvenile idiopathic arthritis, retrocalcaneal bursitis, and avascular necrosis);
3) trauma (for example, talar osteochondral lesion, calcaneal stress injury/fracture, calcaneal apophysitis, and impingement syndrome); and
4) neoplasm/benign masses (for example, unicameral bone cyst, intraosseous lipoma, osteoid osteoma, chondroblastoma, and ganglion cyst). Normal MRI hindfoot anatomy will also be illustrated.
Conclusion: MRI is very useful for the evaluation of pediatric hindfoot pathology. By reviewing this exhibit, the Pediatric Radiologist should become aware of the MRI appearances of common hindfoot abnormalities.

PMS-42

Chronic recurrent multifocal osteomyelitis: an imaging review

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Purpose: Chronic recurrent multifocal osteomyelitis (CRMO) is anautoinflammatory disorder of children and young adults characterized by multifocal recurrent nonbacterial osteomyelitis. The purpose of this presentation is todescribe clinical, epidemiologic, histologic and imaging features of CRMO.
Materials and methods: 25 patients with proven CRMO case were referred to our tertiary care institution between 2003 and 2008 and reviewed for imaging characteristics including CT and MRI findings.
Results: Clinical, epidemiologic, and histologic features are discussed. Imaging features involving tubular bones, clavicle, spine, pelvis and mandible are presented in detail.Characteristic distribution of involvement is discussed with differential diagnosis.
Conclusion: Radiologists are often the first to suggest a diagnosis of CRMO given its characteristic radiographic appearance and distribution of disease. Radiologists should be familiar with the typical imaging findings of CRMO to prevent unnecessary biopsies and long-term antibiotic treatment in children with CRMO.

PMS-43

Radiography of pediatric elbow fratcures—a primer

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Purpose: Elbow fractures are exceedingly common in children; however, interpretation of elbow radiographs is challenging due to the anatomic complexity of the elbow, differing patterns of fracture and varying patient age. The purpose of this educational poster is to review the role of radiography in the evaluation of pediatric elbow injuries and to illustrate common and uncommon injury patterns.
Materials and methods: Department of Radiology electronic medical records were searched to identify elbow fractures in children. Radiographs and medical records were reviewed.
Results: Normal radiographic pediatric elbow anatomy is illustrated using radiographs. Focus is placed upon proper understanding of the changing radiographic appearance of the elbow with skeletal maturation. Common patterns of elbow fracture are illustrated with diagrams and radiographs. Radiographic findings that affect surgical and non-surgical management are discussed. Examples of less common fractures are also included.
Conclusion: Radiography of pediatric elbow fractures is challenging. By viewing this exhibit, the learner will have an organized approach to diagnosis based on normal anatomy and common patterns of injury.

PMS-44

Compressed sensing 3D knee MRI

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Purpose: Volumetric (3D) MRI of joints has been limited to date by suboptimal resolution of reformatted images. We investigate whether compressed sensing (CS) 3D FSE knee MRI enables thinner slices with improved quality of reformatted images.
Materials and methods: A 3D FSE sequence was modified for compatibility with both parallel imaging and CS reconstructions by enabling poisson-disc k-space sampling. 24 consecutive pediatric patients referred for knee 3T MRI with an 8 channel knee coil also underwent proton density 3D FSE with primary "slices" in the sagittal plane. For 12 patients, 2×2 (total of 4) acceleration was used to obtain 1 mm slice thickness, whereas 2.2×2.2 (total of 4.84) acceleration for 0.8 mm slices was used for the next 12 patients. Data were then reconstructed with parallel imaging (ARC) and a CS algorithm (L1-SPIRiT). 3D images along with routine 2D FSE images were reviewed on a workstation with multi-planar reformation capability (Osirix). For each subject, 12 anatomic structures were evaluated on both 3D ARC and CS images by two radiologists on a five point scale. Further, quality of delineation of those anatomic structures was compared between 3D CS and 2D FSE images on a seven point scale. Wilcoxon rank-sum test assessed whether ARC

and CS images are equivalent. Kruskal-Wallis test assessed whether the relative quality of delineation of structures on 3D images is unchanged with higher acceleration.
Results: CS images were superior to ARC images for all structures except for the lateral collateral ligament (LCL) and the medial retinaculum (both for one reader), with $p<0.05$ for all other cases (Wilcoxon rank-sum test). The relative performance of 3D to 2D was unchanged at higher acceleration for most structures. However, thinner slices enabled by higher acceleration better delineated the MCL and LCL for both readers and the medial retinaculum for one reader ($p<0.05$), though still not as well as 2D FSE. *Conclusion:* Thinner slices afforded by CS improves 3D knee MRI, particularly for delineation of structures primarily evaluated on reformatted images (MCL, LCL, medial retinaculum). Further improvement may be required for delineation of structures on reformats equivalent to that of 2D FSE.

PMS-45

Deficiency of interleukin-1-receptor antagonist syndrome: a radiologic mimicker of non-accidental trauma

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Purpose: Since 1946 when Dr. Caffey first noted the association of long bone fractures in young children with chronic subdural hematomas, pediatric radiologists have helped to characterize and expand the many radiological abnormalities found in non-accidental trauma (NAT). Additionally, there have been many disorders described which can mimic NAT. We present the case of a 7-week-old boy with deficiency of interleukin-1-receptor antagonist (DIRA) syndrome, a newly identified immunologic disorder which can mimic NAT and has yet to be described in the radiologic literature.
Materials and methods: The child presented to the emergency department with abdominal pain, vomiting, fever, and leukocytosis with neutrophilia. Previous chest radiograph at one month of age was normal. However, repeat radiographs at 7 weeks-of-age demonstrated new periostitis of multiple bilateral anterior ribs, the proximal left femora, and the medial left clavicle. Due to the multiplicity, NAT was a diagnostic consideration. However, with the additional clinical findings of dermatitis and peri-articular swelling, the radiographic abnormalities were felt to be related to an underlying auto-inflammatory condition. Confirmational genetic testing supported the diagnosis of DIRA syndrome.
Conclusion: This paper presents the clinical and imaging findings of DIRA syndrome, a newly described immunologic disorder. Pediatric radiologists should be aware of this inflammatory condition because its radiologic findings, which include multifocal osteitis of ribs and long bones, can be mistaken for NAT.

PMS-46

Imaging spectrum of winter sports injuries in children

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Purpose: Winter sports are an increasingly popular form of recreational activity among the pediatric population. It is estimated that up to 75% of children participate in at least one form of snow related activity. Given the ability to attain high speeds, relative lack of control, and the potential for collisions it is not surprising that snow related activities can and do result in injury. There have been many descriptive studies of injuries in children and adolescents; however, there has not been, to our knowledge, a study focused on the array of imaging findings than can be seen as the result of winter sports related injuries in the pediatric population. Therefore, we submit a review of the common and characteristic injuries that occur in children and adolescents with an emphasis on imaging.
Materials and methods: We performed a keyword search of radiology reports from January 1, 2000 through December 31, 2008. Keywords included: skiing, snowboarding, ice skating, sledding, and ice hockey. The reports were perused for injuries secondary to a winter sport activity and were recorded in a database. Concurrently, a search of the Cincinnati Children's Hospital Medical Center Trauma Registry during the same time period was performed which included all sports related injuries presenting to our hospital system as well as a detailed search for those patients with winter sport related injuries. A keyword search using the same parameter was also performed at Primary Children's Medical Center, Salt Lake City, UT for additional imaging examples.
Results: During the examined time period, 3,579 patients presented to our hospital system with a winter sport related injury. This represented approximately 15% of all sports related injuries. Of the patients presenting with a winter sport related activity, 14% were found to have an abnormal imaging examination.
Conclusion: Winter sports are a popular activity among children and adolescents and are not an infrequent presentation for an emergency room related visit. Therefore, radiologists should be familiar with the imaging features and injury patterns seen in this patient population.

PMS-47

Autoinflammatory bone disorders: clinical and radiologic findings

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Purpose: To describe the clinical features and imaging of the most common autoinflammatory disorders in which bone is the primary inflammatory target. Autoinflammatory disorders are characterized clinically by recurrent episodes of inflammation without evidence of the typical features of autoimmune diseases such as high titer autoantibodies or autoreactive T-cells.
Materials and methods: We reviewed the updated literature of autoinflammatory bone disorders and collated available imaging.
Results: We found the following disorders now considered to be autoinflammatory bone diseases: Cryopyrin-associated periodic syndrome(CAPS), Deficiency in IL-1 receptor antagonist (DIRA), Chronic recurrent multifocal osteomyelitis (CRMO), Cherubism, and Synovitis acne pustulosis hyperostosis osteitis (SAPHO). Epiphyses of long bones are usually affected in Neonatal onset multisystem inflammatory disease (NOMID) with hyperplasia and osteoporosis as its characteristic bone lesions. DIRA typically affects anterior ribs ends, methaphyses of long bones and vertebrae but other bones may be involved, usually with osteolytic lesions and periostitis. CRMO findings in bones are osteolytic lesions with surrounding sclerosis usually in the metaphyses of long bones, clavicle, vertebrae and pelvis. Cherubism affects mainly the maxilla and rarely the ribs, with multillocular cystic- appearing lesions. The chest

wall, clavicles, sternum and vertebrae lesions are common in SAPHO, with osteitis, hyperostosis with cortical thickening, periostitis and ligamentous ossification. Although bone is the primary inflammatory target, these disorders are often associated with other systemic and local inflammation.
Conclusion: Osteo-articular lesions are common clinical manifestations of these rare childhood disorders. The discovery of their ongoing genetic basis continues to reveal key pathways that regulate organ specific inflammation and has led to the development of novel therapeutic strategies, where images may be of value.

PMS-49

Radiologic survey of brittle bones in neonates

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Osseous developmental in neonates depends upon many factors, including vitamins, minerals, and hormones. Metabolic bone disease in the neonate includes osteopenia of prematurity, Menkes disease, hypophosphatasia, primary hyperparathyroidism, and prostaglandin periostitis. This case review will allow recognition of the distinguishing radiologic findings in five different neonatal metabolic bone diseases. Osteopenia of prematurity is the inability of the premature skeleton to attain optimal calcium and phosphorus levels. The majority of the mineralization of the skeleton occurs in the third trimester of the pregnancy. Generally, the neonates affected are less than 32 weeks gestation and weigh less than 1500 grams. The radiologic findings include diffusely hypomineralized osseous structures and acute or healing fractures. Menkes disease, a neurodegenerative X-linked condition is caused by impaired copper transport. Osteopenia, fractures, and congenital bony deformities can be seen. Other findings include the presence of wormian bones, metaphyseal spurring and widening, diaphyseal periosteal reaction, and posterior scalloping of the vertebral bodies. Hypophostasia is caused by an inherited deficiency in alkaline phosphatase, resulting in an accumulation of pyrophosphate, which prevents proper mineralization. In the neonatal subtype, a classic radiologic finding consists of focal regions of non-ossified cartilage in the long bone metaphyses. Findings include short, irregular long bones with bowing and fractures. Primary hyperparathyroidism is usually associated with maternal hypoparathyroidism, causing parathyroid gland hyperplasia in the infant. The radiographic findings present as osteopenia and subperiosteal osseous resorption, with fractures also seen.

PMS-51

Pilomatricoma in chldren: imaging findings

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Background: Pilomatricoma is an uncommon benign tumor arising from pluripotential precursors of hair matrix cells. It accounts for 0.12% of all cutaneous neoplasms, most commonly affecting children and adolescents. The most common location is the head and neck, but lesions can be found on any hair-bearing body site. Pilomatricomas usually present as a slow-growing, solitary, subcutaneous nodule, but multiple tumors have also been described, in which case they are typically familial. Its clinical and histopathological features are well documented, but there is a paucity of information regarding its imaging characteristics and most radiologists are not familiar with this entity.
Purpose: To describe the imaging features of pilomatricomas in a relatively large series of pediatric patients in order to assess imaging features that may allow an accurate diagnosis.
Materials and methods: A retrospective analysis of all cases of suspected or histologically proven pilomatricoma that had ultrasonography (US) between March 1, 1999 and November 30, 2010 at our institution was performed. The US images were reviewed to assess size, shape, location, echogenicity and vascularity of the lesion. Clinical information regarding gender, age at presentation and indication for examination was also collected.
Results: A total of 28 patients (14 male/14 female) had US findings compatible with pilomatricoma, 10 of which were proven on histology. The tumor was located in the head and neck in 79% of cases, upper extremity in 14 % and lower extremity in 7%. The size of the tumor ranged from 2.8 mm to 19 mm. The most common sonographic appearance was a well marginated, solid, ovoid, heterogeneous subcutaneous nodule with internal scattered hyperechoic foci suggestive of calcifications. On color Doppler evaluation, vascularity was absent or minimal, mainly peripheral.
Conclusion: Most pilomatricomas have a typical US appearance. Recognition of these imaging features may allow diagnosis and guide management.

PMS-52

MR arthrography of the shoulder in children: a pictorial review

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Introduction: Increasing numbers of children are competing in high level sports which are often year-round. Shoulder joint injuries are becoming more common in the pediatric population, particularly traumatic and chronic repetitive injuries.
Purpose: To describe techniques employed at our institution for both the shoulder arthrogram and the MR arthrogram of the shoulder. To demonstrate normal anatomy, normal variants, and common pathology of the glenohumeral joint with arthroscopic correlation.
Materials and methods: Our cases come from a large tertiary referral center with the bulk of our patients sent from a busy Pediatric Sports Medicine Clinic. The cases reviewed are from July 2008 to present.
Results: Technique: Shoulder arthrogram is performed prior to MR arthrography of the shoulder. Imaging principles with a description of our protocol and imaging options will be described. Normal Anatomy and Normal Variants: A systematic approach to the evaluation of the labrocapsular ligamentous complex of the shoulder will be described with normal anatomy and important variants highlighted. Pathology: 1) Rotator Cuff: tendinopathy, tears; 2) Glenoid Labrum: Anterior labrum lesions (cartilaginous and osseous), Posterior labrum, and Superior labrum; 3) Capsular abnormality; 4) Humeral head: Hill-Sachs deformity. Illustrative arthroscopic images will be included where it helps with an understanding of the abnormality.
Conclusion: MR arthrography of the Shoulder is our current imaging gold standard for assessment of shoulder joint pathology

when routine MRI shoulder is inconclusive or glenoid labral pathology is suggested on clinical exam. It is increasingly done in the setting of sports injury prior to arthroscopy and/or surgery. A working knowledge of technique in MR arthrography, Normal shoulder anatomy, and common pathology seen on MR arthrography is important for appropriate patient care.

PMS-53

A tour of rickets and vitamin D

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Rickets results from altered vitamin D metabolism or insufficient calcium or phosphorous which impairs the function of vitamin D. Typical rachitic changes include widening and irregular physeal calcification and metaphyseal fraying and broadening, often seen in the proximal humeral physes and anterior rib ends on chest radiographs of affected infants. Demineralization and blurring of the epiphyseal cortical outline can be seen. Ambulating children can develop genu varum.This poster offers a brief tour of rickets, addressing a variety of etiologies and the corresponding radiographic appearances including: congenital rickets, nutritional rickets, familial hypophosphatemic rickets, renal osteodystrophy and osteopetrosis with rickets.Congenital rickets is often attributable to maternal causes such as nutritional deficiency, poorly controlled hyperparathyroidism or renal insufficiency. The congenital form presents earlier than one would expect to see nutritional rickets.Nutritional rickets results from deficient vitamin D levels due to inadequate ingestion of vitamin D or insufficient exposure to sunlight. Children are at increased risk during winter months or if they live in high northern latitudes. Children with dark skin pigmentation are also at increased risk due to high quantities of melanin in the skin which absorb the ultraviolet radiation that normally serves to create natural vitamin D.Familial hypophosphatemic rickets results from phosphate wasting by the proximal renal tubules with normal levels of active vitamin D. Swischuk and Hayden describe two patterns in this disorder. In Type A, rachitic changes of the knee exceed those at the wrists. In Type B, short, squat long bones and coarse bone trabeculation affect the axial skeleton.Renal osteodystrophy is rickets with osteomalacia and secondary hyperparathyroidism due to chronic renal disease. Glomerular and tubular dysfunction contribute to the phosphorous retention and hypocalcemia that cause rickets. The body's attempt to counteract the hypocalcemia results in hyperparathyroidism, manifesting as osseous demineralization, subperiosteal and endosteal resorption and osteopenia.

PMS-54

Torticollis: a pain in the neck

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Purpose: To review the radiologically apparent causes of torticollis in infants and children.
Materials and methods: A retrospective review of our imaging database was performed to identify studies obtained in pediatric patients presenting with torticollis.
Results: Multiple causes of torticollis were elucidated by Ultrasound, MRI, Fluoroscopy, and CT. Etiologies include: foreign body in the hypopharynx, osteomyelitis, fibromatosis colli, lymphoma, rotary subluxation, CNS infection, Grisel's syndrome, cervical syrinx, spinal cord tumors, Lemierre's syndrome, Sandifer's syndrome, lymphadenitis, and retropharyngeal abscesses. Surgical correlation was included where available.
Conclusion: Torticollis is a relatively common complaint in infants and young children. Radiologic evaluation—including CT, Ultrasound, MRI, and even Fluoroscopy—can be very helpful in determining the underlying cause of the patient's twisted neck and in guiding treatment.

PMS-55

So what's in a hand?: a multimodality pictorial review of congenital hand anomalies

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When children with idiopathic or congenital anomalies of the hand are referred for imaging, it is important for the radiologist to succinctly and accurately describe these findings, as well as have a basic understanding of the clinical or surgical significance of them. This pictorial review will illustrate various common and rare anomalies of the hand including but not limited to brachydactyly, longitudinal epiphyseal bracket deformity, symphalangism, syndactyly, polydactyly, syndactyly, and clubhand. Orthopedic surgical perspective of these findings will also be provided when relevant.

PMS-56

MRI of angiomatoid fibrous histiocytoma with pathologic correlation

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Background: Angiomatoid fibrous histiocytoma is rare soft tissue tumor of uncertain differentiation that most commonly affects children and young adults. Although malignant, it is of overall good prognosis due to low rate of recurrences and metastases. There is little information in the literature regarding MRI appearances of angiomatoid fibrous histiocytoma.
Purpose: Review and illustrate MRI findings in angiomatoid fibrous histiocytoma and correlate with clinical and pathology findings.
Materials and methods: Retrospective analysis of MRI findings in 4 children with angiomatoid fibrous histiocytoma. Patients' clinical findings and histology findings were also reviewed.
Results: All 4 children were male with an age range of 16 months–14 years. All 4 children presented clinically with a slowly enlarging soft tissue mass, located in the shoulder, upper arm, forearm and ankle respectively. Two children presented additionally with systemic symptoms of 6 months and 1 year duration, including fever and weight loss. The lesion size ranged from 1.4 cm to 7.8 cm in maximum dimension. Three of the children had MRI findings that are considered characteristic of angiomatoid fibrous histiocytoma: intralesional blood-filled cystic spaces with fluid-fluid levels and enhancing fibrous pseudocapsule. Two showed hemosiderin deposition. These findings correlated well with histopathology. In the remaining child, who presented with a mass associated with metastatic lymphadenopathy, the findings on MRI were nonspecific.

Conclusion: There are MRI findings that although not specific may suggest the diagnosis of angiomatoid fibrous histiocytoma, including intralesional cystic spaces with fluid-fluid levels, hemosiderin deposition and enhancing fibrous pseudocapsule. A history of systemic symptoms in the presence of a soft tissue mass may also be a hint for the diagnosis of angiomatoid fibrous histiocytoma.

PMS-58

Lawn mower injuries in children

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Purpose: To increase awareness of injuries in children caused by lawn mowers and familiarize the radiologists with the spectrum of imaging findings.
Materials and methods: From the radiology information system of a tertiary children's hospital, we retrieved data from 2003–2010 on all patients younger than 18 years of age with the words 'lawn mower' included in the reports. All pertinent images were then reviewed and a spectrum of characteristic injuries from lawn mower traumas was selected for display.
Results: 60 children had imaging for lawn mower injuries. Severe injuries, such as extremity amputation, were more common in children younger than 9 years of age. The vast majority of children had only plain radiographs. We chose characteristic radiographs and cross sectional studies presenting a range of injuries from foreign bodies and skin lacerations to de-gloving injuries and amputations. Most injuries, as well as the most severe injuries, involved the lower extremities.
Conclusion: Children, especially those younger than 9 years of age, are at risk for severe lawn mower injuries. Plain radiographs are the most commonly utilized method of radiologic imaging to guide treatment for these injuries.

PMS-59

American football knee injuries in teenagers: a pictoral review

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Purpose: The incidence of musculoskeletal injuries in teenagers is increasing owing to increased participation and competitiveness in sports. Our purpose is to review both common and uncommon knee injuries in teenage American football players with correlative MR imaging , follow-up orthopedic management and relevant review of the literature.
Materials and methods: The selective case series will include the Morale Lavallee lesion, Stieda fracture, popliteus tendon injuries and complex mensical and physeal injuries. Clinical presentation, orthopedic management, available surgical findings and patient outcomes will be discussed. MR images are presented with available complementary modalities and diagrammatic correlation of anatomy and mechanism of injury. Diagnostic pearls complement cases when appropriate.
Results: The spectrum of pathology that will be illustrated includes avulsion injuries, meniscal tears, soft tissue trauma and injuries involving the physis.
Conclusion: MRI plays an integral role in the prompt diagnosis of knee injuries in teenage American football which helps dictate the appropriate orthopedic management. Familiarity with these conditions allows for prompt and accurate diagnosis as well as efficient care for patients requiring surgical intervention.

PMS-60

Non-traumatic vertebral column lesions in children: common to rare abnormalities, and things you do not want to miss!

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Purpose: Describe common to uncommon non-traumatic vertebral column abnormalities, utilizing MRI, CT & plain radiographs. Imaging characteristics, symptoms and clinical findings will be emphasized. Relevant imaging characteristics distinct to each condition will be organized according to vertebral location (body, post elements, pedicle, and disc) and mechanism of spread, highlighting pearls and pitfalls in differential diagnosis.
Materials and methods: Our presentation will begin with a discussion of vertebral anatomy, embryology, and development. Using multiple modalities, the normal appearance of the vertebra and bone marrow at different age intervals will be presented. An understanding of normal variants and congenital anomalies is essential and will be included in the discussion. Major categories will include inflammatory and infectious processes, neoplastic disorders (LCH, benign & malignant), vascular malformations, growth disturbance, phacomatoses, hematologic disorders (sickle cell), metabolic disorders (hyperparathyroidism), and some congenital conditions.
Results: Generation of differential diagnosis with consideration to patient age, area of vertebral column involvement and major disease category will be simplified by providing a flow chart. Best and most appropriate imaging modalities and protocols will be reviewed.
Conclusion: Diagnosis of vertebral column lesions requires an understanding of normal anatomy, variants, and development, as well as mechanisms of disease spread. Correct diagnosis of vertebral column abnormalities requires considerations of patient age, specific clinical findings, distinct imaging characteristics and selection of appropriate imaging modalities and protocols.

PMS-61

MRI evaluation of pediatric scoliosis: Where do we stand and what do we need to know?

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Purpose: This exhibit is designed to address the functional utility of MRI, with respect to scoliosis, presented from a clinical imaging perspective. Specifically, we plan to address the essential role of MRI for defining the cause of scoliosis and for pre-surgical planning. The overriding goal of this exhibit is to arm pediatric radiologists and neuroradiologists with an understanding of the utility of MRI, in a format specifically designed to provide a frame of reference that would be useful in clinical imaging practice.

Results: Scoliosis is defined as curvature of the lateral margin of the spine measuring 10° or more. Causes of scoliosis are commonly classified into four major categories: (1) congenital (2) developmental (3) neurologic (4) idiopathic. This study will also include additional causes of scoliosis that should be considered and that are better seen with MR imaging, including: (5) infection (6) genetic causes (7) bone marrow abnormalities and (8) paraspinous masses. MRI has advantages over conventional radiography in that it provides better anatomic detail. In our presentation we will highlight the utility of MRI for the preoperative evaluation of scoliosis and for detection of abnormalities that are not seen on plain films in patients considered to be idiopathic scoliosis based on plain film radiographic findings.
Conclusion: Accurate determination of the cause of scoliosis is essential for presurgical planning. This educational review describes the utility of MRI for the determination of the cause of scoliosis for presurgical planning and treatment. While all abnormal findings are of interest to the surgeon, MRI is clearly indicated for those requiring surgery. In addition, MRI is important to exclude occult causes for scoliosis that cannot be detected on plain film studies and that may be amenable to treatment.

PMS-62

Pediatric shoulder MR arthrogram in patients with shoulder instability and persistent pain

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Purpose: Shoulder pain and instability in pediatric patients, particularly those involved in overhead throwing sports, are common indications for shoulder MRI. Direct MR arthrogram (DMRA) of the Shoulder demonstrates the labrum, biceps labral complex, rotator cuff and other structures with exquisite detail and is superior to conventional MRI for delineation and detection of labral abnormalities. We have selected illustrative cases of labral abnormalities and other pathologic findings, and provided arthroscopic correlation. We also discuss the steps involved in performing the arthrogram, common mistakes, pitfalls, and "pseudo-tears".
Materials and methods: We reviewed 52 shoulder DMRAs done at our institution over the last two years. These were performed by a pediatric Radiologist under fluoroscopic guidance. The joint was injected with a 10 cc mixture of saline, gadolinium and iodinated contrast. All DMRAs were performed on a 3T magnet and included ABER (abduction and external rotation), coronal, sagittal and axial T1-weighted images (WI), and T2-WI with fat saturation.
Results: We were able to identify normal variants frequently confused with labral tears including: Glenohumeral ligament variants (usually Medium GHL), Buford complex and sublabral foramina. Common lesions identified in patients with shoulder instability and recurrent dislocations include antero-inferior labral tears with Hill Sachs fracture. In overhead throwing athletes, findings related to shoulder impingement such as posterior labral and rotator cuff tears were common. In patients with multidirectional instability a capacious joint capsule without labral tearing was frequently seen. DMRAs of patients with prior labral surgery demonstrated labral retears, loose joint bodies and synovial thickening. Correlation with arthroscopic examination was available in the majority of the cases.
Conclusion: DMRA is safe, easy to perform and superior to conventional MRI at evaluating the labrum, the BLC, GHL and other structures. DMRA provides useful pre surgical information and correlates well with arthroscopic findings.

PMS-63

Metaphyseal variations and abnormalities that can mimic fractures typical for child abuse

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Purpose: Evaluate the different metaphyseal variations and abnormalities in young children that can mimic classic metaphyseal lesions (CML) typical for child abuse.
Materials and methods: From the radiology information system, we retrieved all reports on skeletal surveys (2003–2010) for child abuse that included at least one of the following words: irregularity, step off, spur, and metaphyseal variation. All of these studies were reviewed by a Pediatric Radiologist and a Pediatric Radiology Fellow.
Results: Our poster demonstrates metaphyseal variants, including metaphyseal collar, step off, spur, and corner metaphyseal fragmentations that were followed for possible CML. We also demonstrate metaphyseal pathologies including rickets, congenital osteopetrosis, and metaphyseal dysplasia that could mimic CML.
Conclusion: An injury of CML is considered specific for child abuse; however, there are metaphyseal variations and other pathologies that should be recognized by the radiologists to prevent false diagnosis.

