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Picking the Black Hat in the Ovarinoma's' - Imaging Differentiation of the Malignant and Benign Ovarian Lesions

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Learning Objective: Ovarian masses are a common finding in routine clinical practice with many of them being incidentally detected and some identified in symptomatic patients.
Background: Ovarian cancer is the second most common gynaecological malignancy and a leading cause of death among these diseases. A multidisciplinary approach must be undertaken. Preoperative biopsy should not be performed as this raises the risk of spreading cells and potentially leads to iatrogenic upstaging. Pre-operative assessment is a diagnostic challenge.
Findings and/or Procedure Details: Diagnostic imaging plays a crucial role in characterization and staging of adnexal masses. Ultrasound (US) is often the first imaging study performed in evaluation of suspected ovarian lesion because it's widely available, well accepted by patients, non-invasive and of low cost. Contrast Enhanced Computed Tomography (CECT) is important in staging and in detection of disease recurrence after therapy, which limited value in characterization of an ovarian mass. 18F-FDG PET/CT is being increasingly used and its role in the evaluation of ovarian tumours appears to be crucial in the postoperative follow-up of patients with suspected recurrence. Magnetic Resonance Imaging (MRI) is an essential problem-solving tool to determine the site of origin of a pelvic mass and then to characterize an adnexal mass, especially in patients with indeterminate lesions. MRI is also reliable in detecting local invasion.
Conclusion: Characterization of an ovarian lesion is of utmost importance, in order to plan adequate therapeutic management.

Qualitative and Quantitative Volumetric Assessment of Ascites on Plain Computed Tomography Scan of the Abdomen

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Objective: In the UP-Philippine General Hospital (UP-PGH), the volume of ascites on imaging is only subjectively described as minimal, moderate, or massive. This study aimed to compare this qualitative method with established quantitative methods in the volumetric assessment of ascites on plain computed tomography scans of the abdomen and propose a more objective approach in reporting the volume of ascites.
Materials & Methods: All adult patients with ascites who underwent an abdominal CT scan from the period of January to June 2016 were included in this study. The volume of ascites was measured on plain abdominal CT images using the gold standard Volume Rendering method and the Oriuchi five-point method. These were correlated with the amount of ascites using the qualitative method as reported in the official radiologic report. Pearson correlation for the values obtained using both methods was performed. The mean volumes, range of values, and standard deviation for each subgroup of patients based on the UP-PGH qualitative method were also tabulated.
Results: There is significant overlap among the ranges of values for the qualitative descriptors of ascites. There is good correlation between the values obtained using the two quantitative methods (Pearson correlation coefficient 0.902). The Oriuchi method is most accurate when applied for patients with massive ascites (0.863).
Conclusion: The Oriuchi method is a practical method of estimating the volume of ascites on CT, particularly for patients with massive ascites. It may be applied for patients who need quick and reasonably accurate estimation of intraperitoneal fluid volume.

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Role of 3-Tesla Diffusion Weighted MRI in Evaluation of Focal Liver Lesions

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Objective: To evaluate the role of diffusion weighted imaging (DWI) in characterization of focal liver lesions (FLLs) using 3-T MRI.
Materials & Method: MR evaluation was done using respiratory triggered DWI in addition to conventional and contrast-enhanced sequences. A total of 33 patients with 71 FLLs were evaluated qualitatively using visual assessment of DWI, and quantitatively using conventional ADC and normalized ADC measurements using spleen as the reference organ. Receiver operating characteristic (ROC) curve analyses was done to evaluate the utility of ADC for differentiation of benign and malignant lesions.
Results: Visual characterization of lesions using DWI could differentiate benign and malignant lesions with a sensitivity, specificity and accuracy of 100%, 85% and 95.77% respectively. Mean ADC value of benign lesions was 2 ± 1.05 ($x10^{-3}$ mm^2/sec), malignant lesions was 0.84 ± 0.13 ($x10^{-3}$ mm^2/sec) and the difference was found to be statistically significant (p value < 0.050). At proposed ADC cut off of 1.12 ($x10^{-3}$ mm^2/sec), area under ROC curve came out to be 0.843 and benign lesions could be differentiated from malignant ones with 100% sensitivity, 80% specificity and 94.36% diagnostic accuracy. The use of normalized ADC using the spleen as reference organ resulted in a more restricted distribution of ADC values compared to conventional ADC measurements.
Conclusion: DWI shows good potential for accurate characterization of liver lesions. It should be included in routine MR protocol for hepatic imaging. Some benign lesions can be misclassified as malignant using DWI. Thus, it cannot be used as a stand-alone sequence and should be interpreted in conjunction with conventional and contrast-enhanced MR sequences.

Hyperdense Wall-Lumen Sign: New Imaging Clue to the Diagnosis of Gangrenous Cholecystitis

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Objective: The purpose of the study was to review unenhanced CT scans of cases with histopathologically confirmed acute gangrenous cholecystitis and acute non-gangrenous cholecystitis. Our hypothesis was that the density (CT Hounsfield units) of both gallbladder wall and bile increased in cases of acute gangrenous cholecystitis due to early ischemia, mucosal necrosis and hemorrhage within the wall and anaerobic bacteria proliferation, suppurative infection and purulent material filling the gallbladder lumen.
Materials & Methods: We retrospectively reviewed the unenhanced CT scans of surgically proven cases of acute gangrenous and non-gangrenous cholecystitis. 11 cases of pathologically proven acute gangrenous cholecystitis and 11 consecutive cases of surgically proven acute non-gangrenous cholecystitis that underwent CT at our institute were included in the study so as to have 1:1 control. The Hounsfield unit (HU) of the gallbladder wall and intraluminal bile was measured.
Results: The gangrenous cholecystitis group had significantly higher HU values of wall and bile (43.18 ± 14.27 vs. 26.82 ± 11.74 and 41.64 ± 12.64 vs. 25 ± 13.7 for gangrenous and non-gangrenous group, respectively $p < 0.05$). The unenhanced CT cut-off value within wall for diagnosis of gangrenous cholecystitis was 33.5 HU (sensitivity 81.8%, specificity 81.8%, positive predictive value 81.8%, negative predictive value 81.8%, AUC 86.4, Youden index 63.6% which was statistically significant, $p = 0.004$) and intraluminal bile 32 HU (sensitivity 81.8%, specificity 90.9%, positive predictive value 83.3%, negative predictive value 90%, AUC 84.3, Youden index 74.2% which was statistically significant, $p = 0.006$).
Conclusion: We would also like to propose combined hyperdense gallbladder wall-lumen sign for the imaging diagnosis of acute gangrenous cholecystitis.

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MRI-TRUS Fusion Biopsy: A New Paradigm for Prostate Cancer

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Learning Objective: This E-poster describes the advantages, indications, patient preparation, technique and possible complications of MRI/TRUS (magnetic resonance imaging/ transrectal ultrasound) fusion biopsy based on our early experience.
Background: The incidence of prostate cancer is in climbing trend globally. In Malaysia, it contributed to 8.8 per cent of all newly diagnosed cancers in 2018. The management of prostate cancer relies mainly on early detection and the accuracy of cancer sites. The current diagnostic standard i.e. TRUS-guided systematic biopsy has been reported to have limitations and poor sensitivity. A new 'targeted' MRI/TRUS fusion biopsy combines the advantages of MRI in targeting the lesion with that of real-time TRUS guidance.
Findings and/or Procedure Details: Prostate MRI/ TRUS fusion biopsy.
Conclusion: With the excellence detection rate for clinically significant prostate cancers, MRI/TRUS fusion biopsy shows an emerging paradigm in the prostate care by providing faster, more accurate and more reliable diagnosis, hence establishing the corresponding prognosis.

Feasibilty of 15-Minute Delayed Hepatobiliary Phase Imaging Using a 30 Degree Flip Angle in Gadoxetic Acid-Enhanced MRI in the Detection of the Focal Liver Lesion in Cirrhotic Liver

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Objective: To compare the lesion-to-liver contrast-to-noise ratio (CNR), contrast ratio (CR) and sensitivity of focal liver lesion (FLL) detection of a 15-minute delayed hepatobiliary phase imaging (HBI) using a 30° flip angle (15min-FA30) in gadoxetic acid-enhanced MRI with those of a standard 20-minute delayed HBI using 25° FA (20min-FA25) in patient with cirrhotic liver, to evaluate feasibility of shorten examination time with maintained image quality.
Materials and Methods: 70 FLLs from 62 patients who underwent gadoxetic acid-enhanced MRI with 15min-FA30 and 20min-FA25 HBI were enrolled. Lesion-to-liver CNRs and CRs were compared between the two images groups. Two radiologists independently reviewed the presence of FLLs using a four-point scale and detection sensitivity was calculated.
Results: There was no significant difference in the median CNR of all FLLs on the 15min-FA30 (77.6: IQR; 47.4–133.2) and that of the 20min-FA25 (81.5: IQR; 48.2–140.0). The mean CR of all FLLs on the 15min-FA30 (0.47 ± 0.16) and 20min-FA25 (0.47 ± 0.17) was no significant difference. There was no significant difference in FLLs detection sensitivity for two readers between 15min-FA30 (91.4% and 97.1%) and 20min-FA25 (92.9% and 97.1%).
Conclusion: The CNRs, CRs and lesion detection sensitivity of shorten delayed HBI with high FA (15min-FA30) in gadoxetic acid-enhanced MRI are comparable with standard delayed HBI (20min-FA25) in patient with cirrhotic liver. This result indicates that 15min-FA30 can replace 20min-FA25 that help to reduce total examination time.

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Role of Contrast Enhanced Untrasound in Grading the Severity of Acute Pancreatitis

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Objective:
1. To assess the diagnostic accuracy of Contrast Enhanced Ultrasound (CEUS) in grading the severity of acute pancreatitis
2. To correlate CEUS findings with clinical outcome variables such as need for intervention, ICU admission and BISAP score.
Materials and Methods: 56 patients with acute pancreatitis referred for CECT between January 2019 and August 2020 were included in the study and B-mode USG and CEUS were performed in all these patients. Parameters such as size and enhancement of pancreas, presence of peripancreatic fluid collections and extrapancreatic complications were recorded in CEUS and compared with CECT. Ultrasound severity index (USSI) and modified ultrasound severity index were calculated for each patient and compared with CT severity index and modified CT severity index respectively.
Results: The sensitivity and specificity of CEUS in differentiating AIP from ANP were 93.1% and 96.3%. The sensitivity of CEUS in diagnosing splenic vein thrombosis and peripancreatic fluid collections was 87.9% and 76.9%, whereas the specificity was 100% in both. The agreement between USSI and CTSI was calculated as 0.86 (Cohen's kappa coefficient) and between modified USSI and modified CTSI as 0.85, indicating an almost perfect agreement. No significant differences were noted between USSI and modified USSI in grading the severity of acute pancreatitis and both indices showed a good correlation with clinical outcome variables.
Conclusion: CEUS has a good diagnostic accuracy to detect necrosis and grade the severity of acute pancreatitis and can be used as a substitute to CECT. USSI and modified USSI are equally good indicators to predict clinical outcome.

Morphology of Normal Appendices on Computed Tomography

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Objective: To describe the morphology of normal appendices on computed tomography (CT).
Materials and Methods: All patients over 18-year-old who underwent abdominal contrast-enhanced CT for various indications at a single institution from 5/2019 to 7/2020 were enrolled. Exclusion criteria were right lower quadrant pain, fever, colonic wall thickening, history of appendicular disease (chronic appendicitis, appendiceal phlegmon, abscess, mucocele, ...). Appendiceal morphology was documented on the venous phase, including maximal outer-to-outer wall diameter, wall thickness, length, intraluminal contents, base and tip locations. Length was measured using curved multiplanar reconstruction technique. All measurements were obtained utilizing 200% magnification.
Results: 186 consecutive patients (102 men and 84 women), mean age 51.6 ± 13.4, met the inclusion criteria. The mean appendiceal outer-to-outer wall diameter was 6.7 ± 1.3 mm (range, 3.6–11.7 mm), mean length 82.1 ± 24.8 mm, (range, 20.5–138.2 mm), mean wall thickness 2.1 ± 0.4 mm (range, 1.1–3.2mm). Appendiceal diameter between 6–10 mm was seen in 68.8%, > 10 mm in 2.7% of patients. Among 186 appendices, 6.5% were completely collapsed, 14% completely air-filled, 8.6% completely fluid-filled. Eleven patients had appendicoliths (5.9%) in which 4 patients had 2 appendicoliths. The most common locations of the appendiceal tip were subcecal and retrocecal (45.2%); appendiceal base was postero-inferiomedial (75.8%). Appendiceal length was positively correlated with body height and negatively correlated with age whereas diameter was positively correlated with BMI ($p < 0.050$).
Conclusion: Some of the morphological features of a normal appendix overlap with the values currently used to diagnose appendicitis on computed tomography.

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Liver and Liver Tumor Segmentation from Abdominal CT Images Using Deep Learning and K-Means Algorithm

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Objective: We propose liver and liver tumor segmentation algorithms for computer aided diagnosis of liver diseases.
Materials and Methods: The segmentation was performed in two stages, first, the liver was segmented from the abdominal Computed Tomography (CT) images using the deep convolutional encoder-decoder network called SegNet. Then, liver tumors were segmented using K-Means clustering, morphological and logical operations. The concept of transfer learning/fine-tuning was used in the deep learning model. SegNet with pre-trained weights from VGG16 was fine-tuned with 3D-IRCADb-01 dataset. The images were converted to three channels by duplicating the slice in each channel and then resized thus producing images of dimension 380* 380* 3 suitable for SegNet. The number of epochs, learning rate and optimization algorithm used were 90, 0.001 and stochastic gradient descent with momentum, respectively. For empirical testing, ten portal venous phase CT datasets (500 images in Feet First-Supine patient position) obtained from KMC hospital, Manipal were employed for evaluating the performance of the proposed algorithm.
Results: The quantitative evaluation metrics such as, Average Dice Coefficient (DC) = 0.94, Jaccard Index (JI) = 0.888 and Volumetric Overlap Error (VOE) = 0.113 were computed for liver segmentation and for liver tumor segmentation, the values were DC = 0.654, JI = 0.494 and VOE = 0.506.
Conclusion: The proposed segmentation technique has correctly delineated the liver and liver tumor which is proved through statistical analysis (qualitatively and quantitatively).

Audit on Contrast CT Adrenal Protocol: Our Institutional Experience

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Objective: Retrospective review on our protocol driven contrast CT adrenal perform during 2018. Review number of avoidable post-contrast CT adrenal scans if ACR appropriateness criteria applied (i.e. if lesion has pre-contrast HU ≤10 AND max. size ≤ 4cm).
Materials and Methods: Retrospective review contrast CT adrenal performed during 1/1/2018 to 31/12/2018. We look into following parameters: Performed Date, Age, Sex, Number of adrenal nodules, Adrenal nodule size (3 dimension), Attenuation at pre-contrast (HU), Attenuation at portovenous phase, Attenuation at Delay phase, Any Macroscopic fat, Any calcifications, Absolute washout, Relative washout, Report diagnosis.
Results: Total 55 patients were included in this study. 58% are male patients, 42% are female patients. Age range: 36–87, with mean 61.24 and median 62 years old. For the 55 patients included, 5 patients had no adrenal nodules. 54 nodules were detected: 26 are lipid-rich adrenal adenoma. 17 are lipid-poor adrenal adenoma. 7 are indeterminate nodule. 2 are nodules but nature not described. 1 is a cyst. 1 is pheochromocytoma. Primary outcome: For 55 contrast CT adrenal performed, 20 patients had one lipid rich adrenal adenoma. 2 patients had 2 lipid rich adrenal adenomata. 5 patients had no adrenal nodule. These are regarded as avoidable post-contrast scan. % of avoidable scan would be 27/55 = 49.1%
Conclusion: As large proportions of unnecessary post-contrast scans were performed, we will setup new protocol to avoid unnecessary radiation, IV contrast related adverse reaction, wasted CT capacity, unnecessary tube usage, cost of IV contrast, unnecessary usage of image storage, deviation from established guidelines.

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Mucinous Colorectal Adenocarcinoma: Is CT Good Enough for Preoperative Prediction?

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Objective: To assess the characteristics of mucinous versus non-mucinous colorectal adenocarcinoma by preoperative computed tomographic (CT).
Materials and Methods: A retrospective study was conducted for a comparative assessment of preoperative CT in patients post-operatively confirmed with either mucinous or non-mucinous colorectal adenocarcinoma. Two experienced abdominal radiologists separately conducted a blinded review of preoperative CT for location, size, morphology, enhancement, area of hypoattenuation, internal calcification, extracolonic spreading, adjacent organ invasion, obstruction, complications, lymphadenopathy, and distant metastases. Any discrepancies were reconciled by a consensus review. Subsequently, a stratified comparative analysis was performed for patients with mucinous versus non-mucinous colorectal adenocarcinoma.
Results: Over a 12-year, 6-month period, there were 143 patients meeting inclusion criteria, 47 with mucinous and 96 with non-mucinous adenocarcinoma. The mean age (SD) and gender distributions were similar for both groups. The mean (SD) tumor diameter and length were 4.7 (2.1) and 7.7 (3.9) cm in mucinous group vs. 3.1 (1.4) and 5.4 (2.2) cm in non-mucinous group ($p < 0.001$). The presence of heterogeneous enhancement and area of hypoattenuation greater than two-third of tumor volume were more frequently visualized in the mucinous group ($p = 0.001$ and $p < 0.001$, respectively); and the combination of these 2 characteristics had diagnostic utility for mucinous adenocarcinoma with sensitivity, specificity, and accuracy of 66.0%, 95.8%, and 86.0%, respectively.
Conclusion: Preoperative CT had a potential for preoperative diagnosis of mucinous adenocarcinoma. Colonic mass with heterogeneous enhancement and an area of hypoattenuation more than two-third of tumor volume should increase the preoperative index of suspicion for mucinous adenocarcinoma.

Male Infertility: An Insight to the Role of Imaging in Its Diagnosis

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Learning Objective:
1. To demonstrate imaging appearances of the common pathologies resulting in male infertility.
2. To understand the role of imaging in diagnosing these pathologies and guiding clinicians towards appropriate management.
Background: The diagnostic workup for male infertility is assuming greater importance as approximately 50% infertility cases have male factors implicated. Apart from history, physical examination and laboratory tests, imaging offers a great role to identify the underlying aetiology. Therefore, the purpose is to make radiologists aware of imaging appearances of normal and abnormal findings that can be demonstrated on imaging male genital tract, resulting in infertility.
Findings and/or Procedure Details: The investigation of infertile male patients is essential in order to identify potentially treatable causes of infertility and to guide therapy. In this educational exhibit we will demonstrate frequently encountered non idiopathic causes resulting in male infertility. These include:
1. Pre-testicular causes
   a. Primary hypogonadism b. Secondary hypogonadism c. Pituitary tumors
2. Testicular causes:
   a. Varicocele b. Testicular atrophy c. Testicular torsion
   d. Orchitis and epididymo-orchitis e. Microlithiasis f. Cryptorchoidism
3. Post-testicular causes:
   a. Congenital absence of vas deferens b. Obstructive causes (post-surgical, cystic lesions or post infective etiologies)
   c. Erectile dysfunction
Conclusion: Apart from lab investigations, imaging plays an important role in diagnosing the treatable causes of male infertility and this helps the clinicians to adapt the best method for achieving conception.

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Vascular Malformation Mimicking Neoplasms in the Solid Abdominal Viscera

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Learning Objective: The purpose of this pictorial review is to acquaint the reader with vascular anomalies in solid abdominal viscera, and to discuss features that help differentiate these lesions from true neoplasms.
Background: Vascular anomalies are a heterogeneous group of lesions that are commonly encountered in clinical practice. They can present a diagnostic challenge owing to difficulty in differentiating them from enhancing neoplastic lesions. Compared to vascular anomalies in the extremities, lesions in the abdominal viscera are less common. Visceral lesions are also often asymptomatic and detected incidentally, or present with non-specific symptoms. As such, clinical history is often of limited value in differentiating them from more sinister neoplastic lesions. Many of these vascular anomalies do not require further workup. If suspicion for such a lesion is not raised, the patient may be subjected to inappropriate follow-up, or a biopsy with potentially life-threatening consequences. Since accurate diagnosis is essential for optimal management, accurate interpretation of imaging studies is useful to avoid misdiagnosis and inappropriate management.
Findings and/or Procedure Details: We present a case series of vascular anomalies in various solid abdominal viscera, including the pancreas, kidney and adnexa. For each case, we detail the clinical presentation, imaging features, subsequent management and if applicable, histopathology.
Conclusion: It is important for the radiologist to be aware of vascular anomalies in the abdominal viscera, and to identify the characteristic features which allow discrimination between vascular lesions and true neoplasms. Failure to suggest this diagnosis can lead to misdiagnosis and inappropriate management.

Iron Deposition Patterns in Thalassemia on 3T Magnetic Resonance Imaging

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Objective: To study the patterns of iron deposition in chronically transfused thalassemia patients on MRI.
Materials and Methods: 55 thalassemia patients underwent MR examination on a 3T MR scanner (Magnetom Skyra, Siemens, Germany) including T2 weighted (T2W) and T1 VIBE e-dixon sequences.
Results: Signal intensity changes were assessed on T2W, in and opposed phase images in liver, spleen, pancreas, renal cortex, bone marrow and interventricular septum. Iron deposition was recognized by drop in signal intensity on in phase images compared to opposed phase. We attempted to classify iron deposition patterns in thalassemia patients. Reticuloendothelial pattern involved liver, spleen and bone marrow with sparing of pancreas and kidney which is the most common pattern expected in iron overload secondary to multiple transfusions. Mixed deposition pattern revealed involvement of liver along with other organs like spleen, pancreas, kidney or bone marrow. This was the most frequently obtained pattern in our study, probably due to advanced form of the disease. Predominant parenchymal deposition pattern with involvement of liver, pancreas along with bone marrow was also seen, however pure parenchymal pattern with sparing of bone marrow was not seen in any patient. Although no isolated renal deposition pattern was seen, few cases depicted iron deposition in renal cortex and interventricular septum along with other organ involvement. One rare case also showed drop in signal on in phase images in paraspinal muscles.
Conclusion: Mixed deposition was the most frequently seen pattern in our study as compared to reticuloendothelial pattern which is the most commonly observed pattern in chronically transfused patients.

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Imaging of Diverticulae in Gastro-Intestinal Tract

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Objective: To study various forms of diverticulae in gastrointestinal tract and to understand its pathophysiology, role of imaging and different modalities in its diagnosis and its various complications.
Materials and Methods: All the various cases presenting at our tertiary care centre with varied clinical aetiology, which in imaging, mainly Computed Tomography, recognised at a diverticulosis, were included in the study. A diverticulum is a bulging sack in any portion of the gastrointestinal tract. The most common site for the formation of diverticula is the large intestine. Diverticula are classified as true or false: true diverticula are composed of all of the intestine's layers, while false diverticula consist of only the mucosa and the submucosa. Diverticula can be also classified as intra- and extraluminal. Intraluminal and Meckel diverticula are congenital, while extraluminal diverticula can be found at many anatomical sites and are denominated duodenal, jejunal, ileal or jejunoileal.

Major complications:

- Diverticulitis, gastrointestinal hemorrhage, gastrointestinal obstruction, acute perforation, pancreatic or biliary disease, intestinal obstruction/Perforation
- Localized abscess, malabsorption, anemia, volvulus and bacterial overgrowth, malignant transformation

This poster would include the following gastrointestinal diverticulae:

- Esophageal diverticula
- Gastric diverticula
- Duodenal diverticula
- Jejunal and ileal diverticula
- Meckel's diverticula
- Rokitansky-Aschoff sinuses- diverticula in the gallbladder
- Colonic diverticula

Results: The various gastrointestinal diverticulae were analysed and also differentiated from its common mimics or differentials.
Conclusion: The various forms of diverticulae in gastrointestinal tract and the role of imaging and different modalities in its diagnosis and its various complications were recognized.

Real-Time Point Shear Wave Elastography as a Diagnostic Tool for Liver Fibrosis in Alcoholic Liver Disease & Viral Hepatitis in Comparison with Serum Biomarkers

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Objective: Real-time Point shear wave elastography is a recent two-dimensional shear wave elastography method that helps us to estimate the severity & quantify liver fibrosis. Liver stiffness is dependent on its composition, which is altered by deposition of collagen in patients with fibrosis or cirrhosis, hepatocellular carcinoma, or metastases. The aim of our current study is to evaluate P-SWE elastography as a diagnostic tool for liver fibrosis in comparison with Aspartate transaminase to Platelet Ratio Index (APRi) score, and Fibrosis 4 tests in patients with alcoholic liver disease & Viral hepatitis.
Materials and Methods: It was a cross-sectional study at tertiary care center, Bhopal over a period of one year. Patients of age more than 18 years referred for an ultrasound with a clinical diagnosis of CLD were included in the study. Patients with diagnosed hepatocellular carcinoma by imaging or serology; and patients with decompensated liver disease, massive ascites, or Body mass index < 18.5 or > 35 kg/m^2 were excluded.
Results: There were 100 participants, among them 88 patients met the inclusion criteria, rest were excluded due to non-compliance/inability to breath-hold. Kappa value of elastography measurements& biomarker indices in alcoholic & viral hepatitis patients implied a fair & moderate agreement respectively ($p < 0.001$).
Conclusion: We identify P-SWE as an important non-invasive diagnostic test as well as a screening tool in detecting significant liver fibrosis. Data validating our findings from larger multicenter studies in the Indian population is required. P-SWE can eventually replace invasive liver biopsies in near future.

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Real-Time Point Shear Wave Liver Elastography in Healthy Adults in Asian Population

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Objective: Real-time Point shear wave elastography is a 2D shear wave elastography method that helps us to estimate the severity of liver fibrosis quantitatively. Tissue stiffness in the liver is dependent on its composition, which is altered by deposition of collagen, hepatocellular carcinoma or metastases. The aim of our current study is to define the normal range of liver stiffness in healthy volunteers.
Materials and Methods: A total of 100 healthy volunteers underwent P-SWE elastography to determine the liver stiffness by using convex probe with a frequency of 3–5 MHz. Individuals with diseased liver (hepato-steatosis, CLD, cirrhosis, or focal liver lesions) were excluded from the study. Effects of age & gender on P-SWE values were analysed.
Results: SWE imaging was successfully performed in 100 healthy volunteers. The mean elasticity value of the liver was determined as 1.13 ± 0.14 m/s (95% CI 1.13–1.19 m/s). There was no significant difference in P-SWE values between men and women, age or BMI (18.5–24.9 kg/m^2).
Conclusion: In our study, the shear wave velocity of the liver was measured by P-SWE method in normal healthy volunteers. The normal baseline elastography values of liver was established, above which presence of fibrosis can be suggested. With data validating our findings from larger multi-center studies, P-SWE can eventually replace invasive liver biopsies in near future.

Shearwave Elastography Increases the Diagnostic Accuracy of Endometrial Pathologies

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Objective: Transvaginal ultrasound (TVUS) for endometrial thickness is commonly used to assess endometrium pathologies. However, conventional ultrasound may not be able to distinguish different endometrial pathologies. We assessed if shearwave elastography (SWE) ultrasound could be used to differentiate between benign and malignant endometrial pathologies.
Materials and Methods: 117 participants (69 patients and 48 controls) were examined with TVS followed by SWE. The SWE data of the endometrium, i.e. Emean and Emax (kPa) were analysed and compared to the histopathological findings.
Results: Endometrium SWE in all 15 patients with confirmed endometrial carcinoma showed statistically significant higher Emean and Emax ($p < 0.001$) than the benign endometrial diseases. Using ROC analysis, the cut-off values of Emean and Emax were determined as 83.9 kPa (sensitivity 93.3%, specificity 68.5%, positive predictive value [PPV] 48.1%, negative predictive value [NPV] 95.2%, accuracy 76.8%), and 99.3 kPa (sensitivity 93.3%, specificity 79.6%, PPV 56%, NPV 97.7%, accuracy 86.2%), respectively.
Conclusion: Despite a small sample size, the study showed that SWE is a promising diagnostic tool to differentiate between benign and malignant endometrium tissues. The recommended cut-off values for Emean and Emax based on a local population are 83.9 kPa and 99.3 kPa, respectively. However, a larger multi-centre study is needed to further verify these findings.

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Complications of Pancreatitis: A Pictorial Review

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Learning Objective:
1. Using a case-based review, to discuss in details imaging of complications of Pancreatitis
2. To discuss the role of Radiologists in not only accurate diagnosis but also in the management of complications of Pancreatitis.
Background: Pancreatitis is one of the common diseases encountered in Radiology Department. The devastating nature of complications of Pancreatitis reiterates the need of their accurate recognition and timely management.
Findings and/or Procedure Details: CT is of particular importance in evaluation of Complications of Pancreatitis. MRI helps in situations like Duct Disconnection and deranged renal parameters. Collections associated with Pancreatitis range from Acute Peripancreatic fluid collections, Acute Necrotic Collections, Pseudocysts and Walled off Necrosis. Ascites and Pleural Effusion are commonly encountered in Severe Pancreatitis. Of particular importance are Vascular complications like thrombosis of Splenic vein, Portal Vein and/or Superior Mesenteric Vein; Pseudoaneurysms commonly involving Gastroduodenal Artery or Splenic Artery and chronic complications like Cavernoma formation. State of the art CT Angiography helps in accurate evaluation of vascular complications and Interventional Radiologists are the main workforce involved in their management. Using CT Guidance, Radiologists also aid in drainage of infected necrotic Pancreatic Collections. Other rare complications include Emphysematous Pancreatitis, Hemorrhagic collections and Fistula formation with Pleura or Bowel. Representative cases with salient features of these common and uncommon complications of Pancreatitis and their Radiological management are presented in the exhibit.
Conclusion: Radiologists not only play important role in diagnosis but are an integral component of Multidisciplinary team involved in treatment of Pancreatitis and its complications.

The Performance of Shear Wave Elastogrpahy: Comparison 2-Dimension and Point Shear Wave Elastography for Evaluation of Liver Fibrosis

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Objective: This study was purposed to evaluation the technical performance of 3 technique shear wave elastography including success rate, reliability and correlation of liver stiffness values obtained by three technique.
Materials and Methods: This retrospective study included 810 patients who underwent ultrasound examination and additional LS measurement using ElastQ, ELastPQ and LOGIQTM E9 technique. The ElastQ and ElastPQ technique was performed on the same machine. The performance including applicability, repeatability (CV: coefficient of variation), operation time and LS values of three techniques were compared using chi-square and the correlation using Spearman correlation coefficient and linear regression analysis.
Results: The three SWE technique LOGIQTM E9,ElastQ and ElastPQ had low failure rate, high applicibility98.88%, 98.88% and 98.77%, respectively. The performance included success rate, reliability rate of LOGIQTM E9: 99.37% and 99.25% were better than ElastQ (95% and 94.38%) and also better than ElastPQ technique (70.62% and 70.62%). The performing time of LOGIQTM E9 was shorter than ElastQ (77.40 and 97.10 second) and point shear wave ElastPQ took longest time than both 2D-SWE techniques (160.2 second). The LS value of three techniques were significant different.

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Extrauterine Leiomyoma- Atypical Presentations of a Common Disease

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Learning Objective: To review the spectrum and imaging manifestations of extrauterine leiomyomas.
Background: Extrauterine leiomyoma is a rare manifestation of benign leiomyoma with heterogeneous presentations. Their alarming features such as unusual growth pattern, atypical sites, multiplicity and occasional aggressive behaviour can mimic malignant diseases.
Findings and/or Procedure Details: This was a pictorial review of six patients with extrauterine leiomyomas in a regional hospital in Hong Kong. All three patients with intravenous leiomyomatosis had history of uterine fibroids, with two underwent prior hysterectomy. Extent of intravenous invasion ranged from pelvic veins, inferior vena cava (IVC) to right ventricle. One of them had synchronous benign metastasizing leiomyoma in right lung. Another one had concomitant disseminated peritoneal leiomyomatosis. A companion case of intravenous iliac veins leiomyosarcoma without coexisting uterine fibroid was included to contrast the two diseases. Two pathologically proven parasitic broad ligament (lipo) leiomyomas initially got diagnostic dilemma due to their mimicking of ovarian tumours. One resembled a malignant teratoma for its macroscopic fat content from fatty degeneration. Both underwent hysterectomy with bilateral salphingo-oophroectomy.The final case was a patient with disseminated peritoneal leiomyomatosis. PET/CT and ultrasound showed multiple non-FDG avid peritoneal masses and a submucosal fibroid without ascites which were unusual for peritoneal carcinomatosis.
Conclusion: Thorough understanding of imaging and clinical manifestations for extrauterine leiomyomas, including co-existing uterine fibroids, prior hysterectomy or myomectomy and preferential involvement of pelvic veins and IVC, is pivotal in making a correct diagnosis.

Accuracy of CT Scan Staging and Correlation of Histopathological Findings in Patient with Colorectal Carcinoma

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Objective: Colorectal cancer (CRC) is one of the most common malignancies and usually ranks high in incidence and mortality among all Western world malignancies. Carcinoma of the rectum and sigmoid colon is one of the most common gastrointestinal tract malignancy sites and accounts for 20% of all gastrointestinal malignancies.
1. To study the diagnostic performance of preoperative tumour staging by CT scan in colon cancer and comparison with histopathological staging.
2. To characterize benign and malignant colorectal lesions by contrast CT study of the abdomen.
3. To study the demographic pattern of colon cancer.
Materials and Methods: Combinations of biphasic or triphasic enhanced-phase CT scans were obtained for 48 patients with colorectal carcinoma, and the TNM stage was determined based on imaging reconstruction. The preoperative TNM stage was compared with the postoperative pathological stage, and the consistency between the 2 methods was tested by the k test using SPSS software.
Results: The rectum was the most common site of involvement followed by the recto-sigmoid involvement. CT showed to have a sensitivity of 83.3%, the specificity of 92%, in the diagnosis of T1 and T2 lesions, sensitivity and specificity of 88.2%, and 93.8%, in the diagnosis of T3 lesions with a sensitivity and specificity of 100%, in the diagnosis of T4 lesions.
Conclusion: CT scan is an excellent modality in the local staging of malignant lesions of the colon and rectum but in terms of nodal metastasis, it does not fare very well.