PMS-64

Pictorial Essay: a comparison of Panner disease and osteochondritis dessicans

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Purpose: Panner disease (PD), an uncommon osteochondrosis of the humeral capitellum, is likely due to disruption the vascular supply to the immature epiphysis. It occurs in skeletally immature children younger than 10 years of age, usually male, and commonly affects the dominant extremity. There is lateral elbow pain, tenderness, and inflammatory changes including synovitis and joint effusion. Therapy consists of reduction of joint activity and patients fully recover over several months. We found only one prior case report of PD evaluated with MRI. We wish to review the imaging findings of PD differentiating them from osteochondritis dissecans (OCD).
Materials and methods: A PACS database search revealed 3 cases occurring between 1995 and 2010. IRB approval was not necessary as there were less than 5 cases. Imaging studies and clinical notes were reviewed. Three other cases labeled as PD were reclassified as OCD as they were primarily osteochondral lesions in older adolescents.
Results: Three boys, aged 6 yr. and 10 months, 7 yr., and 10 yr. and 4 months (mean age: 8.1 (±1.9) yr.) were evaluated. Two had radiographs at the time of MRI showing irregularity, flattening, and sclerosis of the capitellum, one of them with early healing 6 months later. In the third, radiographs 5 months post MRI showed sclerosis and fragmentation. MRI demonstrated low signal intensity in the capitellum on all sequences (n=3), intact epiphyseal and articular cartilage (n=3), small joint effusion (n=2), and areas of capitellar marrow edema (n=1). A trochlear preossification center was seen in the two younger boys.
Conclusion: Radiographic findings of PD resemble other osteochondroses with fragmentation, lucency, and eventually sclerosis and healing. MRI demonstrates decreased signal intensity on all pulse sequences, with sparing of the overlying cartilage. In contrast, OCD occurs in older children related to throwing sports, involves the subchondral bone and overlying cartilage, and often progresses to instability requiring surgery.

PMS-65

Early onset scoliosis treatment with distraction lengthenable rods: normal appearance and early results

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Purpose: To understand the rationale of the treatment of very early onset scoliosis with lengthenable rods. To be familiar with the normal appearance of these rods and to be able to detect their complications.
Materials and methods: After REB approval the charts of 13 patients (7 males, 6 females) with scoliosis diagnosed before age 5 and treated with distraction lengthenable rods were reviewed.
Results: The scoliosis aetiologies were spine/ribs malformation (5 patients), juvenile/idiopathic (5), Hurler disease (1), neurofibromatosis type1 (1) and traumatic paraplegia (1). The scoliosis was dextro convex in 10 patients. Mean age at 1st surgery was 66 (±30) months. Follow-up extended over an average 29 month period (±14). The average number of surgical procedures was 5.6±3.0. To date 10 patients showed reduction of the Cobb angle (18°±10°) corresponding to 24% (±11) of correctability of the initial spinal deformity. On the contrary 3 patients showed worsening of the Cobb angle (6°±4°) i.e. 18 % (±12) of the initial Cobb angle. Four patients were free of complication. The average number of complications (rod breakage, upper claw disengaging from the rib) for the other 9 ranged from 1 to 6 (m=2.2±1.7). Of the 13 patients, 9 had pre surgical lung volume CT assessment with low lung volume in all of them, the only patient with a post procedural CT lung volume measurement showed to date limited improvement.
Conclusion: Expandable distraction rods for early onset scoliosis treatment are effective to control the spinal deformity. Unfortunately they are associated with multiple rod lengthening surgeries and complications.

PMS-66

Lesser tuberosity avulsions in adolescents

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Purpose: Isolated avulsion injuries of the lesser tuberosity of the humerus tend to occur in adolescents and are relatively rare with only ten cases having been described in the literature. Subscapularis avulsions are often missed acutely and have been misinterpreted as osteochondromas or tumors when the patient presents on followup. This study discusses five adolescents with subscapularis avulsion.
Materials and methods: Five males ranging in age from 12 to 15 years had a history of trauma. Imaging studies included radiographs and MRIs in all patients and an additional CT in one. Two of the five cases had an associated exostosis of the proximal humerus and were suspected to have a neoplasm.
Results: All cases were correctly diagnosed with subscapularis tendon avulsion. Four of the patients received surgical repair with debridement and fixation of the tendon to the lesser tuberosity with suture anchors. One patient was treated conservatively. All patients were successfully treated and recovered shoulder strength and motion upon follow up.
Conclusion: This report highlights the importance of an accurate clinical and imaging diagnosis for subscapularis tendon avulsions in the adolescent followed by appropriate management. Clinicians should have a high suspicion of lesser tuberosity avulsions in adolescents who present with loss of internal rotation and shoulder pain following injuries. In addition, an osseous fragment or exostosis along the inferomedial humeral head should suggest a subscapularis tendon avulsion rather than a tumor.

PMS-67

Pediatric muscle hernias: a clinical challenge resolved by sonography

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Purpose: Muscle hernias are the protrusion of muscle through a congenital or an acquired fascial defect. Published series have focused on this entity in adults. The purpose of this study was to evaluate the demographics, presentation and imaging findings of muscle hernias in pediatric patients.
Materials and methods: We conducted a search of all ultrasound reports with the diagnosis of muscle hernia performed over a 10-year period on patients under 20 years of age. Ultrasound was performed using a high frequency linear transducer with provocative maneuvers and dynamic scanning. Muscle hernia was diagnosed when a focal protrusion of muscle was identified though the overlying fascia. A chart review was performed to determine the reason for referral, imaging performed before and after ultrasound, and subsequent clinical course.
Results: 13 patients were diagnosed with muscle hernia by ultrasound: 9 females and 4 males, aged 3 to 19 years (mean=14.2 years). 4 were athletes, and none reported a specific inciting traumatic event. Hernias involved the tibialis anterior (8), rectus femoris (2), peroneus longus (3). There was clinical suspicion for muscle hernia in 4 patients, and vascular malformation, soft tissue mass, or cyst in the other 9 patients. 3 patients had MRI before ultrasound; 2 were interpreted as normal and one suggested a fascial defect. Dynamic imaging or provocative maneuvers such as plantar flexion, standing or squatting, were either necessary or helpful in visualizing the muscle hernia in all patients. 4 patients had surgery to alleviate symptoms. Surgery was deemed unnecessary in the remaining 9.
Conclusion: Muscle hernias are not often suspected clinically in the pediatric population. Contrary to classic descriptions, they occur over a wide range of ages, many in females, and in non-athletes without reported trauma. Ultrasound with dynamic imaging and provocative positioning is key to diagnosis, and generally eliminates the need for MRI. As defects are often asymptomatic, ultrasound reveals findings that are sufficient for diagnosis, obviating surgery in most patients.

PNE-1

MR imaging findings of enteroviral encephalomyelitis in hand–foot-mouth disease

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Purpose: To illustrate the MR imaging findings of enteroviral encephalomyelitis in hand-foot-mouth disease
Materials and methods: We have retrospectively reviewed the MR imaging findings of the three patients who were diagnosed with hand-foot-mouth disease by laboratory findings and clinical features. In all patients, enterovirus 71 was identified in the samples of the throat swab, rectal swab, or cerebrospinal fluid (CSF). The ages of the three patients who underwent MR imaging of brain ranged from 12 months to 4 years. Three patients were hospitalized with suspicious meningitis or enceph-

alitis with symptoms of fever, vomiting, lethargy, drowsy mentality, or myoclonic jerk. MR findings were analyzed.
Results: MR imaging studies of two patients with relatively severe neurologic symptoms showed T2 weighted high signal intensity in the midbrain, pons and medulla oblongata of the brain stem. Suspicious T2 weighted high signal intensity lesions showed in the upper cervical cord in two patients. On the MRI of the other patient with mild neurologic symptoms, subtle T2 weighted high signal intensity in the midbrain was detected. These findings correlated with previous reports about MR findings of enteroviral encephalomyelitis in hand-foot-mouth disease.
Conclusion: Brain stem and cervical spinal cord involvements are characteristic findings of enteroviral encephalomyelitis in hand-foot-mouth disease.

PNE-2

Unusual brainstem metastasis of neuroblastoma

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Neuroblastoma metastatic to the central nervous system (CNS) is extremely rare. Most CNS metastases are detected at the time of recurrence rather than at initial diagnosis. Metastatic neuroblastoma may also occur anywhere in the CNS as a parenchymal, intraventricular, or spinal cord mass. Supratentorial lesions are more common than infratentorial lesions. We report here for the first time a case of a brainstem metastasis.
Case report: A 3-year-old girl had received intensive chemotherapy, radiotherapy, and hematopoietic stem cell transplantation for stage IV neuroblastoma, followed by total resection of the original adrenal mass. Following recovery from therapy, she presented with sudden onset headache and loss of consciousness. CT of the head revealed a brainstem hemorrhagic mass without peripheral edema. The mass was slightly hypointense on the brain parenchyma on T1 weighted images (WI). On T2WI and fluid attenuation inversion recovery (FLAIR) images, the mass was heterogeneous hyperintense in the posterior medulla. MRI with contrast demonstrated small nodular enhancement in the anterior of the mass with a well-demarcated margin. From these radiological findings, cavenous angioma was initially suspected. Intraoperatively, the mass was seen to originate from the medulla without invasion of the surrounding tissue. Histopathologic evaluation revealed sheets of small round cells, and these cells were more immature than the original adrenal mass. Following chemotherapy, she gradually recovered and started rehabilitation. Eight months later, she presented with general convulsion. CT of the head revealed a large hemorrhagic mass with a massive peripheral edema in the left frontal lobe.
Conclusion: CNS involvement in patients with neuroblastoma can be clinically occult and is associated with poor prognosis. CNS metastatic neuroblastoma, although rare, should be considered in the differential diagnosis of a child with an intracranial hemorrhagic mass even if it is located in the brainstem.

PNE-3

Normal ascent of the conus medullaris: a post mortem fetal MR study

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Purpose: The normal position of the conus medullaris is considered abnormal if it ends below L3 at birth, but it is unclear at which point this ascent occurs: several studies suggest during fetal life. We used magnetic resonance imaging (MRI) to measure the position of the conus in post-mortem fetuses, to establish the timing of normal ascent.
Materials and methods: Whole body 3D T1–weighted Constructive Interference Steady State (CISS) (0.6 mm3 voxels) MR datasets were acquired. We excluded fetuses who had an intracranial or spinal abnormality (e.g. tethered cord or spinal dysraphism). The conus level was identified on sagittal reformatted MR images of the spine, and referenced to the adjacent vertebral body or disc level. A 15 point numerical scale was used for vertebral levels, from 1 (S2) to 15 (T12).
Results: We examined 84 post-mortem MR datasets, with mean gestation 26.5 weeks: range 14–41 weeks. Mean conus position at full term was L2, with no conus below L3 at term. In this population, there was significant ascent of the conus medullaris with gestation. This fitted the curvilinear relationship vertebral level = −0.009 X2 + 0.74X - 4.7 where X is gestation (weeks), with correlation coefficient 0.83. Using this curvi-linear relationship, the predicted conus positions at 15 weeks was L4/5, by 26 weeks was L2/3, and by 39 weeks was L1/2, i.e. an ascent of 2 vertebral bodies in the 2nd trimester, and 1 vertebral body in the 3rd trimester. The earliest the conus lay within the normal adult range was 28 weeks gestation, though more typically by 36 weeks gestation.
Conclusion: Conus ascent occurs predominantly during the 2nd trimester (14–26 weeks). The conus can lie within the normal adult range as early as 28 weeks gestation, though more typically at 36 weeks gestation, but there is wide inter-individual variability. This data confirms that a conus position of below L3 is likely to be abnormal at term.

PNE-4

MR determination of neonatal spinal canal depth

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Purpose: Lumbar punctures (LPs) are frequently performed in neonates and often results in traumatic haemorrhagic taps. Knowing the distance from the skin to the middle of the spinal canal (Mean spinal canal depth; MSCD) may be useful, but there is little data in extremely premature or low birth weight neonates. We used magnetic resonance imaging (MRI) to determine the spinal canal depth (SCD) in post mortem fetal specimens.
Materials and methods: Whole body 3D T1–weighted Constructive Interference Steady State (CISS) (0.6 mm^3 voxels) MR datasets were acquired. We excluded fetuses who had an intracranial or spinal abnormality (e.g. tethered cord or spinal dysraphism). Two measurements were made on an axial plane at the level of the L3 / 4 intervertebral disc space: skin to posterior spinal canal distance (PSCD), and the skin to anterior spinal canal distance (ASCD) were measured. From these, the MSCD was calculated.
Results: We measured spinal canal depth in 78 fetuses (mean gestation 26.5 weeks; mean birth weight 1.09 kg). ASCD and PSCD (mm) correlated significantly with birth weight (W, kg), with the relationships ASCD=2 W+3.18 (0.71); PSCD=3 W+ 6.76 (0.81). MSCD correlated significantly with birth weight, giving the formula MSCD=2 W+5 (0.79). Using this formula gives a measure outside of the spinal canal in 11 / 68 (16%; mean error of −1.8±31%).

Conclusion: There is a significant correlation between spinal canal depth and birth weight even in extremely premature and low birth weight neonates. Use of the formula MSCD=2 W+5 could result in fewer traumatic LPs in clinical practice.

PNE-5

Accelerated myelination on MRI of the brain in children

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Purpose: The normal pattern of white matter myelination begins in fetal life and continues up until the end of the 2nd year. It follows a fixed chronological sequence which has been well described and is best assessed with MRI. Delayed myelination is well recognised in a number of pathological conditions. However, accelerated myelination has only been reported in a few disorders. We summarise the well described normal MRI features of white matter maturation and illustrate cases of accelerated myelination by comparison with these normal imaging features.
Materials and methods: We have encountered a few cases of accelerated myelination in children under two years of age at our tertiary level paediatric hospital since 2007. The relevant brain MR imaging for these cases was reviewed with a paediatric neuroradiologist to evaluate for associated abnormalities. These patients' clinical records were also reviewed for pertinent clinical information.
Results: Four patients with accelerated myelination were identified. One case had both MRI and clinical evidence of Sturge Weber syndrome, whilst another with epilepsy had MRI features of hemimegalencephaly. Accelerated myelination has been previously reported with both these conditions. The third case did not reveal a specific underlying cause but did demonstrate polymicrogyria. With the final case that presented with neonatal seizures, MRI did not uncover any other abnormality, suggesting that accelerated myelination may be intimately linked to the occurrence of seizure activity.
Conclusion: Understanding of the normal pattern of white matter myelination is essential for any radiologist reporting brain MRI in children. Detection of accelerated myelination may provide important clues to the presence of other underlying abnormalities which may or may not be apparent on imaging. Accelerated myelination has been traditionally associated with Sturge Weber syndrome, hemimegalencephaly and cerebral sinovenous thrombosis. We suggest it may also be associated with polymicrogyria and may be closely linked with childhood seizures.

PNE-6

Susceptibility weighted MR imaging (SWI) for the evaluation of iron-loading in β-thalassaemia major (TM)

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Purpose: β-thalassaemia major (TM) is an inherited disorder of hemoglobin synthesis for which regular blood transfusion and consequently, iron chelation therapy are required. Alterations of iron content in the brain may contribute to cognitive impairment as observed in some patients. We evaluated the use susceptibility weighted MR imaging (SWI) to quantify iron in the brain of β-thalassaemia major patients.
Materials and methods: Thirty-four (17 male) TM patients, mean age (+/− SD) 26.4 years (+/− 4.0 years) and 34 (17 male) age-matched healthy normal volunteers were recruited after informed consent in this IRB approved study. SWI and T1-weighted (T1W) sequences were performed using a 3-tesla scanner. Region-Of-Interests (ROI) were drawn on the mean phase map over the bilateral caudate nucleus (CN), putamen, globus pallidus (GP), red nucleus (RN), substantia nigra (SN) and dentate nucleus (DN). Age and gender corrected mean phase value (cPV) was calculated. Low Phase Value ('LPV', i.e. cPV < −2.5*SD) suggesting iron over-loading, 'Normal' and High Phase Value ('HPV') were determined for each ROI. Pearson's correlation was performed between cPV of each ROI with blood ferritin and ANOVA analysis was performed to compare cPV of each ROI between patients receiving different types of chelation therapy (Deferoxamine, Deferiprone, combination of Deferoxamine and Deferiprone, Deferasirox).
Results: Significant negative effect on PV was found with age in DN (p=0.029), suggesting a higher level of iron with increasing age, and females had significantly lower PV in the RN compared to males (p=0.016). Of the 34 patients, 10 had normal PV in all ROIs whilst 24 had abnormal PV in at least one of the ROIs. Among them, 5 (3 female) had "pure" iron over-load as abnormal ROIs were all LPV, 17 (9 female) had "pure" iron "under-load" as abnormal ROIs were all HPV, and 2 (both male) had "mixed" findings of both LPV and HPV ROIs. There was no significant correlation between serum ferritin and PV of ROIs. cPV was significantly higher for patients treated with Deferiprone compared to Deferoxamine in CN (p=0.017) and SN (p=0.021).
Conclusion: A wide-range of PV, indicating both iron-overloading and 'underloading' which may reflect the dynamic interaction between blood transfusion and chelation, was found in TM patients, suggesting that SWI is a sensitive method to quantify iron concentration, and is a potentially valuable tool for brain iron assessment.

PNE-7

Atypical presentation of Kawasaki disease in young infants

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Kawasaki disease (KD), also know as acute febrile mucocutaneous lymph node syndrome, is self limited vasculitis of an unknown etiology which typically affects small and medium sized arteries. Due to no specific laboratory test, the diagnosis is based on presence of at least 5 days of fever with four of five diagnostic criteria: 1) changes in mucosa of oropharynx; 2) polymorphous exanthema; 3) swelling or erythema of the hands and feet; 4) non-purulent bulbar conjunctivitis; and 5) cervical lymphadenopathy (>1.5 cm). However, 10–45% of patients with KD may have atypical clinical presentations. Particularly, head and neck manifestations of KD can mimic other inflammatory or infectious processes often resulting in delayed diagnosis with increases risk of coronary aneurysm. We present two young infants with KD who initially presented with fever, irritability and cervical swelling and their CT findings mimicking retropharyngeal abscesses. Both patients did not respond to antibiotic therapy and one of them underwent retropharyngeal aspiration. No pus was found and no organism was subsequently cultured. Desquamation and polymorphous rash developed over time and KD was subsequently diagnosed in both patients. Echocardiogram revealed perivascular brightening and cuffing of right coronary artery and

inner wall irregularity of left anterior descending coronary artery in one patient and pericardial effusion in the other patient. Currently, here is a paucity of reported cases of presumptively diagnosed retropharyngeal abscesses which were later found to be an atypical neck manifestation of KD. Familiarity with atypical imaging manifestation of retropharyngeal fluid with multiple bilateral asymmetrical enlarged cervical adenopathy in infants with KD can aid in accurate diagnosis, obviate unnecessary or inadvisable interventions and prevent potential lethal cardiac complication from KD.

PNE-8

Audit on compliance with NICE guidelines for investigation of head injury

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Purpose: To review the investigation of head injury against NICE guidelines at Sheffield Children's Hospital.
Materials and methods: Retrospective review of CT head requests for trauma in a 4 month period from July 2010 to October 2010 for the following criteria: Indication for CT, Time from CT head request to provisional report by registrar or general paediatric consultant, Time from CT head request to report verified by paediatric neuroradiologist, Significant finding on CT head.
Conclusion:
• All CT heads were done within 1 hour of the request.
• Only 57% of the CT head reports were issued within an hour.
• Skull X ray – in 23% children had skull x ray as well as CT head. Skull X rays are not indicated in trauma according to NICE guidelines.
• Neuroradiologist double reporting is safer.
There is a 15.9% discrepancy between general and neuroradiologist reporting for CT of the head, especially in picking up subtle fractures and congenital abnormalities. However, 62% were issued >24 hours. Is this a significant clinical risk?

PNE-9

Shunt sereis as an imaging modality for paediatric shunt malformation: a retrospective analysis. Introduction of low-dose CT as study of choice

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Purpose: In recent years, literature has debated the use of the 'shunt series' in the diagnosis of ventriculoperitoneal (VP) shunt malfunction with respect to validity and unnecessary radiation exposure. Implications of radiation dose on paediatric patients suggest that the shunt series is a superfluous method of diagnosis. The introduction of a low dose technique for the Computed Tomography (CT) brain scans allows the radiation dose to the patient to be lowered. Our aim is to evaluate the validity of the shunt series in comparison to CT brain for paediatric patients with suspected VP shunt malfunction, and introduce a low dose CT brain technique for all patients referred for shunt malfunction.
Materials and methods: Over 600 cases where patients presented to a large paediatric teaching hospital with a possible VP shunt malfunction were retrospectively evaluated from January 2001 to May 2010. All patients underwent a CT brain and a shunt series and the radiology results for each imaging study were reviewed.
Results: Whilst the shunt series continues to be the conventional method for determining the possibility of VP shunt malfunction, our results, and the results of the literature, suggest that this is unnecessary. It has been proven that a low dose CT brain provides diagnostic images that are sufficient for the purpose of assessing ventricular morphology. In comparison to a routine CT brain, the low dose technique reduces the dose significantly for the paediatric population.
Conclusion: Routine shunt series as the initial imaging modality in paediatric patients with suspected shunt malfunction is unnecessary. A limited shunt series comprising the head and neck region is to be performed only when the CT brain is abnormal. We also recommend low dose CT brain as the initial modality of choice for potential shunt malfunction.

PNE-10

Ear anomaly in Antley-Bixler syndrome

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Background: Antley-Bixler syndrome (ABS) is a marfanoid craniosynostosis syndrome with joint synostosis/contracture and multiple endocrine abnormalities (adrenal dysfunction and hypogonadism). ABS is caused by homozygous or compound heterozygous mutations of the POR gene, which impair cholesterogenesis and steroidogenesis. The former aberration is responsible for the ABS-associated skeletal changes, while the latter for the ABS-associated endocrine abnormalities.
Purpose: The clinical spectrum of ABS is diverse. Mildly affected individuals are caused by homozygosity of mutations with residual POR activities, while severely affected individuals by compound heterozygosity of a mutation with a residual activity and a null mutation. Complete absence of POR activities is probably incompatible with life. During clinical follow-up of ABS, a high incidence of hearing impairment attracted attention. However, very little is known about otologic findings of ABS. Only a single ABS case with fusion of the incus and malleus to the epitympanum, dehiscence of the semicircular canal, and oval window atresia has been reported to date. Thus, we evaluated the ear in ABS individuals with hearing impairment with high-resolution ear CT.
Materials and methods: CT studies were retrospectively reviewed in 4 ABS subjects, who all are classified into a severe form of ABS.
Results: 1) Bilateral fusion of the incus and malleus to the epitympanic wall was found in all subjects. 2) Bilateral absence of the stapes was found in one, unilateral absence of the stapes in one, and unilateral malposition of the stapes in one. 3) Bilateral semicircular canal dysplasia was found in one with normal stapes.
Conclusion: Fusion of the incus and malleus to the epitympanic wall is prevalent in ABS. Variable abnormalities of the stapes and inner ear may be seen in the disorder.

PNE-11

Update in neuroimaging of pediatric epilepsy

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Purpose: To discuss the role of the advanced MRI techniques (diffusion-weighted imaging, MR spectroscopy, diffusion tensor

imaging, susceptibility weighted imaging, functional MRI and arterial spin labelling) in the diagnosis of the underlying process of the seizures. To describe the advantages of 3.0-T imaging in the study of pediatric epilepsy. To illustrate the spectrum of abnormalities involved in the pathogenesis of epilepsy in childhood.
Materials and methods: MRI is the technique of choice for investigation of patients with seizure disorders because it provides excellent anatomic information and tissue contrast. Recent advances in MR imaging have improved the quality of diagnosis and management of pediatric epilepsy.
Results: Developmental malformations, neurocutaneous disorders, prenatal and perinatal injury, inflammatory conditions, infections, metabolic disorders, vascular malformations, tumours, and hippocampal sclerosis are frequently involved in the pathogenesis of pediatric epilepsy. 3.0-T imaging acquires thin-section high-resolution images increasing lesions conspicuity and providing, in our experience, better visualization of some subtle conditions, such as hippocampal anomalies or cortical dysplasia.
Conclusion: Application of advanced new MRI techniques promises to improve the detection of the substrates of epilepsy and therefore to improve therapy for seizures. 3.0-T MR imaging acquires thin-section high-resolution images that increase lesions conspicuity and provides, in our experience, a better visualization of some subtle conditions, such as hippocampal anomalies or cortical dysplasia.

PNE-12

Types of intracranial tumours occurring in infants, and their imaging findings

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Purpose: Brain tumours in infants are rare, and have a poor prognosis. The imaging features of subtypes are better described in older children than in infants. Atypical teratoid/rhabdoid tumour is now recognised to have a more aggressive clinical course, but is difficult to diagnose on imaging. Differences in ADC values in adult tumours have been described. We aim to discover the most common intracranial tumours in infants in Victoria, Australia, and whether ADC values, or any other features, differentiate between tumours.
Materials and methods: A hospital PACS system was searched over a 10 year period, using codes for brain tumour diagnosis and follow-up. The hospital is the larger of 2 main centres managing brain tumours in Victoria.
Results: Analysis yielded 28 cases. There were 16 boys, 12 girls. Age at presentation ranged from 2 days to 11 months, median 16 weeks. 3 tumours were congenital, but none detected antenatally. 15 were first seen on CT, 10 on MRI, 3 on US. There were 5 AT/RT, 7 high grade glioma, 6 low grade glioma, 2 medulloblastoma, 2 plexiform neruofibroma with intracranial extension, 1 sarcoma, 2 teratoma, 1 pituitary macroadenoma, and 2 choroid plexus papilloma. 8 tumours were in a sella/supasellar location, 8 infratentorial, 7 supratentorial, 1 infra/supratentorial, 2 intraventricular, 1 extended into the cavernous sinus from the orbit, 1 involved a cranial nerve. Most patients had very large tumours at diagnosis. 26 had hydrocephalus. 7 showed surrounding vasogenic oedema. 9 tumours showed calcification. MR signal intensity was heterogeneous on T1 and T2 weighted imaging. Most tumours enhanced, the AT/RTs less than most of the gliomas. Most showed nonspecific cystic components. Where an ADC map was available, average ADC values for AT/RT were higher than for glioma, but varied in medulloblastoma.
Conclusion: The most common intracranial tumour in this infant population was glioma, followed by AT/RT. No specific imaging findings differentiated well between types, but there was a trend for ATRT to have a higher ADC value than glioma or medulloblastoma.

PNE-13

Magnetic resonance imaging findings of spinal congenital pediatric dermal sinus tracts

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Purpose: Congenital pediatric dermal sinus tracts are rare. Presenting symptoms in childhood are skin findings, neurologic deficit, or infection. The aim of this study is to review the Magnetic Resonance Imaging (MRI) findings and influence the outcome of surgery.
Materials and methods: Six children with dermal sinus tracts were operated between 2005 and 2009. Records and MRI exams of the patients were evaluated retrospectively.
*Results:*Clinical examination revealed sinus ostea, pigmentation changes and erythema. All dermal sinuses were located in the lumbosacral region. MRI showed the tracts extended to the dural sac, attached to the filum terminale and caused tethered cord. The tracts were followed from the skin and laminectomy performed. The filum was found and the spinal cord released by cutting the filum. Dermoid tumor and spinal lipoma were removed in two patients. No complication occured. The level of conus medullaris built up gradually over the follow-up period.
Conclusion: Spinal congenital pediatric dermal sinus tracts are important pathologies and need serious evaluation before an operation. Magnetic resonance imaging is very useful for achieving the complete resection of a sinus tract with intradural exploration and correction of associated abnormalities.

PNE-14

Pediatric sensorineural hearing loss: an overview

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Purpose: To review the clinical approach, imaging findings, and imaging technique in pediatric patients with sensorineural hearing loss (SSNHL).
Materials and methods: We reviewed our clinical database and selected children presenting with different types of SSNHL. Clinical approach is emphasized (clinical exam, audiograms). Imaging findings, including CT and MRI, of congenital and developmental anomalies, inflammatory, traumatic and tumoral conditions are discussed. The role of imaging is not only to depict the anomalies, but also to recognize the underlying conditions that may contraindicate a cochlear implantation.
Results: A wide spectrum of imaging findings in children with SSNHL are shown: associated syndromes (PHACE,..), different types of cochlear and vestibular malformations (Michel, Mondini…), cochlear otosclerosis, vestibular aqueduct enlargement, bony occlusion of the cochlear neural foramina, cochlear nerve hypoplasia, internal auditory canal (IAC) anomalies, post meningitis

sequelae, bilateral vestibular schwanomas in patients with NF-2, inner-ear barotrauma and associated perylimphatic fistula, congenital rubella, congenital cytomegalovirus (CMV) and other CNS conditions presenting as sensorineural hearing loss. Absence of the cochlear nerve or cochlear agenesis contraindicate cochlear implantation. The importance of proper technique and reformats (Stenver, 3D FIESTA multiplanar reformats…) is highlighted in each case.
Conclusion: Up to date, imaging plays a central role in the diagnostic work-up of SSNHL in children. The Paediatric Neuroradiologist must be familiar with the normal anatomy of the inner ear and the state-of-the-art technique to depict the underlying anomalies and be aware of the findings that may contraindicate a cochlear implantation.

PNE-15

Amoebic meningoencephalitis—a case report

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Amoebiasis is one of the top three parasitic infections worldwide. It is most commonly an intestinal infection, but although very rare, the other primary clinical manifestations should not be forgotten. This case illustrates the clinicoradiological findings in a case of amoebic meningoencephalitis in an eight-month-old female. Serial CT and MRI studies were performed over a three-week period prior to death. Imaging findings encountered in this case include a florid haemorrhagic meningoencephalitis, progressing to focal right middle cerebral artery vasculitis, narrowing and consequent infarction. Right M1 segment aneurysmal dilatation ensued, presumably inflammatory in nature. Surgical aneurysmal clipping was attempted but due to the friable arterial wall tissue this was not possible and the middle cerebral artery was ligated. The patient subsequently developed additional contralateral cerebral infarction, further vasculitis and venous sinus thrombosis before death. This case report poster will discuss further the radiological, clinical and pathological findings along with the epidemiology of amoebic meningoencephalitis.

PNE-16

CT depiction of the ossification process of the central skull base along with normal variants

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Purpose: To chronicle the ossification process of the central skull base and illustrate normal variants by computed tomography (CT).
Materials and methods: We retrospectively reviewed cranial CT scans performed in our department during the last 2 years for the postnatal development of the occipital and sphenoid bones by observing the closure of synchondroses. Patients' ages ranged from 6 days to 19 years old. The majority were trauma patients undergoing head CT evaluation. We excluded patients with skeletal dysplasias. We also identified normal variants related to the ossification process.
Results: Four ossification centers in the occipital bone were identified surrounding the foramen magnum and 3 major synchondroses. Kerckring ossicle assimilation was observed during the first months of life. Fusion of the posterior and anterior intraoccipital synchondroses began at 2–3 years of age and the sphenooccipital synchondrosis remained open until 15 years. Rapid fusion of the sphenoid ossification centers and synchondroses was identified at ages 0–2. Pneumatization was identified as early as 1 year and advanced from anteriorly to posteriorly. Normal variants of skull base development were also identified such as foramina, clefts, accessory ossification centers, and canalis basilaris medianus.
Conclusion: Demonstration of the morphologic changes in computed tomography of the central skull base can provide imaging maps of this complex ossification process of the pediatric chondrocranium. Knowledge of these developmental steps and variations of sphenoid and occipital bone ossification during infancy, childhood and adolescence is essential in order to properly evaluate pathology of the skull base such as fractures, skeletal dysplasias and craniosynostoses.

PNE-17

Bilateral hippocampal hyperintensities in children with heat stroke: not just an incidential finding

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Purpose: Heat Stroke is a serious life -threatening and fatal condition in the most vulnerable patients, especially children. We present two different Bahraini children who sustained heat stroke, one left by a parent and the other locked in a school bus accidentally on his first day of school, during the summer season.The first child survived but stained cortical blindness. The second older child died a few hours upon arrival at the hospital.
Objectives: To describe the common neurological findings in children with heat stroke To describe the bilateral hippocampal hyperintensities on MRI as an established finding in heat stroke. This was previously reported as a case report by the same author, not as an incidental finding.
Materials and methods: The study involves two children , a girl of 2 years 3 months and the other a 4 year old pre-schoolboy who wase accidentially locked in the school bus on the first day of school. Both children had MRI brain as part of their clinical work up during their presentation to hospital.The first patient had a CT scan on arrival to hospital followed by MRI on the 5th day. The boy had an MRI on presentation.
Results: Brain MRI of both children showed the typical neuroimaging finding of severe brain oedema with involvement of the cerebellum, basal ganglia, thalami however the hippocampal involvement seen as bright signal intensities on T2 and FLAIR although not described before was seen as a constant finding in both children.
Conclusion: Hippocampal involvement was described by the same author as a new finding based on one case report (2007 Paediatric Radiology). However we present here the same findings in a another fatal heat stroke. We propose that the involvement of the hippocampus may be related to its inherent sensitivity to heat as seen in children with febrile convulsions, however none of our patients here presented with convulsions. The neurological findings in our previous patient may have been due to a combination of direct thermal injury and hypoxic–ischaemic insult. We conclude that heat stroke should be considered in the differential diagnosis of hippocampal hyperintensities on MR imaging in an appropriate clinical setting.

PNE-18

Pediatric conductive hearing loss. An overview

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Purpose: To review the imaging findings and clinical approach in pediatric patients with conductive hearing loss (CHL).
Materials and methods: We reviewed our clinical database and selected children presenting with different types of CHL. Imaging findings, including CT and MRI of congenital, developmental, inflammatory and post traumatic anomalies are discussed. Clinical approach is emphasized (clinical exam, audiograms). The role of imaging is not only to depict the anomalies, but also to recognize those anatomic peculiarities that the Paediatric ENT needs to know.
Results: A wide variety of imaging findings in children with CHL are shown:
- Congenital and developmental conditions, like in patients with branchial anomalies (first and second branchial arches, clefts and pouches derived malformations), that are associated with external auditory canal atresia and/or ossicular dysmorphogenesis.
- Inflammatory etiology, like chronic otomastoiditis and cholesteatoma. We highlight possible complications that the Pediatric Neuroradiologist should be aware of in children with cholesteatoma, such as facial canal invasion or perilymphatic fistula. Postsurgical imaging evaluation is also discussed: tips and tricks to differentiate granulation tissue from recurrent cholesteatoma.
- Postraumatic etiology, after a fracture of the temporal bone with secondary ossicular disclocation. It is also important to comment on the position of the internal carotid artery and the jugular bulb when reporting temporal bone CT or MRI, specially in children with CHL, who are potential surgical candidates.
Conclusion: Imaging plays a central role in the diagnostic work-up and presurgical evaluation in children presenting with CHL. The Paediatric Neuroradiologist must be familiar with the anatomy and State-of-the-Art technique to depict the underlying anomalies and be aware of the findings that may complicate a surgical procedure.

PNE-19

Vascular anomalies in NF1

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Purpose: Neurofibromatosis type 1(NF1) is a facomatosis caused by mutation in neurofibromin-encoding gene on chromosome 17. Only few reports suggest increased incidence of vascular anomalies in NF1 patients: aneurysms, vascular narrowing, arteriovenous malformations. The estimated occurrence of these anomalies is 2–5%. There are however publications that don't confirm this correlation. Although most lesions are asymptomatic, complications can occur. Therefore their occurrence rate should be known. Angio-MRI is required for the evaluation of intracranial arteries. The aim of this study is to assess the morphology and occurrence of vascular intracranial lesions in NF1 children.
Materials and methods: NF1 diagnoses were based on the National Institute of Health criteria. All patients underwent MRI of brain and orbits. Angio-MRI (SPGR/3D/TOF) was performed to evaluate intracranial arteries. Examinations were performed using a 1.5 T scanner. 60 NF1 patients were examined, 33 of them had angio-MRI. A quantitative and qualitative (including the morphology and location) evaluation of the diagnosed vascular anomalies was made. The potential advantages of diagnosis (implementation of treatment, better prognosis) were estimated.
Results: 12 children had vascular anatomical variants: posterior cerebral artery (PCA) supplied from the internal carotid artery (ICA) [7 cases], additional posterior communicating basicerebral artery [4], posterior communicating artery (PCoA) hypoplasia [2], anterior cerebral artery (ACA) hypoplasia in the proximal segment (A1) [3], kinking of ICA [5]. 4 patients had more than 1 variant diagnosed.
In the control group consisting of 32 children, 12 had vascular variants: PCoA hypoplasia [4 cases], PCA supplied from the ICA [3], bilateral PCoA hypoplasia [2], kinking of ICA [2], PCA hypoplasia [1].
Conclusion: There were no life- or health-threatening vascular pathologies in the presented material. None of the anomalies required treatment. The occurrence of vascular anatomical variants in NF1 patients was not confirmed to be higher than in the control group. In the study group, however, multiple variants were more frequent.

PNE-20

3T Arterial spin labelling (ASL) in pediatric patients: preliminary results

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Purpose: Arterial spin labelling (ASL) is a non-invasive method to measure brain perfusion. No contrast media is needed since it uses magnetically labelled water protons as an endogenous tracer. This make the method a more suitable technique for perfusion studies in volunteers, pediatric patients and patients who need frequent follow-ups. Our purpose was to apply this MRI method to pediatric patients with different pathologies (tumors, vascular diseases, malformations) and to see the tolerability and feasibility in detecting brain perfusion abnormalities
Materials and methods: We examined 30 patients with an age range of 4 days–16 yrs old. We performed pulsed ASL using EPISTAR strategy for tagging and control images with 130 mm thick slab of tagging pulse proximal to the imaging region. 20 mm is the gap between the inversion and imaging regions. Repetition time of 4s was good enough to achieve relaxation of brain tissue and TE in the range 16–25 ms. 30 dynamics were employed to increase SNR. First of all a multiphase ASL with 8 phases was running with starting delay time (Td) of 300 ms and phase interval of 250 ms. In this way we were able to get the best delay time for each subject as input in the subsequent single phase ASL. Delay times were in the range 900–1250 ms.
Results: Advantages of the methods are the possibility of avoiding ionizing radiation, avoiding venous cannulation and avoiding the somministration of an intravenous exogenous tracer that can be restricted in some cases (e.g. first year of age). The disadvantages mostly include technical problems such as the intrinsically low SNR, magnetization transfer effects, insensitivity to transit time.
Conclusion: ASL is a non-invasive method that is well tolerated by pediatric patients. It can be applied also to newborns, a population in which the use of contrast media is highly restricted. The increasingly number of high field scanners and the technical challenges being overcome will result in this method overtaking the more traditional invasive techniques.

PNE-21

Langherans cell histiocytosis (LCH): neuroradiological aspects in pediatric patients

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Purpose: LCH is a clonal proliferative disorder of mononuclear phagocytic and dendritic cells. The reported incidence is 0.2-2.0 cases per 100,000 children under the age of 15 years. It may present as a solitary bone lesion (about 60%) or as a multi-system disorder. CNS involvement occurs in about 4–10% of the cases. Although the CNS involvement in LCH mostly manifests itself in the pituitary region, the involvement of cerebellum and brain stem is of particular interest as it can lead to cerebellar signs and cognitive deterioration, although this involvement is not necessarily correlated to the symptoms.We will review the presentation, epidemiology and neuroradiological findings in patients affected with LCH and illustrate protocols used to monitor CNS involvement
Materials and methods: We have studied 18 consecutive patients with LCH showing brain involvement with MRI conventional and non-conventional techniques (DTI and MR Spectroscopy). Age range was 4 months −17 yrs old. Among these patients 12 had solitary lesions. MRS was performed in all patients on the right centrum semiovalis, the right basal ganglia and the cerebellum.
Results: In 13 patients, cerebellar white matter showed hyper-intensity at T2w MRI, in 11 patients supratentorial white matter showed alterations, in 6 patients we found alterations of brain stem and in 4, of basal ganglia. Overall data for each anatomic region was not significant in the centrum semiovalis and in basal ganglia, while we detected a decrease of NAA/Cr ratio and a normal Cho/Cr ratio in the cerebellar region.
Conclusion: LCH is a challenging disease with a high relapse ratio. It is important for a radiologist to know the imaging features of LCH for an early diagnosis (cerebellar lesions may preceed the onset of the disease) or for detecting relapses and complications. The neuroradiological assessment in pediatric patients with LCH should be included in the diagnostic and follow-up protocols. MRI non-conventional techniques (Diffusion, MRS) could be helpful in detecting the earlier involvement of and complications.

PNE-22

Sonographic dedection of spinal hemorrhage in non accidental head trauma in infants

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Purpose: Primary diagnostic imaging studies in suspected child abuse in infants include radiographic skeletal survey and a cranial CT scan or MRI. Recently, detection of spinal subdural hematomas by MRI in children with non-accidental head injury has been described. The purpose of this study was to assess whether hemorrhage within the spinal canal in infants with suspected non-accidental head trauma can be detected by means of ultrasound.
Materials and methods: Four infants (median age 3.5 months, range: 2–6) with abusive traumatic injuries were prospectively examined by cranial, spinal and ocular ultrasound.
Results: Two patients presented initially with emesis, one with generalized seizures and one with abnormal breathing and somnolence. None of the infants had a pre-existing neurological or spinal disorder. All four patients with confirmed non-accidental trauma presented with cranial subdural hematoma. Three also had retinal hemorrhages. Spinal ultrasound detected subdural echogenic effusions with floating arachnoidea due to spinal subdural hemorrhages at the level of the cervical or thoracic spine or conus medullaris in three patients, and cervical and thoracic spinal subarachnoid hemorrhage in one infant. The anatomic landmarks (dura mater spinalis, arachnoidea, ligamentum denticulatum) were identified and confirmed the subdural or subarachnoid location. All spinal hemorrhages were asymptomatic and detected by routine ultrasound. The plain radiographs of the spine in these infants showed no osseous lesions.
Conclusion: We conclude that spinal hemorrhage is a common finding in infants with non-accidental head trauma that can be quickly and easily detected without the need for sedation or general anaesthesia using spinal ultrasound.

PNE-23

Correlation between MRI findings and second look operation in cholesteatoma surgery: preliminary results

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Purpose: To compare the MRI findings to the surgical findings of second-look procedures for residual cholesteatoma.
Materials and methods: This was a prospective audit of all patients who underwent intact canal-wall tympanomastoidectomy and had a second-look procedure between 6 and 9 months later. The MRI scan was performed within 1 week of the second-look operation. The scans were obtained on a 3-Tesla Philips Healthcare unit with non-echo planar single-shot water-diffusion sequences.
Results: 8 MRI scans were obtained for 7 patients (5 females). None of the patients required general anaesthetic.One patient had 2 MRI scans and a third-look procedure. True positive (5/8,62.5%) and true negative findings (1/8,12.5%) led to a radiosurgical correlation of 75%.There was one false positive which was found to be a small cyst with a keratin pearl(<3 mm) within the mastoid cavity. One MRI was reported as equivocal although no recurrence was found at second-look.
Conclusion: Less than 3 mm lesions cannot be detected with the present scanning protocol. Movement artifacts can degrade the quality of scans. Despite growing enthusiasm for MRI scanning,it is not accurate enough to replace the need for conventional second-look procedures.

PNE-24

Brain lesions identification in pediatric patients affected by drug-resistant epilepsy: a 3 Tesla vs 1.5 Tesla MRI study

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Purpose: Drug-resistant epilepsy in children can significantly affect cognitive development because of repeated seizures causing atrophy of the hippocampus, the cerebellum and the neocortex. In patients with drug-resistant epilepsy, MRI is a reliable tool for identifying brain lesions responsible for a possible epileptogenic focus. In particular, the very high-field MRI (3T) is characterized by higher signal to noise ratio as compared to MRI at 1.5 Tesla and is potentially more effective in delineating brain structures. The purpose of this study was to evaluate the quality of images obtained with MRI at 3 T with those obtained with MRI at 1.5 T in the depiction anatomical structures and compare, in terms of identifica-

tion of the lesions, the diagnostic efficacy of 3 Tesla versus 1.5 Tesla studies in pediatric patients with drug-resistant epilepsy
Materials and methods: From November 2008 to October 2010, thirty pediatric patients (12 females and 18 males), aged between 6 and 18 years (mean age for females: 14.56, mean age for males: 12.20) and affected by drug-resistant epilepsy, underwent both 1.5 T and 3T MRI examination, in a time interval between the two exams ranging from 6 to 48 months. Of these patients, 16 were affected by generalized epilepsy, 12 by partial epilepsy subsequently generalized and 2 by partial epilepsy. Two radiologists, in independent and blind sessions, evaluated the following parameters: 1) degree of "identification" of the lesion / s (grades 1–4); 2) contrast resolution between white and gray matter (grades 1–4); 3) presence of artifacts affecting image quality.
Results: The results showed a statistically significant difference in 2 out of 3 parameters considered. In particular, higher average scores were recorded in the identification of the lesion (p=0.002) and tissue contrast (p=0.015) for the 3T MRI images. No significant differences were found between MRI at 1.5 T and 3T on presence of image artifacts.
Conclusion: The preliminary results of our study confirm the greatest potential of MR imaging at 3T compared to 1.5 T in terms of both "ease" of identifying lesions (p=0.002) and image quality.

PNE-25

Central nervous system tuberculosis in non HIV-positive children: MRI patterns, complications and pitfalls

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Purpose: Central nervous system (CNS) tuberculosis (TB) is the most life-threatening form of extrapulmonary tuberculosis. In 2007, the World Health Organization (WHO) estimated that there were 9.27 million new cases of tuberculosis (TB) and 1.3 million deaths from TB among HIV-negative people. Tuberculous meningitis (TBM) is the most common presentation of CNS TB. It can be seen at any age, predominantly in young children and adolescents, because of their relative inability to contain the infection at sites beyond the lung. The clinical progression of TBM tend to be rapid, especially in infants and young children, who may experience symptoms for only several days before the onset of acute hydrocephalus, seizures, and cerebral edema. The aim of this study is to describe a broad spectrum of imaging features of CNS TB on magnetic resonance imaging (MRI) studies in non HIV-positive children
Materials and methods: A retrospective descriptive evaluation was conducted on imaging studies obtained from 15 children admitted to our hospital over a 6-year period, who fulfilled criteria for a diagnosis of CNS tuberculosis. Data were collected with regard to the clinical, laboratory and demographic characteristics of patients, as well as results of radiological investigation.
Results: Fifteen children were included, of which 6 were boys and 9 were girls. Median age of patients was 4 years (range between 2 and 16 years). The most frequent complications were hydrocephalus and basal ganglia infarcts. Complications also included tuberculomas in seven patients (70%), cortical infarcts in three patients (30%), cranial nerves involvement in four patients (40%), and subdural empyema in one patient (10%).
Conclusion: CNS tuberculosis is still an important cause of childhood morbidity and mortality even in non-immunosuppressed children. Its clinical presentation can mimic many other CNS diseases by delaying the correct diagnosis. As a prompt diagnosis with consequent earlier treatment leads to better patients' prognosis, it is crucial to be aware of MRI findings in tuberculous meningitis, as well as in its complications and tuberculous intraparenchymal lesions.

PNE-26

Cranial ultrasonographic findings in Canavan's disease

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Purpose: To present the characteristic ultrasonographic findings in Canavan's disease and, in addition, to introduce some new ultrasonographic findings.
Materials and methods: A 6-month-old male child presented with macrocephaly and axial hypotonia. Until the age of 4 months the development was normal, except for a slight head lag. Physical examination at six month of age showed a lively boy with increased head-circumference (> p98), no reaction to visual stimulants, axial hypotonia and severe head lag. Ultrasonography showed normal central and peripheral CSF spaces, a strikingly increased demarcation of gray and white matter (mainly caused by increased echogenicity of white matter), voluminous gyri and increased echogenicity of the thalamus, caudate nucleus and, to a lesser extent the lentiform nucleus. These findings are compatible with Canavan's disease, confirmed by demonstration of the gene mutation.
Results: Canavan's disease is an inborn error of metabolism caused by aspartoacylase deficiency, leading to elevated levels of N-acetyl-aspartic acid in the brain, eventually causing leukodystrophy. Only a few reports describe the ultrasonographic findings consisting of increased echogenicity of white matter (except for corpus callosum), thalamus and caudate nucleus. In addition, our patient also showed increased volume of the gyri (compatible with increased volume of white matter), the subcortical white matter showed higher echogenicity than central white matter and there was a striking discrepancy between abnormal ultrasonographic appearance of caudate nucleus and its normal MR appearance.
Conclusion: Recognition of the typical ultrasonographic features of Canavan's disease will facilitate early diagnosis.

PNE-28

The MRI manifestation of late onset CNS complications following chickenpox infection in children

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Purpose: Chickenpox is caused by primary infection with varicella zoster virus (VZV). 90% of infections occur before adolescence with relatively mild symptoms. Severe cases are more common in immune compromised children, but the most severe cases were seen in healthy children. The late onset complications can occur in the skin, MSK, abdominal organs but also the CNS. CNS complications can occur in 1% of VZV infections, mostly with mild neurological sequel. The more serious complications are encephalitis, cerebellar ataxia, encephalomyelitis, transverse myelitis, vasculities and stroke. Chickenpox is believed to be the cause of one third of stroke cases in children. The purpose of our retrospective study was to elaborate the value of MRI in the diagnostic of late onset CNS complications of VZV infection.

Materials and methods: We reviewed the MRI studies of children with late onset CNS complications following VZV infection, who were admitted to our hospital since Jan. 2007 and correlated with the clinical details in order to find specific features suggestive of previous VZV infection.
Results: From 280 cases with positive VZV titre or previous history of VZV infection, 57 were children with a variety of complications affecting the skin, MSK but also the CNS. All the severe cases involving CNS had remarkable MRI abnormalities. The most common MRI features were cerebral and cerebellar oedema, but also vascular irregularities. The most severe cases had significant long term morbidities.
Conclusion: The pathogeneses of CNS complications post VZV infection is not completely well known but a direct viral invasion or a form of autoimmune response are the most likely aetiologies. VZV is highly cell associated and grows to low titres therefore the virus isolation is difficult. Complementary diagnostic tools are important in the correct diagnosis of these patients. MRI is a highly sensitive tool in the detection of late onset CNS complications and although the MRI features are not specific for VZV infection, MRI is an essential tool in the diagnostic and therapy surveillance of these CNS complications.

PNE-29

Congenital spine and spinal cord malformations in children—A pictorial review

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Purpose: Congenital anomalies of the spinal cord are the most common anomalies of the CNS. Different imaging modalities are today available to evaluate these anomalies.The purpose of this review is to present common imaging findings of the most common spinal cord and spinal canal anomalies in neonates, infants and children.In addition, embryological description of the development of the spine and spinal canal will be given in connection with the anomalies.
Materials and methods: Children referred to imaging department in our hospital with various orthopaedic and neurological problems as well as children with a sacral dimple or ante-natal diagnosis of spinal dysraphism.
Conclusion: Today, several modalities in imaging of the spine, spinal canal and spinal cord are available. Ultrasound is the first line of imaging in neonates and infants due to presence of non ossified parts of the spine. Beyond this group,MRI represent the most important imaging choice in evaluation of the spinal cord and spine since it gives optimal delineation of the normal and abnormal spinal cord morphology.CT plays important role in pre-operative and post-operative evaluation in corrective spinal surgery.The importance of imaging of the whole neural axis is also described, since many children with dysraphism may also have other CNS abnormalities.

PNE-30

All that ring enhances is not abscess: a spectrum of intracranial lesions

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Purpose: To illustrate the wide spectrum of ring-enhancing intracranial lesions and their predominate patterns of enhancement.
Materials and methods: After obtaining permission from the Institutional Review Board that governs our hospital, we collected a variety of intracranial lesions on MRI and CT that demonstrated ring enhancement. Then, utilizing the schematic of enhancement put forth by Dr. Smirniotopoulos (Radiographics 2007;27:525–551), we categorized the lesion's enhancement pattern as smooth, necrotic, or open.
Results: Abscesses—including citrobacter, tuberculosis, cysticercosis, and Eikenella—demonstrate a smooth pattern of ring enhancement. High grade neoplasms—including astrocytoma, primary CNS lymphoma, brainstem glioma, and metastatic osteogenic sarcoma—demonstrate a necrotic pattern of ring enhancement. Demyelinating diseases—including multiple sclerosis and acute disseminated encephalomyelitis—demonstrate an open ring pattern of enhancement. In addition, subacute lacunar infarcts demonstrate an open ring pattern of enhancement.
Conclusion: Intracranial lesions enhance following several patterns. By categorizing a lesion according to its pattern of enhancement, the radiologist can dramatically narrow the differential diagnosis.

PNE-31

Pictorial review of intraventricular hemorrhage

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Purpose: This is an educational exhibit designed for senior radiologists who are involved in teaching trainees that will give them a structured design in how to describe the relevant anatomy and focus on this common condition. For trainees, this will teach Intraventricular Hemorrhage (IVH) in an easy to remember manner. The goals would be to understand the clinical presentations of IVH and recognize the various stages.
Materials and methods: The educational poster will have the following headings:
Pathophysiology and Epidemiology of IVH,
Basic anatomy-a review relevant to IVH Stages-a review of ultrasound findings of the various stages,
Pitfalls in the diagnosis of IVH,
Differences from Periventricular Leukomalacia
Conclusion: The visitor to this poster should be able to walk away with a structured approach and be able to explain the pathophysiology, clinical presentation and epidemiology of IVH as well as the imaging findings of various stages of IVH.

PNE-32

Imaging of bithalamic lesions in the pediatric brain: demystifying a diagnostic conundrum

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Purpose:
1. To review the imaging features of bilateral thalamic lesions in children.
2. To discuss differential diagnoses, including metabolic/toxic phenomena, demyelination, infection, vascular lesions and neoplastic entities.
3. To overview additional imaging sequences and techniques useful for determining the etiology of thalamic involvement.

Materials and methods:
1. Description and classification of abnormal imaging appearances of the thalami.
2. Devising an approach to imaging diagnosis based on patient history, imaging appearances and the presence or absence of extra-thalamic involvement.
3. Role of imaging towards formulating a management plan and in subsequent follow-up.
4. Artifacts and diagnostic pitfalls were noted.
Results: Neuroimaging features of abnormal thalami as encountered in the pediatric population were detailed, and wherever applicable, the relevance of additional MR imaging sequences and techniques to determine etiology was described. While there was considerable overlap in imaging appearances, making a precise diagnosis was found to be challenging in difficult cases, and by and large, a stepwise approach was successfully formulated and used to:
1. Diagnose the more emergent conditions and to
2. Devise a management algorithm for the less acute abnormalities.
Conclusion: Bilateral thalamic lesions are occasionally encountered in pediatric neuroimaging and have a limited differential; a good knowledge base and adequate technique are imperative to tease out the precise diagnosis and institute appropriate management.