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Computed Tomography Findings with Histopathological Correlation in Inflammatory, Benign & Malignant Appendiceal Mucoceles

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Objective: To identify the computed tomography (CT) features of histopathological proven inflammatory, benign & malignant appendiceal mucoceles and whether these entities can be differentiated on CT imaging.
Materials & Methods: Clinical and pathologic data obtained over a 10-year period in 31 patients with appendiceal mucoceles were reviewed. CT studies were analyzed retrospectively by two radiologists. The appendix was evaluated for morphology, location, presence of mural calcification and internal septations, maximal diameter, wall irregularity and thickness, attenuation, soft tissue thickening and enhancement.
Results: The mean appendiceal diameter was 2.6 cm (1.1–5.4 cm), wall thickness was 2.8 mm (1.1–8.8 mm) and mean attenuation was 28 HU (5–173 HU). Focal cystic dilatation was present in 15 out of 31 patients while 16 patients had generalized dilatation; however, these did not show statistically significant associations with histopathology. Presence of soft-tissue thickening was seen in 19.4% and this showed statistically significant association with malignant mucoceles (p = 0.010). Mural calcification achieved statistical significance in predicting benign mucoceles (p = 0.003). Internal septations were seen in only in benign and malignant mucoceles (p = 0.04). Periappendiceal fat stranding showed statistically significant association with inflammatory mucoceles with appendicitis (p = 0.010). ROC analysis showed best cut-off diameter for diagnosis of inflammatory mucoceles ≤ 2.2 cm with a sensitivity of 90.0% and specificity of 71.4%.
Conclusion: Differentiating inflammatory, benign and malignant mucoceles can be challenging with CT. Our results show that soft-tissue thickening and internal septations are features most likely to be associated with malignancy. Mural calcification is more associated with benign mucoceles and periappendiceal fat stranding with inflammatory mucoceles.

Comparative Study of Image Quality and Radiation Dose between 120 kVp Filtered Back Projection and 80 kVp Iterative Reconstructed Computed Tomography Images

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Objective: To compare the image quality and radiation dose between 120 kVp Filtered Back Projection and 80 kVp Iterative Reconstructed CT images.
Materials & Methods: This qualitative/quantitative, cross-sectional study was performed in patients referred for CT Urography examinations for various clinical indications to Tribhuvan University Teaching Hospital, Maharajgunj, Nepal. Data were collected for a period of 4 months from August to November 2019 after approval from Institutional Review Board. Convenience sampling was employed and a total of 96 examinations were included. Among them 48 were male and 48 were female. Data were obtained from the 128 slice MDCT Siemens Somaton Definition AS+ CT scanner. Venous phase scans were obtained with Protocol A (120 kVp and FBP) and non-contrast scans were obtained with Protocol B (80 kVp and Sinogram Affirmed Iterative Reconstruction). The mAs was fixed at 200 for both protocols.
Results: There was a 72.5% reduction in Size Specific Dose Estimates in Protocol B compared to Protocol A. However, there was a 13.17% increase in noise in Protocol B compared to Protocol A. SSDE values showed moderate negative correlation (r = -0.65 and -0.66) with BMI for Protocols A and B respectively. Noise correlated poorly with BMI (r = -0.27 and -0.161) for Protocols A and B respectively. Qualitative analysis showed a 98.95% acceptability for the low dose i.e. Protocol B images.
Conclusion: CT using low kV (80 kVp) and low mAs (200 mAs) along with iterative reconstruction algorithm (SAFIRE) can provide diagnostically acceptable images at very low dose for examinations of the Urinary tract.

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Imaging Features of Peritoneal Tuberculosis in Endemic Country

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Objective: To demonstrate the utility of imaging in diagnosis and outcomes of peritoneal tuberculosis (PT).
Materials & Method: In this retrospective study, we analyzed the data of CT scans and abdominal ultrasound (AUS) of patients with PT between 1/2014 and 1/2019 at the department of radiology of Habib Thameur Tunisia.
Results: We reported 58 cases of adult with PT in 5 years. Only 38 were included in this study. 79% were female. The median age was 49.5 years (26–79 years). Principal clinic presentations were exudative ascites in 100%, fever 49% and abdominal pain 65%. The tuberculosis skin test was above 10 mm in 41% of cases. PT was associated with pulmonary tuberculosis in 5.2%. Thirty-two (84.4%) of patients had CT scans which the diagnosis was guided in 56.5%. In CT scans ascites were present in 100% of cases, thickening of the parietal peritoneum in 71.87%, peritoneal nodules in 22.5% and necrotic lymph node in 37.5%. Follow up was based on AUS which 60% were normal after 9 months of treatment.
Conclusion: PT presents a wide spectrum of clinical and imaging findings. Despite that the diagnosis is confirmed only by bacteriology and/or histology tests, it is important that the radiologist recognizes the imaging findings, allowing for the establishment of a more effective strategy to confirm the diagnosis as soon as possible.

Role of MDCT in Planning Treatment of Hepatocellular Carcinoma and Imaging Findings in Treated Lesions

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Learning Objective:
1) To show the imaging findings of various types of hepatocellular carcinoma.
2) To describe role of imaging in treatment planning of HCC.
3) To define the role of CT in diagnosing local residual disease or recurrence.
Background: CT scan done with dedicated dynamic phase protocol can easily diagnose the presence of HCC by depicting arterial phase enhancement and washout of contrast in venous or delayed phases. CT scan is usually performed on multidetector CT. Development of HCC in cirrhotic liver is multiphase process from regenerative nodule, through dysplastic nodule progressing to HCC focus within dysplastic nodule and develops into a mature HCC.
Findings and/or Procedure Details: CT findings in HCC vary depending on type of HCC, which can be infiltrative, well defined, angioinvasive, fat rich, hypovascular or exophytic. Imaging plays a vital role in deciding the treatment option for HCC, whether it is suitable for curative option of treatment like thermal ablation and transplant or palliative option like transarterial embolization. Imaging depicts involvement of biliary tree, nodal disease and extrahepatic disease. In addition, background extent of portal hypertension effects can be assessed. Multidisciplinary meeting and planning is essential to ensure correct pathway. Following treatment, follow up imaging and regular multidisciplinary discussion is adopted.
Conclusion: Importance of learning radiological findings is vital in treatment planning of HCC. Familiarity with the imaging findings of HCC, its variant types and extent of disease can be helpful in the differential diagnosis of HCC.

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Excellence in Diagnosing Hepatic Lesions on MRI: Discrimination of Benign Lesions from Malignant Lesions with Heavily and Moderately T2-Weighted Fast Spin-Echo Imaging

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Learning Objective:
1. To describe role of combined use of heavily and moderately T2-weighted images in differentiation of benign from solid malignancies.
2. To discuss diagnostic ability of T2-weighted images alongwith dual echo and diffusion weighted sequences.

Background: Liver has relatively low signal on T2WIs, whereas most of the hepatic lesions have higher signal than background liver parenchyma (cysts and hemangiomas). The spin echo technique represents the standard for T2 imaging of the liver, mostly based on FSE and SSFSE sequences. FSE are usually acquired with respiratory triggering or gating, navigators, or breath held. SSFSE has a rapid acquisition time (< 1 s/slice) and can be acquired breath-held. The design of this sequence is suitable for acquisition with long echo time (TE) and heavy T2-weighting.

Findings and/or Procedure Details: Vast majority of focal liver lesions are hyperintense on T2-weighted images. Some hepatic lesions may appear totally or partially hypointense like with deposition of iron, calcium, or copper, or solid lesions like focal nodular hyperplasia, hepatocellular adenoma, hepatocellular carcinoma, metastases. There is role of value of TE in T2 weighted images. In heavily weighted T2 images or SSFSE with a TE of more than 100, any lesion appearing hyperintense to the surrounding liver parenchyma is benign, like hemangioma, cyst etc. Moderately weighted T2 images with TE value of 80–100 would show slight hyperintensity for a solid malignant lesion.

Conclusion: T2 weighted imaging is useful for distinguishing benign from malignant lesion without use of contrast-enhanced images.

Role of Multidetector CT in the Assessment of Acute Pancreatitis and Severity Grading Based on Modified CT Severity Index and Its Correlation with Severity Grading as Per Revised Atlanta Classification 2012 and Clinical Outcome

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Objective: Role of Multidetector CT in the assessment of the severity of acute pancreatitis using modified CT scoring system and correlate the MDCT scoring with clinical severity of the disease and patient outcome.

Materials & Methods: It was a cross-sectional observational study of 152 patients conducted in the Department of Radiodiagnosis at P.G.I.M.E.R & Dr Ram Manohar Lohia Hospital. CT was performed 128-slice Simens dual-energy CT scanner. Severity grading of acute pancreatitis was assessed based on Modified CT Severity Index (MCTSI). Clinical severity of acute pancreatitis evaluated based on Revised Atlanta classification (RAC) 2012. Clinical outcomes of patients were noted in terms of, Duration of hospital admission, ICU stay, Evidence of organ failure., Evidence of infection, The need for intervention and Death.

Results: Study group included 152 cases of acute pancreatitis. According to MCTSI 25 mild, 49 moderate and 78 severe cases. Clinically 27 Mild, 76 Moderately severe and 49 Severe cases based on RAC. MCTSI showed good concordance (Kappa -0.540) with RAC grading in 23 (84.18%) mild, 40 (52.6%) moderate and 44 (89.7%) severe cases. MCTSI showed significant statistical correlation (p < 0.001) with outcome parameters except for evidence of infection and death.

Conclusion: The present study MCTSI showed good concordance with clinical severity grading (RAC). MCTSI grading of acute pancreatitis is helpful for clinicians for prognosticating and decision making in the duration of hospital stay, need of ICU care, intervention and follow up.

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Outcome of Endovascular Treatment in Acute GI Bleeding Referred to Rehman Medical Institute Peshawar

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Objective: The purpose of this study was to find the outcome of endovascular treatment in cases of acute GI bleeding due to different aetiologies.
Materials & Methods: It is prospective evaluation of transarterial embolization done for acute gastrointestinal hemorrhage at radiology department of RMI from March 2015 to October 2019. Total of 10 cases with GI bleed were included, five were female and five were male. Seven patients were with lower GI bleed and Three had upper GI hemorrhage. The patients were treated with superselective transarterial embolization under fluoroscopic guidance at angiography suite. Embolization materials used were coils, particles, gelfoam and amplazer plugs.
Results: Total ten patients were embolized, seven having lower GI causes and three with upper GI cause. Nine patients had vascular cause of hemorrhage i.e AVMs, angiodysplasia, dieulafoy etc. One patient had a tumoral bleed from duodenal mass. Nine patients were embolized with curative intent, while one patient with bleeding duodenal mass was embolized pre-operatively, just before surgery. Coils of varied sizes were used in all cases. Technical success, immediate clinical success, and late success on follow up of one year was recorded in all cases. Technical success in arresting hemorrhage was achieved in all cases. 0% in hospital mortality was recorded in all cases.
Conclusion: We concluded from our results that Endovascular embolization is a management of choice in cases with Acute GI bleeding, after endoscopic attempts have failed/considered inappropriate. Endovascular treatment is a safe and effective technique with a small associated risk of morbidity. Risk of further bleeding is small with vast majority of patients achieving resolution of symptoms.

Main Pancreatic Duct (MPD) Diameter: Cect Measurement in Normal Subjects in Sri Lanka

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Objectives:
- To assess the diameter of MPD in normal subjects.
- To describe the age and sex related changes in the MPD diameter.

Dilatation of the MPD is associated with number of significant pancreatic pathologies. To identify the dilated MPD, it is of great importance to study the demographic data of the normal size of the MPD in a given population.
Materials & Methods: Prospective descriptive study was carried out at Colombo South Teaching Hospital from March 2016 to May 2016. All the subjects with clinical, biochemical and radiological evidence of normal pancreas were included. CT measurements of the MPD diameter were obtained by two individuals independently on the subjects who underwent abdominal CECT scans (16 section MDCT, 1–5 mm increments, and dual phase) and each measurement was measured for three times and mean value was taken.
Results: There were 190 men and 132 women with age ranging from 20–88 years (mean 53.6). MPD was adequately visualized only in 72% (n = 231) of subjects. The mean diameter of the MPD in the head, body and tail were 2.9, 2.2 and 1.6 mm respectively. No statistically significant difference observed in MPD diameter between sexes and two age groups of < 40 and > 40 years ($p > 0.050$).
Conclusion: The diameter values of MPD in our study are comparable to that of foreign population groups. However, there was no correlation between MPD diameter with the age or sex in the study which was different to the published data which showed higher proportion of MPD diameter with increasing age and female sex.

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Ultrasound Guided Pigtail Catheter Drainage: An Effective Alternative to Exploratory Laparotomy

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Objective: It has been long-established that extensive surgeries were the only options available for the management of the intra-abdominal abscesses or collections. These were associated with increased morbidity and mortality. Traditionally, the idea of percutaneous needling could not gain popularity due to poor localization of collections. However, with the advent of ultrasound, percutaneous pigtail catheter drainage has proven to be a safe, effective, minimally invasive and allows precise localization of the drainage site.
Materials & Methods: A total of 48 patients were studied retrospectively in Dr. D Y Patil Medical College and Research center, Pune, from October 2018 to October 2019. Out of 48 patients, 18 cases were liver abscess, 12 were PCN tube placement, 6 cases of malignant ascites and splenic collection respectively, 4 of them were psoas abscess and 2 were pseudocyst. The efficacy of the drainage was assessed by serial ultrasound.
Results: Out of 48 patients, 34 were male and 14 were female, ranging between the age of 19 to 67 years. All patients that were diagnosed for intra-abdominal abscesses or collection underwent ultrasound-guided pigtail catheter drainage. The average hospital stay for patients was 2 to 3 days. All patients were followed up periodically for 3 months following the procedure and none had significant post-procedure complications or recurrence.
Conclusion: Ultrasound guided pigtail catheter is an effective alternative to extensive surgeries and should be the treatment of choice for liquefied intra-abdominal collections or abscesses which help to reduce post-procedure hospital stay and complications.

Renal Resistive Index as a Hemodynamic Predictor of Renal Impairment in Patients with Liver Cirhossis

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Objective: Cirrhosis represents the final common histologic pathway for a wide variety of chronic liver diseases. Interactions between systemic and portal hemodynamics lead to intense renal vasoconstriction and HRS. Renal arterial vasoconstriction may persist for weeks or months before a rise in blood urea nitrogen or serum creatinine values. Methods to diagnose renal disease at an early stage when serum creatinine is normal, are needed.
Materials & Methods: Patients were divided into 2 groups, containing 32 patients with liver cirrhosis and ascites, 28 patients with liver cirrhosis without ascites, and 30 control subjects. All patients underwent laboratory and abdominal ultrasound examination, including renal Doppler evaluation of intrarenal arteries for measuring resistive index (RI). MELD score of the patient also calculated. The mean RI difference was seen between different groups and control. Correlation was performed between RI and MELD score.
Results: RRI was significantly higher in ascitic patients compared to non-ascitic patients (0.71 vs. 0.65, p value < 0.050) and in non-ascitic patients with liver cirrhosis than in control subjects (0.65 vs. 0.61, p value < 0.050). A significant positive correlation was seen between RI and MELD score.
Conclusion: Intrarenal RI measurement is a predictor of renal vasoconstriction and detects early renal function impairment in cirrhotic patients. Renal duplex ultrasound is a non-invasive, simple, and easy method to study intra-renal hemodynamics in patients with liver cirrhosis. The RRI increases with the degree of hepatic decompensation.

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Assessment of Effects and Side Effects in Using Magnetic Resonance Imaging-Guided High Intensity Focused Ultrasound Therapy for Symptomatic Uterine Fibroid

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Objective: MRI-guided High Intensity Focused Ultrasound Surgery (MRI-HIFU) is a minimally invasive treatment for symptomatic uterine fibroids, which have shown clinical effectiveness. This study is to describe our experience of assessing effect and side effect of MRI-HIFU in terms of complications.
Materials & Methods: Observational retrospective cohort study was conducted on 15 female patients who had MRI-HIFU done in HUSM from Jan 2013 until December 2018. The fibroid volumes of pre, immediately after and a month post treatment were measured and analysed using paired *t* test. Data of predicted treatment volumes (PDV) was retrieved from the HIFU system, and non-perfused volumes (NPV) was measured using T1-weighted MRI images immediately post-treatment. Spearmen correlation test was used to test the correlation between PDV and NPV. Data on complications were taken during, after the treatment and during follow-up.
Results: From 15 patients, 60% were type 1 and 40% were type 2 uterine fibroid. The mean fibroid volume before HIFU was 341.69 mL, which increases post HIFU (348.15 mL) and dropped one month after HIFU (305.37 mL). The fibroid volume was significantly lower one month after HIFU compared to immediate post HIFU. The correlation between PDV and NPV was moderate, however not statistically significant. Only 26.7% developed complication during the procedure, however resolved a day after.
Conclusion: Significant change of uterine fibroid volumes at immediate post HIFU and one month after sonication. However, no significant difference of fibroid volumes at baseline and immediately post HIFU. Moderate correlation demonstrated between PDV with NPV.

To Find Correlation of Cholilithiasis and Cholidocholithiasis with Severity of Acute Pancreatitis

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Objective: Acute pancreatitis is a sudden inflammatory condition of the pancreas. Although most patients will improve with conservative management, about 5–10% will progress to develop serious complications like multisystem organ failure resulting in high mortality and morbidity 1. Gall stones remain the most common cause followed by alcohol with about half of UK cases are attributed to gall stones. 3. Although physical examination and laboratory evaluation is the mainstay for detecting pancreatitis, imaging plays a pivotal role in determining the cause, assessing the severity.
Materials & Methods: This retrospective, cross-sectional study was performed at Rehman medical institute, Peshawar from October 2007 till September 2018, and comprised computerized records and contrast enhanced computerized tomography scan images related to cases of pancreatitis. Modified CTSI was calculated for each patient based on imaging findings.
Results: Of the 332 patients included with acute pancreatitis, 197 were male and 135 were female. Out of these 35 had cholelithiasis (15 female and 20 male) and 21 had choledocholithiasis. (11 female and 10 male). Among 35 patients with gall stones, 8 had mild disease, 20 had moderate and 7 had severe disease. Chisquare and pearson correlation was performed which came out to be 0.166 and -0.095 respectively which are not significant. Patients who had cholidocolithiasis, 5 had mild disease. 12 had moderate and 4 had severe disease. Chisquare and pearson came out to be 0.442 and -0.064 which are not significant.
Conclusion: Hence no significant correlation was observed between cholelithiasis and choledocholithiasis with severity of acute pancreatitis.

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Percutaneous Intraductal Biliary Biopsy: An Initial Experience in Nepal

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Objective: Yield of fine needle aspiration biopsy (FNAB) is low in biliary system as compared to other systems as the tumors of biliary system are often too small for having specific imaging findings and also image guided sampling is difficult in those presenting with hilar stricture. Percutaneous intraductal brush cytology and forceps biopsy via percutaneous transhepatic biliary drainage (PTBD) route can be helpful for diagnosis of inoperable hilar strictures. The purpose of this study was to assess yield of percutaneous transhepatic intraductal biliary biopsy in a tertiary hospital of Nepal.
Materials & Methods: Eight patients with inoperable obstructive jaundice due to hilar stricture sent to our department for PTBD during the period of June 2019 to December 2019 were included in the study. Under fluoroscopy guidance forceps biopsy were taken from the stenotic duct through the biliary drainage route. Corresponding histopathology reports were traced.
Results: We obtained 100% technical success rate on obtaining tissue sample from the hilar stricture. Among eight patients, histopathology confirmed malignancy (adenocarcinoma) in six patients (75%) and two patients were negative for malignancy. Repeat biopsy done in one patient with high suspicion of malignancy and histopathology showed eosinophilic cholangitis, a great mimicker of malignancy. No significant complications seen during the procedure, except for mild hemophilia in one of the patient which subsided subsequently.
Conclusion: Percutaneous transhepatic intraductal biliary biopsy is safe and reliable technique for obtaining difficult diagnosis of biliary hilar stricture.

Magnetic Resonance (MR) Guided High Intensity Focused Ultrasound (HIFU) in the Treatment of Uterine Fibroid and Adenomyosis – Our Experience in University Malaya Medical Center

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Objective: Benign uterine conditions such as uterine fibroids and adenomyosis often causes clinical symptoms such as menorrhagia or dysmenorrhoea. Conventional treatment comprises of hysterectomy, myomectomy or hormonal manipulation. High intensity focused ultrasound (HIFU) is a non-invasive treatment compared to surgical treatment. It causes instant coagulative necrosis in 1-3 seconds and can be performed under image guidance.
Materials & Methods: This is a retrospective study of patients from January 2009 to December 2019 who underwent HIFU in University Malaya Medical Center (UMMC). The HIFU treatment is guided by MRI to target the monitor and ablation process. An average of 40 number of sonification was used. The volume of the lesion pre and post ablation was measured.
Results: There were a total of 94 patients who underwent HIFU. The majority of patients had uterine fibroid 70.3% (71), followed by adenomyosis 25.7% (26) and mix uterine fibroid and adenomyosis 4% (4). Successful ablation of more than 50% of tumor were achieved in 47.5% (48). 38.6% of patients (39) had ablation area of between 11–50%. Only a minority of patients had less than 10% of ablation area.
Conclusion: HIFU is a non-invasive technique that can be used as an alternate treatment in uterine fibroid and adenomyosis.

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Correlation of Magnetic Resonance Pancreatography(MRCP) and Surgical Findings in Patients with Obstructive Jaundice at Muhimbili National Hospital (MNH) Tanzania

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Objective: MRCP has shown an excellent capability in outlining the biliary tree hence demonstration of the level of biliary blockage (obstruction). To determine the correlation of MRCP and intra operative (surgical) findings in patients with obstructive jaundice at MNH from June-December 2016.
Materials and Methods: This is a cross-sectional hospital-based study in which patients with obstructive jaundice were recruited. An estimated sample size of 60 patients were studied using standardized questionnaires. Data analysis was done using statistical software (SPSS version 20) and statistical level of significance was $p < 0.050$.
Results: In this study females 37 (61.7%) are more affected than males 23 (38.3%). Of these 41–60 years old age group were commonly seen. Obstructive jaundice was commonly caused by Cholelithiasis followed by pancreatic head tumor. Obstructive jaundice is significantly caused by cholelithiasis ($p < 0.001$) and pancreatic head tumor (p-value < 0.0001). MRCP sensitivity and specificity of almost 100%. The results depict that MRCP findings are almost similar to the intraoperative results. The results show that there were very strong and positive correlation between MRCP and intra operative findings.
Conclusion: MRCP is highly sensitive and specific with almost 100% in provision of accurate diagnosis. It is important because it shows level, possible cause and extent of obstructions making it easier for surgeons to intervene.

MDCT Evaluation of Renal Vascular Anatomy and Variants and Its Surgical Relevance in Donor Kidney Extraction

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Objective: Renal vasculature is known to show multiple variants. With the evolving trend of laproscopic retrieval of donor kidney, knowing detailed anatomy and variants of renal vessels are important to guide surgeon operating in restricted FOV.
Materials & Methods: This is retrospective study evaluating 600 living donors who underwent renal angiogram prior to the surgery using 64 slice MDCT from 2015–2020, between the age group of 20–58 years. Images were reconstructed in MIP and 3D volume rendering images in addition to axial 5 mm thick slices.
Results: Majority of donors were asymptomatic. Major arterial variants includes supernumerary and early branching arteries, seen in 16% and 21% and 22% and 15% respectively in left and right kidneys. Major and minor venous variants were detected in 56% and 12% (Retroaortic vein-9% and circumaortic vein-3%) in left kidney and 14% and 3% in right kidneys. Late confluence of the venous trunk was identified in 15% of left kidneys and 9% of right kidneys. Vascular pathologies like renal artery stenosis seen in 30 cases, 4 abdominal aortic aneurysms noted extending into renal artery and 4 vascular compression syndromes noted causing PUJ obstruction and hydronephrosis. Incidental parenchymal and urothelial abnormalities, most commonly cysts and renal calculi, were identified in 15% of the kidneys. Other relevant findings like cortical scars, hydroureteronephrosis, collecting system abnormalities like duplication of collecting system (7 cases) and angiomyolipomas (19 cases) were detected.
Conclusion: CT Renal Angiogram provides insight to surgeons regarding detailed anatomy of renal vessels & its variants, parenchymal and collecting system abnormalities.

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Efficacy and Safety of CT-Guided Drainage for Complicated Appendicitis and Factors for Predicting Recurrence after the Drainage

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Objective: Preoperative drainage treatment for complicated appendicitis (CA) is increasing with the increase in interval appendectomy (IA). We assessed the efficacy and safety of computed tomography (CT)-guided drainage and prognostic factors for predicting recurrence after the drainage.
Materials & Methods: Twenty-six patients with CA who underwent CT-guided drainage between April 2016 and November 2019 were divided into recurrence (R) and non-recurrence (NR) groups. We retrospectively assessed age, sex, presence of diabetes, white blood cell (WBC) count, C-reactive protein (CRP) levels, hospitalization period, presence of IA, abscess diameter, appendicolith location, percutaneous drainage route, technical success rate, and complications.
Results: The R and NR groups included 6 (4 men; mean age, 48.8 years) and 20 (12 men; mean age, 51.6 years) patients, respectively. There was no significant difference between the groups in the age, sex, presence of diabetes, WBC, CRP, hospitalization period, and presence of IA. The average abscess diameter was 103.1 vs. 64.5 mm. Appendicolith was present in 10 cases: intraluminal type, 2 vs. 1 cases; extraluminal type, 3 vs. 4 cases. Transabdominal, transgluteal, transretroperitoneal, and transiliopsoamuscle approaches were used in 4 vs. 6 cases, 0 vs. 7 cases, 2 vs. 3 cases, and 0 vs. 1 case. Technical success rates were 100% vs. 85%. Complications were detected in 1 vs. 5 cases; no major complications occurred. There was a significant difference in the abscess diameter and appendicolith location ($p < 0.050$).
Conclusion: CT-guided drainage for CA is effective and safe. Abscess diameter and appendicolith location are important factors for predicting recurrence after drainage.

Shear Wave Elastography Detects Changes in Renal Histopathology

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Objective: The purpose of this study is to investigate the association of kidney stiffness and histopathological findings measured by shear wave elastography (SWE) imaging.
Materials & Methods: 75 patients referred for renal biopsy were included. Using an ultrasound system (Philips EPIQ 7, Bothell, Washington) equipped with SWE software (Philips ElastPQ, Bothell, Washington), Young's modulus (YM) measurement in kilopascal (kPa) from SWE were correlated with histological parameters.
Results: Positive correlation was reported between YM measurements with both tubular interstitial score ($\rho = 0.442$, $p < 0.001$) and glomerular score ($\rho = 0.375$, $p = 0.001$). Patients with no glomerular sclerosis showed lower mean YM measurements compared to groups with < 10%, 10%–25%, > 25%–50% and > 50% of glomerular sclerosis. Mean YM measurements increased as the percentage of interstitial fibrosis and tubular atrophy increased. There was a significant difference between the YM measurement of the < 25% (6.13 + 3.42 kPa) and 25%–50% (8.70 + 3.71 kPa) interstitial fibrosis groups, as well as the < 25% and > 50% (8.93 + 3.36 kPa) interstitial fibrosis groups. Significant difference was found between YM measurements of the < 25% (5.86 + 2.95 kPa) and 25%–50% (8.65 + 3.54 kPa) tubular atrophy groups as well as the < 25% and > 50% (11.46 + 3.67 kPa) tubular atrophy groups. The area under the ROC curve for SWE imaging of kidney was 0.702. The cut-off value of ≥ 5.81 kPa indicated moderately impaired kidney.
Conclusion: SWE accurately determine chronic renal damaged resulted in glomerular sclerosis, interstitial fibrosis and tubular atrophy. A cut-off value of ≥ 5.81 kPa suggested a moderately impaired kidney.

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Reduced Contrast Volume and Radiation Dose for CT Chest Abdomen and Pelvis Examination: Protocol Design and Optimisation

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Objective: In general, the standard protocol of a contrast enhanced CT uses a fixed volume (FV) of contrast media with tube potential of 120 kVp. This study compared the image quality, contrast enhancement and radiation dose using a customized CT protocol using weight based volume (WBV) and low tube potential (100 kVp).
Materials & Methods: Data was retrospectively collected for 220 patients who underwent CT thorax-abdomen-pelvis studies using FV with standard tube potential 120 kVp (protocol A) and WMV with standard tube potential 120 kVp (protocol B) between June 2017 to December 2019. A subset of 39 patients also underwent CT studies using WBV with low tube potential 100 kVp (protocol C). Contrast enhancement of the portal venous phase images from the 3 scanning protocols were assessed quantitatively and qualitatively. Radiation dose was also compared.
Results: Quantitative assessment of CE (n = 39) showed protocol A > B, A > C and C > B with $p = 0.030$, $p = 0.320$ and $p = 0.200$ respectively. Median effective dose in protocol A, B and C were 12.4, 12.3 and 10.8 mSv respectively. Patients experienced a mean contrast volume reduction of 23.9 mL when WBV used compared to FV. On qualitative assessment, all images were rated good or excellent.
Conclusion: Weight based protocol with low tube potential improved patient outcomes with reduced contrast volume and radiation dose while maintaining good image quality as compared to standard protocol.

Role of Sonosalpinogography in Female Subfertility – Diagnostic or Therapeutic Tool?

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Objective: Sonosalpingography (SSG) has long been in radiology as a less commonly used tool for assessing the patency of fallopian tubes in subfertile females. Its significance is undermined by laparoscopic evaluation (LE) of tubal patency as latter also allows simultaneous therapeutic procedures to restore its patency, if the obstruction exists. But LE is invasive and expensive. Hence, we evaluated the role of SSG not only in diagnosis of tubal obstruction but also its role in diagnosing the cause and if possible, relieving the obstruction.
Materials & Methods: Fifty subfertile females with normal appearing uterus and ovaries on transvaginal ultrasonography were included in our study. SSG was performed to evaluate tubal patency by recording free peritoneal spill. If peritoneal spill was absent bilaterally then the patient underwent laparoscopic evaluation. However, if unilateral or bilateral peritoneal spill was noted, then patient was recruited for assisted reproductive techniques (ART) and the results were correlated with pregnancy.
Results: Out of 50 patients, SSG demonstrated free peritoneal spill at least unilaterally in 46 patients who conceived with ART. In rest of the four patients, with lack of bilateral spill on SSG, two revealed unilateral partial blocks while other two revealed bilateral tubal block. In all patients SSG correctly depicted the site of obstruction. In nine, patient it revealed PID (tubercular) by demonstrating flimsy peritubal adhesions and in 14 patients, higher pressure exerted during SSG restored the patency with sharp abdominal pain.
Conclusion: SSG is not only a diagnostic Golden Old Tool but a New Therapeutic Platinum tool.

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Estimation of Renal Function Using Kidney Perfusion CT

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Objective: The purpose of this study was to measure GFR with a two point Patlak plot technique based on kidney perfusion CT and correlate with estimated GFR (eGFR) using CKD-EPI (Epidemiology Collaboration) and MDRD (Modification of Diet in Renal Disease Study) equation.
Materials & Methods: Fifty-five adult patients were enrolled with perfusion kidney CT. All kidney perfusion CT acquisitions were obtained on 256-slice multi-detector CT scanner (80 kV; 40 mAs; iterative reconstruction) during 2 minutes continuously with breathing. Both each renal volume and permeability was measured. From Patlak equation, the separate and total renal GFR were measured. Paired *t* tests and Pearson's correlation test (Correlation coefficient, R < 0.25: low, 0.25–0.5: moderate, 0.5–0.75: strong, > 0.75: Excellent correlation) were used for comparisons between the two estimates (perfusion CT and eGFR equations). A *p*-value < 0.050 was considered statistically significant.
Results: The mean GFR from kidney perfusion CT was 91.19 ± 20.71 mL/min/1.73 m^2. The estimated GFR using CKD-EPI and MDRD equation were 89.64 ± 19.74 mL/min/1.73 m^2 and 89.50 ± 24.89 mL/min/1.73 m^2, respectively. No significant differences were found between CT-GFR and eGFRs ($p > 0.050$). Excellent correlation between CT-GFR and eGFRs (correlation coefficient, R = 0.91 in CKD-EPI and 0.84 in MDRD, respectively).
Conclusion: Kidney perfusion CT scan is a simple and feasible technique to assess renal function. The presented method can be used to calculate single or residual renal function in patients receiving surgery partial or radical nephrectomy.

Diagnosis of Gastrointestinal Stromal Tumors: An Imaging Perspective

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Objective:
1. List the clinical features and imaging findings of GISTs.
2. Describe how GISTs can be diagnosed on the basis of the imaging findings.
Materials & Methods: We reported 22 cases of pathologically and surgically proven GISTs at our hospital. The aim of this retrospective study was to review the imaging features of 22 GIST cases. We also describe the clinical and pathological findings of this well-recognized entity.
Results: Gastrointestinal stromal tumors (GISTs) are the most common mesenchymal tumors of the gastrointestinal tract. CT is the imaging modality of choice for diagnosing GIST at initial presentation, staging and monitoring the disease during and after the treatment. The aim of imaging is to locate the lesion, define its morphological characteristics, evaluate local invasion and detect distant metastasis. CT is the imaging of choice for these purposes. Multidetector CT can pick up most lesions > 2 cm. CT is also superior for staging of GISTs and monitoring the disease during and after treatment. Radiologists can often predict the correct diagnosis at presentation by the appearance of a large exophytic gastrointestinal mass without significant lymphadenopathy.
Conclusion: Gastrointestinal stromal tumors (GISTs), which arise from the interstitial cells of Cajal, are the most common mesenchymal tumors of the gastrointestinal tract. The increasing recognition of GISTs and prolonged survival of the patients with GISTs have made imaging increasingly important not only for diagnosis, but also for monitoring the effects of treatment. Computed tomography (CT) is the imaging modality of choice for these purposes.

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Evaluation of Hematuria in Young Adults Using MDCT Urography: A Prospective Study in Tertiary Care Centre

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Objective: To determine the role of MDCT urography in evaluation of hematuria in young adults and to see whether unenhanced images are sufficient for the diagnosis or not.
Materials & Methods: Young adults (40 years or less in age) who presented with macroscopic or microscopic hematuria and underwent MDCT urography were included in the study. Detailed history and findings of clinical examination were recorded. Non contrast and contrast enhanced scans were performed and urographic findings were recorded in detail and tabulated. All the CT images were reviewed to determine whether contrast enhanced images were necessary for diagnosis or not.
Results: Mean age of patients was 29 years; 97.5% were males. Abnormal MDCT findings were seen in 65 of 88 examinations (73.9%) and clinically significant cause of hematuria was seen in 43 patients (48.9%). The most common clinically significant findings were renal or ureteric calculi seen in 74% cases (32/43); five cases of malignancy were also seen. Thirty-six (84.0%) of 43 clinically significant causes were evident on non-contrast images. Solitary tiny vesical mass, urinary tract infections, PUJ obstruction and ureteric stricture were detected only on contrast enhanced scans and were not apparent on non-contrast images.
Conclusion: Clinically significant cause of hematuria was seen in 48.9% of Contrast enhanced CT and CT urograms of the young adults. Non contrast images alone were diagnostic in significant proportion of these cases thereby reducing the requirement of additional CT examination and hence radiation exposure in radiosensitive individuals.

Determination of Urinary Calculi Composition Using Dual Energy CT

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Objective: The main aim is to determine the prevalence of the various urinary calculi composition types using dual energy CT (DECT). We also aim to measure the urinary calculi sizes, location, characterization, and radiation exposure for DECT KUB.
Materials & Methods: This is a cross-sectional study conducted at the Radiology Department of Hospital Tengku Ampuan Afzan (HTAA) from June 2018 until December 2019. All patients who had fulfilled the inclusion criteria will undergo a DECT KUB. A total of 170 patients were selected using simple random sampling.
Results: There are 67% males and 33% females in this study. From that, 26% of the urinary calculi are of a uric acid type. Out of the 74% non-uric acid type, calcium oxalate and calcium hydroxyapatite formed 46%, and cystine formed the other 28% of the urinary calculi. The majority of the calculi (42%) are less than 5 mm in size. 45% are located in the lower pole of the kidney. The average radiation exposure for DECT is about 11.5 mGy.
Conclusion: Dual energy CT is capable of distinguishing uric acid calculi with 92 to 100 percent accuracy from the other types of urinary calculi. Uric acid calculi only formed a small percentage of urinary calculi. The radiation exposure of DECT is not dissimilar with the standard CT KUB (ranging from 6.39 mGy to 20.6 mGy).

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Multiparametric MRI of The Prostate – Its Impact on PSA Testing, Prostate Biopsies & Prostate Cancer in Australia

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Objective: To assess the impact of the availability of multiparametric magnetic resonance imaging (mpMRI) of the prostate as a rebatable Medicare item on rates of prostate-specific antigen (PSA) testing, prostate biopsies and prostate cancer diagnosis in Australia.
Materials & Methods: Retrospective analysis of annual data on Medicare funded prostate mpMRI, PSA testing and prostate biopsies; in comparison with the Australian Institute of Health and Welfare rate and incidence of prostate cancer diagnosis. Trends in PSA testing, prostate biopsies and prostate cancer diagnosis with the increasing availability of prostate mpMRI, and the subsequent availability of a Medicare rebate.
Result: The overall incidence of PSA tests has been steady over the last decade, but free-to-total PSA ratio tests have increased since there has been a Medicare rebate for prostate mpMRI. From 2009 to 2016, the incidence of prostate biopsies has fallen by 50%, but the incidence of prostate cancer diagnosis has only decreased by 29%. Since the Medicare rebate for prostate mpMRI was introduced, 81709 prostate mpMRI were performed of which 82.5% were in patients suspected of having prostate cancer based on an elevated PSA or abnormal digital rectal exam (DRE). The remaining 17.5% of mpMRIs were performed in patients undergoing active surveillance for a known prostate cancer diagnosis.
Conclusion: Medicare funded prostate mpMRI and increased utilisation of free-to-total PSA ratio tests are associated with a decrease in patients requiring prostate biopsies without a significant decrease in prostate cancer diagnosis rates.

Diagnostic Value of Vesical Imaging – Reporting and Data System (VI-RADS) in Differentiating T Staging of Bladder Cancer – A Systematic Review

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Learning Objective: To assess the diagnostic accuracy of the VI-RADS reporting system for multiparametric magnetic resonance imaging of the bladder (mpMRI) for differentiating stage ≤ T1 from stage ≥ T2 urothelial carcinoma (UC) of the bladder.
Background: Histopathological T staging of UC of the bladder, via transurethral resection of bladder tumours (TURBT), determines its management strategies, but is highly operator dependent. In view of this, many patients have to undergo two TURBT's to improve diagnostic accuracy. mpMRI had been shown to differentiate non-muscle invasive (NMIBC) from muscle invasive bladder cancer (MIBC), but there was no standardised image acquisition protocol and reporting until VI-RADS was created in May 2018. A systematic literature review was conducted using the PRISMA criteria for VI-RADS.
Findings and/or Procedure Details: Six studies (1067 patients with bladder cancer) were analysed. Five studies compared the sensitivity (ranging from 94.6% to 82%) and specificity (ranging from 96.5% to 43.9%) of VI-RADS > 2 for confirmed pathological MIBC diagnosis, whereas three studies did the same comparison with VI-RADS > 3 (sensitivity ranging from 91.3% to 76.0%; specificity ranging from 93.0% to 76.0%) instead. One study looked at the overall sensitivity (78%) and specificity (88%) of all VI-RADS categories.
Conclusion: In summary, VI-RADS appears to be a highly promising classification that needs to be further validated in future with large multi-centre studies in order to determine the score best associated with radiological evidence of MIBC.

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Multiphasic Computed Tomography Performances and p53 Expression in Hepatocellular Carcinoma: Correlation Analysis

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Objective: To conduct a correlation analysis between the size of HCC and expression of the p53.
Materials & Methods: 50 patients with HCC were studied. There were 28 men and 22 women, aged 34 to 74 years. Multiphasic computed tomography and immunohistochemistry studies were performed. Pearson's correlation analyses was used.
Results: 56 nodules of HCC were detected, ranging in size from 1 cm to 16.3 cm. The number of HCC depending on size were: up to 1 cm, 10 nodules; 1–5 cm, 31 nodules; 5 cm and more 15 nodules of HCC. The level of p53 overexpression ranged from 32.0% to 50.0% of the HCC area (average 39.7%) with HCC sizes from 4.2 cm to 15.0 cm (average 8.2 cm). High p53 expression ranged from 12.0% to 29.0% of the HCC area (average 20.7%) with HCC sizes from 2.0 to 16.3 cm (average 5.3 cm). Low p53 expression was ranged 4.0% to 9.0% of the HCC area (average 6.2%) with HCC sizes from 1.0 cm to 3.9 cm (average 1.95 cm). The correlation degree between the size of HCC and the level of expression p53 was moderate ($r = 0.48$, $p < 0.01$), which means that the level of p53 expression depends on the size of HCC.
Conclusion: p53 has the meaning in the prognosis of the HCC. The p53 expression was moderate significantly associated with size of HCC. Consequently, we suggest that the size of HCC on multiphasic CT has a predictive role in the prognosis of disease.

Imaging Findings and Clinicopathological Correlation of Hepatocellular Carcinoma Recurrence after Liver Transplantation

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Objective: Orthotopic liver transplantation is the best therapeutic option for unresectable hepatocellular carcinoma (HCC). In Brazil, patient selection for transplantation is based on Milan criteria. The study aimed to identify clinical, epidemiological and radiological factors that would predict HCC recurrence.
Materials & Methods: Data from 1021 patients who underwent transplantation from 2006 to 2015 were retrospectively analyzed. Explanted livers were evaluated for tumor features as size, number, pathological grade and vascular invasion. Dynamic magnetic resonance with gadolinium in a 1.5T/3.0T system or computed tomography with iodinated contrast were performed every 6 months and interpreted by two radiologists experienced in abdominal imaging. Serum levels of alpha-fetoprotein were assessed during follow-up. Prognostic factors significance was assessed by univariate analysis with log-rank test and simple Cox regression and by multivariate analysis with multiple Cox regression. HCC recurrence was based on clinical, laboratory and radiological findings.
Results: HCC recurrence was identified in 31 patients (8.6%), mostly (87.1%) two years after the procedure (mean interval 13.5 +/- 11.6 months). The liver allograft was the most affected organ, followed by the lungs. When compared to the primary neoplasia, recurrence assumed different radiological aspects. Numerous lesions and sometimes an infiltrative pattern were identified. Both micro and macrovascular invasion proved to be independent risk factors for recurrence.
Conclusion: The characterization of microvascular invasion requires histopathological data obtained only after transplantation. The findings reinforce the need to review Brazil's current transplantation criteria, since diagnosis of HCC and treatment decisions are based on imaging findings without histological diagnosis.

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Predicting Pericholecystic Adhesions in Gallbladder Calculus Disease by High Resolution Ultrasonography

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Objective: Currently laparoscopic cholecystectomy forms the mainstay of treatment in gallbladder calculus disease demanding surgeon's expertise. Large size of gallbladder & calculus; inconspicuity of Calot's triangle and presence of large calculus in short cystic duct, biliary drainage anomalies, pericholecystic adhesions, gallbladder wall edema & vascularity in adjacent hepatic parenchyma are unfavourable factors affecting laparoscopic cholecystectomy. With recent-advanced USG scanners, it is now possible to preoperatively assess many of the above factors. Hence, this study primarily aimed to:

- Determine the preoperative role of USG in prediction of pericholecystic adhesions in gallbladder calculus disease.
- Determine the preoperative role of USG in predicting difficult laparoscopic cholecystectomy

Materials & Methods: 100 patients with gallbladder calculus disease were evaluated for presence of pericholecystic adhesions. The data thus obtained was compared with that of laparoscopic or open cholecystectomy.
Results: Pericholecystic adhesions were suspected in patients of gallbladder calculus disease where interface between the gallbladder wall & hepatic parenchyma was indistinct; gallbladder neck was not optimally visualised and patients with WES complex. Using the above criterion, USG predicted pericholecystic adhesions in 84 out of 100 patients with an accuracy of more than 93% with at least 28 patients with difficult laparoscopic cholecystectomy with an accuracy of more than 95%.
Conclusion: USG is highly accurate in only for predicting pericholecystic adhesions in patients with gallbladder calculus disease but also in predicting difficult laparoscopic cholecystectomy thus helping the surgeon in selecting appropriate mode of operation (laparoscopic vs open cholecystectomy). It also helps in predicting time of operation, duration of anaesthesia required and postoperative prognosis.

Evaluating the Role of Sonourethrography (SUG) in Male Anterior Urethral Strictures

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Objective: Sonourethrography (SUG) has recently gained acceptance over Retrograde Urethrography (RGU) for evaluation of anterior urethral strictures becauses of its several advantages. In However, today, MR Urethrography (MRU) is gold standard. This prospective study aimed to:

- Compare accuracy of SUG in evaluation of anterior urethral strictures.
- Role of SUG in predicting management of anterior urethral strictures.

Materials & Methods: Twenty male patients with anterior urethral strictures under SUG prior to MRU that was performed on 1.5T scanner. Data related to site & length of stricture; presence or absence of spongiofibrosis with its extent and any other associated abnormality was recorded in both SUG & MRU.
Results: Out of 20 patients, three patients were excluded from our study due to suboptimal MRI scan quality. Long-segment stricture in anterior urethra was detected in 10 out of 17 (58.8%) patients by SUG while MRU detected it in 14 out of 17 (82.4%) patients meaning thereby that 4 patients were falsely diagnosed as short-segment stricture by SUG out of which two were in bulbar and two in penobulbar urethra. Thus, SUG has a sensitivity, specificity and accuracy of 71.4%, 42.9% and 76.5% respectively. SUG was able to predict the correct mode of management in nearly 90% patients.
Conclusion: SUG can be used with a fair degree of accuracy in anterior urethral strictures especially to complement retrograde urethrography. Clinical Relevance: In developing countries like India with scarcity of MR scanners, competence of radiologist with experience in MRU and financial constraints, SUG can supplement retrograde urethrography and affect management decisions.

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Hepatic Artery Resistive Index (HARI) and Bard Fibrosis Score: Risk Assessment of Advanced Liver Fibrosis in Patients with Non-Alcoholic Fatty Liver Disease (NAFLD)

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Objective: Nonalcoholic fatty liver disease (NAFLD) is a metabolic disorder with a wide clinical continuum of liver diseases that usually progress in a rectilinear fashion. Through this course, they undergo certain hemodynamic changes in the hepatic arterial blood flow. To determine the concordance of Hepatic Artery Resistive Index (HARI) and Bard Fibrosis Score in the assessment of advanced liver fibrosis among patients with NAFLD and across its different disease severity.
Materials and Methods: Observational descriptive study design was used. 94 NAFLD patients without a history of excessive alcohol consumption were invited and voluntarily participated in the research investigation. Ultrasound scanning of the liver to include color Doppler parameters and determination of BARD Fibrosis score were done.
Results: The HARI of NAFLD with BARD Fibrosis scores of 1, 2, 3 and 4 has an average index of 0.84, 0.75, 0.54 and 0.52, respectively. There is an unwavering inverse correlation between HARI to BARD Fibrosis scoring system (r = -0.84). Across the different severity of NAFLD, grade III has the lowest mean HARI at 0.53 followed by grade II and grade I. Correspondingly, the BARD Fibrosis score showed inverse ranking pattern across the different severity of NAFLD, grade I has the lowest BARD fibrosis score followed by grade II and grade III.
Conclusion: The HARI has demonstrated a significant negative correlation with advanced liver fibrosis when correlated with BARD fibrosis score. Thus, this study showed that the conventional Doppler US with hepatic artery indices and laboratory variables can be helpful to detect fibrous tissue accumulation in NAFLD.

Establishing the Clinical Role of Virtual Unenhanced Images in Dual Energy Excretory CT Urography in Detection of Urolithiasis

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Objective: To determine the diagnostic value based on the sensitivity and specificity of virtual unenhanced (VUE) images generated at excretory phase dual-energy computed tomography urography (DECTU) using dual-source CT in the detection of urolithiasis
Materials & Methods: 100 patients had undergone DECTU, which consisted of true unenhanced and excretory phase scans performed using a dual energy dual-source scanner. Commercial software (Liver VNC) was used to create VUE images.
Results: On a per patient basis, sensitivity was 76.6% and specificity was 99.9%. On a per stone basis, the overall sensitivity for detecting stones was 54% (94 of 175 stones). Sensitivities were 7% (1/15 stones) for 1–1.9 mm stones, 10% (4/39 stones) for 2–2.9 mm stones, 23% (8/35 stones) for 3–3.9 mm stones, 80% (16/20 stones) for 4–4.9 mm stones, 93% (14/15 stones) for 5–5.9 mm stones and 100% (31/31 stones) for ≥ 6 mm stones. The size of stones detected on VUE were significantly smaller than those detected on TUE images. Size of stones missed on VUE images was also significantly smaller compared with stones detected on VUE (p < 0.050). 81 stones were missed on VUE and the sizes ranged from 1.0 to 5.3 mm (mean 2.5 ± 0.9 mm).
Conclusion: VUE images generated at excretory DECTU enabled the detection of urolithiasis measuring > 5 mm with good sensitivity and specificity.

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MR Accuracy in Detecting Abnormal Placentation with Strong Ultrasound Concern for Myometrial Invasion and Its Correlation with Clinical Outcome

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Objective: The purpose of this study was to evaluate MRI for the prenatal diagnosis of placenta percreta and its correlation with clinical outcome.
Materials & Methods: This is a study of 6 patients performed at our institution to identify women at risk of placenta accreta who had undergone both prenatal ultrasound and MRI. Findings at ultrasound and MRI were compared with the final diagnosis, which was established with clinical findings at surgery. Volume measurements were made of low-signal-intensity intraplacental bands on T2-weighted image. All those patients who were at a high risk of abnormal placentation (placenta accreta, increta and percreta) regarding their clinical history of either one or all of the following: placenta previa, previous uterine interventional procedures (e.g. cesarean sections, dilation & curettage and myomectomy, maternal age of 35 years or more and grand multiparty. The age of the patients ranged from 20 to 42 years (mean age: 31 years).
Results: Ultrasound and MRI showed no significant difference in sensitivity and specificity in diagnosing abnormal placentation (97 to 100% and 9 to100%, respectively). MRI was more sensitive than US for the detection of myometrial invasion and the type of abnormal placentation.
Conclusion: Early and systematic detection of abnormal placentation is a crucial step in planning delivery and subsequent management to overcome the morbidity associated with abnormal placentation. MRI is highly accurate in predicting the radiological patterns of placenta accreta. MRI and ultrasound are excellent methods for the prediction of maternal morbidity and planning as pre-caesarian section precaution.

Utility of Shear Wave Elastography (ARFI) & Hepatic Vein Doppler in Patients with Budd–Chiari Syndrome: Pre & Post Tips

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Objective: Budd?Chiari syndrome (BCS), which leads congestive hepatopathy and aggravates cirrhosis, is typically treated by interventional angioplasty or TIPSS to ameliorate blood flow. This study was to analyze the relationships between liver stiffness measurement (ARFI)-liver fibrosis in patients with BCs and to demonstrate the utility of real-time shear wave elastography for evaluation of BCs patients before and after intervention.
Materials & Methods: Retrospective study where a total of 3 patients with Budd-Chiari syndrome were included and Shear wave elastography was used to generate dynamic liver stiffness measurement with hepatic vein doppler 2 days before angioplasty and 2 days, 2 weeks, 3 months and 6 months after intervention.
Results: Mean liver stiffness was at baseline and 2 days, 2 weeks, 3 months, and 6 months after intervention were measured. Liver stiffness measured at 2 days before and 2 days, 2 weeks, 3 months and 6 months after intervention was significantly decreased (p < 0.001). Liver stiffness measured by ARFI at 6 months after angioplasty was not significantly different from that measured at 3 months after angioplasty. Liver stiffness measured at 2 days and 3 months after angioplasty was significantly decreased (p < 0.001), remaining stable at 3 months, though still in the cirrhotic range.
Conclusion: The liver stiffness of Budd-Chiari syndrome patients, measured by shear wave elastography, decreased considerably after hepatic venous recanalization, and significantly correlated with hepatic venous pressure though not with degree of fibrosis. Shear wave elastography may be effective in monitoring short- and long-term treatment outcomes in Budd-Chiari syndrome.

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MRI and Laparoscopy in Female Subfertility – A Fair Comparison

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Objective: In modern era of conservative therapies and minimal invasive surgeries, imaging plays an important role in diagnosis, treatment and determination of the prognosis of diseases. Role of imaging in female subfertility has been documented in Medical literature. In this study, we aim to determine the role of magnetic resonance imaging in determining variety of causes of female infertility using hysterolaparoscopy as a gold standard. The aim of study is to assess the relative role of Magnetic Resonance Imaging (MRI) in detecting various causes of female subfertility
Methodology: Fifty-five females in reproductive age-group presenting with primary and secondary subfertility were included in the study. All the patients underwent noncontrast MRI pelvis.
Results: MRI was nearly 100% accurate in detecting the cause of subfertility showing nearly 100% sensitivity and specificity.
Conclusion: MRI is highly accurate in detecting polycystic ovaries, leiomyoma, endometriosis/adenomyosis, endometrial thickening and uterine and ovarian anomalies. It serves as a problem-solving tool in patients with complex clinical disease showing unremarkable or non-characteristic findings on ultrasonography. MR imaging can complement hysterolaparoscopy especially when tubal diseases or endometriosis are suspected causes of subfertility. MR imaging is useful in predicting the outcome in patients treated conservatively for adenomyosis, leiomyoma and endometriosis and may help in better treatment planning.

Audit of CT Liver Volumetry/Liver Dynamic Pre Scan Preparation in Prospective Liver Donors

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Objective: Audit of CT liver volumetry/liver dynamic pre-scan preparation technique, aiming to reduce unnecessary repeat scans, extra contrast and ionising radiation burden.
Materials & Methods: The first cycle of audit is a retrospective analysis of 50 consecutive CT liver volumetry/ liver dynamic studies of liver donors as pre-transplant workup from February 2018 to May 2018, with patients allowed to take liquids but not solids for 6 hours prior to scan. Liver, hepatic artery and hepatic veins were assessed and need for repeat scan was analyzed due to artifacts from air and liquid interface in duodenum and distal stomach. The second cycle of audit is a retrospective analysis of 50 consecutive patients who underwent CT liver volumetry/liver dynamic studies from June 2018 to September 2018, keeping the patients nil per oral (NPO) for 6 hours prior to scan and the results were compared.
Results: First cycle of audit showed that liquid and air interface in duodenum and distal stomach resulted in artifacts in liver in 24 (48%) scans, difficult visualization of hepatic veins in 15 (30%) and hepatic artery in 11 (22%) scans. 5 (10%) scans were repeated. After implementation of change in protocol remarkable results were obtained and none of the scan showed any artifacts.
Conclusion: This study shows that CT liver volumetry/liver dynamic studies performed keeping the patients NPO for 6 hours prevent them from swallowing air with the liquids. This results in better anatomical delineation without artifacts.

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MDCT Evaluation of Pancreatic Lipomatosis and Its Association with Diabetes Mellitus

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Objective: Fatty replacement is a common condition involving the pancreas. Small focal fatty deposits in pancreas are relatively insignificant; however, excessive fat has a pathologic significance and is commonly associated with marked reduction in exocrine function of pancreas. The objective of this study was to evaluate the incidence of pancreatic lipomatosis and its association with diabetes mellitus.
Materials & Methods: Multi-Detector Computed Tomography (MDCT) scans of 270 consecutive patients who underwent abdominal examination during a period of 1 year at a tertiary care centre were retrospectively reviewed. Pancreatic lipomatosis was evaluated in all the patients and their association with Type 2 diabetes mellitus was analyzed.
Results: Among 270 patients, 155 were males & 115 were females. Pancreatic lipomatosis was seen in 8 patients with incidence of 2.96%. Among the two types, even type of pancreatic lipomatosis was seen in 2 cases and uneven type in 6 cases. In 4 out of 6 (66.7%) patients, the uneven fatty infiltration was of type 1 while in 2 out of 6 (33.3%) patients, type 2 pancreatic lipomatosis was seen. Diabetes mellitus was seen in 14 patients out of 270. Pancreatic lipomatosis was seen in 6 out of 14 diabetic patients (42.8%). Significant correlation was established between pancreatic lipomatosis and Type 2 diabetes mellitus ($p < 0.0001$).
Conclusion: Pancreatic lipomatosis is often an asymptomatic and incidental finding in MDCT with incidence of 2.96% and significant correlation exists between pancreatic lipomatosis and Type 2 diabetes mellitus.

To Determine the Sensitivity of Diffusion Weighted Imaging for Diagnosis of Hepatocellular Carcinoma, Keeping the Dynamic Post Contrast MRI as Gold Standard

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Objective: To evaluate and compare the sensitivity of diffusion weighted imaging (DWI) in diagnosis of hepatocellular carcinoma (HCC) with post contrast dynamic MR imaging.
Materials & Method: After IRB approval a retrospective study was conducted, 123 diagnosed hepatocellular carcinoma cases from hospital database from July 2018 to October 2019 were evaluated by two experienced radiologists. MR-imaging was performed at 1.5T Titan Toshiba. Magnetic resonance (MR) sequences were T1, T2, and DWI/ADC (b value of 1000). Contrast enhanced (CE) T1 after 25, 60, 180 seconds. DWI was performed by SEPI sequence. Data analysis was done using SPSS version 21 and results were compiled.
Results: 105 patients (85%) showed typical pattern on CE dynamic imaging. 18 patients (15%) showed equivocal pattern on arterial and venous phases. Restricted diffusion was seen in patients 62 (50%). Sensitivity of diffusion weighted imaging alone for diagnosis of HCC is 91.07%.
Conclusion: DWI can act as standalone sequence in diagnosis of HCC in patients with any contraindication to contrast administration. Exploring new non-invasive diagnostic modality to help improve diagnosis of HCC is challenging, this study will open doors for new researches in future.

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Low-Dose Abdominal CT Using Deep Learning-Based Reconstruction Algorithm: Evaluation of Radiation Dose and Image Quality with an Anthropomorphic Phantom

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Objective: To compare the image quality of abdominal CT images reconstructed with a deep learning-based reconstruction technique (TrueFidelity, TF), a hybrid iterative reconstruction technique (ASIR-V) and a filtered back projection (FBP) at different radiation dose
Materials & Methods: An anthropomorphic upper abdomen CT phantom was scanned with a 256-slice CT scanner (Revolution CT, GE Healthcare) using five different tube-current settings (200, 100, 50, 25, and 12.5 mAs). For each mAs setting, axial images were reconstructed with FBP, 50% ASIR-V, and TF (Medium). Objective image noise and contrast-to-noise ratio (CNR) for the liver parenchyma relative to the portal vein were evaluated. A radiologist assessed the image quality using a five-point rating scale as a qualitative analysis.
Results: ASIR-V yielded 30–38% noise reduction and 37%–61% CNR increase compared with FBP. TF yielded 32–46% noise reduction and 47%–80% CNR increase compared with FBP. Objective image noise and CNR for 50 mAs with ASIR-V (11.2 and 3.3) and TF (10.1 and 3.5) were comparable with those for 200 mAs with FBP (11.2 and 3.3). At lower mAs settings (25 and 12.5 mAs), TF yielded about 20% noise reduction compared with ASIR-V. The visual scores of image quality for 100 mAs with ASIR-V and TF were equivalent to that for 200 mAs with FBP.
Conclusion: Both ASIR-V and TF achieved 75% radiation dose reduction in abdominal CT maintaining objective image noise and CNR in comparison with standard FBP reconstruction. TF would have a potential to enable even lower radiation dose.

Computed Tomography (CT) Imaging of Injuries from Blunt and Penetrating Abdominal Trauma

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Objective: Trauma is the leading cause of death in persons under 45 years of age. Abdominal trauma is conventionally categorized as either blunt type or penetrating type. The principal causes of blunt trauma abdomen are road traffic accident. The prevalence of blunt abdominal trauma is approximately 12–15%, accounts for high mortality rates around 80%. This study is to emphasize the importance of bowel and mesenteric injuries in Blunt/Penetrating abdominal trauma and to illustrate useful tips and tricks in identifying solid organ and vascular injuries on trauma CT.
Materials & Methods: A prospective study of 53 patients with abdominal trauma(48Blunt/5Penetrating) was carried out in MGM hospital Warangal. MDCT with contrast were performed on GE Bright speed 16 slice CT Scanner. Delayed scan obtained to assess the urinary system in the excretory phase. Various injuries seen on the CT images were grouped based on the injury site and the organs involved.
Results: Of the total 53 patients, maximum (17) were in the age group of 21–30 (32.07%) then in 31–40 (12) age group. Only 1 patient was above 60 years. Out of 53 patients 41 patients were male and 12 patients were female. The most common organ injured was spleen (18) followed by liver (17), Bowel (15), Anterior abdominal wall (6), Pancreas (1), Kidney (3), Uterus (2),Stomach (1) and Hemoperitoneum without solid organ injury (1).
Conclusion: Present study conclude that CT scan is highly sensitive and better diagnostic modality for BAT. CT shown to be accurate for the diagnosis of bowel and mesenteric injuries. CT is diagnostic test of choice in the evaluation of abdominal trauma in hemodynamically stable patients. The rapid identification of life-threatening injuries may increase the chance of survival for patients with trauma.

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Assessment of Locoregional Spread of Carcinoma Cervix by Pelvic MRI

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Objective: Cervical cancer is the 4th most common gynaecological malignancy worldwide (GLOBOCON 2018 data) Imaging has a more central role in staging of cervical cancer in 2018 FIGO guidelines. MRI is the preferred imaging modality because of its ability to assess soft tissue in detail. Purpose is to evaluate role of MRI in detection of cervical carcinoma and assessment of locoregional spread of the disease including lymph node invasion for proper staging.
Materials and Methodology: It was prospective single institution cross sectional observational study. Sample Size was 40. Biopsy proven patients before starting any treatment undergone contrast enhanced MRI pelvis in GE healthcare 3.0 tesla machine.
Results: 50% patients were in 5th decade. Majority patients were multiparous (45% 3rd parity). 87.5% patients had squamous cell carcinoma. 75% patients had upper 2/3rd vagina involvement. Only 12.5% patients had rectal invasion. 32.5% patients had pelvic lymph node involvement. Most commonly diagnosed stage was stage IIB.
Conclusion: MRI is very useful in local staging of the disease. Following FIGO 2018 guidelines. It is also helpful to differentiate residual tumour from radiation fibrosis.

Liver Fat Quantification by Imaging Markers: How We Do It

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Learning Objective: Due to percutaneous liver biopsy limitations, noninvasive imaging techniques are increasingly used to manage hepatic steatosis (HS), especially nonalcoholic fatty liver disease (NAFLD). This paper presents an update on imaging markers of HS quantification.
Background: NAFLD is a common chronic liver disease that affects approximately one billion people worldwide. Excessive and prolonged fat accumulation increases liver hepatocyte injury risk, which could cause a range of other serious problems.
Findings and/or Procedure Details: Conventional ultrasound is considered a qualitative method with a low rate of accuracy. Better quantitative methods are being developed based on fundamental tissue parameters such as attenuation coefficient and backscatter coefficient. Controlled attenuation parameter based on transient elastography is also being extensively studied. (2) Computed tomography plays an increasing role in HS assessment based on absolute liver attenuation value or relative liver attenuation value compared with the spleen. Single-energy and dual-energy computed tomography are being developed. (3) In-phase opposed-phase imaging or fat suppression methods with conventional magnetic resonance imaging allow for HS evaluation qualitatively based on observable signal intensity differences. Stimulated-echo acquisition mode and point-resolved spectroscopy method based on magnetic resonance spectroscopy are widely accepted as a reference standard for HS quantification. The chemical shiftencoded magnetic resonance imaging method separates the signal of the water and fat components, allowing good quantification of HS. Parametric quantifying proton density fat fraction maps analysis method can assess whole-liver segmentation automatically.
Conclusion: Imaging markers are non-invasive HS estimation methods developed and hold great promise for the future.

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CT Imaging Features Differentiating Bland vs. Tumerogenic Portal Vein Thrombosis: Pictorial Review

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Learning Objective:
1) To discuss the appearance of tumerogenic and bland portal vein thrombosis on computed tomography.
2) To discuss literature review regarding sensitivity and specificity of these differentiating features.
Background: Portal vein thrombosis is a fairly common complication of chronic liver disease along with increased prevalence in patients with hepatoma. Its recognization is important as it changes the LIRAD category along with tumerogenic thrombosis being a contraindication to liver transplant. Past literature has described certain features which help differentiate tumerogenic from bland thrombosis including thrombus enhancement, venous expansion, neovascularity and thrombus being adjacent to hepatoma. Here we describe a series of three cases with portal vein thrombosis emphasizing the differentiating features between bland and tumerogenic thrombus.
Findings and/or Procedure Details: Three patients, known case of chronic liver disease with hepatoma underwent triphasic CT scan of abdomen with hepatoma protocol. All three cases had findings of chronic liver disease with features of portal hypertension, hepatoma and portal vein thombosis. One patient had bland thrombus, while the other patient has tumerogenic thrombus, while in the third case, both types of thrombogenic mechanism co existed in different branches of portal system.
Conclusion: It is important to identify portal vein thrombosis as it is a contraindication to liver transplant and changes the LIRADS category of the hepatoma.

Tumor Versus Bland Thrombus: Sensitivity, Specificity and Accuracy of Different Radiological Characteristics

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Objective: Characterisation of a portal vein thrombus as bland versus malignant is a crucial deciding factor for management plan of patients with hepatocellular carcinoma as tumor thrombus is a contraindication to liver transplantation. The purpose of our study is to determine CT features that may enable radiologists to noninvasively differentiate tumor from bland thrombus.
Materials & Methods: Retrospective cross-sectional study conducted in Radiology Department of Shifa International Hospitals Islamabad from January 2017 till January 2019. 226 consecutive patients with hepatocellular carcinoma were included of which 125 had tumor thrombus and 101 had bland thrombus in portal vein. Eight characteristics of thrombus were studied.
Results: Wall adherence was seen in 41.6% in tumor group versus 21.8% in bland group, intrathrombus neovascularity in 56% versus 17.8%, portal vein invasion in 42.4% versus 0%, heterogeneity in 36.8% versus 31.7%, contiguity with tumor in 36.8% versus 0%, and progression of thrombus in 67.2% versus 25%. All patients with tumor thrombus of portal vein had thrombus density more than 52 HU. All described characteristics were statistically significant with p value < 0.0001 except heterogeneity and venous expansion. The presence of a combination of 5 more of these characteristics gave highest AUC of 0.828, sensitivity and specificity of 73.6 and 92.1 with p value < 0.0001 to differentiate tumor thrombus from bland.
Conclusion: We propose that non-invasive imaging characteristics can aid in differentiation of tumor versus bland thrombus in portal vein with presence of 5 or more characteristics increasing sensitivity, specificity and accuracy of differentiation.

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The Variants of Hepatocellular Carcinoma on Imaging; A Pictorial Review

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Learning Objective: The aim of this article is to familiarize radiologists with different types and rare forms of HCC highlighting the CT and MR spectrum of atypical appearances.
Background: Hepatocellular carcinoma (HCC) is currently the second most common cause of cancer-related deaths globally with expected increase in its incidence. Most cases of HCC are present in middle to low resource countries like Pakistan due to increased burden of viral hepatitis. As it is a common disease; hence different types and rare imaging features are also encountered.
Findings and/or Procedure Details: CT and MR liver dynamic are non-invasive and highly accurate tools for diagnosis of HCC. The importance of different features of HCC will be highlighted. The CT and MR features of different variants of HCC will be discussed.
Conclusion: The knowledge of different forms and atypical HCC is essential for the general radiologist to avoid unnecessary biopsy in suspected HCCs.