PNE-33

Imaging of oculoauriculofrontonasal syndrome with low-dose three-dimensional computed tomography

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Purpose: Oculoauriculofrontonasal syndrome (OAFNS) combines elements of abnormal morphology of the frontonasal and maxillary processes of the face. The aim of our exhibit is to demonstrate the low-dose Computed Tomography (CT) features of this syndrome in seven patients who have been followed at Seattle Children's Hospital (SCH) over 18 years. We underscore the imaging features of this condition, and describe additional features including bony nasal abnormalities not previously described in the literature, to improve imaging recognition of this spectrum.
Materials and methods: We present 3D CT imaging features of a series of eight patients with OAFNS. In keeping with the As Low As Reasonably Achievable (ALARA) concept and the Image Gently recommendations (www.imagegently.org), CT head and face studies were obtained on six of eight patients at SCH, while two had prior exams at outside institutions. Using a 64-slice multidetector CT scanner (GE LightSpeed VCT, Waukesha WI), low-dose CT (120 kV, 150 mAs or lower depending on age) of the head and face was obtained. Planar bone window and 3D surface-rendered images were analyzed.
Results: Our series of patients demonstrated bifid nasal bones, uni- or bilateral mandibular hypoplasia, temporomandibular and zygomatic dysplasia and bony external auditory canal abnormalities. One patient had an interfrontal bone with a frontal bony defect that was contiguous with the metopic suture. We describe additional previously unidentified CT anomalies of the nasal bones, anterior nasal spine and nasal septum. These structures are involved in all patients who had CT imaging available, although unique features are present in each case.
Conclusion: CT is the mainstay of imaging of craniofacial anomalies in the post-natal period, both pre- and post-operatively. In addition to our low-dose CT imaging findings of OAFNS, novel nasal bone anomalies identified by our group serve to identify a new subset of patients with this syndrome and may help refine the phenotype of the OAFNS spectrum.

PNE-34

Primary melanin-containing lesions of the central nervous system

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Purpose: Primary melanin-containing lesions of the central nervous system arise from the melanocytes in the leptomeninges. Melanin in these lesions result in iso to hyperintense signal on T1 weighted images and hypointense signal on T2 weighted images on MRI. We present three such pigmented lesions.
Materials and methods: Case 1: Melanotic neuroectodermal tumor A 5 year-old boy presented with head trauma. CT demonstrated an expansile, calcified mass arising from the right occipito temporal region with mass effect and sclerosis. MR revealed an expansile, extra-axial mass with mixed signal intensity on T1 and T2, hypointense signal on T2 * and intense peripheral contrast enhancement. The diagnosis of Melanotic neuroectodermal tumor was made. This is a rare melanin containing neural crest origin tumos that mostly occurs in infants and less commonly in older children. They occur in the maxilla (65–70 %), mandible (6–10%), calvarium-dura anterior fontanelle or parietooccipital (10%), brain (5%) and rarely elsewhere. Most run a benign clinical course after surgical resection but tend to recur if incompletely resected and invade locally in 10–15 % of cases. The brain tumors are usually malignant and infiltrative. Case 2: Neurocutaneous melanosis A 3 day old male with multiple giant cutaneous nevi presented for an MRI that demonstrated bilateral asymmetric foci of increased T1 and decreased T2 in the cerebellar hemispheres and the amygdaloid complex of the mesiotemporal lobes. The diagnosis of Neurocutaneous melanosis was made. This is a rare congenital syndrome with multiple large pigmented nevi with intracranial leptomeningeal melanocytosis Case 3: Leptomeningeal melanoma A 20 month old male with a history of hydrocephalus presented with unsteady gait and the MRI demonstrated diffuse abnormally thickened and enhancing leptomeninges with increased T1 and decreased T2 throughout in the subarachnoid spaces, cisterns and upper cervical cord. A biopsy demonstrated leptomeningeal melanoma. This is a rare aggressive neoplasm of the melanocytes in the leptomeninges with a poor prognosis.

PNE-35

MR imaging of cystic lesions in the pediatric spine

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Purpose: A variety of congenital, neoplastic, inflammmatory , post traumatic and post surgical conditions can lead to cystic lesions in the pediatric spine, and are not infrequently encountered in clinical practice. The purpose of this exhibit is to familiarize the reader with the differential diagnosis and optimal imaging approach to cystic lesions of the pediatric spine on MRI.
Materials and methods: Patients with cystic lesions of the spine were identified by a search of our institutional database. Particularly instructive cases were chosen to illustrate key teaching points. A pictorial essay was assembled using these cases. A literature search on the approach to cystic lesions of the pediatric spine was performed, and current recommendations incorporated into the essay.
Results: Cases included spinal arachnoid cyst, neuroenteric cyst, syringomyelia secondary to Chiari 1 malformation, isolated holocord syrinx, presacral meningocle, posttraumatic thoracic menin-

gocele, as well as neoplastic lesions such as spinal astrocytoma, spinal rhabdomyosarcoma , and cystic drop mets from infratentorial ependymoma. We also present an unusual flow related artifact which could potentially be misdiagnosed as a cyst. For each case, the MR features most useful for differential diagnosis and guiding therapy are described.
Conclusion: An approach to MR imaging of cystic lesions of the pediatric spine is presented, allowing the radiologist to make an accurate and confident diagnosis.

PNE-36

Intraosseous cerebrospinal fluid (CSF) pseudocyst: an unusual complication of craniovertebral junction surgery

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Purpose: We report two cases of expansile occipital intradiploic CSF pseudocysts which developed in patients after craniovertebral junction surgery.
Materials and methods: Case 1: A 15-year-old male presented for a VP shunt evaluation before trying out for the high school football team. The patient had a history of VP and cystoperitoneal shunts placed for hydrocephalus associated with a Dandy-Walker malfromation. When the patient presented at age 15 years, he was asymptomatic and denied any signs or symptoms of shunt malfunction. Plain radiographs revealed a break in the shunt catheter at the level of the right upper chest. Skull radiographs showed a cystic expansion of the occipital diploic space measuring 10×10×5 cm. The reservoir of the posterior fossa cystoperitoneal shunt had migrated into the enlarged diploic space. Head CT examination confirmed the intradiploic location of the reservoir catheter of the cystoperitoneal shunt was found to be occluded. Case 2: A 21 year old female with a history of posterior fossa decompression and occipitocervical fusion in infancy at an outside institution. Patient presented at our institution with many years ofheadaches, neck pain, left upper and lower extremity numbness as well as a 2.2×1.3 cm CSF filled occipital diploic space cyst.
Results: Occipital intradiploic expansile cysts containing CSF have been described as a rare entity, and only 14 cases have been previously reported. Almost all of these patients have had a previous history of head trauma with or without occipital fracture. The history of head injury ranges from very recent to as much as 50 years previously. No other cases of intradiploic CSF pseudocysts as a complication of surgery have been reported.
Conclusion: We reported two additional cases of the entity seen as a complication of craniocervical surgery. We consider intraosseous progressive accumulation of CSF through surgically created bone defects and intradiploic expansion as the underlying pathogenesis. It is our theory that these are seen almost exclusively in the occipital bone due to its unique embryogenesis.

PNE-37

Coloboma: different clinical presentations in association with rare syndromes

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Purpose: Coloboma is a rare ocular malformation characterized by the absence of fusion of the tissues of the eyeball. It can involve any eye structure (disk and optical nerve, cornea, retina, choroid, iris, sclera, lens, ciliary body), completely or incompletely, but is generally restricted to the posterior structures near the optical disk. Coloboma may be present as an isolated finding or associated with syndromes such as CHARGE syndrome, Aicardi syndrome, Walker-Warburg syndrome, Goldenhar syndrome, focal dermal hypoplasia (Goltz syndrome), linear nevus sebaceous syndrome, Dandy-Walker malformation and renal coloboma syndrome, among others. Colobomas associated with rare syndromes are demonstrated in this study.
Materials and methods: This paper is based on studies of magnetic resonance imaging, ultrasound and computed tomography of the brain and orbits, performed at our Institution in three cases of rare syndromes.
Results: The presentation of coloboma is variable, depending on the ocular structure involved. Imaging exams assess precisely the ocular structure involved, and detects encephalic anomalies associated with different syndromes. Microphthalmia, orbital cysts, and rarely macrophthalmia can be observed.
Conclusion: Coloboma is a rare congenital ocular malformation and can be associated with rare syndromes. This knowledge is essential for accurate and complete diagnosis.

PNE-38

Differentiation of congenital midline nasal masses: what the pediatric radiologist should know

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Congenital midline nasal masses are rare anomalies estimated to occur in 1:20,000 to 40,000 births. These disorders are clinically important because of their potential to obstruct the airway, association with other anomalies and potential to connect with the central nervous system. Multiple imaging modalities such as ultrasound (US), computed tomography (CT), and magnetic resonance imaging (MR) are often needed to fully characterize the type and extent of lesions present. This case-based poster presentation will illustrate key anatomy, embryology and imaging findings useful for diagnosis and pre-operative planning for these congenital midline nasal masses. Specific disorders will include nasal gliomas (or heterotopias), dermoids, epidermoids, and encephaloceles.

PNE-39

Aggressive desmoid-type fibromatoses of the pediatric head and neck

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Purpose: The following points will be emphasized in this presentation: 1. The role of imaging in initial diagnosis and management planning of aggressive Desmoid-type Fibromatoses (DF) of the pediatric head and neck. 2. Histopathology of

Desmoid Fibromatoses. 3. Differential diagnosis of Desmoid Fibromatoses in children. 4. Role of follow-up imaging in the assessment of treatment response.
Materials and methods: Pathophysiology of agressive Desmoid-type Fibromatoses. Radiologic Findings of Desmoid Fibromatoses (DF) of the pediatric head and neck. -Magnetic Resonance Imaging -Computed Tomography - Sonography Differential diagnosis of DF Histopathology of Desmoid Fibromatoses Sample cases with pre and post treatment imaging findings with emphasis on magnetic resonance imaging.
Results: The major teaching points of this exhibit are: 1. MR imaging of desmoid fibromatoses (DF) in children may show characteristic features of bands of low signal intensity on T2W sequence indicative of high collagen content, however, DF lesions with less collagen may have high signal intensity on T2-weighted images. 2. Post-contrast MR imaging shows variable pattern of enhancement from none to avid contrast uptake by these lesions. 3. Desmoid fibromatosis have a variable histopathologic appearance. 4. DF treated with chemotherapy demonstrate increase in areas of low signal intensity on T1W and T2W images consistent with increase collagen contents 5. Decrease in areas of high signal on T2W image may also be seen with chemotherapy suggesting decrease cellularity.
Conclusion: Extra-abdominal desmoid- type fibromatoses constitute approximately one third of all desmoid tumors. Although head and neck is an uncommon site for these lesions, comprising roughly 11 to 15% of all extra-abdominal desmoids, DF lesions in this location present with a special imaging challenge due to their infiltrative growth pattern and potential complications such as airway compromise and compression of neurovascular structure. Pediatric radiologists should be familiar with imaging features of these lesions for accurate diagnosis as well as assessment of treatment response.

PNE-40

Ultrasound guided administration of botulinum toxin type A for chronic sialorrhea

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Purpose: To reduce the severity of sialorrhea in patients with chronic neurological deficits.
Materials and methods: Cases were obtained retrospectively by dataset criteria as follows: ultrasound modality, age 5–18, pediatric requesting physician, dates 2007–2010, submandibular or parotid gland location. Patients were excluded if they did not receive follow-up within a one year period. Each patient received a Botulinum toxin type A injection for the indication of reduction of chronic sialorrhea. This treatment option was chosen over other options for sialorrhea such as medications (anticholinergics such as atropine and glycopyrolate), surgery with nasal/oral airway patency, and surgery to the salivary glands. The patients were brought to the ultrasound department. Utilizing ultrasound guidance the parotid gland or submandibular gland was located at the gland midline and marked on the skin surface with depth measured. A 100U vial of Antitoxin was diluted with 1 ml of normal saline 0.9%. Antitoxin was administered with a 1 ml syringe and a 3 cm length 27 Gauge needle placed into the capsule at the midline within the glandular tissue. One site was injected, however up to two sites may be injected. The maximum dose per submandibular gland is 15U and the maximum dose per parotid gland is 10U. The total maximum dose per patient shall not exceed 50U. Injections were repeated at 4–7 months. Injections could be repeated up to a maximum of 2 injections 4 months apart.
Results: We retrospectively reviewed the cases of five patients, ages 5 to 14, who received the Botulinum toxin type A injection into the parotid gland and/or submandibular gland. These patients had chronic sialorrhea due to cerebral palsy, congenital hemiplegia, or qualdriplegia. The patients tolerated the procedure well without complication. Each patient received follow-up by their ordering physician within six weeks. Each patient returned at 4–7 months for re-injection. Each patient had favorable results with reduction of drooling (sialorrhea).
Conclusion: Ultrasound guided administration of Botulinum toxin type A is an effective treatment for chronic sialorrhea.

PNE-41

Pictorial review of pediatric ischemic brain injury

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Purpose: To develop an imaging approach for the diagnosis of pediatric ischemic brain injury (PIBI) based on its etiology and pathogenesis. To understand the difference between a pediatric and an adult brain and their response to ischemia. To briefly review the differential diagnosis of PIBI.
Materials and methods:
1. Challenges associated with pediatric ischemic brain injury (PIBI) imaging
2. Anatomy and physiology of pediatric brain
3. Etiology and pathogenesis of PIBI - Perinatal ischemia - Acute arterial stroke - Sinovenous thrombosis
4. Imaging approach
5. PIBI mimics
6. Recent advances
Conclusion:
1. Pattern based approach is crucial in imaging perinatal ischemia.
2. Differentiation between arterial embolism, thrombosis and dissection is essential to evaluate acute arterial ischemic injury.
3. Important mimics of PIBI include infection, non accidental injury, metabolic disorders and others.

PNE-42

Transcranial Doppler (TCD) in children: technique and clinical applications

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Purpose:
1. To discuss the technique of TCD in children
2. To illustrate the clinical applications of TCD
Materials and methods: Ø Introduction Ø TCD in management of sickle cell disease (rationale, technique, ultrasound criteria for transfusion and imaging correlations) Ø TCD in vasospasm Ø TCD in stroke Ø Other applications of TCD Ø References
Conclusion: Transcranial Doppler Imaging is an important technique that assesses the direction and measures the velocity of blood flow through the intracranial blood vessels, primarily the vessels at the base of the brain (circle of Willis). This simple,

radiation-free technique plays an important role in patient management.

PNE-43

Cerebral MR abnormalities in hemiplegic migraine: a case series

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Background: Hemiplegic migraine is an uncommon migraine variant associated with aura and acute neurologic manifestations including sensory, motor or speech deficits, occuring in less than 1% of childhood migraineurs. Hemiplegic migraine may be sporadic or familial with an autosomal dominant pattern of inheritance. Neurologic deficits typically precede the headache and resolve completely following the attack, although cerebral infarction has been described with an incidence of 0.01 % (Thomsen L, Kirchmann M, Faerch R et al. An epidemiological survey of hemiplegic migraine. Cephalalgia. 2002). Proposed pathophysiology is initial hypoperfusion leading to ischemic symptoms followed by headache subsequent to reactive hyperemia.
Materials and methods: We report clinical and MRI abnormalities in three children with hemiplegic migraine. A 13 year old girl with a history of typical migraine presented with altered mental status, aphasia and right hemiparesis. MRI showed increased T2/FLAIR signal in the left cerebral cortex with several scattered foci of restricted diffusion in the left parietal lobe. The patient responded well to intravenous immunoglobulin therapy, with complaints of minor memory deficits. A 15 year old boy with a history of migraine presented with right hemiparesis following minimal trauma. MR showed an increased T2/FLAIR cortical signal in the left cerebral hemisphere with a subtle foci of restricted diffusion. Repeat MR one month later was normal. The patient responded well to steroid and verapamil therapy with minor articulation deficits. An 8 year old boy with a long history of headaches presented with prolonged migraine attack associated with right hemiplegia and expressive aphasia. MR revealed increased T2/FLAIR signal in left cerebral cortex. Repeat MR examination after three weeks was normal. Patient was discharged on verapamil therapy without any residual deficits.
Conclusion: This rare subset of children with hemiplegic migraine emphasizes the need to consider this diagnosis in pediatric patients with headache associated with discrete neurologic symptoms. Prompt clinical investigation, MR imaging and treatment should be performed in these children to decrease the risk of permanent neurologic complications.

PNE-44

Congenital CNS malformations and their association with pediatric epilepsy: a pictorial review with emphasis on pathophysiology and epidemiology

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Epilepsy is a disorder of the central nervous system characterized by recurrent seizures secondary to abnormal neuronal activity. According to the World Health Organization, approximately 50 million people are being affected by epilepsy worldwide. The cause of epilepsy generally varies according to the patient's age of seizure onset with idiopathic epilepsy being the most common diagnosis. There are many causes of epilepsy in the pediatric population ranging from infections, perinatal brain injury, metabolic derangements, congenital central nervous system malformations, and brain neoplasms. In this presentation, we will discuss the current literature review on the pathophysiology and epidemiology of congenital CNS malformations and their association with epilepsy in childhood. We will present the imaging findings of three pediatric patients with epilepsy secondary to congenital CNS malformations. The entities that will be presented include corpus callosal dysgenesis, Dandy-Walker malformation, heterotopias, pachygyria, polymicrogyria, and focal cortical dysplasia.

PNE-45

Congenital brain malformations evaluated by imaging exams: pictoral essay

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Background: Congenital brain malformations constitute a large group of diseases involving the central nervous system. Different classifications can be defined, according to anatomical or embryological origin. By embryogenesis, congenital brain malformations can be divided into: cytogenesis, histogenesis and organogenesis, which can be subdivided into different phases: neural tube closure, segmentation, diverticulation, neuronal proliferation, sulcation and migration, and myelination.
Materials and methods: This study is based on transfontanellar sonography, computed tomography and magnetic resonance imaging exams performed at our hospital in neonates and children with congenital brain malformations, demonstrating Chiari syndrome type I and II, Dandy-Walker complex, tuberous sclerosis, arachnoid cysts, dysgenesis of the corpus callosum, Aicardi syndrome, holoprosencephaly, septo-optic dysplasia, dysgenesis of septum pellucidum, lissencephaly, schizencephaly, gray matter heterotopia, polymicrogyria, hydranencephaly and porencephaly.
Results: Due to their origins, most congenital brain malformations are diagnosed during pregnancy in routine obstetrical sonography exams, or shortly after birth and can be evaluated by transfontanellar sonography, computed tomography or magnetic resonance imaging.
Conclusion: The spectrum of brain malformations is wide, ranging from high complexity and morbidity, such as Aicardi syndrome, to almost asymptomatic findings, such as arachnoid cyst. Imaging exams are essential to diagnosis and follow-up.

PNE-46

Transfontanellar sonography-guided neurosurgical and neuroendoscopic procedures in complicated hyrocephalus after neonatal intraventricular hemorrhage

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Purpose: A female newborn, born at 28 weeks and 1280 g, had an intraventricular hemorrhage evolved with hydrocephaly, treated

surgically and complicated with ventriculitis and noncommunicating multiloculated hydrocephalus. Several sonography-guided neurosurgical procedures were performed, such as ventricular punctures to reduce hydrocephaly and sonography-guided neuroendoscopy to remove intraventricular septations and communicate several loculi. Follow-up imaging exams, such as computed tomography and magnetic resonance imaging, were also performed.
Materials and methods: 8–5 MHz sector and 12–5 MHz linear probes of Philips HDI-5000 sonography device were used to guide ventricular puncture and neuroendoscopic procedures, in order to demonstrate the application of transfontanellar sonography in the diagnosis and follow-up of intracranial hemorrhage complications in preterm infants, as well as guide in neurosurgical and neuroendoscopic procedures, such as complex multiloculated hydrocephalus, correlating endoscopic and sonography images simultaneously. A review of the literature review was also carried out.
Results: Transfontanellar sonography demonstrates high sensitivity and specificity for diagnosing intracranial hemorrhage and its complications, with an important role in guiding diagnostic and therapeutic procedures. Precise correlation was observed between sonography and neuroendoscopy and between transfontanellar sonography, computed tomography and magnetic resonance imaging findings.
Conclusion: Use of transfontanellar sonography is crucial in the diagnosis of intraventricular hemorrhage, follow-up and treatment of hydrocephaly, as well as guiding neurosurgical and neuroendoscopic procedures, achieving better therapeutic results.

PNE-47

Imaging approach to neurometabolic disease referred by the psychiatrist

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Purpose: Inherited metabolic diseases in children and adolescents may present with varied acute and chronic psychiatric manifestations. Imaging studies, when judiciously used, can help diagnose neurometabolic disease expeditiously in these children. Objectives of this exhibit include:
1. Define an approach to indications for imaging children presenting with psychiatric manifestations.
2. Define a rationale for including diffusion weighted imaging, MR spectroscopy and tractography in these patients.
3. Illustrate characteristic imaging findings in certain disorders in this population with a tabulated aide-memoire for the clinician and radiologist.
Materials and methods: Retrospective review of imaging studies performed in patients (age <18 years) presenting with psychiatric manifestations at a tertiary care institution. We documented psychiatric symptoms at presentation and correlated these to imaging studies and final diagnosis. We also conducted a literature review to find evidence for imaging these children.
Results: Imaging must be considered in children presenting with acute psychiatric symptoms when they are associated with neurological signs, organic signs like organomegaly, cognitive decline, visual hallucinations and catatonia. Some of the disorders found in children imaged with these acute symptoms included urea cycle disorders, organic acidurias, aminoacidurias and metachromatic leukodystrophies. In children presenting with more chronic features like autism, depression and mania, mucopolysaccharidoses, non-ketotic hyperglycinemia, Smith-Lemli-Opitz syndrome, Wilson disease, and sphingolipodoses were diagnosed. MRS, SWI and diffusion-weighted imaging provided useful information aiding prompt diagnosis in a proportion of these cases. We provide a summary table correlating age of presentation, symptoms and imaging patterns based on our experience and literature review.
Conclusion: Imaging studies can provide useful clues to early diagnosis of neurometabolic disease in pediatric patients presenting with psychiatric symptoms. Radiologists should be aware of this to ensure prompt diagnosis in these children.

PNE-48

Focal spinal cord lesions in children: differential diagnosis with MRI

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Purpose: Focal spinal cord lesions are rare in childhood. It is important to recognize the neoplastic and non-neoplastic processes, since treatment and morbidity/mortality changes significantly between these two groups.
In this poster we will present leading MR imaging features of these entities, and focus on differentiating features as we present examples of common intramedullary spinal cord tumors (astrocytoma, ependymoma) versus other non-neoplastic diseases such as demyelinating diseases (acute disseminated encephalitis (ADEM), acute transverse myelitis, multiple sclerosis), vascular lesions (such as arteriovenous fistulas (AVF)), and syringohydromyelia. We will show MRI imaging findings, since MRI provides the highest spatial resolution, multiplanar capability, functional information (DTI, DWI) and lacks the risk of ionizing radiation. To adhere to the limit of 5 cases as suggested by the guideline, we will present 2 cases of intramedullary tumors (an astrocytoma and immature teratoma), an ADEM, a transverse myelitis, and an AVF. Each case will be presented with the presenting clinical symptom, age and gender of the child. T1-weighted, T2-weighted and post-contrast T1-weighted images will be presented in each case. In addition, DTI will be presented in the astrocytoma case. Emphasis will be made on the degree of focal enlargement, involvement of the cord (central versus eccentric, cervicothoracic versus lumbar), number of lesions (single versus multiple), T1-W and T2-W signal characteristics, enhancement pattern, involvement of the leptomeninges. MRI with its superior soft tissue contrast as well as lack of ionizing radiation is an invaluable tool in the localization and characterization of focal spinal cord lesions in children. The diagnoses, treatment pathway, follow-up and successful management of these debilitating conditions requires close co-operation between radiologists and clinicians.

PNE-49

Pediatric spinal abnormalities: an embryology, classification, and pitfall review

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A variety of abnormalities and malformations occur in the pediatric spine. Classification of pediatric spinal abnormalities has undergone revision in recent years causing some confusion in terminology. Modern ultrasound techniques and MR imaging enable superior visualization and characterization of congenital spinal anomalies. Using a case based format, this educational poster will review pertinent spinal embryology, normal anatomy, normal variants and pitfalls relevant to diagnosing and classifying congenital spinal disorders based on modern terminology.

PNE-50

3D volume MR in pediatric neuroimaging

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Purpose: To present a pictorial review of 3D volume MR imaging of a spectrum of pathologic entities in the cranium, head-neck and spine in children.
Materials and methods: We retrospectively reviewed the brain, head-neck and spinal MR findings in children who had additional 3D volume sequences performed at two institutions.
Results: A variety of specific pathologic diagnoses in the brain will be presented to contrast conventional and 3 D imaging: aplasia of the olfactory nerves, optic pathway glioma, hypoplasia of the abducens nerve, absence of the cochlear nerve, septo-optic dysplasia, germinoma, posterior fossa neoplasm, aqueductal stenosis, and loculated ventricular system. The choice of imaging technique is also helpful in defining spinal conditions such as: extramedullary arachnoid cyst, spinal dysraphism, dermal sinus, cervical nerve root avulsions, and vascular malformation. In the neck, an oblique reformation of a branchial cleft fistula will be illustrated. Improved imaging techniques may also lead to the diagnosis of unexpected asymptomatic findings and examples of: a thyroglossal duct cyst, dacryocystocele and diastematomyelia
Conclusion: MR 3D imaging, including steady state imaging sequence such as FIESTA (fast imaging employing steady state acquisition) and 'CISS' (constructive interference steady state) is superior to conventional MR sequences, providing improved imaging with higher signal-to-noise, and contrast-to-noise ratios, improved speed of acquisition and reduced motion artifacts. This is particularly helpful in the delineation of small 'objects'.

PNE-51

MRI findings in term infants with clinical presentation of encephalopathy

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Purpose: The objective of this poster is to present the MRI findings of term infants with the clinical presentation of encephalopathy.
Materials and methods: A retrospective review was obtained of all MRI studies performed in term newborns born between 36–42 weeks with clinically suspected hypoxic-ischemic encephalopathy. For each patient, the clinical history, demographics and imaging modalities used were reviewed and recorded.
Results: 151 patients with clinically suspected hypoxia were imaged. Of these, 69 patients had both Day 3 and Day 10 MRI performed. Most of these symptomatic patients had radiologic evidence of hypoxia-ischemia (25), with manifestations of hypoglycemia the next common (8). Foci of white matter injury, either single (3) or multiple (6) also featured. Three patients showed white matter edema as their only abnormality while two had middle cerebral artery infarcts. There was one each of posterior fossa hematoma, Grade IV hemorrhage and traumatic birth history. 19 scans showed no abnormality on either the Day 3 or 10 study.
Conclusion: The MRI findings of the various etiologies for the clinical presentation of encephalopathy in term infants are presented.

PNE-52

Assessment of brain death in children–how can radiologists help?

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Purpose: To review existing brain death criteria and the potential role of various modalities in establishing the diagnosis of brain death in pediatric patients.
Materials and methods: Transcranial Doppler (TCD) and radionuclide studies performed for clinically suspected brain death were reviewed. TCD was performed at the bedside using 1–5 MHz sector transducers (GE Logiq E-9, Philips IU 22). Radionuclide studies were performed in the nuclear medicine department with a single-head gamma camera (Siemens E.cam) and included radionuclide angiography (using non –lipophilic agents such as Tc-99m pertechnetate) or parenchymal studies (with lipophilic agents such as TC99m –HMPAO). Two clinically suspected brain death cases were confirmed by cerebral angiography. Literature review of other brain death imaging strategies was also performed.
Results: Patterns of supratentorial blood flow on TCD in cases of impending brain death included oscillating flow, small early systolic spikes and absent flow in MCA with reversal of diastolic flow in extracranial ICA. On radionuclide angiography absent activity in the MCA and ACA with a satisfactory carotid bolus was used to confirm brain death. Non visualization of the venous sinuses on the static images was a further confirmation. In parenchymal studies, absent activity in the brain parenchyma was used to document brain death. On cerebral angiography, there was no perfusion of intracranial vessels. Illustrative examples of each would be provided.
Conclusion: Establishing pediatric brain death, especially when dealing with the issue of potential organ donation, can be problematic. Neurologic examination, EEG and brainstem evoked potential are used to establish brain death, but can be affected by medications such as phenobarbital. Radiologists can provide several methods in the assessment of brain death including TCD, radionuclide blood flow studies, and the more invasive angiography. CT and MR have recently been suggested as alternative methods. The pediatric radiologist should be aware of potential adjunct role of these modalities to the clinical diagnosis in confirming brain death.