Efficacy of Date Syrup in Suppression of Upper GI Signals in MRCP

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Objective: To assess the efficacy of date syrup in suppression of upper GI signals in MRCP. Orally administered substances which suppress signals from gastrointestinal fluid can be used to enhance image quality in MRCP. Date syrup is a rich source of iron can be used as a suitable negative oral contrast agent in MRCP.
Materials and Methods: This study was conducted at department of Radiology, Khyber Teaching Hospital, Peshawar from January 2019 to June 2019. Date syrup was given to the patient and then MRCP sequences will be done. MRCP done twice in the same patient before and then after the administration of date syrup and effect of syrup on suppression of fluid signal in GI had been evaluated. Eighty patients underwent MRCP before and 30 minutes after ingestion of 100 mL of date syrup. Unenhanced and contrast-enhanced images were scored for gastrointestinal tract signal suppression and visualization of various pancreaticobiliary structures
Result: The images obtained with date syrup had signal-to-noise ratio comparable to that of images obtained with fruit juice and water in MRCP sequences. The iron concentration in date syrup was 2.6 mg/dL. Images obtained after oral contrast administration had significant improvement in gastrointestinal tract signal suppression and an increase in visibility of the CBD, cystic duct, and pancreatic duct.
Conclusion: Date syrup can be used as a negative oral contrast agent for gastrointestinal signal suppression during MRCP and for improving visualization of various structures. The application of oral substances for gastrointestinal signal suppression in MRCP is recommendable.

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The Clinical Value of Contrast-Enhanced Ultrasound (CEUS) for Assessing Diagnosis of Viable Hepatocellular Carcinoma after TACE in Comparison with Contrast- Enhanced MRI and CT

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Objective: The purpose of this study was to focus on the assessing diagnosis of CEUS, CECT and CEMRI which can be used as imaging options for the treatment response evaluation of HCC after TACE.
Materials and Methods: Online databases were comprehensively searched up to 2020. The methodological quality was assessed by using QUADAS-2. Pooled statistics were calculated with a random effect or fixed-effect model. Heterogeneity was assessed by the X2 test and I2 value. The sources of heterogeneity were explored by meta-regression analysis.
Results: 19 studies were finally included in this meta-analysis. In total, there are 862 patients with 1116 nodules of HCC after treatment. Most of the included studies had a low risk of bias regarding the study design and a low risk of concerns regarding clinical applicability. In terms of pooled sensitivity of CEUS, CECT and CEMRI, it was 0.94, 0.73, and 0.90, respectively; pooled specificity was 0.90, 0.88, and 0.92, respectively. Pooled +LR of CEUS, CECT and CEMRI was 7.17, 6.39, and 8.29, respectively; pooled -LR of CEUS, CECT and CEMRI was 0.08, 0.34 and 0.16, respectively. Pooled DOR of CEUS, CECT and CEMRI were 101.74, 19.89 and 53.56, respectively. AUCs of CEUS, CECT and CEMRI were 0.9635, 0.7969 and 0.9452 respectively.
Conclusion: This comprehensive meta-analysis revealed that the assessing diagnosis of CEUS is better than that of CECT and CEMI suggesting that both CEUS and CMRI may play important roles in oncology management and clinical practice.

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Patient Reported Cosmetic Outcome after Vacuum Assisted Excision of Benign Breast Lesions: A Cross-Sectional Study

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Objective: About 80% of all breast tumors are benign and can be excised through a vacuum assisted excision (VAE) under local anesthetics. Although most studies imply that cosmetic outcome after VAE is superior to cosmetic outcome after surgical excision (SE), hardly any studies on this subject are conducted. In this study we aimed to evaluate cosmetic outcome and possible influencing factors after VAE for benign lesions.
Materials & Methods: In this cross-sectional study all eligible patients were contacted to complete the Dutch BCTOS-13 questionnaire on cosmetic outcome (no difference [1] to a big difference [4]). Socio-demographic and procedure-related characteristics were retrospectively collected from the electronic patient record. All possibly associated variables with cosmetic outcome were included in a WLS multivariate linear and a binary multiple logistic regression analysis.
Results: A total of 47/65 (72%) patients completed the questionnaire on cosmetic outcome. Cronbach's alpha for internal consistency of the questionnaire was good (0.73). Overall cosmetic outcome was good in 74% of patients (mean 1.5). The presence of follow-up complications was significantly associated with cosmetic outcome after WLS multivariate linear regression and binary multiple regression analysis.
Conclusion: VAE has several advantages over SE, such as lower costs and less invasiveness. Overall cosmetic outcome after VAE was good and the presence of follow-up complications seem to have a negative effect on cosmetic outcome. Compared to literature VAE seems to have a better cosmetic outcome than surgical excision. A comparative study for results after VAE and SE is necessary to confirm findings.

Clinical and Radiological Manifestations of Male Breast Malignancy in a Local Asian Population –Retrospective Analysis with Utilization of Latest BI-RADS Lexicon

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Objective: Male breast cancer is a rare disease lacking studies investigating its imaging features with reference to the latest ACR BI-RADS lexicon. This is the first study examining both the mammographic (MMG) & sonographic (USG) features of male breast cancer in a local Asian population using the latest BI-RADS lexicon,in addition to studying the clinical presentation.
Materials & Methods: Male breast cancer patients having preoperative imaging from 2007–2019 were included, with MMG & USG images retrospectively reviewed according to the latest BI-RADS lexicon (5th edition, 2013).
Results: Twenty-two patients with imaging were included. Median age was 74 years (range, 43–95). Twenty-one breast cancers underwent both MMG & USG; & two, USG only. Most cancers were ductal carcinoma (invasive/in-situ) [70%, n = 16]. Most cancers presented with a palpable mass (78% [n = 18]), half of which had nipple changes. On MMG, 62% (n = 13) of cancers showed a mass; 28% (n = 6), mass & microcalcifications; & 5% (n = 1),microcalcifications only. Masses (n = 19) mostly had irregular shape (53%, n = 10),indistinct margins (63%, n = 12),high density (89%, n = 17) & located eccentrically subareolar (52%, n = 10). Calcifications (n = 8) were mostly fine pleomorphic (62.5%, n = 5) but less suspicious punctate ones (25%, n = 2) can occur. Most calcifications were regional (62.5%, n = 5). Nipple & skin features (67%, n = 14) were common. On USG, masses (n = 22) mostly had irregular shape (64%, n = 14),parallel orientation (77%, n = 17),indistinct margins (55%, n = 12), hypoechogenicity (73%, n = 16), posterior enhancement (59%, n = 13), internal vascularity (50%, n = 11) & solid nature (64%, n = 14). Metastatic axillary lymph nodes were USG-detected in 13% (n = 3) of breast cancers. However, significantly, more lymph node metastases (26%, n = 6) were detected on sentinel lymph node biopsy.
CONCLUSION: Most male breast cancers present with irregular eccentrically subareolar masses with nipple changes. However, unlike female breast cancers, benign MMG & USG features are common & should not dissuade from prompt workup & intervention. USG has a role in regional lymph node staging but may not be sufficiently sensitive.

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MRI Breast – Initial Five-Year Experience at Tertiery Care Hospital

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Objective: Dynamic magnetic resonance imaging (MRI) of breast is a functional technique. It is relatively newer imaging modality for breast imaging. We aim to share initial five-year experience after installation of MRI machine at our teaching hospital.
Materials and Methods: This study was carried out at Fauji Foundation Hospital, Rawalpindi, from April 2015 to December 2020. Demographic details and indications for MRI breast according to recommendations by American College of Radiology (ACR) relating to each patient were recorded. Mean and standard deviation of quantitative variables were worked out; frequency and percentages were calculated for qualitative variables.
Results: Majority of the patients (51.51%; n = 33) were referred from specialists outside our institution. Age range was 25–82 years (mean 47.96; median 49 years). Out of 33 subjects, 18 (54.54%) were referred for additional evaluation of imaging or clinical findings. Screening was performed in 27.27% patients. This included patients at risk of developing breast carcinoma, screening of malignancy in contralateral breast and in augmented breast. Six out of thirty-three (18.18%) subjects were sent for evaluation of extent of known malignancy. This included ruling out multifocality and multicentricity, relationship to deep fascia and evaluation of treatment response.
Conclusion: Appropriate patient selection, according to ACR practice parameters for performance of contrast-enhanced MRI of breast, is the most important criterion for adequate and accurate reporting of MR mammogram. Effective communication with referring clinicians helps to avoid unnecessary use of resources.

Ultrasound Evaluation of Focal Asymmetry Seen on Mammography: Correlation with Histopathology or Long Term Follow-Up

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Objective: To determine diagnostic value of ultrasound for evaluating focal asymmetry in mammography.
Materials and Methods: The data was retrospectively collected and searched for mammographic reports coded as focal asymmetry and ill-defined density during January 2015–May 2019. We examined patient's sonographic imaging whether it correlated to mammography and then reviewed histopathologic result or at least two-year imaging follow-up.
Results: There were 260 patients with focal asymmetry on mammography and available ultrasound examination. The ultrasound study showed no focal abnormality in 162 patients (62%), benign lesion in 83 patients (32%), and suspicious lesions in 15 patients (5.8%). Of 15 patients with suspicious lesions, 2 patients had malignancy and the rest revealed benign pathologic results or stability after two-year follow-up. The sensitivity, specificity, negative predictive value (NPV) and positive predictive value (PPV) of ultrasound for determining focal asymmetry were 100% (95% Confidence Interval [CI] 75.3–100%), 65.2% (95% CI 58.9–71.1%), 100% (95% CI 97.7–100) and 13.1% (95% CI 7.2%–21.4%), respectively. The percent agreement was analyzed to assess correlation of ultrasound finding with pathologic results or clinical outcome which showed strong agreement (66.92%).
Conclusion: Our study revealed that ultrasound had high sensitivity and NPV but low specificity and PPV for evaluating focal asymmetry. However, it is a good diagnostic tool follow mammography. Focal asymmetry without suspicious lesion in ultrasound can be advised to do routine annual mammography instead of a short interval follow-up which helps to reduce patient's concern and unnecessary expense.

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Image-Guided Localisation of Impalpable Breast Lesions: A Comparative Analysis of Magseed and Hookwire in an Asian Population

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Objective: To compare the performance of Magseed and hookwire localisation of impalpable breast lesions in an Asian population.
Materials and Methods: Retrospective review of patients who underwent breast surgery after image-guided Magseed or hookwire insertion in a regional hospital in Hong Kong from January 2020 to January 2021 was conducted. Rates of placement success (defined as target-marker distance < 1 cm), target detection, marker retrieval and complications were compared.
Results: Choice between Magseed and hookwire was based on clinicoradiological discussion after considering lesion location and scheduling practicability. 22 patients received Magseed and 23 patients received hookwire for preoperative localisation; total 52 lesions (24/52 Magseed, 28/52 hookwire) were marked and excised. Magseeds were placed 0–35 days before surgery (median, 0 day; mean, 16 days; 14/22 same-day operation, 8/22 decoupled operation). Under ultrasound guidance, 66.7% (16/24) and 75.0% (21/28) of the lesions were marked by Magseed and hookwire respectively. Under stereotactic guidance, 33.3% (8/24) and 25.0% (7/28) of the lesions were marked by Magseed and hookwire respectively. Placement success was comparable (95.8% Magseed, 96.4% hookwire, $p = 1.000$). All targets were detected in the first operation and successfully removed intact without complications.
Conclusion: Magseed localisation demonstrates effectiveness and safety comparable to conventional hookwire in Asian patients with thinner and denser breasts, with the additional advantage of decoupling localisation and surgery dates. This flexible and efficient workflow is especially essential in maintaining the capacity to support ongoing patient management and treatment amidst the unprecedented scheduling challenges in the COVID-19 pandemic.

Correlation of the Histopathology of Focal Breast Lesions Found on Mammography with Strain Elastography

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Objective: To assess the validity of strain elastography in better characterization of breast lesions with mammography and histopathological correlation.
Materials and Methods: After approval from the institutional review board committee we conducted a retrospective study, analyzing 50 female patients undergoing diagnostic mammography for palpable breast lumps, January 2017 to December 2019 having BIRADS 3 and 4 lesions on mammography. Ultrasound and strain elastography was performed on these patients with the assessment of strain ratios (SR) for benign and malignant tumors, followed by correlation with histopathological analysis.
Results: All of the BIRADS 4b and 4c lesions having higher strain ratios, were proven malignant on biopsy. While BIRADS 3 lesions having lower values were all benign. Indeterminate BIRADS 4a lesions were benign except for two lesions having higher strain ratios which turned out to be malignant. 21 malignant tumors exhibited an average SR of 7.8 +/- 6.87; SR of 39 benign lesions was 2.21 +/- 1.73. The mean strain ratio was significantly higher for malignant lesions. ROC analysis threshold was > 4 for malignant disease. Strain elastography was able to detect all malignant lesions (sensitivity 99%, specificity 98.9%, and accuracy 95.9%), providing a better diagnostic yield, and NPV of 96%.
Conclusion: Strain elastography is an adjunct method for increasing the accuracy and diagnostic yield of conventional mammography in a clinical setting, especially in low suspicion lesions (BI-RADS 3 and 4A). This would also justify avoiding unnecessary biopsy which adds a financial burden to the patient, instead of considering follow-up mammograms for these cases.

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Comparing the Diagnostic Performance of Strain Versus Shear Wave Elastography in Distinguishing Benign from Malignant Breast Lesions

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Objective: The aim of this study is to determine if incorporating assessment of peripheral stiffness for shear-wave elastography (SWE) can close the gap in diagnostic performance to strain elastography (SE) based on the E/B ratio.
Materials and Methods: A total of 101 individual breast masses were evaluated. Patients presenting to the radiology department for ultrasound (US) guided biopsies were invited to undergo US elastographic assessments of the lesions before the biopsy. The masses were evaluated using a single machine (Siemens Acuson S2000). The histopathologic diagnosis was used as the reference standard. The sensitivity, specificity and area under curve (AUC) were obtained for SE and SWE.
Results: The sensitivity and specificity, respectively, was 94.7% (95% CI: 87.6–100) and 81.0% (95% CI: 71.3–90.1) for SE using the E/B ratio. For SWE incorporating assessment of peripheral stiffness, the sensitivity and specificity was 78.9% (95% CI: 66.0–91.9) and 81.0% (95% CI: 71.3–90.1). The AUC for SE was higher (0.878) compared to SWE incorporating assessment of peripheral stiffness (0.799).
Conclusion: SE elastography using the E/B ratio yields diagnostic performance which is superior to SWE incorporating assessment of peripheral stiffness.

Strain Elastography of Breast Lesions: Elasticity Contrast Index and Its Comparison with Tsukuba Score

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Objective: Elasticity contrast index (ECI) is a strain elastography technique evaluated for thyroid lesions with utility in breast lesions yet to be ascertained. In this study, we determined the cut-off value of ECI for differentiating benign and malignant breast lesions, and compared the diagnostic performance of B-mode sonography, ECI and Tsukuba score.
Materials and Methods: This prospective cross-sectional study included 110 lesions in 102 patients. The solid breast lesions seen on breast ultrasound (BUS) were categorized on grey scale sonography followed by elastography using both ECI and Tsukuba score with pathological diagnosis as gold standard. Cut off value of ECI was obtained using ROC curve. Correlation of B-Mode, Tsukuba score and ECI with tissue diagnosis was calculated using Mann Whiteney U test and independent *t* test.
Results: The mean age was 33 years (range 15–73 years) with nearly 63% of the lesions in BIRADS category 3 and 21% in category 4. On tissue diagnosis, three quarters of lesions were benign. The accuracy of grey scale BUS for benign and malignant lesions was 96.2% and 100% respectively, combined accuracy, sensitivity and specificity being 96.9%, 85.7% and 100% respectively. The ECI cut off value was 2.8. Accuracy of Tsukuba score and ECI was 81.9% and 81.8%, respectively. There was statistically significant correlation ($p < 0.050$) between grey scale, Tsukuba score and ECI.
Conclusion: Grey scale ultrasound imaging has high diagnostic accuracy which increases with addition of elastography. ECI is comparable to Tsukuba score in its diagnostic accuracy.

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Quantitative ADC Evaluation of Breast Carcinoma: Correlation of Diffusional Properties with Tumour Grades and Immunohistochemical Subtypes

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Objective: To investigate the correlation between ADC values with hormone receptor expression, immunohistochemical subtypes, tumour grading and axillary lymph node metastasis of breast cancer patients.
Materials & Methods: A retrospective study of 114 breast cancer patients who underwent MRI breast from 2016 until 2020 was examined. The MRI breast was done in two different 3.0T MRI machines. The hormone receptor expression, immunohistochemical subtypes, tumour grade and axillary nodal metastasis, were obtained and were correlated with the ADC value.
Results: ER/PR negative and HER-2 positive tumour have higher ADC value. Higher ADC value in HER-2 enriched tumour compared to luminal type tumour with no statistically significant relationship noted. ADC value is unable to determine tumour grade and axillary nodal metastasis.
1. 3.0 Tesla MAGNETOM Prisma® Scanner (Siemens Healthcare)
A significant difference was found between ER, PR, and HER-2 positive and negative tumour with a *p*-value of 0.047, 0.019 and 0.040, respectively.
2. 3.0 Tesla Signa® HDx MR Systems (GE Healthcare).
The triple-negative tumour has the lowest median ADC value of 0.722 x 10^{-3} mm^2/s.
3. Combine both MRI machines.
Statistically significant difference noted between hormone receptor (ER, PR & HER-2) positive and negative tumour and immunohistochemical subtypes. ADC value for HER2- enriched tumour (0.995 x 10^{-3} mm^2/s) was significantly higher than that of Luminal A and B (0.827 & 0.843 x 10 x 10^{-3} mm^2/s) (p = 0.005,0.028).
Conclusion: A statistically significant difference between ADC values with hormone receptors and immunohistochemical subtypes. Tumour grade and axillary lymph node status, were not significant as the ADC values overlapped significantly.

Does Bone Scintigraphy Still Have a Role in Staging of Advanced Breast Cancer? The Morecambe Bay Experience

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Objective: The National Institute for Health and Care Excellence (NICE) recommends using CT or MRI or bone scintigraphy to determine the presence or extent of metastatic bone disease in patients with locally advanced breast cancer. The local staging protocol includes both CT of the Thorax, Abdomen & Pelvis and Bone Scintigraphy. The aim is to determine if bone metastases identified on a Bone scan are also identified on CT.
Materials & Methods: A Retrospective review of imaging by a single Radiologist of all asymptomatic patients who had a Bone Scan and CT scan for staging of locally advanced breast cancer in 2016. Patients who had a Bone Scan and CT performed more than 4 weeks apart or for symptomatic bone pain were excluded.
Results: 96 patients were included in the study. Bone metastases detected by Bone scan were visible on CT in all patients. 6.25% of patients had metastases visible in the field of view of CT but had further metastases in the femur or humerus. There was 100% concordance in excluding the presence of bone metastases.
Conclusion: A staging CT examination was able to detect all bone metastases seen on a Bone scan if lesions were within the field of view of a CT examination. There were no False negative findings on CT. Following this study, a Bone scan will now only be performed if the patient is symptomatic or if bone metastases are detected on CT.

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Positive Predictive Values and Predictors of Malignancy in Architectural Distortion on Mammography

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Objective: To evaluate PPV of malignancy on architectural distortion (AD) and to determine associated-architectural distortion findings on mammogram or correlated sonographic features that may indicate likelihood of malignancy.
Materials & Methods: A retrospective cohort review of AD cases in Siriraj hospital from February 2012 until December 2016. Imaging findings and pathology results were reviewed.
Results: AD cases were appeared in 372 mammography. Cases were excluded: postsurgical change (n = 49), associated mass (n = 41), no pathology results (n = 56), or no mammographic images (n = 2). Two hundred and twenty-four cases of 225 AD were included; the PPV was 52.4% (118/225), DCIS alone was 8.0% (18/225). The most common benign was a sclerosing adenosis (35/225, 15.6%). AD was more likely to represent malignancy on diagnostic mammography than on screening (89.4% vs. 44.6%, respectively; $p = 0.003$). A sonographical mass correlate was more likely to represent malignancy than with absence or non-mass (68.9% vs. 27.8%, respectively; $p = 0.001$). A malignancy likelihood was more found when detected on two-view than on one-view mammography (59.6% vs. 29.6%, respectively; $p = 0.035$).
Conclusion: The PPV for malignancy of AD on mammography is 52.4%. Malignancy can be any histologic type, but most are invasive carcinomas rather than in situ carcinomas. AD is more likely to represent malignancy if detect on diagnostic mammography rather than on screening, if there is a sonographical mass correlate, if they are seen on two-view mammography, or if they are associated with asymmetries and asymmetries with calcifications.

Utility of Ultrasound and Mammography in Detection of Negative Axillary Nodal Metastasis in Breast Cancer

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Objective: The objective of our study was to assess the utility of ultrasound and mammography in detection of absence of axillary lymph nodal metastasis in patients of breast cancer, taking histopathology as gold standard.
Materials & Methods: A cross-sectional study was conducted in Department of Radiology, Aga Khan University Hospital, Karachi for a duration of 23 months. All female patients between 20–95 years of age with known diagnosis of breast cancer with mammographic and ultrasound imaging done at our institute were included. Patients having abnormal lymph nodes on imaging, patients already operated for breast cancer, patients who already underwent axillary lymph node dissection and those without histopathology reports or surgery were excluded.
Results: At surgical pathology, a total of 45 of the included 262 patients (17.2%) had one or more positive lymph nodes. 217 out of 262 patients were found to be true negatives as they had absent metastasis on imaging as well as on histopathology. 45 out of 262 patients were found to be false negatives as they had absent metastasis on imaging, however, they were found to be positive for metastasis on histopathology. The negative predictive value was 82.8%. The patients were stratified into seven groups with age range of 10 years, ranging from 26 to 95 years. A p-value of 0.148 showed statistically insignificant effect of age on diagnosing absence of metastasis by ultrasound and mammography.
Conclusion: Ultrasound and mammography even when used in combination cannot safely exclude axillary metastasis thus cannot eliminate the need of sentinel node biopsy.

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Magnetic Resonance Imaging Texture Analysis of Breast Cancer

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Objective: Application of texture-based radiomics to breast magnetic resonance images (MRI) for predicting and diagnosing breast cancer.
Materials & Methods: 84 lesions with histopathologically confirmed primary breast cancer were retrospectively evaluated. 3D volumetric breast lesions were segmented from subtracted dynamic contrast-enhanced (DCE) images. The segmented 3D mask (region of interest) was applied to different MRI sequences (T1-weighted, T2-weighted, STIR, DCE Phase 2, subtracted Phase 2) for texture analysis (TA) of the lesion using MATLAB software. TA of contralateral normal breast tissues were also performed for comparison. The texture features were used to analyze and classify immunohistochemical subtypes, histopathological grades and MRI kinetic curves using Kruskal-Wallis test and Random Forest classification. Validation of radiomics model was carried out using leave-one-out-cross-validation.
Results: 215 texture parameters were analyzed. 177 textures features showed statistically significant differences between malignant lesions and normal breast tissues, with phase 2 DCE and subtracted images being the most useful sequences. The number of statistically significant texture features differentiating IHC subtypes, DCE curves and histopathological grades were 25, 9 and 150 respectively. The most useful sequences were T1W to classify IHC, DCE phase 2 for DCE curve, and T2W for histopathological grades. The test accuracies were 71.6% for IHC subtypes, 51.2% for DCE curves and 65.4% for histopathological grades using Random Forest classification.
Conclusion: MRI based TA radiomics is feasible to diagnose and classify breast cancer. Prospective validation studies with more data are needed to determine the potential usage of TA on breast cancer MRI in daily clinical practice.

Preoperative Tumor Size Measurement in Primary Breast Cancer Using Magnetic Resonance Imaging, Mammography, and Ultrasonography in Comparison to Histological Findings

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Objective: Magnetic Resonance Imaging (MRI) has been widely used in breast cancer staging in terms of tumor size and extents. This study aimed to determine the accuracy of MRI in the measurement of the tumor size in comparison to mammography (MMG) and ultrasonography (USG) with histological examination as the gold standard.
Materials & Methods: A retrospective study was conducted in 30 Thai women diagnosed with primary breast cancer who underwent preoperative imaging with all MRI, USG and MMG, during the period from December 2017 to September 2018. As an inter-rater reliability test, intraclass correlation coefficient (ICC), Pearson's correlation coefficient and Bland Altman plots were used to explore the degree of correlation and agreement of size as determined by MRI, USG, and MMG with histological examination.
Results: MRI was proven to be more accurate than MMG and USG in determining the longest tumor dimension. ICC of MRI, MMG, and USG with histological size was 0.966, 0.960, and 0.917, respectively. While there was excellent correlation in sizing by MRI and MMG with histological sizing, good to excellent correlation was found under USG. Bland Altman plots illustrated that nearly all plots were distributed within 95% limits of agreement implying good agreement between histology and all three imaging examinations. Size underestimation was discovered in evaluation with all three imaging modalities; however, it was statistically significant only in measurement under USG and MMG.
Conclusion: Breast MRI was proven to be the most accurate in determining the longest tumor dimension without statistically significant size underestimation.

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MRI Breast: Features of Malignant vs. Benign Lesions and Current Advances

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Learning Objective: To appreciate features of malignant versus benign breast lesions on Magnetic Resonance Imaging (MRI) and be updated on its current advances.
Background: Breast MRI is essential in improving cancer detection, lesion characterization and determining therapy response. We present a concise educational tutorial, including pictorial review of malignant and benign breast lesions on MRI with current advances of its application.
Findings and/or Procedure Details: Pertinent MRI findings of histopathological proven invasive ductal cancer (IDC), ductal carcinoma in-situ (DCIS), mucinous carcinoma, and angiosarcoma will be discussed. MRI features of benign lesions including fibroadenoma, papillary lesions and benign Phyllodes will also be discussed with highlight on the differentiating characteristics of each lesions. Approximately two-thirds of cancers manifest as a mass (majority of IDC). The remainders are visible as non-mass enhancement (NME) (majority of DCIS). Typical features of malignant masses are irregular size/margin, heterogeneous/rim enhancement, and show washout. Classic malignant NME are segmental distribution and clumped/clustered ring pattern of internal enhancement. Features of mucinous carcinoma with high T2 and slow/persistent kinetic enhancement may cause misdiagnosis of a benign lesion. Triple-negative cancer can also have benign appearance. However, their internal enhancement pattern, central necrosis and rim enhancement, can elicit their aggressive nature. Current advancement in breast MRI including abbreviated MRI, DKI, DWI/ADC and artificial intelligence will also be discussed.
Conclusion: Diagnosis of breast lesions maybe facilitated by features on MRI. Rapid advancement of MRI technology will further enhance breast MRI utilisation thus making it an indispensable tool in breast cancer management.

Comparison of Diagnostic Performance between MRI and Ultrasonography with Mammography in Surveillance for Local Recurrent Breast Cancer after Breast Conserving Therapy

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Objective: This study aims to compare the diagnostic performance of magnetic resonance imaging (MRI) and mammography with ultrasonography for detection of local recurrent breast cancer among female patients with post-breast conserving therapy (post-BCT).
Materials & Methods: We retrospectively enrolled 190 post-BCT female patients who had undergone post-operative surveillance by MRI and mammography with ultrasonography at King Chulalongkorn Memorial Hospital from January 1st, 2008 to July 1st, 2019. Two researchers reviewed the images from MRI and mammography with ultrasonography, independently. The information including radiological and histopathological data were blinded during the review process. Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) was then estimated to reflect the diagnostic performance of the two modalities for detection of local recurrent breast cancer.
Results: Of the 190 patients, 52 of (27.4%) were diagnosed as local recurrent breast cancer. Sensitivity, specificity, PPV and NPV is 98.1%, 92%, 82.3%, 99.2%, respectively for MRI and 88.5%, 62.3%, 46.9%, 93.5%, respectively for mammography with ultrasonography. The findings which can be better evaluated by MRI than by mammography with ultrasonography include post-operative change and benign mass (p-value < 0.001), suspicious mass and suspicious calcification found by mammography with ultrasonography (p-value < 0.001 and 0.003, respectively).
Conclusion: MRI is superior to mammography with ultrasonography for detection of local recurrent breast cancer after BCT. Furthermore, MRI can help clinicians avoid unnecessary biopsy and surgical interventions due to its ability to differentiate post-treatment change from local recurrent breast cancer.

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Comparison of 2D Versus 3D Mammogram in Radiology Department of Hospital Kuala Lumpur

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Objective: A study comparing breast lesion detection ability using 2D versus Tomosynthesis (3D images) over 6 months duration in 2018 in Mammogram Unit of Radiology Department Hospital Kuala Lumpur. To look at the superiority of breast lesion detection using the 3D mammogram over 2D as well as to strengthen the sensitivity of breast lesion detection on both 2D & 3D images.
Materials & Methods: This study was done by performing mammogram on patients who were appointed for mammogram using Hologic Selenia Dimension Full Field Digital Mammography Machine. All patients appointed for both screening and diagnostic mammograms ie, follow-up cases, new patients & post mastectomy patients. The Tomosynthesis Machine has the in-built capability of both 2D and 3D mammogram. Hence, we were able to perform this study without exposing patients to double radiation. The mammograms were interpreted independently by 2 Radiologists. Exclusion Criteria: Patients appointed for Contrast Enhance Mammogram, Stereotactic biopsies & Hook Wire Localization.
Results: Findings of this study in July to December 2018 a total of 1820 patients imaged with 472 lesions detected and 124 of these lesions biopsy proven malignant.
Conclusion: This study showed that Tomosynthesis (3D Mammogram) was far better in detection of breast lesions predominantly in patients with breast density C & D. Furthermore, the characteristics of malignant lesions such as architectural distortion, spiculation and asymmetric density of lesions were sharper on Tomosynthesis. However, micro-calcifications and the morphology of the calcifications were better depicted on the 2D images.

Correlation between Mammographyc Features and Expression of ER, PR and HER2 Receptors

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Objective: Determination of hormone receptors consisting of estrogen receptors, progesterone, and human epidermal growth factors 2 (HER2) in invasive breast cancer is very important as a predictive and prognostic factor in breast cancer management. If morphology tumors based on mammography can be used to predict the types of hormone receptors, this information will be very useful in planning the pretreatment or prognosis of breast carcinoma.
Purpose: To determine the correlation between morphological features and calcifications of breast carcinoma with the hormone receptors.
Materials & Methods: Observational cross-sectional study, non-random consecutive sampling. Assessment of breast morphology, shape, and distribution of calcifications based on mammography of craniocaudal (CC) and mediolateral-oblique (MLO) positions. Assessment of hormone receptor expression consists of estrogen, progesterone and HER2 receptors according to international standards.
Results: A total of 150 subjects, age 22 to 93 years old. The age group that suffers most from breast carcinoma is 40-50 years. Most breast density is scattered fibro glandular and there is a significant relationship between age and breast density. In this study, no significant relationship was found between morphology and the shape and distribution of calcifications with the status of estrogen and progesterone receptors. However, there is a significant relationship between breast carcinoma density and the presence of calcification with HER2 receptors.
Conclusion: Breast carcinoma with hyper dens density and without calcification tends to have negative HER2 receptor status.

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The Role of CT Simulator Findings as a Guidance in Pretreatment and Replanning Radiotherapy Breast Cancer Stage III and IV

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Learning Objective: CT scan is not standard assessed for breast cancer, but the image from CT scan simulator pretreatment and replanning can reveal the size of the tumor, invasion, lymphadenopathy, also skin and fibroglandular thickening.
Materials & Methods: Patients breast cancer stage III dan IV receiving initial and adaptive radiotherapy from January to October 2019 in Ken Saras Hospital, Semarang.
Results: Tumor size was defined as the largest diameter of anterior posterior (AP), latero lateral (LL), and cranio caudal (CC). Among all subjects, mean tumor size in replanning CT simulator was smaller than pretreatment (AP 29.70 ± 15.78 vs. 36.58 ± 21.66, p = 0.004; LL 52.10 ± 32.42 vs. 59.42 ± 36.46, p = 0.036; CC 51.68 ± 31.69 vs. 61.86 ± 43.85, p = 0.029). Mean replanning tumor invasion, skin, and fibroglandular thickening were smaller than pretreatment (30.01 ± 16.90 vs. 37.84 ± 21.83, p = 0.006; 6.09 ± 2.43 vs. 8.03 ± 2.59, p = 0.001; 14.90 ± 7.87 vs. 17.25 ± 9.15, p = 0.025, respectively). Mean lymph node size in replanning CT simulator was smaller than pretreatment (AP 8.72 ± 6.25 vs. 12.21 ± 4.77, p = 0.001; LL 9.20 ± 6.10 vs. 13.42 ± 6.48, p = 0.002).
Conclusion: We strongly recommend an accurate interpretation of the size of the tumor, invasion, lymphadenopathy, also skin and fibroglandular thickening based on CT simulator pretreatment and replanning by a diagnostic radiologist, to emphasize the need for careful review of CT simulator images before adaptive radiotherapy, planning therapy and evaluation.

Contrast Enhanced Spectral Mammography: Initial Malaysian Clinical Experience

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Objective: The main goal of this study was to compare contrast-enhanced spectral mammography (CESM) and conventional digital mammography in the detection of breast malignancy in the Malaysian population. Evaluation was done with histopathological correlation to compare the sensitivity, accuracy, positive and negative predictive values for both imaging modalities.
Materials & Methods: 101 patients who underwent CESM and digital mammography during the study period, from January 2018 to June 2019 were evaluated. The mammogram and Ultrasound images were evaluated by breast radiologists and lesions were evaluated using BI-RADS scoring system. Patients with BI-RADS IV and V lesions underwent CESM. All these BIRADS IV & V lesions were biopsied and their imaging findings were compared with the histopathological report.
Results: The results of this study showed a higher accuracy with CESM whereby 95.40% enhancing lesions with CESM were malignant.
Conclusion: Our study shows CESM demonstrates better sensitivity and specificity compared to conventional digital mammogram. Hence, CESM is a promising tool for breast cancer detection in the Malaysian population.