PNE-53

Spinal lesions in children: a pictorial review

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Purpose: To demonstrate the wide spectrum of pediatric intraspinal lesions, including classic presentations and unusual variants.
Materials and methods: At our institution, MR imaging of the spine is performed either on a 1.5 or 3.0 Tesla magnet. Our

protocols include T1- and T2-weighted imaging in orthogonal planes, and STIR, postcontrast and diffusion-weighted imaging in specific cases. Examples of different pathologies and normal variants were selected from a total of 340 spinal examinations. Patients referred for examination of the spine have had worrisome clinical findings of presumable intramedullary pathology, extrinsic cord compression, or incidental intraspinal abnormalities found on MR or CT examinations performed for other indications.
Results: Common and unusual imaging appearances of intraspinal pathology in children are depicted. Lesions that constitute the majority of pediatric spinal pathology are described by the following categories:
A. Congenital malformations, which can be diagnosed either in the perinatal period or later in life;
B. Cystic and solid intra- and extra-axial mass lesions;
C. Systemic diseases, such as Langerhans cell histiocytosis, metastatic dissemination, tuberculosis, and Sjogren's syndrome;
D. Metabolic conditions, congenital and acquired;
E. Miscellaneous intramedullary pathology, such as cord infarction, posttraumatic contusion and others.
Conclusion: Familiarity with common and unusual imaging appearances of the variety of pediatric spinal disorders is important for a precise and timely diagnosis of numerous developmental, neoplastic, infectious/inflammatory and numerous other pediatric conditions.

PNE-54

Demystifying malformations of cortical development for the pediatric radiologist

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Background: Malformations of cortical development (MCDs) are cerebral cortical abnormalities which develop as a result of disturbance of the process of formation of the cortical plate in fetal life. The stages of development include neuronal cell proliferation and differentiation, neuronal migration and finally organization of the neurons in the developing cortex. Environmental or genetic etiologies can cause disruption of each of these steps and predispose to epileptic seizures. A number of MCDs have been described with characteristic pathological, clinical, and imaging features. Further, a genetic basis has been described in a number of the MCDs.
Purpose: To provide an overview and step-by-step approach to the diagnosis of most common malformations of cortical development in children. To summarize characteristic etiologic, pathological, clinical, and radiological features of each MCD, with representative magnetic resonance imaging (MRI) images shown for each MCD.
Materials and methods: A brief overview of the current classification of malformations of cortical development will be presented. It will include illustrative examples of various MCDs including tuberous sclerosis, focal cortical dysplasia, hemimegalencephaly, classical lissencephaly, subcortical band heterotopia, periventricular nodular heterotopia, polymicrogyria, and schizencephaly along with a tabular summary of imaging features and genetic basis of various MCDs. Tips to ensure accurate diagnosis and potential pitfalls in the diagnostic workup of MCDs on magnetic resonance imaging (MRI) will be described.
Conclusion: Malformations of cortical development are increasingly recognized as a cause for epileptic seizures. It is essential that the pediatric radiologist be familiar with modern imaging strategies, changing nomenclature and potential diagnostic pitfalls when evaluating these patients.

PNE-55

Multi-modality approach to intractable epilepsy—tips, traps and tricks of the trade

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Background: Intractable epilepsy is a cause of significant morbidity in the pediatric population, with 25 to 30% of partial seizures being refractory to medical management. Repeated seizures lead to progressive neuronal injury and, for these patients, surgery often offers the only feasible hope for cure. Through modern imaging, we are increasingly able to delineate the location and extent of epileptogenic foci and to assist in pre-operative planning.
Purpose: To provide a brief overview of the algorithmic imaging approach to drug-resistant focal epilepsy. To summarize, through image examples, features of disorders that are commonly associated with refractory epilepsy. To highlight some of the potential diagnostic pitfalls when imaging patients with refractory seizures.
Materials and methods: An introduction to the pre-operative imaging of drug-resistant epilepsy Illustrative examples of disorders associated with refractory seizures, including hippocampal sclerosis, neoplastic lesions and malformations of cortical development (with emphasis on focal cortical dysplasia). An overview of a suggested diagnostic algorithm, with particular reference to structural imaging (magnetic resonance imaging [MRI] and diffusion tensor imaging [DTI]). Discussion of additional functional studies, including positron emission tomography (PET), single photon emission tomography (SPECT), functional MRI (fMRI), magnetoencephalography (MEG) and arterial spinal labeling (ASL). Suggestions on how to improve the yield of MRI, and discussion of some of the potential pitfalls in imaging refractory epilepsy.
Conclusion: A multi-disciplinary approach to drug-resistant epilepsy is imperative for planning potentially curative excision of an epileptogenic focus. By following a systematic imaging algorithm on both structural and functional studies, the radiologist can significantly aid in the successful management of these patients.

PNE-56

Intravascular gadolinium-based contrast agents for the evaluation of pediatric head and neck soft tissue vascular anomalies

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Purpose: To introduce, discuss and illustrate the advantages of radiation-free high-quality diagnostic imaging of soft tissue vascular anomalies of the head and neck in children using the novel blood pool MR contrast agent gadofosveset trisodium (GFT) in combination with high temporal resolution dynamic three-dimensional contrast-enhanced MRA (DCE-MRA).
Materials and methods: DCE-MRA offers high temporal resolution, allowing acquisition of multiphase studies, with

post-hoc selection of optimal arterial, venous and delayed venous phases. GFT reversibly binds to serum albumin with high affinity, and is therefore strongly restricted to the blood pool in which it remains for a prolonged period of time with only minimal tissue enhancement and extravasation. Advantages include higher contrast to noise and signal to noise ratios, use of up to 3- fold lower contrast doses for more compact bolus injection, and enhanced temporal separation of the various contrast phases. These improvements are especially useful for the imaging of small children, as they can account for differences in pediatric hemodynamics such as a significant faster circulation time, slower injection rates, larger bolus dispersion and smaller contrast doses.
Results: Contrast enhancement dynamics are key decision criteria in the evaluation of vascular anomalies of the pediatric craniofacial region and excellently depicted with DCE-MRA. We review key MR imaging characteristics of hemangiomas, venous malformations, and lymphatic with specific discussion of the integration of new blood pool contrast agents into the MR assessment.
Conclusion: High-quality diagnostic imaging for the characterization of vascular anomalies of the head and neck in children using blood-pool MR contrast agents and rapid DCE-MRA has high potential as an alternative to CT angiography and digital subtraction angiography, while providing unique advantages especially for imaging in the pediatric population. High temporalresolution imaging with prolonged vascular phase aids in the determination of the exact enhancement pattern (arterial, venous or no enhancement) of vascular anomalies as a decisive factor in their diagnosis.

PNE-57

"More than meets the eye": orbital manifestations of pediatric systemic diseases

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Background: A wide variety of systemic diseases can manifest as lesions involving the orbit. Lesions of the pediatric orbit often differ from those found in adults. Often these lesions have imaging features that, when combined with the clinical presentation, allow for a relatively narrow differential diagnosis. Furthermore, given the complexity of their location, and the considerable morbidity that may be associated with biopsy in this region, diagnosis of pediatric orbital lesions falls heavily on the radiologist.
Purpose: The objectives of this poster include: systematically review the imaging features of the orbital manifestations of the more common pediatric systemic diseases, discuss the differential diagnosis of these lesions, with particular attention to their location and their imaging characteristics by MR and CT, and identify key features of the orbital lesions that may allow for differentiation from other similar appearing lesions in children
Materials and methods: We conducted a retrospective review of imaging studies performed at our institutions over the previous 10 years. Additionally, detailed chart review to document the clinical presentation and past medical history at the time of the scan was performed in the selected cases.
Results: Orbital lesions were classified according to the pathophysiology of the underlying systemic illness, with entities including (but not limited to) the following categories: Congenital Phakomatoses: NF 1 & 2, TS, VHL Infection: Cellulitis, Subperiosteal abscess, Invasive Fungal Sinusitis Inflammatory/ Auto-immune: LCH, MS, Rheumatoid, Sarcoidosis, Graves Neoplastic Benign (Fibrous dysplasia, dermoid/epidermoid) Malignant (Lymphoma, Leukemia, Metastasis) Vascular: Hemangioma, Veno-lymphatic malformation Trauma- (accidental and non-accidental trauma) Toxic/Metabolic 4.
Conclusion: A wide range of systemic diseases affecting the pediatric patient can manifest with orbital pathology, and knowledge of their imaging features, in conjunction with a suitable clinical context, is essential to accurate and timely diagnosis as well as differentiation from other similar appearing lesions.

PNE-58

Ultrasound and magnetic resonance imaging features of unusual ocular disease in children with clinical and pathological correlation

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Leukocoria in children is often caused by retinoblastoma but can be due to other uncommon ocular diseases. We reviewed our experience with unusual ocular pathologies that were referred to our institution with a presumptive diagnosis of retinoblastoma. Diagnostic imaging of the eye provides information important for directing the evaluation and management of ocular disease. Ultrasound is a particularly useful modality because it is readily available, mobile, inexpensive, and involves no exposure to ionizing radiation. Though magnetic resonance imaging requires sedation and is more costly, the multiplanar capabilities, lack of ionizing radiation and tissue characterization contribute to preoperative diagnosis. In this case series we review normal eye anatomy demonstrated on ultrasound and magnetic resonance imaging and present the clinical and imaging features, as well as pathology when pertinent, of retinoblastoma, Coats' disease, persistent fetal vasculature, toxacara granuloma, extensive retinal detachment with proliferative vitreoretinopathy, staphyloma, and corneal dermoid. Clinical and imaging features that are useful in discriminating between these entities are emphasized.

PNE-59

Imaging of palpable craniofacial lesions: when to biopsy?

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Purpose: Palpable craniofacial lesions are common and can range from benign and self limiting to malignant and destructive. A small percent can be diagnosed with clinical history and physical examination but most are indeterminate and create significant anxiety in the patient and the parents. Most lesions can have a deeper component while they present with a small palpable abnormality. Our goal is to review the characteristic imaging findings of wide spectrum of palpable craniofacial lesions involving the skin, soft tissues and bones with various imaging techniques including ultrasound, CT and MRI.
Materials and methods: List common and some unusual causes of craniofacial palpable lesions that may be indeterminate on physical examination. Reviewed pathologies will include congen-

ital lesions, infections, benign and malignant tumors, vascular malformations, post traumatic lesions and some idiopathic processes such as infantile fat necrosis (dermoid, epidermoid, skull abscess, pilomatrixoma, parotid infection, ectopic parotid gland, parotid tumor, lymphoma, plexiform neurofibroma, lacrimal gland myofibroblastic tumor, aneurysmal bone cyst, langerhans cell histiocytosis, rhabdomyosarcoma, hemangioma, vascular malformations) Explain imaging techniques (US, CT and MRI) and logical algorithm of imaging. Organize the exhibit in three sections according to the certainty of the imaging diagnosis as definite, probable and uncertain. Illustrate the imaging findings of various lesions with special emphasis on key findings that can lead to accurate diagnosis. Provide a short list of reasonable differential diagnosis when needed.
Results: Some lesions demonstrate classic imaging findings that help accurate diagnosis. Other lesions are indeterminate with imaging and have a differential diagnosis list. These lesions will require follow up or biopsy for accurate diagnosis.
Conclusion: Certain characteristic imaging findings of craniofacial lesions could lead to correct diagnosis or at least a short and reasonable differential diagnosis list which may prevent unruly anxiety, unnecessary imaging and biopsy and surgery.

PNE-60

Imaging review of sinonasal pathology and mass lesions

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Purpose: A detailed and thorough understanding of normal anatomy and embryology is vital to the diagnosis and prognosis of congenital and acquired sinonasal abnormalities that present in childhood. The purpose of imaging the paranasal sinuses is to confirm diagnosis, localize disease, characterize the extent of pathology and describe any anatomical variations. In this review, we aim to demonstrate the complex anatomy of the sinonasal cavities, its variations and the imaging techniques appropriate for their evaluation. We will illustrate the wide spectrum of disorders affecting the nasal cavities and paranasal region and we will describe useful imaging features that are important for surgical planning and aid in the differential diagnosis of sinonasal abnormalities.
Materials and methods: All cases presented are selected from our department database. For practical purposes, an anatomical systematization is applied: 1. Lesions originating within paranasal sinuses. 2. Lesions originating within the nasal cavities. 3. Extrinsic lesion with secondary extension to sinonasal cavities. In each group, several entities are presented according to their frequency and/or incidence in different age groups. Important pathological, clinical and imaging features are emphasized.
Results: A wide spectrum of pediatric sinonasal abnormalities is presented. CT has a primary role and MRI is used as problem solving tool. Congenital sinonasal anomalies are common and the majority are asymptomatic, often incidentally identified. On the other hand, many acquired lesions have nonspecific imaging features, and their diagnosis therefore must be based on the patient's age and histologic features. Acquired sinonasal abnormalities may be caused by trauma, infection, inflammation, or tumors.
Conclusion: Although there is a wide diagnostic range, most often, imaging findings in combination with knowledge of the patient's age group and clinical presentation, can lead to a specific diagnosis, or will at least restrict the diagnostic possibilities.

PNE-61

Childhood Moyamoya disease—evaluation and management in non sickle cell patients

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Purpose: Moyamoya disease accounts for approximately 6% of childhood stroke in the West. Affected children usually present with ischemia before 10 years of age and are at risk for multiple stroke. Early diagnosis and therapy is important to minimize disability. We present seven cases of childhood Moyamoya in the absence of sickle cell disease, discuss the need for consistent imaging surveillance in these patients and suggest a neuroimaging paradigm, based on a literature review for the investigation and management of these children.
Materials and methods: A retrospective review was performed identifying children with stenosis of the circle of Willis in the absence of sickle cell disease, infection or inflammatory disease. Initial presentation, management and clinical course to date was reviewed.
Results: Excluding sickle cell disease, 7 patients were identified. Two with Morning Glory Syndrome, one with Neurofibromatosis (NF) 1, two with trisomy 21, one with vasculopathy following cranial radiation and one with idiopathic disease. Two patients presented with acute stroke. Four underwent surgical revascularization prior to age 6. MRI/MRA was the imaging modality of choice in all patients for diagnosis and surveillance. Our cases highlight the lack of a consistent imaging management protocol for children with Moyamoya who do not have sickle cell disease. Four of seven suffered stroke and subsequently underwent surgical revascularization. We propose an imaging strategy including ultrasound based on a literature review and cost/benefit considerations.
Conclusion: Children with or at risk for Moyamoya excluding those with sickle cell disease, are rare and are not currently imaged in a standard manner. Following a literature review particularly in regard to sickle cell disease monitoring, we suggest an imaging strategy employing MRI/MRA and Doppler ultrasound on an annual basis for patients with bilateral disease and on a semi-annual basis for young patients with unilateral disease. Such a strategy may improve early detection, enable earlier surgical intervention and decrease overall morbidity and mortality from stroke.

PNE-62

Loeys-Dietz Syndrome: neuroradiologic findings and complications in pediatric patients

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Purpose: Familiarity with the neuroimaging features of Loeys-Dietz syndrome (LDS) in children is essential for effective clinical management and pre-surgical planning. The purpose of this presentation is to review the craniocervical vascular and spinal abnormalities and complications in children with LDS. LDS is a rare autosomal dominant connective tissue disorder characterized in 2005 caused by heterogeneous mutations in the genes encoding transforming growth factor–β (TGF- β) receptors. Children with LDS have four main features: (1) vascular anomalies (2) skeletal abnormalities (3) hypertelorism and (4) bifid uvula or cleft palate.
Materials and methods: One neuroradiologist and one pediatric radiology fellow retrospectively reviewed the head, neck and spine CT, MRI, CTA, MRA and plain film examinations performed

between 8/14/2003 and 10/21/2010 of 6 pediatric patients with Loeys-Dietz syndrome confirmed by genetic testing. The children ranged in age from 3 to 17 years (2 males and 4 females). Arteries in the neck and head were evaluated for tortuosity, stenosis, ectasia, aneurysms and dissection. The craniocervical junction and spine were evaluated for atlantodental instability, stenosis and scoliosis.
Results: Widespread neuroradiologic abnormalities were demonstrated. 100% had vascular tortuosity, a finding considered universal to LDS. 80% exhibited normal branching pattern of the great vessels. 80% had moderate to severe S-shaped scoliosis. Additional findings included: (1) arterial ectasia (50%) (2) arterial dissection (2 cervical vessels in one patient) (3) fenestrated intracranial vessels (33%) (4) hypertelorism (33%) and (5) atlantodental instability and associated craniocervical stenosis (one patient).
Conclusion: Familiarity with the unique imaging characteristics found in LDS are essential for effective management and presurgical planning of children with LDS. Serial imaging is recommended to monitor for possible dissection and aneurysms. Children with LDS should also be evaluated for atlantodental instability prior to surgery.

PNE-63

Multimodality imaging for focus localization in refractory pediatric epilepsy

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Background: Imaging of refractory epilepsy in children often presents as a challenging clinical situation. Neuroimaging, especially MRI has established itself as the critical tool for initial evaluation of these disorders. Newer non-invasive techniques including 18F-FDG positron emission tomography (PET), magnetoencephalography (MEG), diffusion tensor imaging, MR spectroscopic imaging and magnetic source imaging have shown to improve focus detection, especially in pharmacoresistant pediatric seizure syndromes.
Purpose: This exhibit aims to familiarize the reader with these techniques and define the role of imaging in multi-disciplinary evaluation of children with epilepsy.
Materials and methods:
- List common causes of Pediatric Epilepsy, with special emphasis on pediatric epilepsy syndromes and pharmacoresistant subtypes
- Explain common MR imaging techniques, and need for sedation
- Review state of the art non-invasive imaging techniques and their role in identifying pathological entities. Illustrate the role of fusion imaging.
- Illustrate MR appearances of various causes of focal seizures
- Describe the role of imaging in guiding surgical resection in refractory epilepsy, including focal cortical dysplasia, tuberous sclerosis, hemimegalencephaly, mesial temporal sclerosis, neoplasms, Rasmussen encephalitis, and perinatal infarction
- Present a systematic approach to imaging, including a flow chart of various approaches to detect focal seizures
Conclusion: Newer imaging techniques combined with standard brain MRI improves the detection rate of epileptogenic foci in pediatric epilepsies. In pharmacoresistant epilepsies, these techniques have improved the accuracy of identification of epileptogenic foci that are potentially amenable to surgical resection and thus possible to cure. This exhibit will familiarize the reader with current protocol with emphasis on fusion imaging in refractory seizures.

PNE-64

Cerebellar leukoencephalopathy in histiocytosis

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Background: Histiocytosis can be associated with cerebellar white matter abnormalities, thought to be paraneoplastic. The associated clinical picture consists of ataxia, spasticity, and cognitive decline. Hormonal dysfunction is frequent. CT and MRI shows cerebellar white matter abnormalities, as well as brainstem and basal ganglia lesions. This so-called "neurodegenerative syndrome" may occur years before or during manifest histiocytosis and also years after cure.
Materials and methods: We report a case of a child of 11 years.
Conclusion: Considering the clinical CT and MRI similarities between our patient and patients with neurodegenerative syndrome in the context of proven histiocytosis, it is likely that they share the same paraneoplastic syndrome, although we cannot exclude a genetic disorder. The fact that we found histiocytic lesions in this patient substantiates our conclusion. Patients with cerebellar white matter abnormalities should be monitored for histiocytosis.

PNE-65

Diffusion-weighted imaging of spinal tumors with reduced field of view EPI

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Purpose: At our institution, there is a great need for diffusion-tensor imaging (DTI) of the spinal cord for the assessment of cord lesions, however spinal cord DTI has been limited by geometric distortion that arises from the use of conventional single-shot diffusion EPI. Here we demonstrate the feasibility at clinic level of a technique called ZOOM-EPI used for reducing distortion. To demonstrate the potential for further improvements in this technique for assessing spinal tumors, we also present distortion-corrected images acquired on a healthy volunteer at 3T.
Materials and methods: ZOOM-EPI DTI datasets were acquired at 1.5T and 3T in 2 minutes each on a 5 year old male with a suspected thoracic cord neoplasm and a 35 year old female with cervicomedullary neoplasm. In addition, volunteer cervical and thoracic DTI data were acquired at 3T to demonstrate the potential for additional distortion correction using post-processing.
Results: The 35 yr old DTI images showed a well-encapsulated tumor. It was found surgically to lack local tumor infiltration and was confirmed pathologically to be a low-grade tumor (grade I pilocytic astrocytoma). The 5 yr old had a more aggressive neoplasm with an infiltrative tumor biology where neoplastic cells infiltrated and traversed alongside spinal tracts. At surgery, the lesion was adherent and difficult to completely excise due to its infiltrative nature; pathologic assessment revealed infiltrating grade II astroctyoma, confirming our pre-operative diagnostic suspicion based on ZOOM-EPI data. The distortion-corrected data in a volunteer also showed the possibility of further improvements to ZOOM-EPI with post-processing.
Conclusion: Based on the utility of these first patient data acquired at our initiation, ZOOM-EPI DTI data enhanced diagnostic capacity for pathologic tumor grade, and further defined the relationship between spinal tracts and the underlying lesion, an important potential

application in surgical management. We are also encouraged by volunteer data that further reduced distortion can be achieved in combination with distortion correction.

PNE-66

Susceptibility-weighted imaging (SWI) post-processing to enhance clinical utility of conventional 2D-gradient echo (GRE) in the pediatric neuroimaging

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Purpose: SWI is an MRI technique that utilizes a high resolution 3D GRE acquisition together with phase post-processing to accentuate the paramagnetic properties of blood products. Long scan time of 3D GRE (up to 10 mins) limits its utility. Our goal was to evaluate clinical application of SWI-phase and magnitude post processing normally reserved for 3D GRE images to conventional 2D GRE with a shorter scan time (2.5 min)
Materials and methods: SWI-processing (SWIP) and phase unwrapping were performed on routine 2D GRE data of 50 consecutive pediatric brain MRI at 3T resulting in: SWIP 2D GRE, SWIP 2D GRE minimum intensity projection (MinIP), 2D GRE Phase Unwrapped (GPU), and 2D GPU MinIP series. 2 neuroradiologists compared these SWI-processed data against conventional 2D GRE.
Results: As compared to 2D GRE, SWIP showed new lesions in 18/50 cases. Lesions were more conspicuous on SWIP MinIP vs. 2D GRE MinIP in 43/50 cases. However, SWIP rendered lesions less conspicuous in 23/50 cases. In 9 cases, GPU images distinguished calcium from hemosiderin (confirmed by CT). In cases of venous thromboses, detection was more challenging on 2D SWI due to enhanced visualization of all venous structures (thrombosed and non thrombosed). Catheter lumen and their drainage holes were also more conspicuous on 2D SWI, especially on phase images. In instances of motion and dental braces, SWIP worsened the artifacts.
Conclusion: SWIP technique applied to 2D GRE images increased iron-sensitivity with no additional scan time. The phase images distinguished calcium from hemosiderin. Limitations included: (1) with better delineation of normal venous structures on SWIP, pathologic venous structures may be less evident; (2) metal-induced artifact may be worsened and (3) MinIP post processing can obfuscate findings due to imprecise anatomic localization. However, >50%of the cases, new lesions were found or lesions became more conspicuous with SWIP, which suggests that this technique may be a useful adjunct in pediatric practice where long scan times of 3D SWI are difficult to implement.

PNE-67

Quality assurance in multi-institution and multi-scanner MRI neuroimaging research

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Purpose: The goal of the study is to present the design and initial quality assurance (QA) data in a multi-center and multi-scanner MR project in the context of a four-year longitudinal DTI study of pediatric hydrocephalus (R01 NS066932).
Materials and methods: To establish the MR compatibility (two 1.5T GE Signa scanners from Cincinnati Childrens' Hospital Medical Center (CCHMC) and one 1.5T Siemens Avanto from St. Louis Childrens' Hospital/Washington University (SLCH/WashU)), the MRI protocol including DTI, T1w and T2w sequences was tested at both sites using the same MR phantom (BIRN) and a human subject. After the establishment of site/scanner compatibility, the same process will be conducted annually over the four year period of the study. The study protocol also requires both sites to collect QA data using ACR phantoms within a week of each subject's scan to assess the stability of scanner performance and to detect system performance change relative to established baseline.
Results: The scanner compatibility test shows that the phantom mean diffusivity (MD, in units of 10–6 mm/s) was 1840±150, 1840±140 and 1849±82 for the three scanners, respectively. DTI results from the human phantom also showed high compatibility in a series of regions of interests. The relative inter-scanner difference was between 0–3.3% for fractional anisotropy (FA) and 0–2.5% for MD. In the routine stability testing, the maximum percent error in geometry accuracy measurement was 1.35% in length (147.7±0.8 mm, 95% CI=147.3–148.1 mm) and 0.53% in diameter (189.8±0.8 mm, 95% CI=189.4–190.1 mm) across the scanners and centers. The SNR of b0 images remained stable for both GE (25.89±2.21; 95% CI=24.55–27.23) and Siemens scanners (46.21±1.99, 95% CI=44.12–48.3). The MD results had a range from 2.09 to 2.15 for GE scanners (2.15±0.03, 95% CI=2.13–2.16) and a range of 1.97–2.07 for the Siemens scanner (2.03±0.04, 95% CI=1.99–2.07).
Conclusion: The scanners from the two sites showed high compatibility during the initial setup. The routine QA scans showed that the performance of all the scanners remained highly stable throughout the period in geometric measurement, SNR, and DTI measurement.

PNE-68

Primary CNS vasculitis in children: comparison of clinical, radiological and pathological findings

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Background: CNS vasculitis is a serious but potentially reversible inflammatory brain disease. It can occur as a secondary manifestation of an underlying systemic condition or a primary isolated disease. In children, primary or isolated CNS vasculitis is an increasingly recognized inflammatory brain disease. It may cause devastating neurological deficits and, in some patients, the disease progresses rapidly leading to a fatal outcome. However, it is believed that if recognized early and treated appropriately, the disease can be reversible.
Purpose: The purpose of this review was to retrospectively assess 8 children with small vessel vasculitis who presented to our institution between 2001 and 2011. The clinical charts, cross sectional imaging (MRI and CT), angiography studies (when available) and pathological findings, were independently reviewed by our multidisciplinary team. Review of the images was performed blinded to the pathological findings. By performing this multidisciplinary reassessment we intend to illustrate different imaging patterns of primary vasculitis as well as correlate them with the clinical and pathological findings.

PNE-69

Pontine and midbrain echogenicity explained: in vivo and ex vivo US anisotropy with MRI diffusion tensor tractography correlation

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Purpose: Neurosonography of the infant brainstem through the anterior fontanel reveals that the anterior pons is hyperechoic and the posterior brainstem is hypoechoic. We postulate that this is due to anterior-posterior anisotropy in the anterior pons and superior-inferior anisotropy in the posterior midbrain.
Materials and methods: US images of the pons and midbrain were performed via the anterior fontanel and via alternate acoustic windows in the same patients to evaluate differences in appearance from different insonation angles. Echogenicity was evaluated visually as well as with a quantitative region of interest analysis using NIH ImageJ software. Diffusion-tensor MRI (25 or 52 directions) and white matter tractography was performed in normal infants and compared the US findings from similarly aged children. Two post-mortem pathologic specimens were evaluated sonographically from different insonation angles and relative pontine and midbrain echogenicity compared; tractography was performed in one specimen.
Results: Insonation in vivo from alternate acoustic windows shows that the relative echogenicity of the pons and midbrain is angle dependent. Echogenicity of the pons vs. posterior midbrain was significantly greater when insonated from the anterior fontanel (0° insonation angle) vs. from the foramen magnum (approximately 45° insonation angle) at $p<0.01$. In a fixed brain specimen, insonation angle from 0 to 45° correlated with decreasing echogenicity differences with $r=-0.74$. MRI tractography showed marked differences in fiber tract orientation, with mainly superior-inferior fiber tract orientation in the posterior midbrain, and mainly anterior-posterior fiber tract orientation in the anterior pons.
Conclusion: The differential echogenicity of the anterior pons and posterior midbrain depends upon insonation angle. Differences in white matter fiber tract orientation explain the echogenicity differences of the pons and posterior midbrain.

PNE-70

The diagnostic yield of imaging simple sacral dimples in neonates

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Purpose: Studies examining imaging cost-effectiveness recommend ultrasound (US) screening in infants with simple sacral dimples. However, other studies and experience suggest that the yield of US studies is quite low. We reviewed our experience imaging neonates with simple sacral dimple, and the literature on sacral dimples and tethered spinal cord, to determine the incidence of relevant findings in these patients
Materials and methods: All patients who underwent spine US from September 2000 through August 2010 for sacral dimple were initially considered. Patients with other cutaneous stigmata or inconclusive imaging due to ossification were excluded. Studies were considered abnormal if the conus was below L2/3, if the filum was abnormal, or if there was any evidence of intraspinal mass or dysraphism. Medical records were reviewed for other conditions that might predispose to spine malformations, additional imaging studies, results of subsequent physical exams, and any neurosurgical follow up or procedure.
Results: Among our patients, 55/1303 (4.2%) presenting with an isolated simple sacral dimple were found to have a low conus or abnormal filum. 29 cases had other conditions or mitigating factors (chromosomal disorders, imperforate anus, and other malformations and syndromes) to explain the abnormal spine, leaving 26/1274 abnormal (2.0%). To date, 15 patients have had neurosurgical consultation; 2 patients without demonstrable physical exam findings underwent surgical untethering. Thus, in our experience, the incidence of eventual treatment among infants with isolated simple sacral dimples is 2/1274 (0.16%; 95% CI: 0–0.38%). Among 2665 literature cases, only one case had surgical intervention, also done in the absence of symptoms. Two other possible cases have been reported, but it is unclear if the lesions were simple dimples. Considering our cases and those in the literature, the incidence of a potentially relevant abnormality among infants with simple sacral dimples is 5/3939 (0.13%; 95% CI: 0–0.24%).
Conclusion: The incidence of relevant cord abnormalities in neonates with isolated sacral dimples is very low.

PNE-71

Occult white matter diffusion abnormalities detected by tract-based spatial statistics (TBSS) in children with sickle cell anemia

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Purpose: To evaluate for occult white matter injury in sickle cell patients with radiologically normal brains using diffusion tensor imaging (DTI).
Materials and methods: A prospective study compared adolescents with HgSS (SCD) and "negative" MRI scans of the brain with age-matched, unaffected siblings or friends (controls).Thirteen SCD subjects with mild gliosis (SMG) identified from a separate study were also compared. The DTI images were obtained on a 3T scanner using a 30-direction EPI-based DTI sequence (b=1000 s/mm2). The DTI data was processed in FSL and the maps derived from the DTI images (fractional anisotropy (FA), ellipsoidal area ratio (EAR), and mean diffusivity (MD)) were then projected onto this skeleton for voxelwise statistics testing between the SCD, SMG and control groups ($n=13$ for each group).
Results: The TBSS analysis revealed significant differences ($p<.05$) between both the SCD and SMG groups and the controls. Specifically, increased MD was seen in the subcortical white matter, with the SMG showing more extensive changes than SCD. The SMG group had changes throughout the corpus callosum (CC) while the SCD group had more limited changes in the CC compared to controls (predominantly in the splenium.) When comparing the SCD and SMG groups, no significant changes were seen at $p<.05$, however when the threshold was reduced to $p<.3$, increased MD was seen in the two groups and the pattern of the changes was similar to that seen when comparing these two groups to the controls. FA was decreased in the SMG group compared to controls, less broadly seen as compared with MD—predominantly seen in the CC. The SCD group showed no significant changes in FA compared with controls or SMG at $p<.05$, but with $p<.03$ a similar pattern of decreased FA in the CC was revealed for the SCD-SMG comparison. Using the EAR instead of the FA, the same pattern of changes between the SCD

and control groups was revealed without having to decrease the threshold.
Conclusion: This study confirms subtle white matter abnormalities are present in children with sickle cell anemia not identified with conventional MR imaging but revealed with TBSS analysis of DTI data. The study also shows that the ellipsoidal area ratio is a more sensitive parameter for measuring diffusion anisotropy than fractional anisotropy.

PNE-72

The value of head CT in children with headache, without any other complaints
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Purpose: To study the real value of computed tomography (CT) in children with headache alone. Headache is one of the most common symptoms in childhood and presents a broad spectrum from normal examinations, benign etiology, such as migraine or the presence of a fever, such as meningitis through to associated neurological disorders such as in cases of brain tumors. Cranial CT stands out among the imaging techniques as being fast and offering high sensitivity in detecting structural changes in the brain, as is thus the most requested in a complementary evaluation of headaches. It does, however, place a heavy burden on health services, considering the high rates of normality. The headache with no structural findings such as a history of seizures, changes in level of consciousness and abnormal neurological examinations (absence of neurological abnormalities such as papilledema, nystagmus, abnormal gait or motor abnormalities) as explanations for its etiology are low
Materials and methods: Of 400 head CT without contrast, with the indication of headache, with the inclusion criteria of headache alone and exclusion of children with headache and another symptoms such as: epilepsy, fever, migraine, altered level of consciousness and neurological diseases, 95 CTs, children of 5 months to 16 years of age.
Conclusion: The analysis of CT of children with headache alone showed that of 95 children, all had normal CT scans. The use of CT scan as a routine evaluation of patients with headache alone is unnecessary. We also found within the normal range, one patient with asymmetry of the lateral ventricles, one patient with benign macrocania of infancy and one patient with a small left middle fossa arachnoid cyst. Most patients had sinus disease.

PON-4

Prolonged survival in a child with soft-tissue epithelioid haemangioendothelioma with erosion into the femur and distant metastases: a case report
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Epithelioid haemangioendothelioma (EH) of the soft tissues is a rare low-grade vascular malignancy first described by Weiss and Enzinger in 1982. It is associated with a clinical course between that of a haemangioma and angiosarcoma. This tumour is seen mainly in middle-aged adults and is exceedingly rare in children. Most cases are associated with a low mortality rate but metastases have been reported in some cases causing patient death. In this poster, we describe a case of a soft tissue EH which eroded into the right femur with metastases to the lungs, and subsequently the liver, in a boy who initially presented at 2.5 years of age. Over a 12-year period, the patient was lost to follow up on 2 occasions only to re-present with pain at the tumour site. Other than pain relief, the patient refused treatment until he was 13.5 years of age when the tumour was finally resected. The patient is still alive and stable at 14.5 years. This case report poster will trace the imaging findings and evolution of the lesion over a 12-year period. The pathological specimen and histological slides will also be shown. This case is unique because of the previously unreported young age of the patient at initial presentation and long-term survival despite extensive lung and liver metastases.

PON-5

A pictorial review of the manifestations of paediatric leukaemia and complications of its treatment
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Purpose: Leukaemia is one of the most common malignancies encountered in paediatric and adolescent oncological practice. Although the most common imaging manifestation is lymphadenopathy, there are other potential imaging findings. We aim to refresh the readers' knowledge of leukaemic manifestations using a pictorial review of its varied presentations.
Materials and methods: Multimodality imaging findings of two paediatric patients who have been treated/ followed up at UCLH.
Results: Here we present a pictorial review of two adolescent patients with leukaemia, who illustrate the wide variety of its radiological manifestations. We will present both primary disease manifestations including bone leukaemia, lymphadenopathy, solid organ and CNS manifestations and the imaging of complications including neutropenic colitis, fungal infections and treatment related leukoencephalopathies.
Conclusion: All modalities in radiology have an important role in defining disease sites in paediatric leukaemia and assessing disease and treatment related complications.The multisystemic nature of this disease and the use of varied imaging strategies, including newer techniques such as diffusion-weighted MRI, will be highlighted.

PON-6

Soft-tissue tumor like lesions of the neck: a systematic imaging-approach review
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Purpose: Soft-tissue lesions of the neck in childhood are frequently encountered by radiologists, and most of them are benign in nature.We attempted to analyze various clinical modes of presentation of pediatric neck soft-tissue benign lesions, and their correlation with final histopathological diagnosis.
Materials and methods: We reviewed ultrasound (US) and magnetic resonance imaging (MRI) of 53 soft benign tissue lesions of the neck in children (age 8 months-15 years). All underwent biopsy.
Results: The diagnosis was made primarily by medical history and clinical manifestations and pre-operatively by sonography and MRI. In our series, thyroglossal duct cyst was the most common (21) lesion diagnosed. This was followed by the branchial cleft cyst (11),

lymphangioma (9), hemangioma (8) and cystic hygroma (4). MRI was particularly useful not only to visualize the full extent of the lesion, but also to delineate its association with adjacent structures. The branchial cleft cyst presented as anechoic lesions anterior to the sternocleidomastoid muscle. Cystic hygromas/lymphangiomas are developmental anomalies of vasculolymphatic origin. Lymphangioma were multilobulated, thin-wall, lymph-containing sacs while hygromas appeared as unilobulated cystic lesion. Doppler US image showed spectra with slow-velocity blood flow from the ovoid vascular lesion. Thyroglossal duct cyst remnants presented like midline neck cysts on US; MRI revealed medial basilingual cyst with varied segnal in T1 sequences, depending on its protein content and hyperintense on T2 images. On US, haemangiomas manifested as mixed echogenicity but predominantly hypoechoic. Colour Doppler showed variable flow patterns (3 arterial flow, 4 venous flow, 1 combined arteriovenous flow). On MRI, the majority of the lesions were T1 iso- to hypo-intense and T2 hyperintense with mild internal heterogeneous signals.
Conclusion: After a clinical evaluation, radiologic assessment by using US and MR imaging is useful to confirm the diagnosis and define the extension of the lesions and their relationship to adjacent structures.

PON-7

Imaging of non-Hodgkin lymphomas in children: patterns of diseases and pathologic correlation

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Purpose: The pattern of disease involvement in childhood non-Hodgkin lymphoma (NHL) is not random: there is a correlation between histologic subtype and primary sites of involvement. The aim of this study is to describe the spectrum of imaging in NHL in children.
Materials and methods: We reviewed records of 36 patients (age 2–16 years) with NHL histopathologically proven. All patients underwent ultrasound, CT and/or MRI examinations.
Results: The most common subtype was undifferentiated lymphoma (19 cases) with the abdomen as the most common involved sites. Lymphoblastic lymphoma in all cases (10) spread in the mediastinum and lymph nodes. Large cell lymphoma (7 cases) showed heterogeneous imaging features but tended to spare the anterior mediastinum.
Conclusion: Each of NHL subtypes has typical imaging and clinical features. Familiarity with typical patterns of tumoral behaviors and optimal imaging methods aid in the diagnosis and appropriate follow-up of these tumors.

PON-8

Imaging of primitive neuroectodermal tumour: CNS and peripheral

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Primitive neuroectodermal tumours (PNET) are rare but highly aggressive tumours presenting in infants and young adults. Here, we review the imaging features to increase awareness of the diversity of possible presentations. Our pictorial review aims to demonstrate the common imaging findings of CNS PNET, the varied presentations of peripheral forms of PNET, and the manifestations of metastatic spread. We review the imaging findings of intra-cranial and the less common intra-spinal PNET on plain radiography, CT and predominantly magnetic resonance (MR) imaging. We demonstrate the aggressive nature of CNS PNET and how it traverses normal anatomical boundaries. We also show how techniques such as diffusion weighted imaging and spectroscopy can be used to help differentiate PNET from other intracranial tumours which may present in children. Peripheral PNETs (pPNETs) are rare with an incidence of 1% amongst all types of sarcomas. We present CT and MR imaging examples of thoracic and abdominal pPNET. There is a high incidence of metastatic disease at presentation with PNET, which is the most important prognostic factor in determining survival. We present examples of metastatic spread to various sites including lung, liver and bone as detected on CT, MR and nuclear medicine imaging, and highlight how early diagnosis can often improve outcome.

PON-9

Uncommon infantile neck tumors: imaging findings

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Lymphangioma is the most common cause of neck mass in infants; however, other lesions may also occur. We report two rare cases. The first patient was a 3-week-old male baby with left neck mass. MRI revealed a large partially cystic mass with heterogeneous contrast enhancement in the left masticator, parotid and parapharyngeal spaces with upward intracranial extension and airway compression. The lesion was a teratoma. The second patient was a 4-week-old female baby with left neck mass. CT scan showed a huge lobulated soft tissue mass with heterogeneous enhancement in left parotid, parapharyngeal and retropharyngeal spaces with focal compromise of upper oropharyngeal cavity. The lesion was an undifferentiated sarcoma. These two patients were stable after operation.

PON-10

Undifferentiated embryonal sarcoma of the liver: report of two cases and review of the literature

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Undifferentiated embryonal sarcoma (UES), also known as undifferentiated liver sarcoma (ULS) is a rare primary malignant neoplasm of the liver, first described by Stocker and Ishak in 1978, which affects predominantly pediatric and young adult patients. Clinical symptoms are usually non-specific. Patients may present with abdominal mass with or without pain. Fever can occur if there is hemorrhage or necrosis within the mass. Plain radiographs may be normal, or reveal a large soft-tissue mass displacing bowel loops. The sonographic appearance varies from a multiseptated cystic mass with or without echogenoic nodules, to an echogenic mass. Computed tomography typically demonstrates a multiseptated hypodense mass with or without hemorrhage and necrosis. Rim and septal hyperattenuation may be seen. The differential diagnosis of multicystic solitary hepatic masses also includes hydatid cysts,

cystic hepatoblastomas, mesenchymal harmatomas and biliary neoplasms. Combined surgery and chemotherapy is currently the treatment of choice. Local recurrence and distant metastases can occur, especially involving the peritoneum, pleura and lung. Because there is no tumor marker to predict local recurrence, regular imaging surveillance following treatment should be considered. In this exhibit, we report two patients with UES; 9 and 13 year-old females, who each presented with an abdominal mass. Imaging findings with pathological correlation will be discussed.

PON-11

Non-rhabdomyosarcoma soft-tissue sarcomas (NRSTSs)

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Sarcomas constitute, in general, about 1% of all malignant tumours but, specifically in the paediatric age group, soft tissue sarcomas (STS) represent about 7% of all cancers. Nearly half of STS in children are rhabdomyosarcomas (RMS), but this group has already been extensively reviewed. The authors will, instead, address the clinical presentation of NRSTSs at our institution during the past 10 years, and illustrate this data with representative images of various tumours, namely: PNET/Extraosseous Ewing Sarcoma, synovial sarcoma, fibrosarcoma, epithelioid sarcoma, among others. Although in children the diagnostic workup usually starts with ultrasound, magnetic resonance is superior in defining the extent of the tumour and its relation to surrounding structures, including vessels and nerves, and also in evaluating the regional lymph nodes. Computed tomography can be used to determine the presence of pulmonary metastases, keeping in mind that a significant percentage of the nodules identified are benign. Radionuclide bone scans point out the presence of bone metastases.

PON-12

Pictorial essay of chest-wall tumors in children

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Purpose: Chest-wall tumors in childhood are rare. The most common malignancies are Ewing/Primitive Neuroectodermal Tumors (PNETS), rhabdomyosarcoma and primary bone sarcomas. Nevertheless, a few benign entities such as lipoblastomas, fibromatosis and vascular lesions may also resemble neoplasia and therefore be considered as differential diagnosis, as displayed in this work.
Materials and methods: From 2002 until present the authors present a group of 13 patients who were initially diagnosed with chest-wall malignancy. Data were collected from patient's clinical records, images obtained from PACS and the information was completed with pathological support.
Results: After gathering information we had the following diagnoses that were submitted to pathological confirmation: 2 Ewing Sarcoma/PNETS (formerly Askin Tumors) 1 rhabdomyosarcoma, 1 osteosarcoma, 1 synovial sarcoma, 2 lipoblastomas, 3 different types of fibrosis and 3 cases of other benign conditions mimicking chest wall-tumors. The ages ranged between 1–19 years old, and the mean of age was 7,2 years old. There was no gender predominance 8M:5F. Some patients had undergone partial or total excision of the tumor (10/13). From those who were diagnosed with primary malignancies (5/13), 4M:1F, ages ranged from 3–19 years. In accordance with international protocols, patients were submitted to surgical removal combined with chemotherapy (previously and/or afterwards surgery) and pathological diagnosis was confirmed. Two patients (2/5) had secondary involvement (lung metastases) at the time of presentation. Patients are currently in follow-up in our Institution: (3) had complete response after treatment, (1) had partial response and (1) showed local recurrence.
Conclusion: US and CT are determinant in establishing initial diagnosis, local extension and bone involvement and evaluating secondary involvement (lung). MRI with DWI best describes tumor features as well as the extent of invasion into the vicinity structures (nervous bundles, vessels, muscle layers). It also depict residual disease/recurrence. Imaging is important after surgery to assess surgical margins, response to chemotherapy and/or radiotherapy as well as predicting outcome.

PON-13

Paediatric chest wall masses

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Purpose: Referrals for the investigation of paediatric chest wall abnormalities are common. Chest wall masses in this population encompass a wide range of pathological processes from congenital and developmental conditions and benign tumours to aggressive inflammatory and infectious diseases and malignant tumours of both bone and soft tissue. The investigation of chest wall masses often involves a range of imaging modalities including plain radiography, ultrasound, CT and MRI. Many pathologies have typical imaging appearances which, when recognized by the radiologist, allow a prompt definitive diagnosis to be made, therefore facilitating any further management.
Materials and methods: The range of paediatric chest wall masses is reviewed and a variety of pathologies are illustrated with cases encountered in a busy tertiary paediatric radiology department. Where relevant, pathological correlation and the findings of other complementary imaging modalities are included.
Results:
o The range of chest wall masses presenting in the paediatric population is reviewed.
o A variety of pathological processes are illustrated with cases encountered at our institution in order to familiarise the radiologist with the multimodality imaging features of chest wall lesions.
Conclusion: Paediatric chest wall masses are varied in their aetiology and a multimodality imaging approach is often necessary. Recognition of typical imaging features can often help to establish a definitive diagnosis and can faciliate further management.

PON-14

Imaging findings of childhood rhabdomyosarcoma

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Purpose: Rhabdomyosarcoma is a common childhood malignancy. We aim to determine common sites of the primary tumor and pattern of metastasis of the childhood rhabdomyosarcomas seen in KK Women's and Children's hospital, Singapore.

Materials and methods: This is a retrospective review of the imaging findings of all children with histologically proven rhabdomyosarcoma seen in KK Women's and Children's Hospital between April 2005 and December 2009.
Results: A total of 19 patients were diagnosed with rhabdomyosarcoma between April 2005 and December 2009, 10 males and 9 females, aged 9 months to 13 years at the time of diagnosis.The distribution of the primary tumours were 9 (47%) in the head and neck, 5 (26%) in the pelvis, 2 (11%) in the extremities, 1 (5%) in the chest with 2 patients having metastatic disease. Alveolar carcinoma was the most common histological subtype (37%), followed closely by embryonal subtype (32%). The 2 patients who had metastatic disease at the time of diagnosis had alveolar subtypes with one patient having the involvement of spine and intrathoracic lymph nodes and the other having a tumour in the right thigh muscles, bone marrow and sphenoid body.
Conclusion: Childhood rhabdomyosarcoma most commonly occurs in head and neck and pelvis with metastatic disease present in 11% of our study population at the time of diagnosis.

PON-15

Solid neonatal neoplastic masses—a pictorial review

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Purpose: 1. To provide a comprehensive pictorial and educational overview of the imaging characteristics of common solid neoplastic neonatal masses. 2. To provide a brief synopsis on the clinical findings and presentation.
Materials and methods: A retrospective review was performed to identify neoplastic solid lesions encountered clinically or imaged in the neonatal period. Correlation was made between clinical and radiological findings.
Results: Solid tumours encountered in the neonatal period differ from those seen in later childhood in terms of their type, clinical features and outcome. Ultrasound is the initial imaging modality of choice and can often suggest correct diagnosis, but CT and MRI are helpful in aiding diagnosis, further management and surgical planning. Clinical findings and imaging features are presented across multiple modalities for a variety of benign and malignant lesions, including neuroblastoma, mesoblastic nephroma and sacrococcygeal teratoma, with a focus on characteristic imaging features and the utility of each modality.
Conclusion: Information obtained from imaging is critical in facilitating the diagnosis and management of neonatal masses, and may provide valuable anatomical information for the surgeon. Consequently, radiologists need to be familiar with the spectrum of solid neoplastic lesions that may be encountered in this age group, as well as the specific advantages and limitations of each of the imaging modalities used in evaluating this category of abnormalities.

PON-16

Atypical suprasellar presentation of a rhabdoid/teratoid tumour in a child

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Rhabdoid/teratoid tumour of the CNS is a rare childhood malignancy. The age at presentation is usually 2 years, but this tumour may occur in other age groups. The typical location is the posterior fossa 62%, while 27% of these tumours occur supratentorially. Suprasellar location is a rare presentation with only isolated case reports in the literature. We present an atypical primary rhabdoid/teratoid tumour located in the suprasellar region, which demonstrated atypical features radiologically and pathologically. As this case proved to be a radiological diagnostic dilemma, we review the literature and describe the distinguishing radiological features of rhabdoid/teratoid tumours.

PON-17

An unusual presentation of an intra-abdominal rhabdomyosarcoma

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Rhabdomyosarcoma (RMS) is a common neoplasm representing 5–10% of malignant solid tumors in childhood and is the commonest soft tissue sarcoma in the pediatric age group. Even though the tumor commonly arises from striated muscle, RMS frequently originates from sites devoid of striated muscle such as the urinary bladder, prostate and the gallbladder. We present an unusual case of a large intrabdominal embryonal RMS, spindle cell variant, of unknown organ origin, which demonstrated a mesenteric cleft inferolaterally with feeding vessels entering the mass. This unique presentation of embryonal RMS proved to be a diagnostic challenge.

PON-18

Role of ultrasound in imaging of pediatric lumps

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Background: Ultrasound has long been a mainstay in the evaluation of palpable lesions in the Pediatric age group. We present a review of the common lumps occurring in children and their common sonographic features.
Purpose: To evaluate the role of ultrasound in the assessement of subcutaneous and palpable swellings in the pediatric age group and its impact on the further management of these lumps.
Materials and methods: A retrospective review of all pediatric patients who were referred to the department for an ultrasound study for an assessment of a palpable lump over a period of the last 2 years was performed. Further management of all the patients was ascertained, including follow-up and surgical findings along with histological correlation.
Results: A total of 89 ultrasounds were performed for this specific indication. A varied range of diagnoses included hematomas (10), sebaceous cysts (7), ganglion (2), neurofibromas (4), dermoid (6), hemangioma (9), lymphadenitis (20), abscess (11), thyroglossal cyst (3), lipoma (4) and mediastinal PNET (1).
Conclusion: Ultrasound plays a major role in the diagnosis, follow up and management of lumps in pediatric age group. It is the first and usually the only investigation required for assessment of the lump and provides an accurate insight into the underlying process. In our study, it was the key factor in deciding whether the child required further imaging, surgical intervention/evacuation (for hematomas, ganglion, thyroglossal cysts) or conservative management for lumps like lipomas, abscess, lymphadenitis etc.

PON-19

MIBG scanning and bone scintigraphy in the staging of neuroblastoma. Are both required?

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Purpose: Over two thirds of patients with neuroblastoma will have metastatic disease at presentation. Some centres combine MIBG and bone scintigraphy in the diagnostic work-up to maximise detection of metastatic disease. However, guidelines from the International Neuroblasotma Risk Group Staging System (INRGSS) have stated that bone scintigraphy is required only if MIBG positivity of the primary tumour cannot be confirmed. The purpose of our study was to investigate this statement.
Materials and methods: All new cases of neuroblastoma were identified from a prospectively maintained database of a large teaching hospital over a five-year period. MIBG and bone scintigraphy reports at initial diagnosis were obtained and any discrepancies identified.
Results: During this period 23 patients (13 male, 10 female) were identified who had undergone both investigations. In all cases, the MIBG scan was positive and no additional sites of disease were identified by bone scintigraphy.
Conclusion: The great majority of neuroblastomas are MIBG positive. Our audit supports the INRGSS recommendation that bone scintigraphy is not required if the primary tumour is MIBG avid.

PON-20

Disseminated rhabdomyosarcoma with spinal metastases

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Rhabdomyosarcoma (RMS) is the most common pediatric soft tissue sarcoma representing 5–10% of malignant solid tumors in childhood. On the basis of histopathological criteria, RMS in childhood is classified into two main subtypes: embryonal RMS and alveolar RMS. Alveolar has an unfavorable prognosis. Approximately 20% of patients with RMS present with disseminated disease at the time of diagnosis. Lungs, lymph nodes and bone marrow are frequently involved. However extradural extension of a RMS is rare and not often included in the differential diagnoses of extradural tumours. To our knowledge, RMS with leptomenengeal spinal metastases has not been described in the literature. We present a case of disseminated alveolar RMS, in a 15 year old girl, involving the pleural space with extension into the extradural spinal space associated with leptomenengeal spinal metastases and diffuse bone marrow infiltration. This case proved to be a radiological diagnostic challenge.

PON-21

Fibromatosis and fibromatosis-like lesions in children: from head to toe

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Purpose: The term "fibromatosis" is a ragbag in which all fibroblastic tumours are included. Fibrous components, present to a greater or lesser extent and a high tendency to recur, are common features in these lesions. Pediatric fibromatosis is rare. The aim of this poster is to present different cases of fibromatosis in children and their mimicking lesions.
Materials and methods: We reviewed our clinical database and selected all the surgically proven cases of fibromatosis and fibromatosis-like lesions. We present the radiological manifestations, highlighting in each case the differential diagnosis.
Results: From head to toe, we present several examples of pediatric fibromatosis. Those in the skull should be differenciated from extraxial and soft tissue lesions; deep fibroblastic tumors in the head and neck may mimick neuroblastoma; thoracic fibromatosis is in the differential diagnosis of mediastinal and chest-wall masses; in the extremities, rhabdomyosarcoma and Ewing sarcoma should be considered in the differential of aggressive fibromatosis. Lymphoma is the main differential diagnosis in children with mesenteric fibromatosis. Visceral fibrous tumors are exceedingly rare. We present a case of a kidney fibrous tumor mimicking a Wilm's tumor. As a rule, they don't have specific radiological features, but the following may represent diagnostic clues, when present. Low T2 signal-intensity-bands, related to the collagenized bands seen at gross pathologic examination, are suspicious for fibromatous lesions. Another common feature of these lesions is the marked enhancement after contrast administration, representing their aggressive behavior.
Conclusion: We reviewed pediatric fibromatosis and mimicking entities, from head to toe. The Pediatric Radiologist has to be aware of this condition and include it in the differential diagnosis of tumors and tumor-like lesions.