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Overview of Early Clinical Implementation of Digital Breast Tomosynthesis: A Single Centre Experience

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Objective: Evaluate impact of performance of mammographic study before and after the introduction of digital breast tomosynthesis (DBT) into clinical practice in our Centre (UMMC).
Materials & Methods: Retrospective study was conducted on patients who underwent breast biopsy in UMMC 6 months before and after the introduction of DBT. The patients were divided into two groups: FFDM (n = 1250) and FFDM + DBT (n = 2174). Histopathological examination results were the gold standard of the study. Biopsy rate, cancer detection rate, sensitivity & positive prediction values (PPV) were calculated & compared between the groups.
Results: Combination of FFDM and DBT resulted in significant reduction of biopsy rate from 9.8% to 7.7% (p = 0.030). The cancer detection rates were not statistically significant different between FFDM and FFDM + DBMT groups (43% versus 36%, p = 0.275). Not significant difference (p = 0.326) was found between BIRADS scoring (1–3 considered as benign; 4–5 considered as malignant) and histopathological results for the FFDM + DBT group. However, statistical significant difference (p = 0.001) was found between BIRADS scoring and histopathological results for the FFDM group. The sensitivity and PPV were 90% and 36% for FFDM group; and 92% and 38% for FFDM + DBT group, respectively.
Conclusion: Combination of FFDM and DBT significantly reduced biopsy rate compared to FFDM alone. Sensitivity and PPV were also increased from 90% to 92% and 36% to 38%, respectively, indicating that incorporation of DBT in mammographic examinations increased the number of true positive cases.

Ductography Combined with Digital Breast Tomosynthesis for Evaluation of Nipple Discharge: A Feasibility Study

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Objective: To evaluate performance of the ductography combined with digital breast tomosynthesis (DBT).
Materials & Methods: Consenting patients with uniporous spontaneous serous or bloody discharge underwent ductography combined with DBT. All patients underwent discharge cytology and whole-breast hand-held ultrasound before the procedure. Conventional ductography technique was used for duct cannulation and introduction of contrast media. DBT and digital mammography images were acquired in two standard projections. Breast radiologist with 8 years experience interpreted images. Lesion visibility was assessed using scale of 10. Lesion margin was characterized using scale "not visible, poor, satisfactory, good, excellent". All patients underwent either core biopsy or lumpectomy with histopathologic evaluation.
Results: A total of nine patients were examined. Three of them presented with unilateral serous discharge, five with unilateral bloody discharge and one with serous discharge from one breast and bloody discharge from another breast. Breast ultrasound detected abnormalities in six out of nine cases (duct ectasia or intraductal lesion). Ductography combined with digital mammography and DBT was able to detect abnormalities in all nine cases: duct abruption in three cases, filling defect in six cases. In five cases these abnormalities were associated with dilatation of the involved duct. Pathology revealed two malignant (one invasive cancer and one carcinoma in situ) and seven benign lesions. Margin evaluation was better with DBT, and visibility score improved from 7/10 to 9/10 with use of DBT.
Conclusion: Ductography combined with DBT is a safe procedure that has same indications as a conventional ductography but provides better margin characterization and improves radiologist confidence.

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The Clinical Diagnostic Value of BI-RADS in Mammography

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Objective: To evaluate the diagnostic value of the breast imaging reporting and data system (BIRADS) in mammography
Materials & Methods: A total of 911 patients with 1063 breast lesions were included in this study. Each lesion was analyzed according to BI-RADS and categorized as category 3 (probably benign), category 4A, 4B, 4C (probably malignant), or category 5 (highly suggestive of malignancy). The classification of BI-RADS assessment results was compared with the pathological results.
Results: Compared with the pathological results, the area under the receiver-operating characteristic curve (AUC) of BI-RADS classification for breast lesions was 0.94 ($p < 0.010$), the sensitivity was 86.5%, the specific degree of 88.5%. The Positive predictive value (PPV) for category 3, 4A, 4B, 4C, 5 were 7.2%, 25.2%, 75.8%, 96.9%, 98.7%. The diagnostic performance of BI-RADS Compared with the pathological results, the area under the receiver-operating characteristic curve (AUC) of BI-RADS classification for breast lesions was 0.94 ($p < 0.010$), the sensitivity was 86.5%, the specific degree of 88.5%. The Positive predictive value (PPV) for category 3, 4A, 4B, 4C, 5 were 7.2%, 25.2%, 75.8%, 96.9%, 98.7%. The diagnostic performance of BI-RADS.
Conclusion: The BI-RADS reporting system has a high value in the qualitative diagnosis of breast diseases and provides guidance for the follow-up treatment.

Correlation of Mammography to Histopathology Result on Breast Cancer Patients in Yogyakarta

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Objective: Mammography examination is still the most trusted method and is widely used for breast cancer screening and for the diagnosis of breast cancer. The description of an abnormality or a lesion on mammography reflects the pathological changes that occur in breast anatomy.
Materials & Methods: This research is a retrospective observational analytic study to determine the morphological picture of breast carcinoma based on mammography examination with histopathological examination results.
Results: The results of this study showed that there was no correlation between age and breast cancer patients 'pathology with a significance value of 0.531, did not have a correlation between breast composition with breast cancer patients' pathology with a significance value of 0.105, did not have a correlation between the shape and the breast cancer patient's pathology with a value of significance 0.809, do not have a correlation between the border with hispathology of breast carcinoma patients with a significance value of 0.286, do not have a correlation between the number of lesions with hispathology of breast carcinoma patients with a significance value of 0.778, has a correlation between calcification forms with hispathology of breast carcinoma patients with a significance value of 0.032 and has a correlation between calcification distribution with hispathology of breast carcinoma patients with significant values fish 0.042.
Conclusion: The majority of morphological variables with hispathology have no correlation.

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The Usefulness of Pre-Operative MRI to Assist in Decision Making for Patients Selected for Breast Conserving Surgery with Intraoperative Radiotherapy (IORT)

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Objective: We aim to determine the usefulness of MRI in decision making and surgical management for patients selected for IORT. We also aim to compare lesion measurements in different modalities (ultrasound, mammogram, MRI) against pathological size as gold standard.
Materials & Methods: 62 patients were eligible for IORT over a 34-month period. All had pre-surgical mammogram and ultrasound while 41/62 had preoperative MRI. Imaging-pathological size concordances were analysed.
Results: 5/21 (23.8%) patients were subjected to additional EBRT post-surgery due to lymphovascular invasion and involved margins. 10/41 patients (24.4%) in the MRI group were subjected to additional EBRT due to lymphovascular invasion, involved margins, and axillary lymph node metastasis. 5/41 patients were deemed not suitable for BCS and IORT and had change in surgical management post MRI. MRI and mammogram showed better imaging-pathological size correlation with smaller mean difference in size compared to pathological size. Ultrasound underestimated lesion sizes by a mean of 4.5 mm, while MRI and mammogram overestimated with a mean of 1mm and 1.1 mm respectively. Statistically significant differences were seen in tumors smaller than 2 cm on ultrasound, whereas no significant differences were noted on MRI and mammogram regardless of tumor size. Discordant sizes were seen in larger tumors and associated with estrogen receptor negativity.
Conclusion: MRI is a useful adjunct to conventional imaging and impacts decision making in IORT. It is also the better modality in determining the actual pathological size.

Mean Glandular Dose of Three Mammographic Procedures: 2D, 3D Imaging and Contrast Enhancement Digital Mammography (CEDM) at Different Breast Thickness

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Objective: This study was done with the aim to determine the Mean Glandular Dose (MGD) delivered by three mammographic procedures ie two dimensional (2D) imaging, three-dimensional (3D) imaging and contrast-enhanced digital mammography (CEDM) at different breast thickness.
Materials & Methods: The data on patient's demographic information, breast thickness, the compression force, peak kilovoltage (kVp) and current (mAs) from January 2018 until December 2019 were collected from the Hologic Selenia Dimensions machine console retrospectively. MGD was determined by multiplying the surface exposure value and published dose factors at different breast thickness and the results were tabulated.
Results: The results from this study shows a difference of MGD among 2D mammography, 3D mammography and CEDM however these were within the acceptable range. The radiation dose of CEDM was slightly higher than 2D and 3D mammography and was directly proportional to the breast thickness.
Conclusion: The MGD for 2D mammography, 3D mammography and CEDM were within the acceptable range. Although an increment of the radiation dose was seen in CEDM, the value does not exceed the recommendation for maximum dose in mammography.

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Sonoelastography in Evaluation of Fibrocystic Breast Disease

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Objective: Fibrocystic breast disease or fibroadenosis is a benign disease characterised clinically by mastalgia, firm palpable regions in the breast and at times a suspicious palpable lump. Mastalgia is characteristically premenstrual and is partially or completely relieved with menstrual flow associated with decreased firmness of breast tissue. For long, high-resolution ultrasonography (HRUS) is being utilised for differentiating benign from malignant breast diseases. Recently, sonoelastography especially acoustic radiation forced impulse (ARFI) imaging is being evaluated for its various applications in breast imaging. Hence, this prospective pilot study aimed to:

- Evaluate role of Sonoelastography in evaluation of fibrocystic breast disease.
- Evaluate role of ARFI in differentiating normal from fibrocystic breast parenchyma.

Materials & Methods: At least 30 breasts, 15 each with normal and proven fibrocystic disease were evaluated by sonoelastography. Data from virtual touch tissue quantification (VTTQ) was collected from fibroglandular parenchyma in the region of axillary tail and superolateral quadrant of breast in both normal & disease groups. The data obtained from control group was then compared with that from of cases.

Results: Sonoelastography picked up 12 out of 15 cases with elasticity values lower than that of normal breast (usually less than 2 m/sec).

Conclusion: Sonoelastography is highly accurate allowing confident diagnosis of fibrocystic disease thus obviating need for tissue diagnosis. Given high prevalence and benignity of fibrocystic breast disease and high accuracy of sonoelastography, imaging can be used with in not only reaching the diagnosis but also in monitoring the treatment of disease thus optimising cost and duration of treatment.

Usefulness of Pre-OP Evaluation Using Contrast-Enhanced Ultrasound (CEUS) in Breast Cancer Patients

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Learning Objective: This exhibition is to introduce breast CEUS and explain the diagnostic and clinical usefulness of CEUS in various breast cancer cases.

Background: Contrast-Enhanced Ultrasound (CEUS) is able to assess the microflow of tumors using microbubble contrast agents and provide quantitative qualitative analysis of tumor microvasculature. Recent studies report that hemodynamic features assessment of breast cancer through CEUS is comparable to contrast-enhanced magnetic resonance imaging.

Findings and/or Procedure Details:

- Introduction of CEUS
- Methods of CEUS in breast evaluation
- Analysis of CEUS in breast tumors
- Features of CEUS in breast cancer
- Comparison of CEUS and dynamic contrast enhanced MRI of breast cancer
- Application of CEUS on 2nd look US for evaluation of additional suspicious lesions on preoperative breast MRI
- CEUS for evaluation of neoadjuvant chemotherapy

Conclusion: Understanding of features and characteristics of CEUS in breast cancer will be helpful for accurate diagnosis and appropriate management.

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Sonographic Features to Differentiate Phyllodes Tumors and Fibroadenomas

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Objective: Due to the high resemblance of clinical characteristics between phyllodes tumors and fibroadenomas, this study was conducted to distinguish them in sonographic features.
Materials & Methods: We collected 32 breast ultrasound images of female patients presented in Oncology Clinic Yogyakarta, to this retrospective study; 15 pathologically proven phyllodes tumors and 17 pathologically proven fibroadenomas. Patients' age was also recorded. Statistical significance was then evaluated using chi-square analysis.
Results: In sonographic features, tumor size for more than 5 centimeters were seen in 82.4% of phyllodes, while only 4% in fibroadenomas ($p < 0.0001$). Phyllodes showed 88.2% heterogenous internal structure compared to 11.8% in fibroadenomas ($p < 0.0001$). About 94.1% oval shape lesion were observed in fibroadenomas and 29.4% in phyllodes ($p = 0.047$). Solitary lesion was characteristic of phyllodes; 35.3% of fibroadenomas were multiple ($p = 0.011$). About 88.2% of phyllodes presented with vascularization in color Doppler; 47.1% in fibroadenomas ($p = 0.001$). The presence of cleft cyst spaces in phyllodes was 82.4% compared to fibroadenomas for only 1% ($p < 0.0001$). No significant difference was found in posterior attenuation ($p = 0.320$) and location of the affected breast ($p = 0.290$). All of the lesions examined in the study presented with circumscribed margin and parallel orientation. Meanwhile, age also differed phyllodes from fibroadenomas ($p = 0.019$) with 73.3% occurrence in more than 40 years-old in phyllodes, and only 23.5% in fibroadenomas.
Conclusion: Breast ultrasound could help radiologists to differentiate phyllodes tumors from fibroadenomas related to pathological findings concordance. Age could also be considered as an important factor to make diagnosis more accurately.

MRI Features of Papillary Lesions of the Breast: Imaging and Histopathologic Correlation

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Objective: To evaluate the imaging findings of papillary breast lesions (PBL), in particularly the characteristic features of malignant papillary lesions on magnetic resonance imaging (MRI).
Materials & Methods: This retrospective study includes 33 histopathological proven PBL in 18 patients who underwent MRI between 2016 and 2019. The imaging findings were reviewed by breast imaging specialist based on Breast Imaging Reporting and Data System (BIRADS) parameters. Lesions were divided into benign (with/without atypia-BA) and malignant categories. Chi-squared and Fisher's exact tests were used for analysis between these two groups.
Results: There were 18 BA and 15 malignant lesions. On MRI, irregular shapes (n = 6), non-circumscribed margins (n = 6), heterogenous enhancement (n = 11) and associated non-mass enhancement (NME) (n = 11) were all significantly associated ($p < 0.050$) with malignant lesions. Linear (n = 6) and segmental NME (n = 4) were observed in malignant lesions. No associated NME was seen in BA lesions. On ultrasound, posterior features (n = 6) and increased vascularity (n = 10) were significantly associated ($p < 0.05$) with malignant lesions. Absence of posterior features (n = 15) and vascularity (n = 13) were significantly associated ($p < 0.050$) with BA lesions. On mammogram, malignant lesions (n = 6) frequently presented as mass while majority of BA (n = 16) did not present as mass on mammogram ($p = 0.025$). No significant differences were seen in other parameters on MRI, mammogram or ultrasound between the two groups. There were 6 BA lesions upgraded to malignant on surgical excision with no surgical intervention in 3 cases.
Conclusion: Irregular shapes, non-circumscribed margins, heterogenous enhancement and association with linear and segmental NME were features significantly predictive of malignant papillary lesions on MRI.

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Radiological Findings and Clinico-Pathological Correlation of Ductal Carcinoma In-Situ (DCIS): 10-Year Review from Opportunistic Screening and Diagnostic Assessment

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Objective: To determine the incidence, clinical features and imaging findings of different grades of ductal carcinoma in-situ (DCIS) in a tertiary referral centre over a 10-year period.
Materials & Methods: Retrospective recruitment of 142 patients diagnosed pathologically with DCIS obtained through breast cancer registry. Patient's clinical presentation, imaging features and histopathological features were evaluated and the relationship between pathological and imaging findings was investigated.
Results: Of the 142 patients, 49.3% and 50.7% were from symptomatic and opportunistic screening respectively. 70.4% were in the high risk (age 50–74), 24.6%, intermediate risk (age 40–49) and 4.9% low risk (age < 40) groups. 38.7% were high grade, 20% intermediate and the rest were low grade DCIS. Mass with/without calcifications was found in 72% of high grade, 76% intermediate and 82.8% low grade, with most of them were symptomatic and majority was associated with B3 lesions. Of the 32 patients who presented with calcification, only 4/5 were from screening. Irregular hypoechoic/heterogeneous lesions with indistinct or spiculated margin were the most common sonographic findings in high grade DCIS (14.5%, n = 8/55). Comedonecrosis was more significant in high grade DCIS (n = 8, 14.5%) Whereas non-comedo cell type was more commonly seen in low and intermediate grade cases 19.5% (n = 19/87).
Conclusion: DCIS incidence was highest in the high-risk age group. Most DCIS in our study presented with mass with/without calcification, contrary to screening population data whereby 75% of DCIS present with microcalcifications only. Careful consideration of mass and proliferative B3 lesions were therefore crucial to capture DCIS at its early stage.

Preoperative Evaluation of Axillary Lymph Node Status in Breast Cancer Patients Using Ultrasound Shearwave Elastography

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Objective: Ultrasound shearwave elastography (SWE) has been shown in several studies to improve diagnostic value of the conventional ultrasound in the assessment of axillary lymph node (ALN) metastases in breast cancer patient. The objective of this study is to evaluate the diagnostic performance of ultrasound SWE in differentiating benign and metastatic ALN.
Materials & Methods: SWE ultrasound was performed as a preoperative assessment using Supersonic Aixplorer scanner in women with breast cancer from August 2018 until November 2019. Conventional ultrasound of the breast lesion and ALN were evaluated based on the size of the breast lesion and ALN, presence of ALN hilum and also ALN cortical thickening. For Qualitative SWE, the images of ALN were classified into four colour pattern. Quantitative SWE measurements involved calculation of the stiffness of the breast lesion and ALN.
Results: To date, a total of 105 patients, comprising of 98 patients with invasive carcinoma and 7 ductal carcinoma in-situ were examined. 49 patients have metastatic ALN whilst 56 were benign. Qualitative SWE gives a positive predictive value of 65.2% with sensitivity 95.9% (p value < 0.001). Using cut off value ALN Emax (maximum stiffness) of 12.7 kPa Quantitative SWE, gives a positive predictive value of 61.0% with sensitivity 61.2% and area under the curve (AUC) of 63% (p value < 0.005).
Conclusion: SWE in combination with conventional ultrasound have a potential diagnostic tools adjunct in differentiating metastatic ALN. Qualitative shearwave elastography in our study exhibited better diagnostic performance than quantitative SWE and conventional ultrasound parameters.

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Artificial Intelligence in Breast Cancer Detection Using Deep Learning

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Objective: Convolutional neural network is an artificial intelligence technique based on physiological principles underlying human visual cortex. This study aims to evaluate the potential of a deep learning algorithm to be used for evaluation of these masses for breast cancer detection.
Materials and Methods: Mammograms conducted at a tertiary hospital between May 17 and April 19 were studies with equivocal findings excluded resulting in 190 mammograms. Test set of 45 images was randomly selected from initial sample (27 abnormal, 18 normal) and were not used in training process. Further 37 abnormal scans were randomly excluded resulting in training set of 54 normal and 54 abnormal mammograms. Equal number of images were required in each group for optimal network training and converted to JPEG format image. The initial sample was amplified 26-fold using combination of horizontal flip, size alteration and rotation. The pre-trained Inception v3 network was then retrained using the amplified mammograms with learning rate of 0.01.
Results: The proportion of abnormal mammograms was 62%. Area under receiver-operator curve for this CNN as a diagnostic test was 0.87 demonstrating a high level of diagnostic test accuracy. Output from CNN produces a continuous score of between 0 (abnormal) and 1 (normal). Setting the threshold to 0.395 as the output score results in a test sensitivity of 96.3%, specificity of 66.7%, positive predictive value of 81.3% and negative predictive value of 92.3%.
Conclusion: This proof of concept study demonstrates that high diagnostic test accuracy can be achieved in automated analysis of mammograms. In this study CNN could never outperform radiologist since radiologist's opinion was the ground truth.

Artefacts in High Resolution Imaging of the Breast Onco-Radiologist's Worst Nightmare

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Learning Objective: The purpose of this study is to present the varying appearances of artefacts in ultrasound of the breast because they may result in the failure to recognize a breast cancer or prompt unnecessary biopsy of a benign finding.
Background: Ultrasound is a useful imaging tool to provide clinically vital information in assessing a wide range of breast pathologies. It is an excellent imaging tool to determine the nature of a mass lesion (cystic or solid) and anatomic relation to adjacent structures. Lesions can be also characterized in terms of their size, shape, number, echotexture, and vascularity with power and colour Doppler US. Ultrasound can also demonstrate compressibility of the lesion and relation with adjacent moving structures, such as tendons. In this pictorial assay we present the common sources of error include the failure to recognize the sonographic appearance of normal breast anatomy, the improper setting of instrumentation controls, strangeness of sonography physics, and the presence of iatrogenic air and foreign bodies in the breast. To minimize confusion and misdiagnosis, we review and illustrate characteristic artefacts and pitfalls encountered during ultrasound of the breast.
Findings and/or Procedure Details:
Normal Anatomy: Rib, Nipple, Fat Lobule, Lactiferous Duct.
Acoustic Shadowing: Cooper's suspensory ligament, Poor transducer–skin contact, Scar formation Sonography Physics and Instrumentation: Edge Shadowing, Reverberation Artefact, Gary-Scale Gain, Dynamic Range, Focal Zone.
Air and Foreign Bodies.
Conclusion: To circumvent overlooking signs of breast cancer while preventing unnecessary biopsies, It is important to recognize the artefacts and pitfalls commonly encountered at breast sonography. Knowledge of normal breast anatomy, an understanding of the appropriate instrumentation, and the performance of routine imaging in two orthogonal planes is essential for accurate interpretation of breast sonograms.

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Pre-Operative Assessment of Congenital Heart Disease a Pictorial Assay

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Learning Objective: Congenital heart disease (CHD) is an important cause of Neonatal and Paediatric mortality & morbidity. CHD is invariably a developmental defect that may occur singly or in combination with other anomalies. Patients with complex congenital heart disease (CHD) have a high incidence of extracardiac vascular and non-vascular malformations. Those additional abnormalities may have an impact on the precise planning of surgical or non-surgical treatment.
Background: Accurate diagnosis with detail delineation of extra-cardiac, systemic and pulmonary arterial and venous structures are very important in managing these patients, surgical planning or other interventions. Cardiac computed tomography angiogram (CCTA) is a non-invasive, increasingly popular modality in evaluation of congenital heart diseases (CHD) in children. Despite radiation exposure, (CCTA) is now commonly used for evaluation of the complex CHD, giving information of both intra-cardiac and extra-cardiac anatomy, coronary arteries, and vascular structures. It is important for radiologists to have extensive knowledge of cardiovascular anatomy, physiology, and surgical techniques.
Findings and/or Procedure Details: Here, several cases are discusesed where CCTA played an invaluable role in diagnosing the CHD. We scanned patients using 128 slice CT scanner, iodinated contrast media 2 mL/kg body weight, 4 phase non-ECG gated CCTA. Some patient needed anaesthesia/sedation. Post processing multi planar/3-D image reconstruction was done for image analysis.
Conclusion: CCTA is an accurate modality & plays a key role for demonstrating the anomalies, extracardiac structures in complex CHD and guiding the surgical team for a proper planning.

Isolated Interrupted Aortic Arch

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Learning Objective: To demonstrate importance of multislice CT (MSCT) in the diagnosis of interrupted aortic arch (IAA).
Background: IAA is an extremely rare congenital malformation of the aorta which occurs in approximately 3 per million live births. It is defined as complete luminal and anatomical discontinuity between the ascending and descending aorta. Most patients are diagnosed in early childhood, however there are sporadic incidences of survival up to adulthood.
Findings and/or Procedure Details: A 25-year-old lady, diagnosed with young hypertension, presented with symptomatic anaemia, fever and right ankle pain and was treated as rheumatoid arthritis (RF positive). On physical examination, her blood pressure was 162/98 mm Hg with a normal heart rate. Cardiovascular examination did not reveal any murmur. Echocardiography demonstrated an enlarged ascending aorta. Turbulence was seen after the descending aorta suggesting the possibility of a coarctation of aorta or aortic dissection. The patient was referred for a MSCT angiography of the thoracic aorta which revealed an enlarged ascending aorta with interruption of the aortic arch distal to the level of the left subclavian artery, with numerous collateral vessels arising from the descending thoracic aorta. No intimal flap to suggest aortic dissection. This case demonstrates the clinical value of MSCT angiography in detection of IAA which was not seen on echocardiography.
Conclusion: IAA is rarely encountered in adults. MSCT angiography is a useful diagnostic imaging modality in patients with this congenital anomaly for precise and prompt diagnosis.

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Myocardium Viability in Impaired Left Ventricular Ejection Fraction Patients as Evaluated Using Tc99m-Tetrofosmin Cardiac Viability Study

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Objective: Impaired ejection fraction (EF) ≤ 40% denotes heart failure with reduced EF. However, viable myocardium has been demonstrated in considerable number of severe left ventricular dysfunction patients. Nitrates-enhanced Tc99m-Tetrofosmin cardiac viability study is a feasible relatively uncomplicated procedure providing information pertinent to heart failure management. We aimed to describe clinical profile and myocardium viability/scintigraphy findings of impaired EF patients as demonstrated on Tc99m-Tetrofosmin viability study.
Materials & Methods: Analysis of patients who underwent cardiac viability study in our centre between July 2014 and August 2018. They received sublingual nitrates (GTN) 15 minutes prior to Tc99m-Tetrofosmin injection. Imaging performed one hour later. Viability evaluation was done using Emory Cardiac Toolbox with 50% perfusion cut-off point. Clinical data and scan findings of impaired EF patients (n = 28) were compiled and analysed accordingly. One patient with incomplete information was excluded.
Results: Average age was 55.2 years. Majority were males (n = 25) and reported ≥ 3 risk factors (n = 24). 13 patients had prior cardiac admission (myocardial infarction, n = 8). Viability study demonstrated biventricular dilatation in 6 patients. Mean percentage of previous EF and viability study-calculated EF were 27% and 29% respectively. The overall mean percentage of estimated viable myocardium was 70.6%. Males were associated with lower mean percentage of viable myocardium compared to females (68.2% vs. 100%, $p < 0.050$). Among 21 cases of dilated heart with presence of non-viable lesions, biventricular dilatation was associated with extensive RCA territory involvement ($p < 0.050$).
Conclusion: Males were found to have lower mean percentage of viable myocardium. Biventricular dilatation was associated with extensive RCA territory involvement.

Patterns of Hypertrophic Cardiomyopathy in Cardiovascular Magnetic Resonance; Hospital Serdang Experience

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Learning Objective: Non-invasive imaging is principal to the diagnosis of hypertrophic cardiomyopathy (HCM). Cardiovascular magnetic resonance (CMR), being one of the common armamentarium aiming at detailed cardiac assessment primarily in characterising cardiac morphology, function and tissue abnormalities. HCM prognostic factors can be evaluated through the assessment of myocardial wall thickness, systolic function and late gadolinium enhancement.
Background: HCM is the most common genetic disease of the heart with a prevalence of 1:500 in the general population. It is an autosomal dominant trait attributed to more than 1000 gene mutations that encode for sarcomere proteins of myocardium. The clinical presentation ranging from asymptomatic mutation carriers to sudden death, commonly known as hypertrophic obstructive cardiomyopathy (HOCM).
Findings and/or Procedure Details: We describe a wide phenotypic range of HCM which includes sigmoid septum, reverse contour, mid ventricular, apical, symmetric and asymmetrical hypertrophy commonly encountered in our hospital. The related clinical presentation includes abnormal heart rhythm, syncopal attack or heart failure symptoms. Left ventricle wall thickening with preserved systolic function happened in early HCM. Whereby, late HCM or "burn out phase" presented with dilated thinning wall and poor systolic function. Left ventricular outflow tract obstruction, increase myocardial thickness of more than 3cm and late gadolinium enhancement were the signs of poor prognosis.
Conclusion: Understanding the characteristics and phenotypes of HCM is important for accurate diagnosis and proper treatment of cases. Optimisation of heart failure symptoms are the mainstay in HCM management. Alcohol ablation of myocardium is usually offered to HOCM cases in our hospital.

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Biomechanical and Electrical Properties of the Heart During Mild Anxiety

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Objective: The electrical properties of heartbeats may change significantly during certain medical conditions such as anxiety disorder that cause a change in the normal function of the heart. It can be detected through an electrocardiogram (ECG) that records the electrical activities of atriums and ventricles in mV over time.
Materials and Methods: A basic device of the ECG system was applied in this study by attaching two electrodes to the inner side of the wrist. The electrical activity of the heart was recorded for a person who was diagnosed with mild anxiety and complains to have feeling like fluttering inside the chest in the middle. A QRS complex wave was given more attention in the analysis of ECG.
Results: The ECG graph showed abnormality and instability in the electrical activity of the heartbeat in the form of the ectopic beat with the missing of a P wave or atrium contraction. The graph also showed a drop in heart electrical potential for ventricles for few heartbeats. It was found that anxiety may cause physiological changes of the heart that cause a person to have an ectopic beat every 13 beats on average and an uncomfortable sensation of heart palpitation.
Conclusion: Monitoring electrical properties of heartbeats during anxiety may provide early information regarding any possibility of heart arrhythmias. It can provide some medical information that necessary for any proposed clinical intervention.

The Role of CT Angiography and ECG in Heart Arrhythmia Diagnoses after Beta-Blocker Administration

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Objective: Using modern medical technologies such as electrocardiography (ECG) systems and computed tomography (CT) scan machines in diagnostic procedures of heart arrhythmia may provide reliable clinical results. Sometimes some of them play the main role in the diagnosis of heart disease associated with the early stage of stress.
Materials and Methods: In this study, both ECG graph and CT angiogram were analysed after beta-blocker administration for mild anxiety case. The electrical properties of ECG were evaluated before and after beta-blocker administration while CT angiography was applied after medication's intake.
Results: The angiogram results showed no sign of coronary artery disease with zero score of calcium as reported by a cardiologist. The number of ventricular ectopic beats that recorded by Ambulatory Holter was 26 for 24 hours monitoring time which represents 0.02% of total heartbeats after beta-blocker intake. There were only changes in electrical signals and properties of the heart was observed in the ECG graph that can be explained the effect of beta-blocker on heart arrhythmia diagnosis.
Conclusion: The beta-blocker intake was found to be the most effective medication to suppress the ectopic beat that occurs during the early stage of stress. Its symptom reduction was clearly being observed through the ECG graph that showed a more consistent and arithmetic heartbeat.

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Optimization of Computed Tomography Pulmonary Angiography Protocols Using 3D Printed Model with Simulation of Pulmonary Embolism

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Objective: The aim of this study was to investigate optimal computed tomography pulmonary angiography (CTPA) protocols for detection of pulmonary embolism based on a 3D printed pulmonary model.
Materials & Methods: A patient-specific 3D printed pulmonary artery model was generated with thrombus placed in both main pulmonary arteries to represent pulmonary embolism. The model was scanned with 128-slice dual-source CT with slice thickness of 1 mm and 0. 5 mm reconstruction interval. The tube voltage was selected to range from 70, 80, 100 to 120 kVp, and pitch from 0.9 to 2.2 and 3.2. Signal-to-noise ratio (SNR) was measured in the main pulmonary arteries and within the thrombus regions to determine the relationship between image quality and scanning protocols.
Results: There were no significant differences in SNR measured in the main pulmonary arteries with 100 and 120 kVp CTPA protocols ($p > 0.05$), regardless of pitch value used. SNR was significantly lower in the high-pitch 3.2 protocols when compared to other protocols using 70 and 80 kVp ($p < 0.05$). There were no significant differences in SNR measured within the thrombus among the 100 and 120 kVp protocols ($p > 0.05$). For low dose 70 and 80 kVp protocols, SNR was significantly lower in the high-pitch of 3.2 protocols than that in other protocols with different pitch values ($p < 0.01$). Radiation dose was reduced by up to 80% when lowering kVp from 120 to 100 and 80 kVp without significantly affecting image quality.
Conclusion: Patient-specific 3D printed model can be used to develop optimal low-dose CT pulmonary angiography protocols.

Clinical Value of 3D Printing in Cardiovascular Disease

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Learning Objective: To demonstrate the clinical applications of patient-specific 3D printed models of heart, aorta, coronary and pulmonary arteries in terms of quantitative assessment of model accuracy, depiction of cardiovascular disease and development of optimal computed tomography (CT) scanning protocols.
Background: Three-dimensional (3D) printing has been increasingly used in clinical practice with promising reports in the cardiovascular disease. Studies have shown that realistic 3D printed models are able to replicate complex cardiac anatomy and pathology with high accuracy. However, comprehensive assessments of 3D printing in cardiovascular disease with regard to model accuracy, clinical value and optimisation of imaging protocols remain to be determined.
Findings and/or Procedure Details: 3D printed models were successfully generated with excellent demonstration of cardiovascular disease. Cardiovascular pathologies such as ventricular septal defect, aortic aneurysm, or aortic dissection can be clearly depicted on 3D printed physical models. Models were found to be highly accurate in replicating anatomical structures and pathologies when compared to the original source CT images with mean differences less than 8%. Low-dose CT protocols of 70 or 80 kVp and high pitch 2.2 or 3.2 are recommended for dose optimization. Calcified plaques were clearly visualized to demonstrate coronary stenosis, while coronary stents were visible within the 3D printed coronary arteries with stent lumen visibility > 70%.
Conclusion: Patient-specific 3D printed models have potential value to improve clinical practice by simulating surgical procedures and surgical planning. 3D printed models can be used to optimize CT protocols with low radiation dose but acceptable diagnostic images.

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Creation of Personalised 3D Printed Coronary Artery Models for Investigation of Optimal Cardiac CT Imaging of Calcified Plaques

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Learning Objective: This study aims to utilise three-dimensional (3D) printing technique for generation of patient-specific or personalised coronary artery models with simulation of calcification in the coronary arteries. with the objective of developing optimal coronary computed tomography angiography (CCTA) for diagnostic assessment of calcified plaques.
Background: Diagnostic value of CCTA is affected to some extent due to presence of heavy calcification, which results in low specificity and positive predictive value due to high false positive rates caused by calcification-related blooming artifacts. Thus, identification of optimal CCTA protocols for visualisation of calcified plaques and assessment of coronary stenosis is clinically important.
Findings and/or Procedure Details: CCTA images were used to create normal coronary artery models consisting of right coronary artery, left anterior descending and left circumflex arteries. Coronary artery models were printed using soft and elastic material, TangoPlus, which calcification was used with Verowhite, rigid material. Calcification which was printed with different sizes to simulate 50%, 70% and 90% stenosis was inserted into these coronary arteries and scanned using synchrotron radiation CT with different slice thicknesses ranging from 0.095 to 0.208, 0.302 and 0.491 mm. Results showed the significant impact of spatial resolution on accurate assessment of coronary stenosis in the presence of calcified plaques, with spatial resolution of 0.491 mm leading to significant overestimation of lumen stenosis.
Conclusion: This study shows the feasibility of using 3D printed coronary models with simulation of calcification for determining CCTA protocols for accurate assessment of coronary stenosis.