PON-22

One of the lucky faces of neuroblastoma

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Background: Neuroblastomas are the third most common paediatric neoplasm after leukaemia and brain tumors; although they're malignant tumors, their course can vary greatly. The infant form is notably less aggressive and, if enrolled in stage IVs, often requires no therapy, although it can present with a significant mass.
Purpose: The aim of this work is to improve knowledge because this is a mandatory step paediatric radiologists have to take.
Materials and methods: During 2009 and 2010 , we had 3 cases of stage IVs NB. One 4-week-old boy with bluish skin lesions and adrenal nodule, one eleven-month-old boy with a large intrathoracic mass and a seven- month-old girl with whole liver structural subversion and hepatomegaly. We performed ultrasonography, MRI and CT examinations. Only the intrathoracic mass required surgical treatment. For the first baby, wedetected a hipo-hisoechoic adrenal nodule during the US screening exam, for the second presenting an airway obstruction, a chest radiograph showed an intrathoracic mass. Then, MRI revealed it rose up from the sympatethic chain in posterior mediastinum. We examinated the last patient, after her discharge with diagnosis of liver disease without any laboratory evidence of hepatic failure.
Results: On sonography, the hepatic involvement had appearances of both diffuse infiltration and multiple, focal "target" lesions with

varying color Doppler flow, mimicking haemangioma. On MRI we had occasional sightings of a very small retroperitoneal mass. The infant neuroblastoma occurs under one year of age: in stage IV, survival rate is very low, particularly with MYCN amplification. In the stage IVs, the tumor is limited to the primary organ or extended in continuity to homolateral structures, with metastasis confined to one or more of the following sites: liver, bone marrow and skin. In this stage the survival rate is over 90% without any therapy.
Conclusion: These cases are rare, but a paediatric radiologist must know of this possibility and search for a primary lesion in babies with suspected, inhomogeneous hepatomegaly or strange bluish skin nodules before diagnosis.

PON-23

Rhabdomyosarcoma in children: report of rare cases with head and neck involvement

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Background: Rhabdomyosarcoma (RMS) is the most common childhood primary soft-tissue sarcoma, with head and neck lesions presenting in approximately 30% of cases. We present rare clinical and imaging features of this tumor, including RMS in the middle ear cavity, eyelids, infratemporal fossa, and maxillary antrum. Cases: 1) A 3-year-old girl presented with hearing loss and pain in left ear. She had a polypoid tissue in the left external auditory canal. Axial CT scan with bone window setting revealed increased density in the left middle ear cavity and mastoid. 2) An 8-year-old girl presented a large mass projecting from the anterior right orbit (arising from the lids). Axial CT section through mid orbits displayed a large mass anteriorly, enveloping the right globe. Sagittal orbital section demonstrated a large mass with no evidence of bony erosion. 3) A 3-year-old girl presented with eye swelling, esotropia, nerve Palsies III-V-VI, abrasion of cornea, and involvement of bone marrow. Axial contrast-MR images revealed an enhancing mass in left infratemporal fossa-parapharyngeal space. Coronal Gadolinium-enhanced T1 image revealed a marked enhancement of the tumor and invasion of left skull base/intracranial cavity including sphenoid sinus. 4) A 19-month-old boy had a history of pain and swelling of the left cheek and mouth. Coronal CT scan demonstrated a tumor in the left maxillary antrum with extension into the inferior orbit, left nasal cavity, and left ethmoid sinus.
Conclusion: Imaging such as CT and MRI is indicated for the evaluation of tumor size, location, its relation to surrounding structures, and metastatic diseases. Prognosis of RMS is closely related to the location of the lesion. CT is helpful in detecting bony changes and intralesional calcification. Contrast-enhanced MRI is useful in tumors with invasion to soft tissue planes. RMS has iso or slightly higher signal intensity than surrounding muscles on T1 images, moderate to high signal intensity on T2 images.

PON-24

The spectrum of cancer in teenagers and adolescents: a clinico-radiological pictorial review

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Purpose: Cancer is the second most common cause of death in teenagers and adolescents after accidents, with the incidence increasing between 13–24 years of age. The incidence of cancer in this age group is higher than in younger children, yet survival rates are lower. The reasons for this partly reflect the different spectrum of cancers, but also reflect advanced stage at diagnosis, this being a common finding. Our aim is to demonstrate the spectrum of cancers occurring in 13–24 year olds presenting at a regional Tertiary Referral Teenage Cancer Unit between 2008–2010. The typical imaging characteristics of the more common tumours, and rarer carcinomas are described, with particular emphasis upon stage at diagnosis and time to presentation.
Materials and methods: All patients registered on the Teenage Cancer Unit Database at our Institution between January 2008–November 2010 were retrospectively reviewed. Tumour type, imaging and clinical data, which included; age, time from symptoms to first presentation, time to diagnosis, were reviewed.
Results: 44 patients were registered between 2008–2010. The spectrum of non CNS cancers in order of frequency included leukaemia, Hodgkins and non Hodgkins lymphomas, germ cell tumours, Ewings and Osteogenic Sarcomas. Rarer tumours included nasopharyngeal carcinomas, soft tissue sarcomas, renal cell carcinoma, Wilms Tumour, small round cell desmoplastic tumour, ovarian and cervical carcinomas. Time from first symptoms to first presentation varied from 2 w–9 mo. Advanced stage at diagnosis was more common in males and also varied with tumour type being more frequent with bone sarcomas, and soft tissue carcinomas.
Conclusion: The spectrum of cancers in our cohort mirrors that described in the literature. Although it included some childhood tumours, carcinomas more commonly seen in adults, occurred more frequently. Advanced stage at diagnosis was common, often associated with a delay in presentation or mis-diagnosis. This review illustrates why survival of Teenagers and Adolescents with cancer is unchanged and highlights the need for radiologists to be aware of the diverse spectrum of malignant disease in this age group.

PON-25

High-resolution evaluation of extremity soft-tissue masses in children: a useful diagnostic tool

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Purpose: Ultrasound is emerging as a viable imaging modality in the diagnosis and assessment of extremities' soft tissue masses in children. The ability to evaluate the cystic or solid nature of the lesion, the pattern of vascular supply as well as the capability of correlating the patient's exact clinical findings with underlying anatomical structures and an associated pathology is advantageous. The purpose of this study is to evaluate the efficacy of ultrasound as a first-line investigation in patients with a clinical soft-tissue mass of the extremities.
Materials and methods: Ninety consecutive patients (53 male, 37 female, age 6 months–13 years) referred with soft-tissue masses of the extremities underwent ultrasound evaluation. Four radiologists performed ultrasound using a 10–12 MHz linear transducer and recorded lesion size, anatomical location and depth, internal echogenicity, external margins and vascularity on color Doppler. Ultrasonographic diagnoses were compared with histopathologic findings for patients who underwent surgical removal and with clinical course and final diagnoses at the time of discharge for the rest of the patients.

Results: Masses were divided into inflammatory (20 cases), noninflammatory benign (18 cases), noninflammatory malignant (8 cases) of traumatic (20 cases) and of vascular origin (17 cases). Seven lesions presented non-specific ultrasound characteristics and diagnosis was not set with ultrasound. Ganglion was the most commonly encountered noninflammatory benign lesion (10 cases). Among inflammatory lesions, cellulitis accounted for 12 out of 20 cases. Hematoma was the commonest lesion of traumatic origin (8/20 cases) and hemangioma the commonest of vascular origin (8/17 cases).
Conclusion: Ultrasound cannot only determine the cystic or solid nature of a lesion but also its relation to other anatomic structures and the internal characteristics of it. In our series, it allowed for accurate diagnosis in the majority of cases.

PON-26

Beyond Wilms Tumor: clinical and imaging features for accurate preoperative differential diagnosis of pediatric renal neoplasms

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Purpose: 1) To review imaging features and clinical associations of the spectrum of pediatric renal masses. 2) To recognize several renal neoplasms as distinct histopathologic entities, rather than subtypes or variants of Wilms tumor. 3) To present a schema by which pediatric renal masses can be differentiated from Wilms tumor by clinical and imaging features.
Materials and methods: 1) Review of Wilms tumor. 2) Review of Wilms tumor associations. 3) Visual presentation of Wilms tumor and the range of other benign and malignant pediatric renal neoplasms and cystic diseases.
Results: Development of diagnostic algorithm for the exclusion of Wilms tumor.
Conclusion: 1) Although Wilms tumor comprises the majority of renal masses, other histopathologies exist and should be considered based on imaging characteristics, patient age, and presentation. 2) An organized approach to pediatric renal lesions using specific clinical and imaging characteristics allows the construction of a limited differential diagnosis and appropriate preoperative management.

PON-28

Use of gadoxetate disodium in the diagnosis of paediatric hepatic lesions

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Purpose: Gadoxetate disodium (Gd-EOB-DTPA, Eovist®, Bayer HealthCare) is a relatively new, hepatic-specific, MRI contrast agent. Gadoxetate disodium is unique among MRI contrast agents in that in patients with normal liver and kidney function, approximately 50% of the administrated dose is excreted via the hepatobiliary system. This property has made the contrast popular in the adult setting to help diagnose multiple hepatic abnormalities including focal nodular hyperplasia, hepatic adenoma, hepatocellular carcinoma, and metastases. There is little published on the use of gadoxetate disodium in children. The purpose of this presentation is to describe a paediatric-based scanning protocol, as well as the imaging appearance of common paediatric liver lesions.
Materials and methods: The MR imaging characteristics of paediatric liver masses scanned using gadoxetate disodium as a contrast agent were reviewed.
Results: Twenty-five patients were scanned using gadoxetate disodium as the contrast agent. The patients ranged in age from 9 months to 20 years. Hepatic lesions imaged included hepatoblastoma, hepatocellular carcinoma, undifferentiated hepatic embryonal sarcoma, focal nodular hyperplasia, hepatic adenoma, dysplastic/regenerative nodules, and hepatic cyst.
Conclusion: As a hepatocyte specific MRI contrast agent, gadoxetate disodium has the potential to improve the diagnosis and staging of many paediatric liver lesions.

PON-29

Pediatric synovial sarcoma masquerading as retroperitoneal hematoma

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Pediatric synovial sarcoma most commonly affects the extremities, especially the lower thigh and knee region; other primary sites such as the retroperitoneum have been only infrequently reported. We report an extremely rare case of a retroperitoneal synovial sarcoma masquerading as retroperitoneal hematoma in a 16-year-old white female with non-traumatic back pain. Non-contrast enhanced computed tomography demonstrated a right quadratus lumborum and psoas region presumed hematoma. Coagulation studies revealed Factor XI deficiency also known as Hemophilia C. However, on follow-up imaging, the presumed retroperitoneal bleed persisted and a subsequent MR examination revealed a solid enhancing mass. CT, MR, and FDG-PET findings as well as a brief histopathology are discussed. Our case is rare in so far as the tumor occurred in an uncommon retroperitoneal location in a pediatric patient and was mimicking a retroperitoneal hematoma, which posed a significant diagnostic challenge. Despite a rare entity, synovial sarcoma among other sarcomatous lesions maybe considered in the differential consideration of a spontaneous retroperitoneal hematoma, even in hemophiliac patients.

PON-30

Extra-pulmonary thoracic masses in children

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Purpose: Extra-pulmonary thoracic masses are uncommon in children but can cause significant imaging uncertainty as well as potential morbidity. The majority of lesions are benign with only 1–6% of soft tissue masses demonstrating malignancy. Here, we describe a diagnostic approach, using a low radiation dose protocol, to assess chest wall masses in children.
Materials and methods: We will present imaging appearances (including plain film radiography, CT, MRI, and ultrasound) of extra-thoracic masses from a large tertiary referral pediatric center, and show how a limited radiation dose protocol can be successfully applied to their investigation.

Results: Chest wall masses can be broadly classified into two groups; infant (<1 year) and older child (>1 year). In the former age group, congenital malformations predominate, including lymphatic malformations (lymphangioma), vascular malformations (hemangioma) and thoracic cage malformations. Less common lesions in this age group can be categorized by radiographic tissue type, include those containing fat, such as lipoma and lipoblastoma and also rib-based pathologies such as mesenchymal hamartoma or non-accidental injury. More rarely, malignant lesions arise and include thoracic neuroblastoma and infantile fibrosarcoma. In the older age group malignant tumors are more common but still represent only 2% of all pediatric tumors. Fat containing lesions such as lipoma and involuting hemangioma are common or more rarely liposarcomas. Bony lesions are also more common than in the younger age group and include osteochondroma, fibrous dysplasia or more rarely aggressive lesions such as the Ewings sarcoma family of tumors or lymphoma. Irrespective of the age group, given the inherent characteristics of the lesion (fat, bone/calcification or soft tissue) the modalities of plain film or ultrasound are often sufficient to identify benign or malignant characteristics, only the latter of which would then require additional imaging.
Conclusion: A low dose protocol employing plain film and ultrasound (and possibly MRI) can be used to assess chest wall masses in children. CT is required only if the lesion is aggressive or ambiguous in appearance.

PON-31

CT and MRI appearances and radiologic staging of pediatric renal cell carcinoma

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Purpose: To review computed tomography (CT) and magnetic resonance imaging (MRI) appearances and radiologic staging of pediatric renal cell carcinoma (RCC).
Materials and methods: Institutional Department of Pathology records were searched from 1995 through 2010 for all children (less than 18 years of age) with RCC. Preoperative CT and MRI examinations were identified and reviewed by two radiologists in consensus. Pertinent imaging findings were documented, and correlation was made between radiologic and surgicopathologic TNM staging.
Results: Nine children (four girls and five boys; mean age= 12.9 years) with 10 RCCs were identified. The mean size of the primary tumor at presentation was 6.2 cm (range: 1.5–12.6 cm). Ninety-percent of RCCs demonstrated heterogeneous postcontrast enhancement. Fifty-percent of masses had associated hemorrhage, while 40% contained internal calcification. Five RCCs suggested perinephric spread at imaging (compared to only two at pathology). Abnormal retroperitoneal lymph nodes by imaging size criteria were noted in five cases, while only a single case had intra-abdominal distant metastatic disease. Radiologic staging was concordant with surgicopathologic staging in six cases. Imaging overestimated the actual stage in three cases, while underestimating it in one case.
Conclusion: Pediatric RCCs typically present as large, heterogeneously enhancing masses, and they frequently hemorrhage and contain internal calcifications. Radiologic staging is commonly concordant with surgicopathologic staging, although both understaging and overstaging can occur.

PON-32

The blastomas: a pictorial review

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Purpose: Tumors arising from undifferentiated embryonic cells, commonly referred to as blastomas, are unique to the pediatric population. The incidence and prognosis of these lesions vary considerably. The purpose of this exhibit is to review 15 different types of blastomas and present the distinguishing imaging findings and management in a head-to-toe approach.
Materials and methods: 15 separate blastoma cases were compiled over 3 years at two free standing pediatric hospitals.
Results: Blastomas can arise from the brain, eyes, lungs, liver, kidneys, pancreas, adrenal glands, bone and fat. Imaging examples and descriptions are provided.
Conclusion: Pediatric imagers play an integral role in detecting and characterizing blastomas throughout the body in the pediatric population.

PON-33

Pediatric rhabdomyosarcoma from head to toe: role of imaging in diagnosis, staging and treatment

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Purpose: To describe the imaging appearance of pediatric rhabdomyosarcoma, with specific reference to imaging findings important for treatment.
Materials and methods: The current literature on imaging and treatment of rhabdomyosarcoma in children was reviewed. The database at our institution was searched to identifiy illustrative cases of rhabodmyosarcoma, for use in an educational exhibit.
Results: The imaging appearance of the tumour in a variety of sites including parameningeal, spinal, biliary, pelvic, thoracic, intraperitoneal and genitourinary (bladder and paratesticular) is illustrated, and differential diagnosis discussed. The optimal approach to imaging of each site is described. The current International Rhabdomyosarcoma Study Group (IRS-V) risk classification is described with specific reference to the role of imaging and clinical variables used in risk stratification. The classification is presented in a case base format to facilitate learning.
Conclusion: The imaging appearance of rhabdomyosarcoma " from head to toe" is presented,with specific reference to the IRS-V risk classification, allowing confident diagnosis and knowledge of imaging and clinical variables that determine treatment in these patients.

PON-34

MR imaging features of fetal mediastinal and intrapericardial teratomas

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Fetal mediastinal or intrapericardial teratoma is a relatively rare diagnosis and carries a grim prognosis. As many fetal imagers have

not encountered this entity in their practice, this poster presentation will review the diagnostic pitfalls, imaging features and outcomes in 3 cases of fetal mediastinal/intrapericardial teratoma as imaged by fetal magnetic resonance imaging (MRI). Fetal lung lesions are fairly common. It is not surprising that is typical for a fetus with a mediastinal or intrapericardial teratoma to have been referred to a tertiary center with a presumed diagnosis of a lung lesion with high risk imaging features. Therefore, the imaging features characteristic of mediastinal or intrapericardial teratomas are worth reviewing, as the clinical management, prognosis and family counseling for mediastinal/intrapericardial teratomas and lung lesions are vastly different. While some of the imaging features of a teratoma may overlap with lung lesions (cysts, septations, fetal hydrops, vascular supply), there are other imaging features which are useful in distinguishing the two entities, such as the direction of displacement of the heart and components of fat and/or hemorrhage. The importance of correct diagnosis lies in the different management, family counseling and prognosis. Lung lesions may respond to steroid therapy, and follow an expected trajectory of growth with subsequent plateau. Prognostic features of lung lesions are thoroughly described in the medical literature, and the majority have a good prognosis. In contrast, fetal mediastinal/intrapericardial teratomas are not expected to respond to steroid therapy, continue to enlarge and have a dismal prognosis. An accurate diagnosis prepares the family and eschews unnecessary therapies.

PON-35

Imaging findings of NUT midline carcinoma in three patients

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Purpose: To highlight the imaging features of poorly differentiated carcinomas associated with chromosomal translocation (15, 19) of the gene nuclear protein in testis (NUT oncogene). These are rare and lethal tumors that primarily present in young individuals but can occur in all age groups. So far to our knowledge only one case has been described in the radiology literature and none in dedicated pediatric radiology literature.
Materials and methods: IRB approval was obtained for chart review. We retrospectively reviewed the chart and imaging studies of 3 patients whose initial age at presentation ranged from newborn to 14 years. All three cases were pathology proven. Cross sectional imaging including CT, MRI and one patient with PET imaging was available for review.
Results: Case 1: a 4 week old male with a congenital left supra orbital mass that was increasing in size. Initial imaging additionally demonstrated bilateral suprarenal and renal masses, pulmonary nodules, masses in the spinal canal and numerous subcutaneous nodules. Case 2: a 2 year old male presented with a 3 week history of intermittent fevers, abdominal pain and emesis. Initial imaging demonstrated a large mass arising from the left lobe of the liver with pulmonary nodules. Case 3: a 14 year old female who initially presented with a solitary mass in the left thigh. In follow up, the patient developed thoracic metastatic disease.
Conclusion: We describe the imaging features in 3 pediatric patients with highly aggressive malignant tumors associated with the NUT oncogene. Although rare, consider NUT midline carcinomas in the differential diagnosis in young patients with tumors that do not demonstrate typical imaging features of common pediatric tumors and have an unusually aggressive clinical course.

PON-36

Atypical manifestations of neuroblastoma

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Purpose: Neuroblastoma is the most common extracranial solid tumor in infancy and most often presents as a palpable abdominal mass. It is a malignancy derived from neural crest cells that form the sympathetic nervous system and thus can arise from anywhere along the sympathetic chain including the neck, thorax, adrenals/retroperitoneum and/or pelvis. Common sites of metastatic involvement include the bones, regional lymph nodes, liver, dura, and in infants, the skin. However, both initial and recurrent presentations of neuroblastoma can occur in unusual sites and may manifest as symptoms and/or signs not commonly associated with this childhood malignancy. Such cases therefore carry the potential for delayed diagnosis. We aim to increase awareness among radiologists of alternative or unusual manifestations of this complex disease.
Materials and methods: We present cases of: 1) unusual clinical presentations of either primary or recurrent neuroblastoma, and 2) imaging findings at unusual sites of primary and/or metastatic involvement.
Results: Brief clinical scenarios of unusual presentations will be discussed and supported with plain film/CT/MRI/radionuclide images. Cases will include a back mass in a newborn, scrotal swelling in infancy, cheek swelling in an infant, facial swelling in a toddler, varicocele in a toddler, foot drop in a toddler, small bowel obstruction in an infant, inguinal mass, headaches, and right iliac fossa pain in an adult. Radiological images of atypical sites of neuroblastoma will include cerebral and cerebellar parenchymal lesions (solid, hemorrhagic and cystic lesions), lungs (nodules and consolidation), pleura, scapula, mandible, groin and testes.
Conclusion: Neuroblastoma is a common pediatric tumor and radiologists should be aware of the unusual manifestations of this complex disease so as to reduce the potential for delay in the diagnosis of both the initial presentation and of recurrence.

PON-37

Masses of masses: Our 5-year experience of imaging nephroblastomatosis

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Nephroblastomatosis is an uncommon condition characterised by the presence of multifocal or diffuse nephrogenic rests (NR), defined as abnormal persistence of nephrogenic cells that can be induced to form Wilms' tumour (WT). Children with nephroblastomatosis undergo regular imaging because of the risk of developing WT but there is no clear consensus as to how often, and with which imaging modality, follow-up should be performed. Contrast-enhanced CT and MRI with gadolinium maybe more sensitive than ultrasound (US) in detecting small NR but confer risks associated with sedation, contrast administration and, in the case of CT, ionising radiation. In addition, neither imaging nor histopathology can always distinguish between NR and WT. Between 2006–10, five children (2 male, 3 female) have been serially imaged for nephroblastomatosis at our institution. Age range at diagnosis was 1 y 2 m–5 y 0 m. At presentation one child had diffuse nephroblastomatosis, one child had multifocal, bilateral nephroblastomatosis without WT and 3 children had WT (multiple in one case) with multifocal, bilateral nephroblastomatosis. Two

children underwent chemotherapy followed by nephrectomy for WT; 3 children received chemotherapy alone. Follow-up imaging has involved a combination of US, CT and MRI at intervals no more than 3–4 months. One child also underwent FDG-PET at diagnosis. Three children developed WT at 9 m, 2 y 7 m and 2 y 10 m following initial diagnosis, detected on MRI in 2 cases and on US in one case. All these lesions were treated with chemotherapy and partial nephrectomy. One child developed a second WT in the contralateral kidney 3 y 5 m after initial diagnosis and 7 m after developing the first WT. In patients with extensive multifocal disease, we have found that assessing each lesion within a kidney for interval growth with US can be problematic. In these patients we favour MRI at 3 monthly intervals. Addition of US at the midway point between MR studies, such that imaging is performed every 6 weeks, is also used to target specific lesions of concern.

PON-38

Malignant pediatric liver masses

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Purpose: Pediatric liver tumors are rare. Patient factors such as age, clinical symptoms and signs and serum aFP are key to the differential diagnosis. Imaging is important to determine the location and characterization of the hepatic lesion(s), and also, to determine local extension and the presence of complications or metastases.
Materials and methods: A retrospective search of electronic medical records was performed to identify patients attending the pediatric oncology service with a diagnosis of a malignant liver lesion. The Imaging finding s on US, CT and MRI were reviewed.
Results: Patients with the following malignant liver lesions were identified: hepatic metastases (neuroblastoma, Wilm's, renal cell carcinoma, immature ovarian teratoma), hepatoblastoma (6 cases), hepatocellular carcinoma , fibrolamellar carcinoma and undifferentiated embryonal sarcoma (6 cases). A pictorial review will be presented of the imaging findings on US, CT and MRI in each of the above malignant pediatric lesions. Examples of local tumor invasion with hepatic, portal vein and IVC involvement, diaphragmatic involvement, extension into the thoracic cavity and complications such as intraabdominal rupture of tumor and gallbladder perforation will be presented. Examples of distant spread such as peritoneal carcinomatosis, osseous and pulmonary metastases will also be shown.
Conclusion: Pediatric liver masses are rare but malignant in the majority of cases. We provide a pictorial review of the imaging findings on US, CT and MRI in a series of pediatric patients with primary and secondary malignant lesions of the liver.

PRS-1

Adaptive post processing filters in thoracic CT in children in order to reduce the radiation dose

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Purpose: Adaptive post processing filters (APPF) have been used in adults for improving image quality of low dose CT images for several years with reported promising results while using dosages 30–70% less than regular levels. Since there are few reports regarding the usage in children, the purpose of our study was to assess if a dose reduction of 70% (i.e., using a dosage as low as 30 % of regular dose) was possible while using APPF in a pediatric chest CT.
Materials and methods: 20 patients (11 boys, 9 girls; age range 6–18 yrs, mean age 13.7 yrs) undergoing a planned chest CT were included in the study. The CT scanner used was a GE LightSpeed 16. A volume of 5 cm thickness was scanned twice in each patient: first, using the standard protocol for thoracic CT and second, using a low dose protocol followed by APPF (SharpViewCT). Both protocols utilized tube current modulation (AutomA).The low dose level was achieved by adjusting the noise index to a level corresponding to a 70 % decrease in volume computed tomography dose index (CTDIvol) relative to the standard dose protocol. Both the standard and the filtered low dose images were independently evaluated by two pediatric radiologists with special interest in thoracic CT, concerning spatial resolution, noise level and the visibility of small vessels while using a 5-grade scale. The presternal subcutaneous tissue thickness was measured in each patient.
Results: The post processed images were graded as "not acceptable" and "barely acceptable" to a greater extent than the standard protocol images. Still, several filtered low dose examinations performed in male patients 17–18 yrs old were graded as "acceptable" or higher. The presternal subcutaneous tissue thickness had no influence on the grading.
Conclusion: Despite the small number of patients included, our study indicates that APPF used cannot compensate for a radiation dose reduction as high as 70% in thoracic CT in children although it could be useful in adolescent men.

PRS-2

Patient dose reduction in pediatric abdominal CT using adaptive post processing filters: A prospective randomized study

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Purpose: Although APPF have been used in adults for improving image quality of low dose CT images for several years, the number of reports regarding pediatric usage is limited. The purpose of our study was to assess if a 30% dose reduction in abdominal CT in children followed by post processing using SharpViewCT is achievable without compromising the diagnostic information.
Materials and methods: 292 patients (153 boys, 139 girls, age range 2–18 yrs, mean age 10.6 yrs) admitted for an contrast enhanced abdominal CT were included in a prospective randomized study. All examinations included in the study were performed on a GE LightSpeed 16 scanner. The main questions were appendicitis or trauma; oncology patients were excluded. The patients were randomized to undergo abdominal CT using either the regular protocol, or a low dose protocol followed by post processing (SharpViewCT). Both protocols utilized tube current modulation (AutomA). The low dose level was achieved by adjusting the noise index to a level which would correspond to a 30% decrease in volume CT dose index (CTDIvol) relative to the regular protocol. All images were assessed by a radiology resident and a pediatric radiologist, or by two pediatric radiologists. The final clinical outcomes were determined by surgery and histopathology in operatively treated patients. The nonsurgically treated patients were followed up by a review of the medical records and a questionnaire.
Results: There was no difference in the diagnostic accuracy between patients undergoing enhanced abdominal CT using the regular protocol and using the reduced dose filtered images.
Conclusion: The diagnostic accuracy is well comparable in regular dose abdominal CT protocols and 30% dose reduced CT protocols

followed by post processing using SharpViewCT in children. The usage of APPF increases the acceptability of low dose images without compromising the diagnostic information and hence, facilitates patient dose reduction.

PRS-3

Socio-economic variation in the use of CT scans in young people in the north of England, 1993–2002

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Purpose: To assess the socio-economic variation in young people having CT scans in the North of England between 1990 and 2002
Materials and methods: Electronic data were obtained from Radiology Information Systems of all nine National Health Service hospitals in the region. Data related to CT scans, including sex, date of scan, age at scan, number of scans and type of scan were assessed in relation to quintiles of Townsend deprivations scores obtained from linkage of census data with postcodes.
Results: During the study period, 39,676 scans (23,705 [60%] in males) were recorded on 21,089 patients. The number of scans and patients scanned differed significantly in relation to quintiles of deprivation, with increasing numbers of scans and patients associated with increasing area-level deprivation. Significant associations were also seen between deprivation quintiles and age at scan, age at first scan, type of CT scan, and the number of scans per patient.
Conclusion: Social inequalities exist in the numbers of young people undergoing CT scans with those from deprived areas more likely to do so. Higher prevalence of trauma and accidents would account for some of the increase. These findings imply that certain groups within the paediatric population receive higher radiation doses than others due to medical procedures, notably CT.

PRS-4

Impact of radiation dose and protection in the Italian paediatric radiological literature

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Purpose: Radiation protection and awareness of radiation exposure in the paediatric population remains a critical point recently emphasized by the wider use of MDCT technology. These topics have recently gained more attention and many researchers are involved. To ascertain the impact of the radiation protection issue on the Italian radiological literature, the abstract books of the Italian Society of Medical Radiology (SIRM) biennial congress and the original papers published on "La Radiologia Medica" -the Italian journal of radiology - were retrospectively analysed from 2004 to 2010.
Materials and methods: A search in the abstract books of the SIRM congress and a medline search in "La Radiologia Medica" was made using as key words: low dose, dose reduction, dosimetry and radiation protection, all matched with "paediatric patients" or "paediatric population" terms. The abstracts and papers selected according to the impact of radiation dose were classified in three groups as follows. Mentioned: radiation dose was addressed in any form; secondary: radiation dose was one of the subjects of the paper; primary: radiation dose was the main subject of the paper.
Results: 6478 abstracts and 745papers (total of 7223) were analysed. Only 44 abstracts and 5 papers matched the key request. Concerning the impact of radiation dose: among the abstracts 13/44 were classified as primary, 9/44 as secondary, 22/44 as mentioned; among the papers 3/5 were classified as primary, 1/5 as secondary, 1/5 as mentioned.
Conclusion: Paediatric radiology has significantly more often dealt with radiation exposure and protection but the papers focusing on these topics remain a minority. However a slight increase in the trend has been recently y observed, but the arguments need strong impetus to stimulate researchers to focus on the problem.

PRS-5

Awareness of radiation protection issue in paediatric trainees. A questionnaire study

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Purpose: The number of radiological investigations is rapidly increasing in the paediatric population, along with the wider and diffuse use of MDCT. In parallel, radiation protection is becoming a major issue, and better knowledge is now required, especially for physicians involved with care forinfants and children. To ascertain knowledge levels on radiation protection among Paediatric trainees, a simple anonymous questionnaire was administered.
Materials and methods: A 12-question-multi-choice questionnaire aiming to analyse knowledge levels on risks and awareness in exposing infants and children to common X ray investigations was administered to a population of 35 Paediatric trainees of various years of training. The data were than elaborated using a non-parametric analysis by the software SPSS for Windows®.
Results: 28/35 (80%) questionnaires were completed in full. With a generous pass mark of 50%, only 47% of the Paediatric trainees passed. In more detail, only 32% of them knew the ALARA principle, less than 15% of them knew the risk of induction of fatal carcinoma by a CT of the abdomen, and more dramatically still, 42% of them think that panoramic radiography can be carried out easily in pregnancy, wearing just a protection shield.
Conclusion: The study demonstrates an urgent need to improve knowledge of radiation protection and relative risks among junior doctors, especially if they care for children, due to the higher radiosensibility of this age population.

PRS-6

Emergency low-dose pediatric CT-scan: single acquisition with bi-phasic iodinated contrast injection

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Purpose: To minimize irradiation and optimize the diagnostic quality of an emergency CT-scan by applying a dual-phase iodinated contrast injection protocol, offering both venous and arterial enhancement of organs and vessels in a single acquisition. To present the injection scheme and CT-scan protocols, including technical aspects and dosimetry, and the resulting diagnostic image quality relating to a selection of caracteristic cases found in emergency situations.
Materials and methods: In our pediatric hospital, since 2006 we have succesfully applied a dual-phase iodinated contrast injection scheme for generic elective thoraco-abdominal CT-scans. Since November 2009, we have included emergency cases to our study, with more than 150 new scans, including patients from 1 year to 16 years old, of which we present a selection of representative examples. Using a 64-slice GE CT-scan and a MedRad dual-head injector, we included cases where CT-scans were deemed necessary to guide the therapy and where other non-irradiating techniques were not adequate, available or inconclusive. Doses ranged between 1.5 and 2cc/kg of contrast (Acupaq 300), and 1.42 to 4.45mGy of CTDIvol (weight related), with automatic exposition variation activated. The injection scheme was programmed in order to optimize venous and arterial opacification, and set to a fixed delay of 65s.
Results: An examination was considered successful on the basis of its ability to answer the diagnostic question asked. Our bi-phasic protocol offered a better overall opacification of organs and vessels using low-dose settings. Because of its fixed timing, we gained a better understanding of the physiology and physiopathology linked to vascular circulation. The simplified workflow in an emergency setting also offered greater comfort and was thus less prone to technical errors and variability in the image quality.
Conclusion: The extended use of our biphasic injection protocol to emergency CT-scans enhanced our diagnostic ability and understanding in single low-dose irradiation, while simplifying the workflow, and thus reliability, of the examination under emergency conditions.

PRS-7

Justification of paediatric CT, a self assessment in a paediatric hospital

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Background: CT is a high dose modality and therefore its justification, especially in the paediatric population, is of extreme importance. The national guidelines for paediatric imaging also include referral guidelines for paediatric CT-examinations and continuous radiation protection education is also mandatory for referring physicians. Therefore, the number of unjustified examinations was suspected to be low in our institution.
Purpose: The object of this study was to determine the number and type of unjustified paediatric CT-examinations in the Hospital for Children and Adolescents in Helsinki.
Materials and methods: All paediatric CT examinations carried outin our institution during a three month period were retrospectively analyzed. The referrals were independently reviewed by two experienced paediatric radiologists. The reviewed referrals were classified in two groups: justified and possibly or clearly unjustified.
Results: A total of 164 CT paediatric CT-examinations were performed during the three-month period. The patients' ages ranged from 0.2 years to 20 years. The number of CT examinations were: 74 thorax with 7 HRCT-examinations; 22 head; 11 abdominal; 5 body examinations performed for high energy trauma (either thx + abdomen or abdomen only); 5 cervical spine; 3 whole spine and 43 peripheral joint examinations. In 163 examinations, 23 (14%) were either clearly or possibly unjustified by both radiologists. The unjustified examinations included eight head CTs, mostly done for headache, and seven thorax CTs. There was a single head CT where justification could not be determined due to referral with no clinically relevant information.
Conclusion: Despite the practice of reviewing all referrals by the radiologist, 14% of paediatric CT-examinations were found to be unjustified. This emphasizes the need for education of referring physicians, and for radiologists to maintain their role as a gate-keeper for high-dose examinations.

PRS-8

Feasibility of retrospective determination of paediatric CT-dose from PACS

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Background: Monitoring of the patient dose is a fundamental part of the radiation protection of patients and the basis of the optimization process. The increased use of high-dose modalities like CT, in the paediatric population as well, emphasizes the determination of the radiation exposure. In previous projects, the CT imaging parameters were manuallly tabulated on a special form during the examination in order to ascertain all the information needed to calculate the dose. This has led to missing data because of lack of time and enthusiasm during everyday practise.
Purpose: The purpose of this study was to determine whether it is possible to retrieve enough data retrospectively from PACS to determine the patient dose for both optimization and cumulative dose tracking.
Materials and methods: Dose indicators like CTDIvol and DLP can be registered from the scanner dose report, which in our practise is always stored in PACS, together with the patient images. The phantom used to calculate the dose-indicators is also stored in the dose report in our scanner, which is not the case with all vendors. Basic scan parameters e.g. kilovoltage is included in the image metadata. The age and sex of the patient can be determined from the social security-number recorded in the images. Imaging parameters and dose are better related to weight than age, but weight is not routinely stored in PACS. However, in our practice, the weight can usually be obtained from the RIS-system.
Results: We retrospectively recorded available CT-dose parameters from PACS for 141 consecutive patients. Dose indicators such as CTDIvol and DLP are automatically stored in PACS in image format, and were available for all patients.
Conclusion: Radiation dose-related information for optimization is available from the PACS system, but the methodology required to retrieve the patient's cumulative radiation exposure involves additional calculations.

PRS-9

The use of iterative reconstruction (IR) as a new advanced technique for dose reduction and image quality improvement in computed tomography (CT) of the paediatric chest

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Purpose: To evaluate the use of iterative reconstruction (IR) as a new technique for dose reduction and image quality improvement in computer tomography (CT) of the paediatric chest.
Materials and methods: Low dose paediatric chest CT scans using the adaptive statistical iterative reconstruction (IR / ASIR©) method and the standard paediatric chest CT protocol without IR were performed on a GE Discovery CT 750 HD® scanner. As phantoms, we used natural sponges as a lung equivalent, saturated with iodinated contrast media (25% Peritrast® solution) inserted within a chicken specimen simulating a neonatal patient of about 4 kg body weight, and within a turkey specimen as an infant phantom of about 9 kg body weight. For the neonatal study, the tube current was set to 80 kVp, for the infant studies it was 100 kVp. The IR / ASIR© reconstruction level was 40% for both the neonatal and the infant chest CT scan. The noise index was identically for all protocols with a value of 45.
Results: The radiation dose delivered during the standard low dose CT scan without IR was 1.64 mGy CTDI (25.25 mGy*cm DLP) for the neonatal phantom and 4.06 mGy CTDI (100.79 mGy*cm DLP) for the infant phantom. For the neonatal phantom, the dose delivered using the low dose CT protocol with iterative reconstruction (IR) was 0.93 mGy CTDI (14.30 mGy*cm DLP) and for the infant phantom 2.29 mGy CTDI (57.92 mGy*cm DLP). With iterative reconstruction (IR), dose reduction was 43.3% for the 80 kVp neonatal protocol and 43.6% for the 100 kVp infant protocol.
Conclusion: When using iterative reconstruction for dose reduction in paediatric chest CT compared to the standard low dose chest CT protocol, we found an identical image quality with a patient radiation dose being significantly reduced by up to 43% when using the iterative reconstruction algorithm.

PRS-10

Optimisation of CTPA protocols on a 128-slice CT scanner to minimise radiation dose

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Purpose: CT Pulmonary Angiography is a key imaging technique in the management of pulmonary embolism, but it involves a significant radiation dose to the patient. Breast dose to younger patients is of particular concern. This study evaluated measures to minimise radiation dose while maintaining diagnostic accuracy.
Materials and methods: The scanner was a 128 slice Siemens Definition AS+. The existing scan protocol used 120 kV and mA modulation with a reference Effective mAs of 110 and an estimated effective dose of 5 mSv. Three dose reduction measures were evaluated: Bismuth breast shields, setting 100 kV and 80 kV. Organ doses were measured using TLDs in an Alderson RANDO phantom. Image quality was assessed using an Alderson lung / chest phantom. A graded scoring scheme was used to assess the visibility of pulmonary arteries and simulated pneumonia.
Results: Bismuth shields reduced breast dose by 25% with no change in overall DLP and no reduction in graded image quality. Reducing the kV to 100 and applying mA modulation reduced breast dose by 35% and DLP by 40%. The image quality was slightly higher than for the standard protocol. Selecting 80 kV reduced breast dose by 60 % and DLP by 65% with graded image quality similar to 120 kV.
Conclusion: Reducing the tube voltage to 80 kV or 100 kV gave significant dose reductions with equal or better image quality. The optimum setting for the phantom was 100 kV, but this will vary with patient size and clinical validation is required.

PRS-11

New released DR detector (Canon CXDI 70C) tested at premature neonates chest examination focusing on dose and image quality

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Background: Canon has recently released a new wireless DR detector based on a new technical design which has a smaller pixels size and a higher fill factor than previous detectors on the market. Higher fill factor results, in theory, in a higher sensitivity thus possibly decreasing the dose while maintaining image quality—in accordance with the ALARA principle.
Purpose: To investigate whether there is potential dose savings associated with using the new detector rather than the previous model at chest examination of preterm neonates and still maintaining image quality at a diagnostic level.
Materials and methods: A quantitative experimental study based on experiments with technical and human phantoms. A technical CDRad phantom was used and the images were analyzed using CDRad software, giving results as objective IQF values. A human neonates chest phantom by Gammex was used and the images analyzed by 3 radiologists specialized in pediatric chest examinations using the Visual Grading Analysis (VGA). Images were taken at all combinations of exposure parameters from 50 to 80 kV and 0.1 to 2.0 mAs and all dose measurements was controlled through Monte Carlo and analyzed in conjunction with exposure index values. Statistical analysis supported the results.
Results: The IQF value from the technical phantom is clearly higher with the new detector at all exposure values. The VGA also shows great potential for improving image quality and possibilities for reducing dose, especially at the lower kV levels. Software optimization improves the images at higher kV even though the dose effect will always influence the experienced image quality.
Conclusion: Optimal image quality can be maintained at a lower dose level on the new detector for pediatric chest examinations. Exposure index values are clearly higher on the new detector at all kV levels, which means the sensitivity is approximately 45 % higher than the previous detector, which will benefit image quality. The final statistical calculations will be available in January 2011.

PRS-12

Comparison of standard low-dose and iDose multidetector computed tomography (MDCT) techniques for assessment of tracheobronchial stenoses by vascular anomalies in children

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The aim of this study was to assess the effects of radiation dose reduction on the assessment of the airway stenoses induced by vascular anomalies on multidetector computed tomographic (MDCT) images with iDose iterative reconstruction technique versus low-dose CT standard scan. We carried out a restrospective study of 15 standard-dose and 15 iDose MDCT studies (a total of 30 patients) performed for the evaluation of tracheobronchial stenoses in pediatric patients (5 days to 16 years). Two experienced pediatric radiologists, who were blinded to the CT tecnique, reported their levels of confidence for measuring the quality of the images obtained, the feasibility of obtaining 2D and 3D diagnostic reconstruction (MPR and virtual tracheobroncho-scopy), the identification of vascular anomalies and the severity

and the degree of tracheo-bronchial narrowing in comparison with tracheobronchoscopy (TBS), considered as the gold standard. With filter back projection recontruction, helical scan protocol optimization was performed as a function of patient size. This gave us a tool to control dosage for pediatric patients. After instaling iDose alghoritm reconstruction, we were able to reduce doses by a range of 20%–30%. In fact, IDose alghoritm deals with subtraction of the image noise while preserving the underlying edges associated with changes in the anatomic structure of the scanned object. The results obtained were concordant with the results of bronchoscopy in all patients for both tecniques, maintaining a similar diagnostic confidence for assessment of the airway stenoses compared to a standard dose technique in pediatric patients with a significant reduction of dose.

PRS-13

A review of local dose-area product levels for paediatric fluoroscopy in a tertiary referral centre. Are national reference doses falsely reassuring?

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Purpose: A retrospective study of dose-area product (DAP) values for fluoroscopic examinations was undertaken in a paediatric tertiary referral centre. The aims were to establish local diagnostic reference levels (DRLs) and to compare our results with the current UK national reference doses (NRDs) and local DRLs from another paediatric tertiary referral centre.
Materials and methods: 1732 examinations were performed in a dedicated paediatric fluoroscopy room over a period of 42 months ending June 2010. Data for four commonly performed examinations (1024) grouped according to the standard age of the patient are presented.
Results: Our local DAPs were substantially lower for upper gastrointestinal studies (eight to fifteen fold lower) and micturating cystourethrograms (three to eight fold lower), than the current NRDs published by the Radiation Protection Division of the Health Protection Agency in 2009. The difference is likely to reflect technological advances in the equipment used and optimisation of both equipment performance and operator technique. The results obtained are comparable to those published by another paediatric tertiary referral centre in 2006.
Conclusion: It is important that practitioners carrying out paediatric fluoroscopy studies are aware that NRDs might not reflect contemporary best practice. Regular review of local and national practice is essential to identify the DAP levels that are achievable.

PRS-14

Radiographic exposure for neonatal chest radiographs: A comparison study at four academic hospitals

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Purpose: We used two newly described indices (the Exposure Index and the Deviation Index) to compare exposures used for neonatal portable chest radiographs in four hospitals. The Exposure Index gave us an indication of the actual exposures used. The Deviation Index allowed us to look at how much the exposures in each hospital differed from their preset target exposure. The Deviation Index is specifically defined. 1 deviation unit equals 26% increase (+1) or 20% decrease (−1) in exposure; and 3 deviation units equals 2x exposure or _ target exposure (+3 or −3).
Materials and methods: At each hospital, we determined the mean Exposure Index for 50 recent neonatal chest radiographs. This gave us a measure of the difference in exposures used by each hospital. This mean was also used to set a Target for future studies.We then measured the Deviation from this Target exposure at each hospital.
Results: The number of studies at each of the four sites was 1,884, 974, 423 and 65. For each site the mean and SD for the Exposure Index was 372.1 +159; 556.5+241.7, 521.3+208.7; and 343.3+ 158.4. There was not a large difference in Exposure Index between sites. No site has an Exposure Index mean that is more than twice or less than half that of any other site The ratio of std deviation to mean exposure index is similar for each site. It was 0.43, 0.43, 0.40, 0.46 The Deviation Index is designed to easily express deviations from the Target Exposure. The mean+sd for the Deviation Index for each hospital was 0.08+1.68; -0.82+1.89: -0.07+1.67 and −0.48+1.94. Thus exposures at each hospital are within a narrow spectrum. For all 4 sites combined, 95% of exposures had a deviation index within the range from −3 to +3. This indicates that technologists do keep their exposures within a narrow range and that major over-exposures (upward dose drift) is not occurring.
Conclusion: For four hospitals, the exposure difference for neonatal chest radiographs is relatively minor. At each hospital, deviations from predetermined target exposures were small and relatively similar.

PRS-15

Modern imaging of pediatric appendicitis emphasizing pitfalls and radiation concerns

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Background: Appendicitis is the most common cause of acute abdominal pain requiring surgical intervention in the pediatric population. Ultrasound (US) and Computed Tomography (CT) have become progressively more utilized in making the diagnosis of appendicitis prior to surgery. Disorders mimicking appendicitis can create difficulty in imaging interpretation and may lead to delayed or inappropriate treatment. In addition, radiation exposure in the pediatric population is becoming an increasing concern.
Purpose: This poster presentation will: (1) outline a modern approach to imaging appendicitis, (2) review key pitfalls in image interpretation that are useful to distinguish acute appendicitis and potential mimicking disorders, (3) describe radiation risks associated with CT imaging and methods to reduce such risks.

PRS-17

Redefining low radiation dose: iterative reconstruction facilitates sub-milliSievert pediatric MDCT

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Purpose: Iterative reconstruction (IR) is an image reconstruction method newly incorporated into CT. When blended with traditional filtered back projection (FBP), IR can be used to reduce image noise or to reduce radiation dose. This exhibit illustrates how sub-mSv doses in pediatric MDCT are achieved using IR in addition to traditional dose lowering strategies.
Materials and methods: Scans were done on a 64 detector, 128 slice MDCT equipped with IR software, iDose4 (Ingenuity CT, Philips Healthcare, Cleveland, OH). Following a 15 day evaluation of iDose4 image quality at standard pediatric weight-based techniques (n=46; # exams=58), a 40% mA reduction was instituted for pediatric neck, body and spine exams (n=154; # exams=363). Effective radiation dose (mSv) was calculated using the product of CT dose index (CTDI) and z-axis length (cm) to achieve dose length product (DLP). The product of DLP and age-appropriate k factor was used. Subjective diagnostic image quality was determined by two board certified pediatric radiologists using a 3 point scale (1-non-diagnostic, 2-diagnostic, 3-excellent). Objective image noise and CT number (HU) were measured using ROIs in contrast enhanced and non-contrast enhanced structures and were compared to exams using standard pediatric protocols in patients of similar body habitus. Statistical analysis was performed using paired t-test, Bland-Altman plots, and Wilcoxon signed rank testing.
Results: In exams performed with 40% mA reduction and IR, sub-mSv effective doses were achievable. Subjective diagnostic image quality was maintained. ROI data in baseline and reduced dose examinations showed insignificant changes in image noise and HU.
Conclusion: Redefining low dose MDCT as sub-mSv effective radiation doses is achievable without loss of diagnostic image quality when using IR to enable reduced dose parameters in addition to traditional dose lowering strategies.
Disclosure: Ms. Asimoto is an employee of, and Dr. Bardo a speaker for, Philips.

PRS-18

Factors effecting occupational doses during pediatric fluoroscopic procedures

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Purpose: Pediatric Interventional Radiology procedures have become increasingly common and complex, affording patients minimally invasive procedures, more rapid recovery times and less days spent in hospital. However, this movement has resulted in higher occupational radiation doses. Therefore, the purpose of this study was to determine factors that effect staff radiation exposure during simulated pediatric cases.
Materials and methods: Digital radiation detectors were placed on a mannequin to simulate interventional staff; anthropomorphic phantoms were used to simulate patients between the ages of 1 and 10 years. Factors such as imaging modality, patient body site being irradiated, patient size, collimation and magnification were tested to determine their effects on occupational dose. The amount of dose to various team members was also investigated. Finally, the lead shielding available in the procedure suites was tested to determine its effectiveness at reducing radiation.
Results: Spin angiography resulted in the highest occupational dose, a factor of 8 larger than one minute of regular fluoroscopy, and should therefore only be used in extreme situations. Dose, specifically to hands, is needlessly increased if the source to image distance is larger than necessary. The lead aprons provided the most protection against radiation, with the skirt attenuating 99.06% of radiation and the shirt attenuating 99.47%.
Conclusion: Maintaining a low occupational dose is possible by recalling factors that decrease scatter such as adjusting the SID effectively and by using the lead shielding provided in the suites.

PRS-19

Emerging focus of CT in morbidity and mortality rounds

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Purpose: To review and analyze the incidence and spectrum of morbidity/mortality or potential morbidity issues related to CT throughout the process from examination request to final report and relevant communications. To identify influencing factors and points of intervention for process improvement.
Materials and methods: A retrospective review of morbidity and mortality (M&M) records from 2001–2010 at a large pediatric teaching hospital was conducted. CT-related events were categorized using a 9 point system: referral decisions; request submission; protocol selection; sedation/ anesthestic; contrast; technical factors; interpretation; report delivery; and family concerns, in order to identify trends. CT requests flagged for clarification over a 6 month period in 2010 were analyzed regarding potential morbidity related to patient identity, body region and/or protocol requested, clinical information, and request timing/duplication.
Results: M&M events per 1000 CT examinations increased >3 fold over the past decade. Trending of these cases identified an evolving spectrum of issues and concerns within a developing culture of safety reporting. Radiation awareness is an emerging focus, now involved in 64% of CT events, encompassing referral decisions; request submission; protocol selection; technical factors; and family concerns. Multidisciplinary care, misinformation, physician awareness of appropriateness criteria and dose, and public awareness of potential risks combined with evolving CT technology and PACS/ reporting capabilities have altered the dynamics for performing and communicating results, with converging risk of potential morbidity. Vigilant requisition screening and open dialogue at every stage from imaging modality choice by the referring physician through to final prescan review, help to reduce process errors. Averted morbidity events, although infrequently reaching M&M, present a significant point of intervention and education.
Conclusion: The evolving spectrum of issues in CT that present in daily practice and M&M require sustained quality improvement efforts, process modification, and communication to minimize radiation risks and avert morbidity.

PRS-21

Updated estimated radiation does for pediatric nuclear medicine studies

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Purpose: Estimated radiation dose is an important factor in assessing the relative risks and benefits of pediatric nuclear medicine studies, and depends on the radiopharmaceutical, administered dose, and patient factors such as age and size. Most radiation dose estimates for pediatric nuclear medicine are not based on

current dose guidelines for pediatric nuclear medicine or recent radiation dosimetry models. Therefore, we have refined the pediatric radiation absorbed dose estimates for the most common procedures in pediatric nuclear medicine.
Materials and methods: Estimated radiation dose (mSv/study) was calculated for the most common procedures in pediatric nuclear medicine. Administered dose was based on recently released North American consensus guidelines for radiopharmaceutical doses in pediatrics. Estimated radiation absorbed dose per administered dose (mSv/MBq) was obtained from recent work by Stabin, et al, using sophisticated phantom studies to update these values. Based on standard models, radiation dose was estimated for typical patients at age 1 y, 5 y, 10 y, 15 y, and 20 y.
Results: Using the most current data, we have refined pediatric radiation absorbed dose estimates for the most common procedures in pediatric nuclear medicine. These studies include eight studies using Tc-99m labeled radiopharmaceuticals and three F-18 PET studies. These data provide estimated doses for typical pediatric patients with a range of ages (1 y to 20 y) and sizes (9–70 kg).
Conclusion: For the most commonly performed pediatric nuclear medicine studies, estimated radiation absorbed doses have been refined using the most recent pediatric radiopharmaceutical dose administration guidelines and data from the most current internal dosimetry models. These estimates will guide departmental quality control efforts to minimize radiation exposure and will provide the most current information for discussing radiation dose and risk with referring physicians, patients, and families.

PRS-22

Iterative reconstruction in pediatric MDCT: Diagnostic ramifications of various levels of noise reduction

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Purpose: Iterative reconstruction (IR) is an image reconstruction algorithm that uses statistical modeling to subtract image noise but maintain anatomic information. However, when used alone, IR changes the texture of MDCT images in an undesirable way. For this reason, IR is typically applied in combination with filtered back projection (FBP) to reduce noise and radiation dose but preserve the look of FBP images. The purpose of this study is to illustrate diagnostic ramifications of various levels of noise reduction through iterative reconstruction in pediatric MDCT.
Materials and methods: Teaching material is drawn from 425 examinations in 200 children, performed using low dose pediatric protocols, on a 64-detector, 128-slice MDCT equipped with IR software iDose4 (Ingenuity CT, Philips Healthcare, Cleveland, OH). Image reconstructions were performed using 100% FBP and FBP/IR blends from 80/20 to 20/80 (corresponding to manufacturer reported noise reduction levels of 0%, 11%, 23%, 37%, and 55%). Two board certified pediatric radiologists evaluated all images for diagnostic certainty, visual appeal, spatial resolution, and lesion conspicuity using a 3 point scale (1-non-diagnostic, 2-diagnostic, and 3-excellent). ROIs to measure objective mean CT number (HU) and noise levels were placed in contrast enhanced and non-contrast enhanced structures. Data was analyzed using Bland-Altman plots, Wilcoxon signed rank and paired t-tests. Illustrative image sets are compared and contrasted.
Results: Image noise decreases as more IR is applied, as expected given proposed noise reduction values provided by the manufacturer. Of the ratios tested, a 60/40 FBP/IR blend is favored in terms of lesion conspicuity, spatial resolution, diagnostic confidence, and visual appeal. Objective measurement of image noise reduction is equal to or greater than estimated. There is no significant difference in the overall mean CT number.
Conclusion: Iterative reconstructions facilitate significant image noise reduction while maintaining diagnostic certainty and mean HU.