Usefulness of Patient-Specific 3D Printed Coronary Models in Coronary Stenting

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Objective: To insert coronary stents into personalized 3D printed coronary models with the aim of determining optimal coronary CT protocols for stent lumen visibility.
Materials & Methods: A total of six coronary stents with diameter ranging from 2.5 to 4.0 mm were placed into 3 3D printed coronary models for simulation of coronary stenting. The 3D printed models were placed in a plastic container and scanned on a 192-slice third generation dual-source CT scanner with images reconstructed with soft (Bv36) and sharp (Bv59) kernel algorithms. Thick and thin slab maximum-intensity projection (MIP) images were also generated from the original CT data for comparison of stent lumen visibility. Stent lumen diameter was measured on 2D axial and MIP images.
Results: The stent lumen visibility ranged from 54 to 97%, depending on the stent location in the coronary arteries. The mean stent lumen diameters measured on 2D axial, thin and thick slab MIP images were found to be significantly smaller than the actual size ($p < 0.010$). Thick slab MIP images resulted in measured stent lumen diameters smaller than those from thin slab MIP images, with significant differences noticed in most of the measurements (4 out of 6 stents) ($p < 0.050$), and no significant differences in the remaining 2 stents ($p = 0.190–0.380$). Images reconstructed with sharp kernel Bv59 significantly improved stent lumen visibility when compared to the smooth Bv36 kernel ($p = 0.010$).
Conclusion: This study shows the feasibility of using 3D printed coronary artery models in coronary stenting for investigation of optimal coronary CT protocols.

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A Lasso-Derived Risk Model for Subclinical CAC Progression in Asian Population with an Initial Score of Zero

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Objective: This study is aimed at developing a prediction nomogram for subclinical coronary atherosclerosis in an Asian population with baseline zero score, and to compare its discriminatory ability with Framingham Risk Score (FRS) and Atherosclerotic Cardiovascular Disease (ASCVD) models.
Materials & Methods: Clinical characteristics, physical examination, and laboratory profiles of 830 subjects were retrospectively reviewed. Subclinical coronary atherosclerosis in term of coronary artery calcification (CAC) progression was the primary endpoint. A nomogram was established based on a least absolute shrinkage and selection operator (LASSO)-derived logistic model.
Results: Of the 830 subjects with baseline zero score with the average follow-up period of 4.55 ± 2.42 year in the study, these subjects were randomly placed into the training set or validation set at a ratio of 2.8:1. These study results showed in the 612 subjects with baseline zero score, 145 (23.69%) subjects developed CAC progression in the training cohort (n = 612), while in the validation cohort (n = 218), 51 (23.39%) subjects developed CAC progression. This LASSO-derived nomogram included the following 10 predictors: "sex," age," "hypertension," "smoking habit," "Gamma-Glutamyl Transferase (GGT)," "C-reactive protein (CRP)," "high-density lipoprotein cholesterol (HDL-C)," "cholesterol," "waist circumference," and "follow-up period." Compared with the FRS and ASCVD models, this LASSO-derived nomogram had higher diagnostic performance and lower Akaike information criterion (AIC) and Bayesian information criterion (BIC) value. The discriminative ability, as determined by the area under receiver operating characteristic curve was 0.780 in the training cohort and 0.836 in the validation cohort.
Conclusion: This validated nomogram provided a useful predictive value for subclinical coronary atherosclerosis in subjects with baseline zero score and could provide clinicians and patients with the primary preventive strategies timely in individual-based preventive cardiology.

Evaluation of an Open-Source Software Tool For T2* Mapping in Quantitative MRI

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Objective: Magnetic resonance (MR) imaging technology of cardiac and liver MR T2* mapping are used as indirect methods to measure iron load in myocardium and liver respectively. There are different sources for T2* relaxation time measurement. The purpose of this study was to validate free software for T2* measurement. It is assumed that if similar fitting algorithm is used for the T2* measurement, the free software would be interchangeable with the commercial software used.
Materials & Methods: Multi-echo gradient-echo technique on the 1.5 T MRI system would be used to measure T2* value of a series of aqueous MnCl2 phantoms and patients registered as thalassemic patients respectively. T2* obtained from CMRtools was used for reference. T2* values generated from the free software tool were compared with these from CMRtools. Bias and variability were computed using the Bland-Altman analysis.
Results: The correlation coefficient were > 0.99 for both patients and phantoms. The agreement of the T2* calculation were calculated by free software as compared to CMRtools. There were only minimal differences (< 3 ms and < 0.5 ms) with a small bias (0.08 ms and 0.11 ms) for cardiac and liver protocol in patients respectively. All points lie inside the limits of agreement for data from patients. The two methods might be considered to be in agreement and may be used interchangeably.
Conclusion: The free software for T2* measurement was evaluated. Bias and variability were found quite low. Our results show that the open source software tools might provide accurate T2* relaxation time measurements as CMRtools does.

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Severity of Coronary Atherosclerosis on CT Coronary Angiography in Patients with Zero Calcium Score

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Introduction: To find frequency of the presence and severity of coronary plaques on computed tomography coronary angiography (CTCA) in patients with zero calcium score.
Materials & Methods: Prospective descriptive study of 245 selected patients, who had a zero coronary calcium score (Age range of 30 to 66 years, Median = 44.8) and underwent CT coronary angiography on 128 slice Toshiba's Multidetector CT scanner (MDCT), between Dec 2012 and January 2018 at a hospital in Peshawar. Images were assessed on Vitrea workstation for calculation of plaque burden and vessel analysis was done using automated and manual select vessel option. The presence of plaques and extent of stenosis were evaluated. Retrospective interpretation of prospectively acquired data was done using Microsoft Excel and SPSS.
Results: 130 patients (53%) had atherosclerotic disease; 23 (9.3% of total patients) had significant (> 50%) coronary stenosis, out of which 10 patients had > 70% stenosis. 107 (43.6% of total patients) had non-significant (< 50%) coronary stenosis. 115 (46.9%) of the patients had normal coronary arteries with no disease. We conclude from our results that in patients with zero calcium score, atherosclerosis was seen in 53% patients and 9.3% had significant coronary artery disease. Hence, zero calcium score does not absolutely exclude the coronary artery disease.
Conclusion: We conclude form our results that in patients with zero calcium score, atherosclerosis was seen in 53% patients and 9.3% had significant coronary artery disease. Hence, zero calcium score does not absolutely exclude the coronary artery disease.

CT Radiation Dose Reduction in Pediatric Cardiac CT for Cardiovascular Anomalies – Clinical Audit in a Single Centre

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Objective: To reduce radiation dose from Multidetector computed tomography (MDCT) using techniques with low tube voltage and modified image parameters without significant degradation of image quality.
Materials & Methods: This is a prospective analysis with single blind selection of cardiac anomaly patients referred to radiology department for cardiac CT scan during Jan 2013 to Dec 2015. Total of 100 patients with age range of 1 week to 16 years were selected with echocardiographic suspicion of cardiovascular anomalies. It was probability sampling. Scan was performed on 128 multislice Toshiba scanner. Electrocardiographically (ECG)-gated retrospective and prospective scanning was performed using modified tube voltage (80 kVp, 100 kVp and 120 kVp) and with manual adjustment of low tube current. Radiation dose measurement was done by multiplying conversion factor with dose length product (DLP), which was provided by the CT scanner. Data wa processed using Microsoft Excel 2010. Images were reviewed on 5.1 vitrea workstation using multiplanar and 3D reconstruction. Two radiologists independently assessed subjective quality of the CT images to assess cardiac anomalies and normal anatomical structures.
Results: Prospective ECG gating significantly reduced radiation dose 22 mSv (retrospective) to 13.96 mSv (prospective) with standard inbuilt 120 kVp setting. Reducing the kVp to 100 further reduced dose to 10.3 mSv and dropped down to 5.46 mSv with 80 kVp and no significant image distortion. Manually adjusting and reducing the mAs with added filtration reduced the radiation dose to 3.64 mSv.
Conclusion: By using radiation lowering dose techniques i.e. prospective ECG gating, low kVp and mAs, we reduced radiation dose by 83.45% (22 to 3.46 mSv)

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Aortic Disease Assessment by Multidetector CT Aortogram

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Learning Objective: To evaluate reliability of 128-slice Multidetector computed tomographic (MDCT) angiography in differentiating aortic diseases and for aortic morphologic assessment.
Background: MDCT angiography has replaced invasive angiography for evaluation of patients suspected to have aortic disease. Although most aortic disease is associated with atherosclerosis (i.e. aneurysms and dissection), the spectrum of aortic disease is vast and includes various congenital and acquired entities. Radiologists should be familiar with uncommon aortic diseases, which are divided into those that are congenital in origin and acquired disorders, and with their findings at MDCT. Imaging information important to surgeons includes diagnosis, location of lesion and extent of disease.
Findings and/or Procedure Details: CT aortography is performed on a multidetector scanner with a breath-hold of 15 to 20 seconds and 1 or 2 mL/kg of nonionic contrast is given by power injector. Electrocardiographically (ECG)–gated studies are performed, when concern is to assess aortic root. Axial images are obtained from above arch to femoral arteries and reconstructed at 0.5 mm interval. Aortic measurements are made in true short axis projection acquired from double oblique views, from one blood-wall boundary to the other. The types of aortic abnormalities diagnosed on CT include atherosclerosis, coarctation, thoracic aortic aneurysms, dissections, diffuse aortic ectasia, pseudoaneurysms, PDA aneurysms, interrupted aorta, right sided aortic arch, Kommerells diverticulum, aortitis, Midaortic syndrome, arteriovenous malformation and Leriche syndrome.Different anatomical congenital variations can be seen like aberrant subclavian artery, right aortic arch etc.
Conclusion: Knowledge of the CT imaging appearances of aortic lesions enables preoperative assessment and post-procedural follow up for detection of complications.

Embryological Perspective and MDCT Evaluation of Anomalous Pulmonary Venous Return

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Learning Objective:
- To analyse the spectrum of anomalous pulmonary venous connection.
- To detect associated cardiac anomalies.

Background: In early embryonic period pulmonary venous drainage is through communication between splanchnic venous plexus in respiratory diverticulum and systemic cardinal & umbilico-vitelline veins which is followed by development of definitive pulmonary veins from left atrium. Failure of normal separation process between pulmonary and systemic venous connection leads to anomalous pulmonary venous drainage. Anomalous pulmonary venous drainage includes total anomalous pulmonary venous return (TAPVR), partial anomalous pulmonary venous return (PAPVR), sinus venosus defect and malposition of septum primum. Multidetector computed tomography (CT) is used to assess these complex anomalous venous connections associated with cardiac anomalies because of rapid acquisition, high spatial resolution and availability of data manipulation.
Findings and/or Procedure Details: Cross sectional observational study in infants and children diagnosed/clinical suspicious of anomalous pulmonary venous drainage associated with congenital cardiac disease based on echocardiography (ECHO). Image acquisition: Retrospective cardiac imaging in 128 slice Siemens Dual energy scanner. All cases were categorized based on CT imaging into TAPVR, PAPVR, sinus venosous defect and malposition of septum primum. Associated anomalies like ASD, heterotaxy syndrome and other intra and extra cardiac anomalies were detected in CT. The commonest pattern in our study was TAPVC.
Conclusion: Common anomalous pulmonary venous drainage in our study is TAPVC. CT is excellent imaging modality having high special resolution to detect anomalous connection and associated anomalies. CT imaging having rapid acquisition, no patient sedation needed and widely available but it is inferior to ECHO/magnetic resonance imaging in temporal resolution and functional data assessment.

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Embryological Perspective and MDCT Evaluation of Fallot Tetralogy

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Learning Objective:

- To study the embryological perspective Tetralogy of Fallot (TOF)
- To analyze the imaging findings in TOF and associated cardiac anomalies.
- Evaluation of post-surgical changes (patency of palliative shunt placement) and long-term complication including pulmonary regurgitation, right ventricular outflow obstruction, conduit stenosis, aortic root dilatation etc.) using multidetector computed tomography (MDCT).

Background:

Embryology

- TOF is the most common conotruncal anomaly. Anomalies in division of truncus arteriosus by abnormal aortopulmonary spiral septum lead to TOF

Tetralogy of Fallot (TOF)

- Malformation characterized by four constant features: sub-pulmonary infundibular stenosis, right deviation of aortic valve with a biventricular origin of its leaflet and right ventricular hypertrophy

Findings and/or Procedure Details: Cross sectional observational study of TOF patients (pre- and post-operative). Study was conducted in tertiary care hospital, ABVIMS and Dr. RML hospital, New Delhi, India. Image acquisition: Retrospective cardiac imaging technique in 128 slice Siemens Dual energy Scanner during the period of June 2018 to December 2019. Cases based review.

Conclusion: MDCT having superior spatial and temporal resolution. It has become a valuable modality in evaluating the complex anatomical cardiac and extra cardiac findings. MDCT is usual in evaluation of other associated cardiac and extra cardiac anomalies with will help in the surgical planning.

Functional Assessment of the Heart in Patients in the Early and Delayed Periods after Pulmonary Valve Replacement

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Objective: Tetralogy of Fallot (TF) is the most common cyanotic (blue) congenital heart disease and accounts for about 7–10%. According to the Baltimore-Washington Infant Research, tetralogy of Fallot accounts for 6.7% of all newborn with congenital heart disease.

Materials & Methods: In the radiology department of the NRCSC since October 2011 to December 2019 a total of 122 patients were examined on magnetic resonance imaging (MRI) after radical surgical correction of the Fallot tetrad, of which 30 (24.5%) patients showed indications for the second operation - implantation of a valve -bearing conduit into the position of the pulmonary artery.

Results: The age of patients who underwent implantation of a valve-containing conduit was from 5 to 15 years. The interval between TF correction and the second operation averaged from 2 to 12 years. The average level of the ejection fraction was 51%. In addition, we calculated the coefficients end diastolic volume (EDV)/body surface area (BSA) (mL/m^2) and end systolic volume (ESV)/BSA (mL/m^2) in 30 patients and amounted to 136.4 ± 11 and 75 ± 9, respectively (with normal values up to 108, 46), which served as an additional the criterion for the selection of patients for the second stage of the operation. The correlation between the level of NTproBNP pg/mL and EDV was also calculated and amounted to $r = 0.4$, which indicates a weak positive direct correlation.

Conclusion: MRI allows to effectively evaluate and predict the results of surgical correction of TF.

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Survey of CT Practice in Malaysia: Local Diagnostic Reference Level (LDRL) with the Advancement of Noise Magnitude Performances in Adult Computed Tomography Pulmonary Angiography (CTPA) Examination

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Objective: To establish the Local Diagnostic Reference Levels (LDRLs) of CTPA examinations in our institution with respective of image noise in different patient's size groups.
Materials & Methods: This study was held in Radiology Department, Hospital Kuala Lumpur. 127 patients (55 males and 72 females) who had undergone CTPA examinations using 128-slices CT-Scanner (Philips Brilliance iCT) were retrospectively selected. Dose information, scanning acquisition parameters and patient demographics, are recorded in standardized forms. Patient's sizes were categorized into three different groups based on their effective diameter (cm), P1 (14–19), P2 (19–24) and P3 (24–31). Noise was determined quantitatively by measuring the standard deviation in Hounsfield unit (HU) at five different arteries within the pulmonary trunk.
Results: We observed that the LDRL values are significantly different ($p < 0.050$) with the sizes, where median values of CTDIvol for P1, P2 and P3 sizes indicate 6.13, 8.3 and 21.40 mGy respectively. It is notable that the noise reference value is 23.78, 24.26 and 23.97 HU for P1, P2 and P3, respectively ($p = 0.538$). The CTDIvol and DLP attained to have the second highest value, 15 mGy and the highest value 542 mGy.cm, respectively compared to other countries available.
Conclusion: This study has successfully established the LDRLs with respective of image noise in different patient's size groups.

Tolerance and Safety of High Dose Adenosine in Stress Perfusion Cardiac Magnetic Resonance Imaging

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Objective: To assess the tolerance and safety of high dose adenosine in patients with inadequate haemodynamic response to the standard dose adenosine during stress perfusion cardiac magnetic resonance imaging (CMR).
Materials & Methods: A total of 125 consecutive patients with known or suspected coronary artery disease underwent CMR at 1.5 Tesla. Prior to scan, patients were screened for contraindications to adenosine. Blood pressure, heart rate, and electrocardiogram were obtained at baseline, during and after stress perfusion. All patients received the standard dose adenosine (140 mcg/kg/min for 2 minutes), the infusion rate was increased up to maximum of 210 mcg/kg/min (maximum infusion duration 6 minutes) in patients with inadequate haemodynamic response (deemed as increase heart rate [HR] < 10 bpm or decrease systolic blood pressure [SPB] < 10 mm Hg from baseline). Presence of chest pain, dyspnoea, flushing, and headache were recorded. Ejection fraction was measured from short axis images of the heart via software from ReportCARDTM.
Results: Fifty-two patients (42%) were non responders to standard dose adenosine. Following increase of infusion rate, 45 patients (87%) showed adequate haemodynamic response. Two patients (2%) developed transient advanced atrioventricular block during standard adenosine infusion. No scans were abandoned during or after high adenosine infusion. On multivariate analysis, ejection fraction < 59% is the only independent predictor of non-responders to standard dose adenosine.
Conclusion: High dose adenosine was safe and well tolerated and was effective in producing adequate haemodynamic response in non-responders. Ejection fraction < 59% is an independent predictor of non-responders to standard dose adenosine.

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Left Ventricular Abnormalities Detection Through Automatic EDGE Contouring Method

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Objective: The left ventricle (LV) shape of a cardiac magnetic resonance imaging (CMRI) helps doctor's identify various cardiac problems, but this involves difficulties such as the intensity and resemblance in shape between the LV and other organs. The main goal of this study is to segment 3D LV from CMRI images and classify the normal and abnormal conditions of heart automatically.
Materials & Methods: We have proposed an automatic edge contouring method that enables a system to take the decision from a CMRI left ventricle whether the patient belongs any abnormalities. This method utilizes the artificial neural network to predict the possible initial position of the LV and contour accurately the left ventricle from the CMRI. From the segmented shapes of the left ventricle from a series of CMRI, this method can predict the volume of the LV of the heart from where it finds the end-diastole and end-systole volume. From some standard statistical references, the proposed work decides the abnormalities of the CMRI.
Results: The model was applied to a renowned database and found that the accuracy of abnormality detection is 92%. On the other hand, the overall normal-abnormal detection rate is 85%.
Conclusion: Since the results of this work are quite convincing, hope that the proposed method will reduce the manual effort to detect left ventricular abnormalities based on CMRI images. Furthermore, this is the first work that utilizes the proposed method to evaluate the stroke volume and predicts the left ventricular abnormalities from the CMRI images.

Triple-Rule-Out CT Angiography for Evaluation of Acute Chest Pain

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Learning Objective:

- Briefly discuss importance of Triple-rule-out (TRO) computed tomographic (CT) angiography.
- To discuss the indications and patient suitability.
- Role of CT angiography in ruling out aortic, pulmonary and coronary arteries in one scan.
- To present and review CT images of patients with acute chest pain who undergone Triple-rule-out CT angiography at our department.

Background: TRO CT angiography can provide a cost-effective evaluation of the coronary arteries, aorta, pulmonary arteries, and adjacent thoracic structures for a patient with acute chest pain.
Findings and/or Procedure Details: It is most appropriate for the patient who is judged to be at low to intermediate risk for acute coronary syndrome (ACS) and whose symptoms may also be attributed to acute pathologic conditions of the aorta or pulmonary arteries. Although a regular cardiac rhythm remains an important factor in coronary CT image quality, newer multidetector CT scanners with electrocardiographically (ECG) gated imaging can provide high-quality CT studies in patients with a heart rate of up to 80 beats per minute. When performed with appropriate attention to timing and technique, TRO CT provides coronary image quality equal to that of dedicated coronary CT angiography and pulmonary arterial images that are free of motion artifact related to cardiac pulsation. It can exclude pulmonary embolism, aortic dissection and coronary stenosis in a single scan.
Conclusion: In an appropriately selected emergency department patient population, TRO CT can safely eliminate the need for further diagnostic testing in over 75% of patients.

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State of the Art of Coronary Computed Tomography Angiography

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Learning Objective: The aim of this paper is to evaluate contrast media (CM) bolus geometry and opacification patterns in the coronary arteries with particular focus on patient, scanner and safety considerations during coronary computed tomography angiography (CCTA).

Background: With rapid advances in CT scanner technology with faster scan acquisitions, the risk of poor opacification of coronary vasculature increases significantly. Therefore, awareness of CM delivery is paramount in consistently providing optimal image quality at low radiation dose.

Findings and/or Procedure Details: The rapid evolution of computed tomography (CT) technology has seen this imaging modality challenge conventional coronary angiography in the evaluation of coronary artery disease. Increases in spatial and temporal resolutions have enabled CCTA to become the modality of choice when evaluating the coronary vascular tree as an alternative in the diagnostic algorithm for acute chest pain. However, these new technologic improvements in scanner technology have imposed new challenges for the optimization of CM delivery and image acquisition strategies.

Conclusion: Understanding basic CM-imaging principles is essential for designing optimal injection protocols according to each specific clinical scenario, independently of scanner technology.

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Variability in the Size of Pulmonary Nodules and Masses Obtained Using the Lung Window and Mediastinal Window of the Computed Tomography Scan

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Objective: Accurate measurement of the size and doubling time of a pulmonary nodule is essential to predict its malignant potential and for cancer staging purposes. This study aimed to determine if there is variability in the measurements of the sizes of pulmonary nodules obtained using the lung and mediastinal windows of computed tomography scans.
Materials & Methods: A total of 132 patients with chest CT scans from the period of June to December 2014 were selected via stratified random sampling. Size measurements were taken in the preset lung and mediastinal windows using the ruler tool of the Philips Intellispace Portal program. Patient demographics and the imaging characteristics of the masses (margins, attenuation, presence of adjacent atelectasis, pleural/mediastinal attachment) were also tabulated. The mean difference, standard deviation, and Pearson correlation values were computed to determine the correlation between the measurements obtained using the two windows. Correlation between the inherent imaging appearance of the nodule and variability in their sizes taken using two different windows was also established.
Results: There was excellent correlation between the measurements obtained using the lung and mediastinal windows for both anteroposterior (Pearson's correlation coefficient 0.995) and mediolateral (0.988) dimensions. However, for lesions which exhibit ground-glass attenuation (0.716) and for small nodules (0.901), a marginal discrepancy was noted.
Conclusion: There is negligible variability between measurements of pulmonary nodules and masses obtained using the lung and mediastinal windows in the sample population. It may be prudent to indicate the specific window used in size measurement for follow-up purposes, especially for ground-glass nodules.

The Accuracy and Precision of HRCT Chest for Diagnosis of Anaemia

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Objective: In Pakistan, the prevalence of anemia is high. The aim of our study is to determine the accuracy and precision for diagnosis of Anemia at HRCT chest, keeping Complete blood count (CBC) as the gold standard.
Materials and Methods: A cohort of 124 patients attending our Hospital underwent CBC and Chest HRCT within 7 days interval comprised the study population. The Blood attenuation measurements and visual perception of inter ventricular septum (IVS) was done while blinded to Hemoglobin (Hb) lab values; IVS visualization is equivalent to Qualitative diagnosis of anemia. Region of Interest (ROI) cursor was placed within Right and Left ventricular chambers at Soft tissue window on axial sections. Quantitative diagnosis of anemia at CT was made when the HU was < 35HU in a chamber.
Result: There were 62 males and 62 females. 50 subjects comprised the control group and 74 were anemic acc. to Hematology. The Sensitivity, Specificity, Positive Predictive Value, Negative Predictive Value and Diagnostic accuracy of HRCT Chest for Quantitative diagnosis of anemia was 48.6%, 76.5%, 76.5%, 50.6% and 60.5% resp. and for Qualitative diagnosis of anemia was 55.4%, 88.0%, 87.2%, 57.1% and 68.5% resp. Chi square demonstrated significant association of anemia with visualization of IVS and AUC was found to be 0.312 with left sided skewed ROC curve; ICC = 0.74.
Conclusion: Overall, there is a high positive predictive value for the Quantitative diagnosis of anemia at HRCT chest with good precision. A Radiologist can arouse the suspicion of anemia 'Virtually' at HRCT chest.

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Diagnostic Accuracy of Non-ECG Gated Chest CT (NEGCT) for Cardiac Chambers' Dimensions, in Comparison with Echocardiography

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Objective: Assessment of heart chambers at CT scans has been understudied subject among Radiologists. Our study analyzed the accuracy of NEGCT for cardiac chambers' dimensions, keeping Echocardiography (Echo) as the gold standard.
Materials and Methods: After IRB approval, patients' data were archived from HMIS PACS that comprised NEGCT/CTPA and Echo exams performed within a month interval. The sizes of right ventricle (RV), left ventricle (LV), left atrium (LA) were recorded in shot axis at axial sections. RV and LV- transverse diameter was measured at basal third of the heart, from the inner-to-inner myocardium perpendicular to the inter-ventricular septum and LA- max. Anterior-posterior dimension was measured at the level of the aortic root. Concurrent Echo measurements were recorded.
Results: Total 213 subjects were found in the study, with average age of 52.1 yrs. The CT-Echo measurement concordance rates are significantly high for LA, LV and RV measuring 93.8%, 96.7% and 69.01% resp. Using CT threshold for LA, LV, RV enlargement > or equal to 45, 55, 35 mm, the AUC via ROC curve analysis was estimated to be 0.912, 0.992, 0.650 respectively. The Sensitivity, Specificity, Positive Predictive Value (PPV), Negative Predictive Value (NPV), Diagnostic accuracy of NEGCT was found to be 66.67%, 95.10%, 37.5%, 98.5% and 93.90% for LA; 100%, 96.67%, 30.0%, 100%, 96.7% for LV and 33.33%, 74.86%, 17.86% 87.26% and 69.01% for RV resp.
Conclusion: The accuracy of chamber dimensions at NEGCT was excellent, making it a modality of choice for examining cardiac chamber sizes.

COVID-19 Chest X-Ray Severrity Score

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Objective: COVID 19 is a global pandemic affecting most countries including Australia. Prognostication and assessment of disease severity on the basis of initial chest radiography (CXR) findings may be useful. Our aim was to assess whether initial CXR findings can predict hospitalization and intubation in patients that are RT-PCR SARS-CoV-2 positive in a large tertiary hospital in Sydney Australia (Westmead adults hospital).
Materials and Methods: All patients with RT-PCR SARS-CoV-2 positive were identified and their first CXR was analyzed by two senior radiology registrars (and adjudicated by a radiology consultant), splitting the frontal CXR into 6 zones and creating a severity score based on the number of lung zones that contain airspace opacities. The electronic notes for each patient were reviewed to establish which patients were hospitalized and which were intubated. The results were then analyzed to assess the utility of the CXR severity score for prognostication.
Results: In total, 215 patients were identified as RT-PCR SARS-CoV-2 positive. 143 of these had a CXR. If a severity score of ≥ 2 was used to predict hospitalization – this was 100% specific with 100% PPV but with 50% sensitivity and 64% NPV. If a severity score of ≥ 3 was used to predict intubation – this was 86% sensitive, 87% specific with a 43% PPV and 98% NPV.
Conclusion: Initial CXR evaluation may be useful to assess risk of hospitalization and intubation in Australian COVID-19 patients. Further studies with larger patient cohorts are required.

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Computer Aided Reading of Chest X-Ray in Screening of Pulmonary Tuberculosis in a High-Volume Tertiary Care Public Sector Hospital, Peshawar, Khyber-Pakhtunkhwa Province, Pakistan

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Objective: An important aspect of the report was to highlight the incidence of positive GeneXpert and its correlation with both the number of patients having a score above the value of 70 as well as below on CAD4TB software. This screening program involves a cascade including inter-referral between chest clinic and mobile x-ray unit, referral for GeneXpert, treatment plan, drug availability, testing for rifampicin resistance and treatment outcome. All of the above were provided free of cost.
Materials and Methods: This retrospective observational study was conducted by Radiology Department of a high-volume tertiary care public sector hospital in affiliation with Indus Hospital network. Data collected from mass screening by using CAD4TB software to analyze chest radiographs using scoring of 1–100. Individuals presumptive of tuberculosis referred for GeneXpert.
Results: Out of 26997 individuals screened, 2617 individuals were found presumptive for pulmonary TB by CAD4TB on X-ray findings and symptomology. Sputum samples for GeneXpert were obtained in 2100 individuals, out of which 1825 were presumptive on CAD4TB. GeneXpert was positive in 159 patients and negative in 1666 individuals. 275 of the 2100 were assessed for GeneXpert on the basis of symptomatology as their CAD4TB was negative out of which 32 patients were positive and 243 negative on GeneXpert. Hence sensitivity of 83.2% and specificity of 12.7%.
Conclusion: CAD4TB used for reading CXR is a useful tool for mass screening of TB in high burden countries. The software can be strengthened by radiologist input, hence making it an effective tool for mass screening and early diagnosis of TB in individuals, who would otherwise go undiagnosed.

Diagnostic Validity of Chest-Xray in Diagnosing Pulmonary Tuberculosis with Respect to Genexpert and The Radiologic Findings Correlated to Genexpert Results

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Objective: PTB is the sixth leading cause of morbidity and mortality in the Philippines. Part of the technical aspect of DOTS strategy involves case detection, which is crucial in decreasing the communicability period of a patient, which would in turn decrease the transmission rate of the disease. Screening for PTB includes doing a chest radiograph on a patient. While molecular based methods such as GeneXpert, are already being explored as confirmatory test. This study aims to determine the diagnostic validity of CXR in diagnosing PTB and the common CXR findings that are significantly correlated with GeneXpert results.
Materials and Methods: The study is a retrospective analytical study in which 286 subjects were divided into two groups based on their GeneXpert results. The two groups were then further divided based on whether they were diagnosed with PTB on CXR. CXR findings for each group were tabulated based on frequency of parenchymal opacity characteristics, presence of cavitation, pleural effusion, bronchiectasis and atelectasis. Sensitivity, specificity, positive and negative predictive values, and likelihood ratio positive and negative of CXR was computed with GeneXpert used as a gold standard.
Results: Chest X-ray has a sensitivity of 86.4% and a specificity of 38% in diagnosing PTB. Reticular and nodular opacities, and cavitation are significantly associated with positive GeneXpert PTB diagnosis (p-value of < 0.001). Cavitation has a highest positive predictive value (86%), followed by nodular opacities (44%), and by reticular opacities (31%).
Conclusion: CXR is an adequate screening test for PTB due to its high sensitivity but should be used with a confirmatory test.

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Qualiy Control of Digital Radiography Systems for General Radiography

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Objective: For general radiography, x-ray images were first recorded digitally with cassette-based storage-phosphor image plates in 1980. Today, manufacturers provide a variety of digital imaging opportunities based on various detector and readout technologies. Optimization of patient dose and image quality is of primary concern in the field of diagnostic imaging, including general radiography. It is recognized that comprehensive Quality Assurance programs, including acceptance and Quality Control (QC) testing of diagnostic imaging equipment are a vital component of the optimization process. Ultimately, QC is performed to ensure that the clinical image quality is adequate and does not deteriorate and adversely affect clinical decision. Presently, most QC testing of digital radiography systems is carried out using either qualitative or utilizes relatively simple quantitative analysis. However, digital radiography systems also provide the opportunity for quantitative analysis, thus removing subjectivity of testing.
Materials and Methods: The paper aims at presenting methods for performing QC testing of digital radiography system for general radiography including tests on Detector Dose Indicator, Signal Transfer Properties, Threshold Contrast Detail Detectability, Variation of Noise with Detector Air Kerma, Signal to Noise Ratio, Limiting Spatial Resolution and Square Wave Contrast Transfer Function.
Results: It is important to ensure that the digital detector maintains its performance and produces images free of artifacts and defects.
Conclusion: These tests can be undertaken using test tools generally available to the medical physics unit of the hospital.

X-Ray Patterns of COVID-19 in Patients Presenting to Lady Reading Hospital, Peshawar, Pakistan

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Objective: To determine the pattern of COVID 19 on chest radiograph in patients presenting to Lady Reading Hospital, Peshawar, Pakistan.
Materials and Methods: This prospective observational study was conducted on 178 consecutive swab positive COVID-19 patients presenting to Lady Reading Hospital, Peshawar, Pakistan from 15th March to 15th June 2020. Patients of all ages and both genders were included. Chest X-rays performed by portable X-ray unit were viewed for different patterns by two consultant radiologists independently and results were analyzed using IBM SPSS 20.
Report: Out of 178 patients 134 were male. Common radiographic patterns observed were predominant ground glass haze without or with reticulation (44.9 % and 21.9% respectively) and predominant consolidation either alone or in combination with ground glass haze and reticulation (24% collectively). Peripheral distribution pattern was seen in 68.5% of patients with bilateral findings in 84.3% of patients. The patterns were further categorized according to pulmonary zonal demarcation with changes most commonly involving four zones (33.1%).
Conclusion: Portable chest radiography is an essential supporting tool for assessing different patterns in COVID-19 infection. The most common pattern observed is alveolar opacities with predominant peripheral distribution either unilateral or more frequently bilateral, starting from the lower and mid zones extending to the upper zones and becoming diffuse with disease progression.

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Malposition of the Central Venous Catheter in the Accessory Hemiazygos Vein

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Learning Objective: Chest radiographs are routinely performed post central venous catheter insertion to confirm tip position. One of the rare causes of catheter malposition is anomalous venous route.
Background: Central venous catheters are cannulation devices used to access to the central venous circulation. When internal jugular vein (IJV) is chosen as insertion site, the correct placement for its tip is within the superior vena cava (SVC). The frequency of accidental azygos vein cannulation during central venous catheterization was reported to be 0.7–1.2%. Our case represents a rare variant of venous system in which the accessory hemiazygos vein is connected with the left brachiocephalic vein via the left superior intercostal vein.
Findings and/or Procedure Details: In our case, central venous catheter was inserted uneventfully for haemodialysis access in a 63-year-old patient through the left IJV. Post-procedural chest radiograph showed catheter along the left side of the thoracic spine. Its tip was projected over the 8th thoracic (T8) vertebra, raising the possibility of aortic injury. CECT thorax confirmed the catheter being inserted into the left IJV. Instead of coursing into the SVC, it coursed postero-medially into the accessory hemiazygos vein via the left superior intercostal vein. It then traversed inferiorly along the left posterior mediastinum, tip at T8 level. No aortic injury seen.
Conclusion: Knowledge of normal venous variant is important in interpreting chest radiograph post central venous catheter insertion. CECT is indicated if there is suspicion of complication or catheter tip is seen at unusual location.

Chest Computer Tomography Findings of Patients with COVID-19 Disease Who Are in the First Day of Their Symptoms

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Objective: As chest computer tomography (CCT) mostly detects coronavirus disease 2019 (COVID-19) patients who have been symptomatic for > 3 days, it was aimed to report the CCT findings of COVID-19 patients who are in the first day of their symptoms.
Materials and Methods: In a retrospective-design, CCTs' of COVID-19 PCR positive patients in the first day of symptoms between 1st June 2020- 1st August 2020 were evaluated by two radiologists independently.
Results: Totally, 612 COVID-19 patients were recruited, 329 (53.8%) were excluded as they had symptoms for > 1 day, 146 (23.9%) had no symptoms, 40 (6.5%) were younger than 18 years, 34 (5.6%) had chronic lung diseases. Remaining 63 patients (10.3%) comprised the sample, 46 (73.0%) were male. Mean age was 42.3 ± 12.2. Overall, 36 (57.1%) patients had normal CCTs. All 26 patients with abnormal CCTs had ground glass opacities, 21 (80.8%) had lesions in > 1 lobe, 17 (65.4%) in bilateral lungs. Seven patients (26.9%) had air bronchograms, 7 (26.9%) vascular thickening, 6 (23.1%) subpleural linear opacities, 3 (11.5%) consolidations, 3 (11.5%) nodular infiltration, 2 (7.7%) bronchiectasis, 1 (3.8%) interlobular septal thickening, 1 (3.8%) halo sign. No patients had reticular pattern, intralobular septal thickening, bronchial thickening, reverse halo sign, tree in bud, pleural effusion, crazy paving pattern, fibrosis, cavitation, pericardial effusion or pneumothorax.
Conclusion: This study reported the abnormal CCT findings of the COVID-19 positive patients in the first day of their symptoms and showed that most had normal CCTs. The results imply to clinicians and radiologists working with COVID-19.

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Interobserver Variability and Correlation with Clinical Outcomes in Assessing COVID-19 Related Chest X-Ray Findings Using the Brixia Scoring System

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Objective: Chest X-ray is valuable in monitoring the rapid progression of COVID-19 pneumonia, especially in critical patients. Borghesi and Maroldi have proposed the Brixia score, a chest X-ray scoring system that aims to facilitate the clinical grading of chest X-ray reports in hospitalized patients with COVID-19 pneumonia. This study aims to further validate the Brixia Scoring system for grading the severity and monitoring disease progression of COVID-19 pneumonia.
Materials and Methods: A total of 70 COVID-19 confirmed x-ray images were interpreted by junior and senior trainee radiologists using the Brixia scoring system, which were compared against an expert radiologist. The Brixia scores were dichotomized into < 8 and ≥ 8, and the levels of agreement were computed. The final outcome of each patient, which were classified as either improving or worsening, were correlated with the expert radiologist's Brixia score.
Results: There was substantial agreement (kappa = 0.74) between the junior residents and expert reader, as well as with the senior residents and expert reader (kappa = 0.68). Based on review of records, of the patients with poor outcomes, majority (79.3%) had an overall Brixia score ≥ 8. Of the recovered patients, 68.3% had an overall Brixia score of < 8. Using the Mann Whitney U test, it was noted that the Brixia scores were significantly higher among those with poor outcomes.
Conclusion: In a COVID-19 referral center, chest x-rays proves to be a cost-effective tool in monitoring disease progression of COVID-19 pneumonia. The Brixia scoring tool is straightforward and provides possible insight to the patients' clinical outcome.

DWI N MRS in Esophageal Dysphagial a Novel Mnemonic Based Approach

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Learning Objective:

- To discuss the spectrum of conditions presenting as structural esophageal dysphagia with the aid of a novel mnemonic " DWI N MRS"
- To illustrate the relevant characteristics of such lesions with focus on MDCT imaging.

Background: Dysphagia which refers to a clinical syndrome defined by a difficulty in swallowing is a result of structural and functional pathologies that affect the pharynx and esophagus. While Barium swallow is the initial imaging modality recommended in most patients presenting with dysphagia, MDCT allows for anatomical assessment of the esophagus in its entirety, simultaneously providing a global perspective of the surrounding structures thus aiding in detection, localisation and diagnosis of both intrinsic and extrinsic pathologies.
Findings and/or Procedure Details: A novel mnemonic to remember the various conditions causing structural esophageal dysphagia is introduced "DWI 'N' MRS" which stands for Diverticula, Webs, Infection, Neoplasia, Mediastinal, Ring (vascular), Strictures for use by radiologists when studying or interpreting cases. MDCT images of these entities are presented from cases studied at our institute. Important findings, both clinical and radiological are discussed.
CONCLUSION: Esophageal dysphagia is a common presenting complaint in day-to-day practice. Therefore, it is important for the radiologist to have diagnostic keys like the novel mnemonic put forth that allows them to become familiar and remember the most frequent entities to assist in the clinical approach of patients.

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Challenging Chest Wall Lesions: A Layered Imaging Approach

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Learning Objective: To review spectrum of pathologies presenting as chest wall masses using a structured radiologic approach focusing on MDCT imaging findings.
Backgrounds: The thoracic wall is an anatomically complex and functionally critical structure comprising of multiple elements. On MDCT imaging, the chest wall can be divided into three layers: a superficial layer of skin and subcutaneous fat; an intermediate layer containing the shoulder girdle and pectoralis muscles; and a deep layer including the sternum, ribs, intercostal space, spine, fascia, and parietal pleura. Lesions may arise from any of these layers and their components including the vessels and nerves that course through them. While chest radiography and ultrasound are the initial modalities used, MDCT is the workhorse of diagnostic imaging for chest wall lesions.
Findings and/or Procedure Details: MDCT images of patients reporting with chest wall masses to our department were reviewed retrospectively and selected cases presented using a novel approach based on layer of origin. The cases highlighted include lesions of neoplastic, infective (tubercular, hydatid), traumatic (hematoma) and vascular origin. MDCT findings of both benign and malignant pathologies (Askins tumor, liposarcoma, metastases) affecting the chest wall are also described.
Conclusion: It is important for the radiologist to be aware of the wide range of etiologies presenting as chest wall masses in order to make an accurate diagnosis. The layer-based imaging approach presented in this exhibit aids in easier diagnosis of and further treatment planning for these lesions.

Sponatneous Pneumomediastinum, Pneumothorax and Surgical Emphysema in COVID 19 Patients

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Learning Objective: Presentation of spontaneous pneumomediastinum, pneumothorax and surgical emphysema in COVID 19 patients and their increased incidence in COVID 19 patients who are either intubated or put on non-invasive ventilation.
Background: We describe four cases which presented with suspected symptoms of COVID 19 and were diagnosed with pneumomediastinum, pneumothorax and surgical emphysema which would have been missed if not for CT scan performed at the time of admission. While subcutaneous emphysema and spontaneous pneumomediastinum have been observed in a variety of viral pneumonias as a complication of mechanical ventilation, the development of these conditions in non-intubated patients suggests an alternative aetiology.
Findings and/or Procedure Details: 0.43% of patients developing pneumothorax, pneumomediastinum or surgical emphysema with intubation related barotrauma being attributed as the aetiology to 80% cases while 20% cases were designated spontaneous, as a sequela of COVID 19. COVID induced fragility of the alveolar system could be one of the important factors to be taken into consideration causing air tracing via Macklin phenomenon.
Conclusion: A susceptible trachea in combination with altered immune status, emergency intubation, frequent proning and high positive end-expiratory pressure can lead to an increase in the occurrence of pneumomediastinum and surgical emphysema. Other factors involve a large turnover of the COVID 19 patients, the paucity of skilled health workers, long working hours and fear of infection amongst the medical fraternity add up to the risk of complications. Regular follow-up with inflammatory marker levels and CT post-admission especially in a refractory case can prove to be a boon for the patient.

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Bronchial Artery Embolization; Retrospective Survey from a Tertiary Care Hospital in a Developing South-Asian Country

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Objective: To evaluate clinical presentation, etiological cause and source of hemoptysis in patients undergoing bronchial artery embolization. A 5-year experience of success rate, complications and follow up at a tertiary care hospital in developing country.
Materials & Methods: A retrospective cross-sectional study was conducted between January 2014 to December 2018. The study population included patients undergoing angiography for Bronchial artery embolization (BAE). Demographic details including risk factors were included. Clinical sign and symptoms were recorded. Bronchoscopy and Arteriography were used to locate the source of bleed. Embolization technique and post procedure results were analyzed. Success and Failure rates were noted. Lastly, complication, follow-up results and mortality were also discussed.
Results: The study included 40 cases. Of these, 80% were males. 50% had tuberculosis. 37.5% underwent bronchoscopy. On imaging 32.5% had bronchiectasis, 30% had pleural thickening and infiltrate/consolidation was seen in 32.5% of cases. Disease distribution was unilateral in 72.5% of cases. Bronchial artery involvement was seen in 67.5% and both bronchial and systemic involvement was seen in 25% of cases. Technical success of embolization was 87.5%. Micro catheter was used in 91.4%.Poly vinyl alcohol (PVA) alone was used in 68.6%.
Conclusion: Bronchial and non-bronchial systemic artery embolization is a safe and effective nonsurgical treatment for patients with massive hemoptysis.

Image Detection of Lung Cancer Using YOLOv4

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Objective: Lung cancer is one of the most highly malignant types of tumor. Statistically, its 5-year survival rate is 40.6%, which is lower than any other cancer in Japan. Chest computed tomography (CT) scanning plays an important role in identifying and diagnosing lung cancer. For this reason, the accurate detection of a tumor from CT images is important. Recently, a remarkable development within Artificial Intelligence particularly, the generation of deep learning models, has improved the identification of various diseases. In this study, we trained a neural network termed YOLOv4-arch to detect lung tumors on CT images. Then, we evaluated its detection performance on test dataset.
Materials & Methods: We retrospectively built the training dataset of lung tumors by collecting 2731 CT images from 108 patients. With this training dataset, a YOLOv4 model was trained to detect lung tumors on CT images. Then, we collected 69 images of lung tumors from another 56 patients as the test dataset. Finally, we evaluated the detection performance of the YOLOv4 model on this test dataset.
Results: The YOLOv4 model accurately detected lung tumors on 64 images (92.8%).
Conclusion: Although a neural network requires considerable amount of training data to detect something, our YOLOv4 model performed well with less training data. Based on these results of the identification of lung tumors on CT images, the YOLOv4 may be an efficient neural network model.

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Differential Diagnosis of Mediastinal Masses Using Chemical Exchange Saturation Transfer (CEST) MR Imaging: Phantom & Clinical Studies

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Objective: To evaluate CEST effects under various conditions of the respiratory gating (RG) on dynamic phantoms, and to differentiate mediastinal masses using CEST effects.
Materials & Methods: In a phantom study, each raw egg on the static condition (C0) was scanned on amide proton transfer (APT)-weighted CEST MR imaging. Next, each raw egg on the anterior chest of 5 volunteers was scanned on CEST MR imaging under various conditions of the RG: voluntary breathing without the RG (C1); voluntary breathing with the RG (C2); slow breathing (half the normal RR) with the RG (C3); and fast breathing (twice the normal RR) with the RG (C4). In a clinical study, 12 thymic cysts and 13 thymic epithelial tumors (8 thymomas, 5 thymic carcinomas) were scanned on CEST MR imaging. A region of interest (ROI) was placed over objects, making it as large as possible to minimize the effects of inhomogeneity. Each z-spectrum within the ROI (offset frequency, 7 to -7 ppm) was computationally generated. A magnetization transfer ratio (MTR) asymmetry at 3.5 ppm (MTRasym[3.5 ppm]) was measured as a CEST effect (%). Mean MTR values at z-spectrum were statistically evaluated.
Results: Mean MTR values at z-spectrum had no significant differences among C0-4: C0, 16%; C1, 11.9%; C2, 10.9%; C3, 11.9%; C4, 11.4% ($p > 0.05$). MTRasym[3.5 ppm] was significantly lower for thymic cysts (mean ± SD, -11.1% ± 12.9) than for thymic epithelial tumors (5.4% ± 4.8, $p < 0.0001$). The threshold value (0.635%) can differentiate between thymic cysts and thymic epithelial tumors (sensitivity, 100%; specificity, 100%; $p < 0.001$).
Conclusion: APT-weighted CEST MR imaging without the RG can differentiate between thymic cysts and thymic epithelial tumors.

A Comparative Study to Evaluate CT Based Semantic and Radiomic Features in Preoperative Diagnosis of Invasive Pulmonary Adenocarcinomas Manifesting as Subsolid Nodules

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Objective: This study aims to predict the histological invasiveness of pulmonary adenocarcinoma spectrum manifesting with subsolid nodules ≤ 3 cm using the preoperative CT-based radiomic approach.
Materials and Methods: A total of 186 patients with 203 SSNs confirmed with surgically pathologic proof were retrospectively reviewed from February 2016 to March 2020 for training cohort modeling. The validation cohort included 50 subjects with 57 SSNs confirmed with surgically pathologic proof from April 2020 to August 2020. CT-based radiomic features were extracted using an open-source software with 3D nodular volume segmentation manually. The association between CT-based conventional features/selected radiomic features and histological invasiveness of pulmonary adenocarcinoma status were analyzed.
Results: Diagnostic models were built using conventional CT features, selected radiomic CT features and experienced radiologists. In addition, we compared diagnostic performance between radiomic CT feature, conventional CT features and experienced radiologists. In the training cohort of 203 SSNs, there were 106 invasive lesions and 97 pre-invasive lesions. Logistic analysis identified that a selected radiomic feature named GLCM_Entropy_log10 was the predictor for histological invasiveness of pulmonary adenocarcinoma spectrum (OR: 38.081, 95% CI 2.735–530.309, $p = 0.007$). The sensitivity and specificity for predicting histological invasiveness of pulmonary adenocarcinoma spectrum using the cutoff value of CT-based radiomic parameter (GLCM_Entropy_log10) were 84.8% and 79.2% respectively (area under curve, 0.878). The diagnostic model of CT-based radiomic feature was compared to those of conventional CT feature (morphologic and quantitative) and three experienced radiologists. The c-statistic of the training cohort model was 0.878 and 0.923 in the validation cohort.
Conclusion: The nomogram may help clinicians with decision making in the management of subsolid nodules.

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A New Protocol Utilizing Dual Energy Dual Source CT Venography (DECTV) for the Diagnosis of Central Vein Stenosis/Occlusion in Patients with End Stage Renal Disease (ESRD)

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Objective: To propose a new protocol applying dual-energy dual-source CT venography (DECTV) in the diagnosis of central vein stenosis/occlusion in patients with end-stage renal disease (ESRD), in comparison to the gold standard, digital subtraction venography (DSV).
Materials & Methods: 11 ESRD patients (21 readings) scheduled for DSV in our center were consecutively enrolled to undergo the proposed CT protocol. Both studies were done during the same visit. The degree of stenosis, image quality/artefacts, and confidence level of making a diagnosis when compared to DSV (as the gold standard) were assessed. The specificity, sensitivity, positive predictive value, and negative predictive value were also determined. Statistical analysis was done utilizing Cohen's kappa coefficient and Chi square.
Results: The inter-observer agreement analyzed via Cohen's kappa coefficient demonstrated excellent agreement, with kappa of 0.93 for DECTV, and kappa of 1.00 for DSV. Meanwhile, the sensitivity of DECTV when compared to DSV was 71.4%, while the specificity was found to be 100% ($p < 0.050$). The positive predictive value of DECTV, in comparison to DSV was 100%, while the negative predictive value was found to be 87.5% ($p < 0.050$). Lastly, DECTV managed to demonstrate additional causes of central vein stenosis/occlusion, which were not seen on DSV.
Conclusion: Our proposed protocol demonstrates that DECTV is a viable alternative to DSV, in the diagnosis of central venous occlusion/stenosis. Additionally, other causes not demonstrable on DSV as the cause of stenosis/occlusion were detected on DECTV. This protocol allows prompt diagnosis in Centres where endovascular intervention is not readily available.

The Development and Evaluation of Flipped Classroom of Ultrasound Detection Acupuncture

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Objective: Flipped classroom had been widely used in education. Acupuncture need to adopt it to increase the self-directed learning of students as well. Ultrasound detection acupuncture (UDA) performed an ultrasound to ensure the safe needling depth before acupuncture to reduce pneumothorax. The study intended to develop a flipped classroom for UDA.
Materials & Methods: First, we made a specific ultrasound for acupuncture (UFA) as a teaching tool. UFA used M mode to measure the depth of the lung by identifying the Seashore sign. We applied UFA on 3 acupoints near the chest of health and COPD subjects to validate its effect. Then we setup flipped classroom of UDA by using Facebook and Youtube. We recruit 20 students and 20 interns to take the course and pre/post-tests were performed. Statistical analysis and group interviews were used to evaluate the efficacy of the course.
Results: The result of the first part showed that the content validity index of UFA on three acupoints were 0.8, 0.9 and 0.8 respectively. UFA was developed successfully by demonstrating a safe needing depth of the lung.
Conclusion: UFA is good to establish the Flipped classroom of UDA in the next part of the study.

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Chest Imaging: Diagnostic Value of Ultrasound in Detecting Central Vein Thrombosis

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Objective: This prospective study was performed to evaluate the diagnostic value of ultrasound in detecting central vein obstruction, as compared to venography. Venography is an invasive diagnostic test that uses contrast material and radiation in the diagnosis of central vein obstruction, which poses some risks such as contrast nephropathy with contrast injection and radiation exposure. On the other hand, ultrasonography examination, being non-invasive, easy to perform and radiation free could be a good alternative tool as compared to venography in the assessment of central veins.
Materials & Methods: The patients who referred to radiology department for central venogram to rule out central vein thrombosis were recruited by convenient sampling. Patients were first assessed by ultrasound followed by venography. Sonographic examination was performed using linear probe, where the proximal part of the internal jugular vein was examined. The proximal internal jugular vein was assessed for its respiratory phasicity, absent of venous flow and absent of phasicity of flow with respiration. Normal and abnormal findings from both ultrasound and venography were compared.
Results: There are total of 60 cases collected for period 8/8/17–5/10/18. Data is collected for analyzed using SPSS software. Overall diagnostic value of color Doppler ultrasound has a sensitivity of 76.9%, specificity of 97.9%, positive predictive value of 90.9% and negative predictive value of 93.9%.
Conclusion: In conclusion, color Doppler ultrasound could be a good alternative and reliable tool for detecting central venous obstruction.

HRCT Patterns of Interstitial Lung Disease in Psoriasis: A Report of Four Cases

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Learning Objective: To demonstrate different interstitial lung disease manifestations and patterns in patient with psoriasis.
Background: Psoriasis commonly presents with chronic inflammatory dermatological manifestations, or psoriatic arthritis. Whilst it has been commonly associated with diabetes mellitus, hypertension, obesity and dyslipidemia, recent emerging studies have shown association between psoriasis and Interstitial Lung Disease (ILD).
Findings and/or Procedure Details: Four patients who were diagnosed with psoriasis, had high resolution computed tomography (HRCT) performed for respiratory complaints. The four patients show different ILD patterns, two of which with Usual Interstitial Pneumonia (UIP)-like pattern, the remainder showing non-specific interstitial pneumonia (NSIP)/Organizing Pneumonia (OP)-like pattern and indeterminate pattern respectively.
Conclusion: These findings correspond to previous case series of psoriasis and ILD, which showed multiple different patterns of HRCT findings. Further prospective studies are needed to determine the association of ILD and psoriasis.

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The Bubbly Lung Patterns– Differentials & Approach to Diagnosis

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Learning Objective: Cystic lung diseases are one of the commonest presentations in radiological practice & they include true cystic lesions & cyst-like lesions or mimickers. There is an exhaustive list of differentials of cystic lesions, but the prime concern is differentiation of true cystic lesions from the mimickers. "BUBBLY LUNG" refers to lungs having multiple cyst-like lesions, & the presentation describes an approach towards simulators of cystic lung diseases.
Background: True Pulmonary cystic disease should be differentiated from other simulating entities (like emphysema, bronchiectasis and honeycombing) & the various causes of pulmonary cavities (malignant, infectious, inflammatory, vascular, traumatic) because of the differing prognostic implications.
Findings and/or Procedure Details: "BUBBLY LUNG" refers to lungs having multiple cyst-like lesions, & the presentation describes an approach towards simulators of cystic lung diseases.
Conclusion: True cystic lung disease should be differentiated from mimickers, the mimickers are more commonly encountered in practice. Heterogenous imaging appearance, morphology, distribution of cysts, number , location of cysts & other ancilliary HRCT features should be considered. Clinical inputs & knowledge of the associated pulmonary and extra-pulmonary disease patterns may lead to the correct diagnosis

Pocus for Acupuncturist: A Training Program of Ultrasound Detection Acupuncture

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Learning Objective: This study established an Ultrasound detection acupuncture (UDA) training program and recruited trainees in the hospital to validate the effectiveness of the program.
Background: UDA was a new clinical skill of acupuncture. In order to avoid the complication of pneumothorax while needling, ultrasound was introduced to measure the safe needle depth to improve patient safety. UDA was a good practice for POCUS of acupuncture as well.
Findings and/or Procedure Details: The trainees attended an eight-hour course and practiced their UDA skills on an acupuncture simulator model ASM21. Pre- and post-test data were analyzed using the Mann-Whitney U test and Fisher's exact test. In total, 16 trainees completed the course. Kendall's coefficient for the program was 0.82, and the average CVI was 0.98, showing good reliability and validity. Trainees exhibited significant improvement in terms of reduction of the incidence of pneumothorax after completing the course ($p < 0.050$). Acquisition of ultrasound skills significantly reduced the incidence of pneumothorax ($p < 0.001$). Feedback from interviews showed that use of ultrasound to measure the safe needle depth may improve the mastery of acupuncture point GB21 and reduce the fear of causing pneumothorax.
Conclusion: The UDA program demonstrated good teaching results and could be used as a basis for the development of the POCUS acupuncture in future.

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Radiological ILD Patterns on HRCT by Non-Thoracic Versus Thoracic Radiologist: A Single Centre Experience

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Objective: Interstitial lung disease (ILD) is a heterogeneous group of condition denoted by inflammation and/or fibrosis. Thoracic radiology as sub-interest is only recently gained attention in Malaysia. Most of the ILD patterns were diagnosed by general radiologists or radiologists of other sub-speciality. We seek to re-review the radiological ILD patterns on HRCT by a thoracic radiologist and compare with previous reports by non-thoracic radiologists at our centre.
Materials & Methods: All patients who had thoracic CT scan performed within a period of 5 years were searched for ILD cases using relevant keywords. Only those reported by general radiologist were included. The ILD patterns were categorised into UIP, NSIP, mixed NSIP/OP, OP, HP and the rest were grouped as 'others' (primary radiological pattern diagnosis). The cases were re-reviewed by thoracic radiologist (blinded to previous report) using the same categories. Correlation was made with the demographic information, connective tissue disease and smoking history.
Results: A total of 96 ILD cases (age; 63.3 years old [mean], 26–91 yrs old [range], 20.8% male) were analysed. There was only fair agreement between thoracic and non-thoracic radiologists ($\kappa = 0.29$). Significant correlation between NSIP and CTD (p value 0.001) as well as female (p value 0.003) when compared with other radiological ILD patterns.
Conclusion: Reporting ILD is challenging with low interobserver agreement between thoracic and non-thoracic radiologists. Input from thoracic radiologist in ILD multidisciplinary team discussion is imperative in diagnosis and management of ILD.

Thymoma: A Radiological Review Along the Who Classification and Masaoka Staging System

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Learning Objective: To review the radiologic findings of thymoma classified according the current World Health Organization (WHO) histologic classification and clinical Masaoka-Koga staging system, and to help the clinical preoperative staging.
Background: Thymoma is the most common primary neoplasm of the anterior mediastinum. CT and/or MR imaging are useful screening methods for identifying thymoma and preparing for surgery. However, imaging findings alone do not accurately reflect WHO classification, so reviewing the imaging finding that reflect Masaoka staging can help with preoperative preparation.
Findings and/or Procedure Details: CT images of thymoma subtypes according to WHO classification in thymoma patients diagnosed by operation or biopsy were compared with the Masaoka staging system, and additional MRI and PET/CT findings were reviewed.
Conclusion: Through various radiological reviews along the WHO classification and Masaoka staging system, Radiologists should be familiar with imaging findings of thymoma and will help to make more accurate clinical staging.

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Chest Radiographic Features of Pulmonary Tuberculosis Patients with Underlying HIV

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Objective: To characterize the differences in chest radiograph (CXR) findings among patients with pulmonary tuberculosis (PTB) and human immunodeficiency virus (HIV) co-infection.
Materials & Methods: A retrospective study was conducted with 200 PTB patients who are above 18 years old and had initial CXR, laboratory confirmation of HIV status, CD4 T-lymphocytes count and sputum AFB results. These patients were sub-divided into four groups: Group 1 (smear +, HIV +), Group 2 (smear +, HIV -), Group 3 (smear -, HIV +) and Group 4 (smear -, HIV -). Two radiologists analysed the chest radiographs on standard image viewing box and filled a data collection sheet which was later analysed using SPSS.
Results: Mean age was significantly higher among Group 3 patients (50.4 years old). All patients in Group 3 had abnormal CXR with consolidation, higher proportion of multifocal pattern (55.8%), mixed type consolidation (59.7%) and bilateral lung predominance (70.1%). Almost 98% patients with no cavities were reported in Group 2.
Conclusion: All four groups have differing CXR features but there's still some overlap in their radiographic findings. Lung cavitations which were not commonly seen in smear negative PTB group regardless of their HIV status can be used to build a predictive model in the future and possibly be used to do away with sputum AFB and proceed straight with sputum culture.

Are We Over-Reporting Pulmonary Edema as Indeterminate COVID-19 Pneumonia on HRCT? an Inter-Departmental Observation

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Learning Objective: To learn about the coinciding features of pulmonary edema and COVID-19 pneumonia on High Resolution Computerized Tomography (HRCT).
Background: COVID pneumonia and pulmonary edema both affect lung parenchyma in a similar way given the fact that air in alveoli is replaced by fluid in both of these conditions. There is an overlap of some of the changes in lung parenchyma caused by these two entities, like ground-glass opacities and septal thickening. We observed these similarities and tried to hypothesize that pulmonary edema should be labeled as atypical and not indeterminate COVID-19 pneumonia.
Findings and/or Procedure Details: We analyzed HRCT of 59 patients on Picture Archiving System (PACS) who were reported as indeterminate pulmonary edema with underlying co-morbidities like ischemic heart disease or renal failure. These were also RT-PCR negative. The similarity of ground glass opacities was noticed, however in pulmonary edema patients, additional features like cardiomegaly, septal thickening, central congestion, consolidation, pleural effusion and lymphadenopathy were seen. These according to RSNA classification of COVID-19 pneumonia falls under atypical category of COVID. Results were achieved using SPSS 21.
Conclusion: Our analysis led us to conclusion, that during this on-going pandemic situation we should be aware of the overlap features of CT Chest findings observed in pulmonary edema. The cases with predominant CT findings of pulmonary edema should be classified as atypical more willingly than indeterminate. This knowledge and its application are important, given re-emergence of COVID positive cases in many parts of the world, including Pakistan.

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Local Adaptation Improves Accuracy of Deep Learning Model for Automated X-Ray Thoracic Disease Detection: A Thai Study

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Objective: Despite much promising research in the area of artificial intelligence for medical image diagnosis, there has been no large-scale validation study done in Thailand to confirm the accuracy and utility of such algorithms when applied to local datasets.
Materials and Methods: We constructed two variants of deep learning models: the Reference model and the Locally Adapted model. The Reference model was trained on a repository of 705184 CXR images gathered from medical centers around the world, excluding Thailand. The Locally Adapted model was trained on the Reference dataset combined with the Thai CXR dataset, comprising 421859 frontal chest X-ray images from Siriraj Hospital in Thailand.
Results: The Reference model saw a 3.8% drop of the area under receiver operating characteristic curve (AUROC) from 0.899 when tested with the Reference dataset to 0.848 when tested with Thai CXR dataset. On the contrary, the Locally Adapted model was able to obtain the AUROC of 0.914 when tested with Thai CXR dataset while maintaining the AUROC of 0.894 when tested with the Reference dataset. This represents 8.3% improvement from the Reference model on the Thai CXR dataset. When set at an operating point at which the algorithm makes only 5% false negative error, our Locally Adapted model reduces screening load by 55.9% on average.
Conclusion: We present a locally adapted state-of-the-art model for diagnosis of Thai chest X-ray images, coupled with analysis on the usability and utility of deep learning in realistic clinical scenarios.

Contrast Media Volume Is Significantly Related to Patient Lung Volume During CT Pulmonary Angiography when Employing A Patient-Specific Contrast Protocol

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Objective: To investigate the effect of contrast media and patient lung volume on pulmonary artery opacification using a patient-specific contrast formula during pulmonary CT angiography.
Materials & Methods: IRB approved this retrospective study. CTA of the pulmonary arteries was performed on 200 patients with suspected PE using a 256-channel computed tomography scanner and a dual-barrel contrast injector. The contrast media volume was calculated by employing a patient-specific contrast formula. Both contrast media and saline were injected at flow rate of 4.5 mL/s. The mean cross-sectional opacification profile of eight central and eleven peripheral pulmonary arteries and veins were measured for each patient and arteriovenous contrast ratio (AVCR) calculated for each lung segment. Mean body mass index (BMI) and lung volume were quantified. Receiver operating (ROC) and visual grading characteristics (VGC) measured the confidence intervals and image quality respectively. Inter and intra-observer variations were investigated employing Cohen's kappa methodology
Results: Right upper (316.51 ± 23 HU), middle (312.5 ± 39 HU) and lower (315.23 ± 65 HU) lobes and left upper (318.76 ± 83 HU) and lower (321.91 ± 12 HU) lobes. The mean venous opacification of all pulmonary veins was below 182 ± 72 HU. Subsequently, the AVCR was observed at all anatomic locations ($p < 0.0002$) where this ratio was calculated. Mean contrast volume of 33 ± 9 mL. Larger lung volumes were significantly correlated to larger volumes of contrast ($r = 0.89$, $p < 0.030$). Inter-observer variation was observed as excellent ($\kappa = 0.71$).
Conclusion: Increased patient lung volume is significantly correlated to increased contrast media volume and radiation dose when employing a patient-specific contrast formula. The effects of patient habitus and weight are highlighted.

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Radiological Features of Pulmonary Fat Embolism in Trauma Patients: A Retrospective Cohort Study

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Objective: Fat embolism syndrome (FES) is a rare complication in trauma patients (usually with long bone fractures), with migrating medullary fat precipitating multiorgan dysfunction, including pulmonary fat embolism (PuFE). Presence of petechial rash and neurocognitive dysfunction occurring with FES may aid PuFE diagnosis. Typical radiographic features of PuFE are not established, although increasing use of CT Pulmonary Angiography (CTPA) in this cohort may provide important diagnostic information. We therefore conducted a retrospective cohort study of FES patients who had undergone a CTPA at a Level 1 Trauma Centre in Melbourne, Australia.
Materials & Methods: Records and radiology of FES patients between 2006 and 2018, including demographics, injury, hospital course, and CTPA images, were reviewed.
Results: Fifteen FES patients with retrievable CTPAs were included (mean age 31.2 years, range 17–69; 12 males [80%]). 93.3% had long bone fractures. CTPA was performed 2.00 ± 1.41 days post-admission, with images showing: opacity in 14 (93.3%; 9 ground-glass opacities [64.3%], 6 alveolar opacities [42.9%]), interlobular septal thickening in 10 (66.7%), and pleural effusions in 7 (46.7%). Opacities were most frequently distributed to left/right postero-basal segments (n = 12, 85.7% each), or left apico-posterior segment (n = 10, 71.4%). Filling defects were identified in three (20%) CTPAs, with density -20 HU to +63 HU. Ten patients (66.7%) had neuroimaging performed, with two cerebral fat emboli identified: one 19.7 hours prior to CTPA, one 45.3 hours post-CTPA.
Conclusion: CTPA features of PuFE are variable, with ground-glass parenchymal opacification and septal thickening most commonly seen. Filling defects were uncommon.

Fournier's Gangrene: Update in Diagnosis and Management

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Learning Objective: To present Fournier's gangrene (FG) overview, focusing on diagnosis and management.
Background: FG is a fulminant progressing necrotic infection involving the perineal, perianal, and genital regions that can constitute a life-threatening statement with multiple organ failures. FG is generally secondary to the genitourinary tract, lower gastrointestinal tract, or skin infections affiliated with local trauma, urinary tract damage, or pelvic interventions. This infection can be caused by mixtures of aerobic, anaerobic bacteria, fungi, or viruses and typically detected in men with diabetes mellitus or chronic alcohol misuse.
Findings and/or Procedure Details: Clinical presentation of FG includes perineal or scrotal pain, swelling, hyperemia, pruritus, crepitus from soft tissue gas, and systemically unwellness. Bedside ultrasound can be carried promptly to assume for subcutaneous gas besides other manifestations related to possible etiologies like scrotal skin thickening and peritesticular fluid. CT images can reveal subcutaneous emphysema (a hallmark of FG, resulting from gas-forming bacteria or necrotic) and inflammation signs (soft-tissue thickening, fluid collection, surrounded fat stranding). Broad-spectrum antibiotics and urgent surgical debridement of necrotic tissue are the fundamental treatment of FG.
Conclusion: FG is a rare emergency disease with a high mortality rate and should be diagnosed promptly based on the clinical and radiological features for proper treatments.

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The Lateral Crescent Sign of Direct Inguinal Hernias Differentiates from Indirect Inguinal Hernias and Femoral Hernias

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Learning Objective: The lateral crescent sign and differentiate types of inguinal femoral hernias.
Background: Differentiation of direct inguinal hernias, indirect inguinal hernias, and femoral hernias is often challenging in clinical examination and diagnostic imaging. Direct inguinal hernias protrude through the Hesselbach triangle above the inguinal ligament and medial to the course of the inferior epigastric vessels. Indirect inguinal hernias protrude posterolateral and superior to the course of the inferior epigastric vessels, lateral to the Hesselbach triangle, enter the inguinal canal, and maybe into the scrotum. Femoral hernias protrude inferior to the course of the inferior epigastric vessels and medial to the common femoral vein.
Findings and/or Procedure Details: Herniated omentum or viscera causing compression and lateral displacement of the inguinal canal contents (testicular vessels, vas deferens, nerve branches, or round ligament) form a semicircle of tissue that resembles a crescent moon seen lateral to the hernia. This sign is usually observed in the early stages of direct inguinal hernia. As it progresses, the inguinal canal contents are tightened, and the crescent-like shape tends to disappear.
Conclusion: The lateral crescent sign is easily identified on axial computed tomography images and is useful in diagnosing early direct inguinal hernias. This sign can help the radiologist better assist the clinician in correctly analyzing the hernias of the inguinal femoral area.

Rational Use of Computed Tomography Scan Head in the Emergency Department of a High Volume Tertiary Care Public Sector Hospital

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Objective: To emphasize the rational use of Computed Tomography (CT) head in emergency department of a high volume tertiary care hospital.
Materials and Methods: This retrospective observational study was conducted in Radiology Department of Medical Teaching Institute Lady Reading Hospital (MTI-LRH), Peshawar, Pakistan from 01.11.2017 to 31.01.2018. Patients of all ages and both genders presenting to the emergency department with post traumatic and non-traumatic indications for emergency CT scan were included in the study. The imaging was performed on 16 multi slice CT system. The imaging protocol included slice thickness of 3–5 mm, non-contrast study for cases of trauma or stroke. Where needed intravenous contrast was administered. CT images were reported on PACS in morning and evening sessions. Information was analyzed using latest SPSS version.
Results: Out of total 4284 CT scans performed in ED 90.8% were CT head (3893). Among 3893 CT brain scans done in ED, 2581 cases were reported normal (66.29%), while 1312 cases had positive findings (33.7%), including post traumatic and non-traumatic.
Conclusion: Misuse of CT scan is common especially in an emergency setting. Emergency physicians should be encouraged to obtain a detailed history and perform a thorough physical examination with reference to internationally standardized guidelines while requesting a CT scan.

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CT Imaging of the Traumatic Brain: Coup and Contre Coup Injuries as Predictors of Outcome

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Objective: Focal brain injuries are found in approximately half of all the patients with severe brain trauma and are responsible for nearly 66% of deaths . With CT imaging, it is possible to precisely delineate and determine whether injuries are coup or contre coup. Since there are very few studies in literature comparing outcome in coup-contre coup injuries, this study aims to bridge the gap.
Materials & Methods: A retrospective study of 179 patients with traumatic head injuries who underwent CT scanning was carried out. The injuries were divided into three groups: Coup injuries with intraparenchymal injury (n = 89)contrecoup injuries (n = 44)and coup-contrecoup injuries (n = 46).Site of primary impact was determined by clinical and CT scan criteria. Using the chi-square test, the mortality rates were compared across the groups and then correlated with the GCS and age and conclusions were made based on the "*p*" value.
Results: The most common coup injury was depressed fracture with contusion while bilateral contusions and EDH with contusion formed the majority in the coup-contre coup group. There was a statistically significant difference in mortality between patients with coup injuries and patients with contrecoup ($p < 0.005$) and coup-contrecoup injuries ($p < 0.001$).Mortality in patients aged less that 60 years and patients with GCS > 8 was significantly higher in patients with contrecoup and coup-contrecoup injuries.
Conclusion: The present study shows that the presence of contrecoup contusions, with or without coup contusions, is associated with a poor prognosis across all GCS and age categories and may warrant aggressive management.

Audit to Assess Adequate Contrast Enhancement in CT Pulmonary Angiograms (CTPA) in Patients Presenting with Acute Onset Shortness of Breath

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Objective: The aim of the audit is to evaluate the adequacy of the CT angiograms done for diagnosis of pulmonary embolism.
Materials & Methods: This audit was done in the Radiology department with the permission of the ethical committee. CTPA performed on 128 row CT scanner were retrospectively selected from the PACS. Randomly 100 cases were selected, who underwent CTPA for suspicion of pulmonary embolism. In each study different parameters were observed like age, gender, HU of the main pulmonary trunk, and the final diagnosis. A circular region of interest (ROI) was measured in the largest axial image of the main pulmonary artery with a diameter covering approximately 50% of the vessel. According to Royal college of Radiology (RCR), the minimum enhancement of main pulmonary trunk should be 211 HU. Above than 211 is considered satisfactory and below 211 HU as not satisfactory.
Results: Of all the scans evaluated, in 12% of cases the enhancement of pulmonary trunk was below 211 HU, hence were labelled unsatisfactory scans. 88% (n = 88) were as per acceptable standard. The results revealed that 60% patients were female and rest were male. The maximum patients (n = 38) were in the age category between 41–60 years . Acute pulmonary embolism was diagnosed in 15 cases.
Conclusion: Audit results show that 88% CTPA examinations were satisfactory. Rest of the unsatisfactory pulmonary artery opacification was likely due to technical factors and should be addressed before re-audit. We will plan a re-audit to assess and address the causes of unsatisfactory CTPA at RMI.

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Direct CT Venography for Upper Limb Deep Vein Thrombosis

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Learning Objective: To illustrate protocol and technique to obtain a good quality direct computed tomographic (CT) venogram. Educational cases will be presented to demonstrate the findings of deep vein thrombosis (DVT), frequently encountered pitfalls and artefacts, including relevant comparison with duplex ultrasound scans and indirect CT venograms.
Background: Upper limb DVT is an increasing clinical problem due to use of upper limbs veins for lines, pacemakers and other invasive procedures. Traditionally digital subtraction venography (DSV) and duplex ultrasonography are the investigations of choice in lower limb DVT but have significant limitations in the upper limb veins. We have developed a local protocol for direct CT venography to overcome these difficulties.
Findings and/or Procedure Details: Direct CT venography involves cannulation of the ipsilateral hand or forearm and a tourniquet in the upper arm during the scan. Dilute contrast (20% iobitridol 350, 80% saline) is injected via a dual head injector with helical scan acquired after a 25 second delay. Its' advantages include reduced contrast and radiation dose in comparison to conventional DSV, reduced artefacts from overlying structures and improved recognition of flow artefacts versus thrombus.
Conclusion: Direct CT venography is a robust diagnostic technique which can reliably diagnose DVT and potentially other venous abnormalities in the upper limb with high diagnostic confidence and should be considered as a first line investigation for suspected upper limb DVT. We present our protocol should be relatively straight forward to replicate in most radiology departments together with a series of educational cases.

High Resolution Ultrasonographic (HRUS) in Evaluation of Subglottic Diameter for Preanesthetic Estimation of Endotracheal Tube Diameter

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Objective: Endotracheal intubation, a prerequisite for surgical procedures is mainly governed by narrowest diameter of upper airway. Size of endotracheal tube can be calculated by physical indices or invasively by laryngoscopy. Over-size tubes lead to airway injuries while under-size tubes lead to inadequate ventilation. High-resolution ultrasonography (HRUS) not only allows objective measurement of airway dimensions but is also non-invasive & cheap technique. This prospective study mainly aimed to:

- Determine the accuracy of HRUS-determined diameter compared with endotracheal tube diameter used clinically during surgery.

Materials & Methods: This study was carried out on 25 patients appearing for preanesthetic check-up for elective surgery. HRUS was performed in extended neck position . The subglottic, transverse, tracheal diameter was measured just inferior to true vocal cords at the level of cricoid arch. The diameter of endotracheal tube used clinically during the anaesthesia was noted. The diameters thus obtained were then matched with each other to determine the accuracy of the HRUS determined diameter.
Results: The age of patients ranged from 3rd to 6th decade. The accuracy of HRUS determined subglottic diameter is approximately 75% in patients below the age of 50 years.
Conclusion: HRUS is a safe and reliable imaging tool for preanesthetic determination of subglottic diameter for ET insertion. Though in experienced hands, HRUS-determined subglottic diameter may not be significantly useful in decreasing the number of attempts required for determination of clinically useful ET diameter yet it may be definitely useful for trainees / residents / inexperienced hands and in emergency, thus reducing morbidity related with intubation.

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Cardiopulmonary Resuscitation Injuries: Type and Incidence with Computed Tomography in Return-of-Spontaneous-Circulation Patients

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Objective: The type and incidence of cardiopulmonary resuscitation (CPR)-related injuries are insufficiently assessed. Hence, we examined the type and incidence of CPR injury using computed tomography (CT) in return-of-spontaneous-circulation (ROSC) patients.
Materials & Methods: We retrospectively evaluated 242 ROSC patients with non-traumatic and non-acute type A aortic dissection who underwent manual CPR from January 2015 to May 2018. Patients were divided into out-of-hospital (OHCA) and in-hospital (IHCA) cardiac arrest groups. CPR administration time, CPR injury type, and incidence were assessed.
Results: The OHCA and IHCA groups included 189 (127 men; mean age, 69.2 years) and 53 (35 men; mean age, 68.3 years) patients, respectively. Average CPR time was 19.5 and 12.8 minutes, respectively. CPA injuries were observed in 111 (58.7%) and 24 (45.3%) cases, respectively. Rib fractures were observed in 49.2% and 39.6% (the average number of rib fractures was 2.2 and 2.1), respectively. Sternal fractures (21.7% and 15.1%); mediastinal hematoma (23.8% and 3.8%); pneumothorax (4.2% and 3.8%); hemothorax (1.6% and 3.8%); and mediastinal emphysema (1.1% and 3.8%) were observed in the OHCA and IHCA groups, respectively. OHCA group showed subcutaneous emphysema, subcutaneous hematoma, and hemopericardial effusion in 3 (1.6%), 1 (0.5%), 1 (0.5%) cases, respectively. Significant difference occurred in CPR time and mediastinal hematoma ($p < 0.010$).
Conclusion: CPR-related injuries are common on CT. Among OHCA cases, CPR was performed for a long time, possibly resulting in mediastinal hematoma. Radiologists need to be careful about these injuries while reviewing postmortem CT images.

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Computer-Assisted Subjective Analysis of Thyroid Nodules May Limit Nodule Non-Specification Than Computer-Aided Diagnosis

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Objective: To evaluate the diagnostic performance of a thyroid ultrasound computer-aided diagnosis (CAD) software in comparison with computer-assisted subjective analysis for thyroid nodule differentiation.
Materials and Methods: Grey-scale sonograms of 48 benign and 32 malignant thyroid nodules that were diagnostically confirmed by fine-needle aspiration cytology or histopathology after thyroidectomy, were analyzed in this retrospective study. The AmCAD-UT (AmCad Biomed, Taipei, Taiwan) software was used for the CAD malignancy risk stratification of the ultrasound images using the American Thyroid Association (ATA) and American Association of Clinical Endocrinology (AACE) guidelines. Two readers who were blinded to the pathology results independently rated the sonographic features of the thyroid nodules using a web-based scoring risk-stratification system (http://www.gap.pe.kr/thyroidnodule.php). The diagnostic performance measures of the readers and CAD software were calculated and compared with reference to pathology results based on the corresponding guidelines.
Result: The sensitivity of computer-assisted rating was higher than CAD with ATA (65.6% vs. 50%, $p < 0.050$) whereas it was comparable for all raters with AACE (84.4% vs. 81.3%, $p > 0.050$). The AACE specificity was higher with computer-assisted rating than with CAD (72.9% vs. 54.2%, $p < 0.001$), whereas that of ATA remained the same for computer-assisted rating and CAD (87.5% [74.8; 95.3]). The CAD non-specified rate was 35% (28/80) with ATA and 31.3% (25/80) with AACE. Computer-assisted rating had a 13.8% (11/80) non-specified rate with ATA, while AACE specified all nodules.
Conclusion: Computer-assisted subjective analysis has high sensitivity and specificity and may best limit the non-specified nodule rate in ATA and AACE guidelines than sole CAD analysis.

Frequency of Bone Involvement in Oral Cavity Squamos Cell Carcinoma Using Multislice Computed Tomography as a Modality of Choice

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Objective: Squamous cell carcinoma of oral cavity stands at the 11th most common malignancy in the world. At present, Pakistan is second most commonly affected country in the world. Its incidence is related to tobacco chewing in various forms. Our main objective was to determine the frequency of bone invasion using Multislice Computed Tomgraphy as a modality of choice in oral cavity squamous cell carcinoma patients at the time of first presentation, as bone erosion and distant nodal metastasis are adverse prognostic determinants and changes the regimen of treatment overall.
Materials and Methods: A prospective study done at Radiology department JPMC over a period of 6 months from 01-07-2020 to 31-12-2020. All biopsy proven new patients presented to our department for pre-treatment scan with the history of pan, gutka, naswar and tobacco addiction were included. Post-surgical and post chemo-radiation treated patients were excluded.
Results: Age range of patients varies from 26 to 65 years with the mean age of 50.3 years. Out of total 80 patients, 54 (67%) were males and 26 (32%) were females with male to female ratio is 2:1. Out of 80 patients 43 (54%) showed bone erosion at the time of first presentation while 37 (46%) did not show any at first pre-treatment scan. MDCT using bone algorithm has sensitivity of 90% while specificity of 95% in diagnosing bone erosion.
Conclusion: Multi-slice CT reconstructed with bone algorithm is accurate in detection of bony invasion in oral cavity squamous cell carcinoma.

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A Comprehensive Pictorial Essay of Orbital Mass Lesions by 3 Tesla Magnetic Resonance Imaging – Looking Throgh Orbit Beyond the Fundoscopy

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Learning Objective:

- Review the orbital anatomy on MRI to compartmentalize orbital mass lesions.
- Highlight imaging features which helps in differentiating between benign and malignant lesions.
- Discuss the imaging characteristics of common and/or rare orbital mass lesions by using high field strength 3 Tesla MRI.

Background: Orbital lesions form a wide range of pathologies that pose challenges in diagnosis, management and treatment. The soft tissue detail provided by Magnetic Resonance Imaging (MRI) allows for better lesion characterization. MRI therefore plays a crucial role, especially in cases where history and clinical evaluation are inconclusive. Imaging features of these lesions often reflect their tissue composition.

Findings and/or Procedure Details: We have demonstrated orbital mass lesions from the patients who presented in the department of radiology since 2017 by using high fields strength 3 Tesla scanner. MRI imaging plays a valuable role in diagnosis of benign and malignant lesions, supplementing ophthalmologic examination and providing information beyond what can be seen at fundoscopy. A general approach should consider the anatomic compartment of involvement. MRI features of the important orbital mass lesions like retroorbital and choroidal hemangioma, melanoma, retinoblastoma, dermoid, optic nerve glioma, optic nerve sheath meningioma, neurofibroma, retroorbital arteriovenous malformation, metastasis have been discussed.

Conclusion: MRI offers high accuracy in characterization of orbital mass lesions and in delineating their extent in the orbit. Knowledge of orbital anatomy is essential. This pictorial review aims to provide radiologists a summary of the key imaging features which will help to differentiate benign and malignant lesions.

Revisiting Sinonasal Masses: A Pictorial Review

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Learning Objective:

- To revisit the imaging features of Sino-nasal masses using a case-based approach
- To review the advances in imaging including DWI imaging to classify benign and malignant Sino-nasal Tumors

Background: Sino-nasal masses encompass a myriad of benign and malignant etiologies affecting the nasal cavity and paranasal sinuses. An in-depth discussion of the imaging features including nuances in imaging of Sino Nasal Masses is presented in the exhibit.

Findings and/or Procedure Details: Sino-nasal masses usually have non-specific imaging characteristics. Certain morphological features like remodeling of the adjacent bony structures rather than destruction or absence versus presence of perineural extension can help differentiate benign and malignant masses. CT provides an accurate assessment of bone erosions and destruction whereas MRI acts an excellent tool to assess perineural extension. However, further research into Diffusion weighted MRI imaging provides an insight to differentiate high and low-grade neoplasms using ADC values. Certain specific features like hyperintensity on T1 Weighted imaging in Melanoma, Cerebriform pattern in Inverted Papilloma etc. should be known to a reporting Radiologist to suggest the appropriate diagnosis. Using a case-based review, the generalized as well as salient features of common and uncommon Sino-nasal masses like Sino-nasal Polyposis, Inverted Papilloma, Esthesioneuroblastoma, Nasopharyngeal Lymphoma, Sino-nasal Melanoma, Sino-nasal NUT Carcinoma, Sino Nasal Undifferentiated Carcinoma (SNUC), Sino-nasal Hemangioma, Sino-nasal Rhabdomyosarcoma are discussed thoroughly in the exhibit.

Conclusion: The detailed knowledge about Sino-nasal masses can help Radiologists provide an accurate diagnosis and help in their timely management.

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Role of Ultrasound Elastography: Differentiating Tuberculosis from Malignant Lymph Nodes

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Objective: To assess the diagnostic accuracy of ultrasound elastography and grayscale features in differentiating TB and malignant lymph nodes.
Materials & Methods: 54 patients (6 malignant, 39 tuberculosis, 9 reactive) were examined by both elastography and B mode sonography in this cross-sectional study. Elastographic patterns were determined according to the area and appearance of the hard regions within the lymph node, grade 1 to grade 6 in ascending stiffness. Strain ratio was obtained by comparing the stiffness of the lymph node against the adjacent sternoclaidomastoid muscle. Greyscale features of both lymph node groups were compared.
Results: Sensitivity, specificity, positive predictive value and negative predictive value of elastography of 2 and below as well as a strain ratio of higher than 3.475 to diagnose tuberculosis (TB) were 92.3%, 71.4%, 94.7% and 57.1%. It also found that greyscale features of thin echogenic layer and strong internal echoes were only present in TB lymph nodes and not the reactive or malignant lymph node groups.
Conclusion: This study shows that the accuracy of ultrasound elastography to differentiate TB from malignant lymph nodes is higher than usual B mode parameters. This can expedite treatment and reduce the need for unnecessary biopsies.

Relationship between Parathyroid Hormone Level and Parathyroid Gland Size and Numbers in Renal Hyperparathyroidism

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Objective: The aim of our study is to investigate the relationship between serum parathyroid hormone (PTH) levels and the parathyroid gland size and numbers in patients with renal hyperparathyroidism.
Materials & Methods: We retrospectively identified patients with renal hyperparathyroidism who had focused ultrasound of parathyroid glands performed in our institution between August 1st, 2010 and June 30th, 2019. The summations of maximum diameters and numbers of parathyroid glands were collected and compared with serum PTH levels using Pearson correlation, ANOVA test and independent t test.
Results: A total of 110 parathyroid glands in 40 patients were identified by ultrasound. There was positive correlation between serum PTH levels and the sum max diameters of parathyroid glands ($r = 0.397$, $p < 0.050$). There is a trend toward statistically significant to predict parathyroid enlargement ≥ 3 glands (AUC = 0.659, 95% CI: 0.482–0.836, $p = 0.085$). At cut-off PTH level of more than 2100 pg/mL, high specificity was achieved (> 81%) for detection of ≥ 3 parathyroid glands enlargement.
Conclusion: Serum parathyroid hormone level in patients with renal hyperparathyroidism is positively correlated with parathyroid gland size. Patients with higher serum parathyroid hormone levels also tend to have increased numbers of parathyroid glands. Further searching for more parathyroid tissue may be helpful in patients who have discrepancy between parathyroid gland size and serum parathyroid hormone level.

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Imaging Features of Invasive Otitis Externa (IOE)

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Objective: Illustrate CT findings that can help in the diagnosis and complication of invasive otitis externa (IOE)
Materials & Methods: In this retrospective study, we analyzed the data of CT scans and MRI of cases diagnosed with IOE between 01/2014 and 09/2019 at the department of radiology of Habib Thameur Tunisia.
Results: We reported 15 cases of adults with IOE in 5 years. 46.6% were female. The median age was 64 years (46–88 years). Principal clinic presentations were unremitting otalgia, otorrhea, headache and decreased oral intake secondary to trismus. All patients are urgently diagnosed with CT showing mucous thickening and bony erosion of the external auditory canal. 100% of subjects had diabetes. Nine patients out of 15 had an extension of the disease toward the petrous apex, deep soft tissue spaces of the face and neck, intracranial organs, middle ear, and large blood vessels MRI was realized with only four patients to complete extension and follow-up.
Conclusion: Invasive otitis externa (IOE) is a rare infection of the temporal bone primarily affecting elderly patients and diabetics or immunocompromised individuals, which may have dismal prognosis if treatment is not prompt and adequate. Both CT and MRI have a complementary role in detecting and demonstrating the extensiveness of the lesion involving the petrous bone, tympanic cavity and mastoid bone.

Evaluation of Ultrasound and Cytology of Thyroid Nodules Using the TI-RADS and Bethesda Classifications: A Retrospective Study

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Objective: The Thyroid Imaging, Reporting and Data System (TI-RADS) is a risk-stratification system for classifying thyroid nodules based on their ultrasound features. Prior to 2019, referrals for ultrasound-guided fine-needle aspiration (FNA) in our centre were determined on a case-by-case basis. We aimed to categorise the thyroid nodules which underwent FNA using TI-RADS classification, and to study the corresponding Bethesda cytology classification.
Materials & Methods: We retrospectively selected all patients who underwent FNA in our centre from January 2018 to December 2019. Two experienced radiologists blinded to the cytology results reviewed the ultrasound images and assigned a TIRADS category independently. Differences were resolved with consensus.
Results: A total of 122 thyroid nodules from 113 patients were analysed, with mean size of 2.7 cm. Most FNA were performed on patients with TI-RADS 3 (32.0%) and 4 (36.1%), while 23.8 % was performed on patients with TI-RADS 1 and 2 collectively. Of the total 122 FNA, 30.3% were nondiagnostic and 51.6% were benign. Only 7.4% nodules were classified as Bethesda IV, V and VI, and these were from TI-RADS categories 3, 4 or 5. Excluding the nodules which were classified as nondiagnostic, those with TI-RADS 2 category were mostly Bethesda 2 (87.5%).
Conclusion: Without a standard risk stratification system, there is a high percentage of FNA performed on benign nodules. TI-RADS is useful in the assessment of thyroid nodules and prevention of unnecessary FNA.

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On-Site Microscopic Evaluation of Unstained Slides to Assess Adequacy of Ultrasound Guided Fine Needle Aspiration Cytology of Thyroid Nodules

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Objective: On-site evaluation of thyroid fine needle aspiration cytology (FNAC) on stained slides is a useful way to reduce inadequate samples, however, slide preparation requires additional time and reduces clinic throughput. Our institution utilizes a unique approach to evaluating the adequacy of thyroid cytology sampling by assessing unstained slides. This study aimed to evaluate our practice of assessing adequacy of ultrasound guided fine needle aspiration biopsy of thyroid lesions using contemporaneous microscopy on unstained, air-dried samples.
Materials & Methods: Retrospective review of cytopathology and radiology reports on 139 consecutive patients who had undergone FNAC sampling between September 2015 and August 2016 at regional specialist service for suspected thyroid cancer. The samples were obtained and slides prepared by 3 Histopathologists and 1 Radiologist using a standardized technique. Each operator evaluated the unstained slides for adequacy and performed up to 3 needle passes if the sample was inadequate on microscopy.
Results: Using our method of assessing unstained thyroid fine needle cytology biopsy, our service was able to achieve a collective adequacy rate of 93.9% (range 90–100%). This adequacy rate is higher than that cited in literature when on-site evaluation of adequacy is not utilized. Our adequacy rate is comparable to studies that evaluate stained samples, but without the time penalty required to prepare the slides.
Conclusion: On-site evaluation of thyroid FNAC on unstained slides is practical and efficient in achieving high adequacy rates. Radiologists can adopt this skill to expedite diagnosis and prevent repeat sampling.

Postcontrast T1 GRE or T2 FLAIR – Which Is Better and Where?

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Objective: Usually pre and postcontrast T1-gradient recalled echo (T1GRE) scans are compared to assess lesion vascularity, internal necrosis or breach in blood brain barrier. However, post-gadolinium enhancement is also seen on T2-fluid attenuated inversion recovery (T2FLAIR) images because of T2- prolongation effect of various lesions and T1-shortening effect of gadolinium acting in synergism. Hence, we share our experience on postcontrast-T2FLAIR images versus postcontrast- T1GRE images in variety of brain pathologies.
Materials & Methods: Twenty patients with clinical suspicion of brain pathologies were randomly selected & their non-contrast and postcontrast MRI brain examinations were performed. Non-contrast and postcontrast 3D-T1GRE and 3D-T2FLAIR images on 1.5Tesla MRI scanner with a high-resolution image matrix were used to make diagnosis.
Results: Postcontrast-T1GRE images are superior to postcontrast-T2FLAIR images in:
- delineating degenerating cysts of cysticerci,
- demonstrating internal air and perilesional edema in patients with pyogenic abscess
- determining the extent of meningeal enhancement especially in sulcal spaces (especially in tubercular meningitis) and dural sinuses due to presence of luminal signal void of sinus lumen on T2FLAIR images,
- determining the nature of internal contents and number of lesions in cases of tuberculoma with an additional advantage of demonstrating edema,
- determining the nature of internal contents and mural characteristics in cases of intracranial tumors.
- postcontrast-T2FLAIR images may obviate the need for noncontrast-T2FLAIR images.

Conclusion: Postcontrast-T2FLAIR images may be routinely used as an additional tool to postcontrast-T1GRE scans in MRI examination of a variety of brain pathological conditions as it provides additional clinically useful information that may be helpful in management and predicting prognosis.

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Systematic Approach to Computed Tomography in the Assessment of Vocal Cord Palsy

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Learning Objective: To systematically review the course of the vagus and recurrent laryngeal nerves and describe some of the common pathologies that occur at various levels along the course of these nerves that can lead to vocal cord palsy.
Background: Vocal cord palsy can be identified or suspected on computed tomography (CT) in symptomatic or asymptomatic patients. Contrast enhanced CT from the skull base to the aortopulmonary window is a powerful adjunct to clinical and laryngoscopy assessment in identifying the underlying cause of vocal cord palsy. Although the vagus and recurrent laryngeal nerves are not readily demonstrated on CT, the expected course of these nerves have been described on various literature and can be easily evaluated on CT for evidence pathologies or previous surgery/trauma.
Findings and/or Procedure Details: Pictorial description of laryngeal and hypopharyngeal CT changes in vocal cord palsy. Annotated CT images of the course of the vagus and recurrent laryngeal nerves from the brainstem to the larynx. Common pathologies at the level of posterior cranial fossa, skull base, neck (descending course of vagus nerves), thoracic inlet, superior mediastinum and neck (ascending course of recurrent laryngeal nerves) that can result in vocal cord palsy.
Conclusion: Understanding the course of the vagus and recurrent laryngeal nerves as well as knowledge about the pathologies that commonly occur at various levels of the nerves course is integral to the reporting radiologist in the evaluation of vocal cord palsy.

Radiological Evaluation of Typical and Atypical Cases of Mucormycosis Infection and Pathological Correlation: Case Based Review

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Learning Objective:
- Radiological evaluation of typical and typical cases of mucormycosis infection and imaging findings
- To analyse the CT and MRI appearance of rhinocerebral mucormycosis, local invasion and its complication.
- To analyse the typical and atypical CT appearance of pulmonary mucormycosis, its complication and follow up imaging.
- Radiological evaluation of rare infestation of mucormycosis infection affecting stomach and kidney.

Background: Mucormycosis is life threatening invasive fungal infection caused by filamentous fungi of all class Zygomycets. Types are rhinocerebral, pulmonary, disseminated, cutaneous/soft tissue, gastrointestinal, uncommon (like Renal). Mode of inoculation are inhalation, ingestion and traumatic. Pathophysiology- Angioinvasion, Vessel thrombosis, Tissue necrosis. It has very high Mortality (50%–85%).
Findings and/or Procedure Details: Case-based review of mucormycosis infection involving different organs. Imaging was done in 128 slice Siemens Dual-energy Scanner and 3T Siemens MRI in Dr. RAM MANOHAR LOHIA hospital, New Delhi. Radiological diagnosis was correlated with histopathological report. Cases were categorized into four groups – rhinocerebral mucormycosis, pulmonary mucormycosis, renal mucormycosis and gastric mucormycosis.
Conclusion: Mucormycosis is a life threatening invasive fungal infection commonly affecting immunocompromised patients like uncontrolled diabetes, hematological malignancy, HIV infection, solid organ transplant patients etc. In rhinocerebral mucormycosis computed tomographic evaluation helps to assess epicentral of lesion, local invasion and its complication. CT is superior to MRI in evaluation in bony involvement. MRI is superior to CT in assessment of invasion into neck spaces, orbital and brain involvement. Usual CT appearance of pulmonary mucormycosis are lobar consolidation, mass like lesion and multiple nodules. Classical radiological appearance in pulmonary mucormycosis is reverse halo sign. Pulmonary mucormycosis can also present as multi focal lesion giving centrilobular air spaces nodules with peripheral ground glassing in invasive endobronchial mucormycosis. Renal and gastric mucormycosis is rare form of infestation, usually these are histopathological diagnosis.

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The Factors Behind the Increasing Trend in the Use of Diagnostic Imaging in the Philippine General Hospital from the Radiologists' Point of View

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Objective: There has been an increasing trend in the use of diagnostic imaging in the clinical setting. This study aims to obtain the perspective of radiologists on the increasing demand for and possible perceived utility of radiologic examinations in the UP-Philippine General Hospital (UP-PGH).
Materials & Methods: This is a descriptive study wherein information was collected using a questionnaire adapted from the parent study. The radiologists were asked to rate the frequency of potential causes of increased demand for diagnostic imaging, their level of participation in the decision making of requesting physicians, and their perceived role in patient care using five-point scales. Responses were analyzed and ranked using the Likert scoring system, and grouped and ranked using Factor Analysis.
Results: The latent factors that influence the increasing trend in the use of diagnostic imaging in the UP-PGH are, in order of decreasing significance: 1) lack of communication between radiologists and requesting physicians regarding appropriate use of diagnostic imaging; 2) patient demand for health assurance and fascination with technology; 3) demand for efficiency from radiologists; and 4) patient and physician insistence on proceeding with the examination.
Conclusion: According to the respondents, the most important causes of increased volume of radiologic examinations are the lack of communication between radiologists and requesting physicians, and the availability of new imaging technology. These can be addressed by maintaining a healthy relationship between the clinician and radiologist, as well as with the formulation of hospital policies that will ensure the appropriate allocation of limited resources.

Simple and Cost-Effective Medical Imaging Solution Setup in Combination with Cloud Technology as an Alternative to Conventional RIS-PACS

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Learning Objective: This poster aims to
i) illustrate a simple, relatively low-cost but robust medical imaging solution ('The Envelope') as an alternative to conventional RIS-PACS
ii) demonstrate the practicality of this setup at a few reference sites and
iii) highlight the advantages of this system versus conventional RIS-PACS
Background: Conventional RIS-PACS systems are expensive, bulky and require extensive security setup. 'The Envelope' was developed to liberate such constraints. This is achieved by combining selected hardware, PACS storage repository and cloud technology, creating an affordable yet powerful solution for medical image archiving and communication.
Findings and/or Procedure Details: DICOM images from modalities are transmitted to a local DICOM respository (Osirix MD) via port 11118. Images are then automatically forwarded to a gateway (Ambra) through port 104. HL7 messages if present, are parsed via port 12000. For external transmission via WAN connection, port 443 with TLS 1.2 end-to-end encryption are utilised to ensure integrity and privacy. Subsequently, images are further processed and stored via Ambra's patent split-merge technology. A registered user would then login to Ambra via a secured channel. At the backend, Ambra would combine anonymised DICOM data with respective metatags in its computer memory and transmit via encrypted means to the user's browser.
CONCLUSION: Recent advances in technology has enabled a RIS-PACS setup to be less complex and easily accessible without compromise of security and privacy. This decreases setup cost, time and space. RIS-PACS administrators and decision makers should therefore consider this alternative, which has been proven functional and practical.

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Burnout: Prevalence and Associated Factors among Radiology Residents in the Philippines

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Objective: Burnout is a state of mental and physical exhaustion related to work or caregiving activities. Increased attention is given to burnout among resident physicians because of the negative consequences associated with it. The author has not encountered any local published data on burnout rates among Radiology residents. Aim of the Investigation: To identify the prevalence rate of burnout among Radiology residents in the Philippines and the demographic and program-related factors associated with it.
Materials & Methods: This was a cross-sectional survey among 100 randomly selected residents during the scientific meetings of the Philippine College of Radiology- Residency Council. A 34-item survey, including four demographic and eight program-related questions and the 22-item validated Maslach Burnout Inventory- Health Services Survey- was administered. Emotional Exhaustion (EE), depersonalization (DP), and personal accomplishment (PA) scores were calculated using published normative data. Multiple logistic regression analyses were performed to identify predictors.
Results: There were 87 responses. High EE, high DP and low PA scores were reported by 48%, 39% and 55% of respondents, respectively. The type of institution (government facility) where the resident is training (p = 0.041) correlated with high EE, male gender was a risk factor using the DP scale (p = 0.048), and relationship status (being single) correlated with low PA (p = 0.012).
Conclusions: High burnout prevalence was observed among Radiology residents in the Philippines. The predictors for burnout are gender, relationship status and the type of institution. Single, males and training in government institutions were more likely to experience burnout.

Ideal Practice for Avoiding Radon Accumulation in X-Ray Room

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Objective: Monitoring the concentration level of radon inside any building may provide critical and meaningful information regarding its accumulation and dissipation. The high amount of radon inhalation may cause significant unwanted long health effects such as lung cancer as reported by the World Health Organization (WHO).
Materials And Methods: In this study, the concentration level of radon was monitored weekly inside the room that was being identified to have high radon concentration levels such as the x-ray room in the Medical Imaging Laboratory of the University Selangor. The amount of radon was recorded daily for seven sequence days including weekends through a passive diffusion chamber using Alpha Spectrometry devices.
Results: The test results showed that there is high radon accumulation exceed a healthy level of 100 Bq/m^3 inside few tested rooms. These rooms have a different graph of radon accumulation and dissipation. Its concentration was higher in the x-ray room during the weekend days and dissipates gradually on the next working day to a healthy level in the evening. It was noticed that opening the room's door after a weekend break may reduce the high amount of radon accumulation on the next day and keep the door be opened all time including weekends may prevent the process of radon accumulation inside that room.
Conclusion: It is most recommended to keep the door of the x-ray room to be opened all the time except for clinical procedure in order to avoid the high potential of radon accumulation and its possible harm to human lung.

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Comparison of Machine Learning Algorithm for Classification of Mammographic Masses

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Objective: To compare the performance of 14 machine learning classification algorithms for classifying mammographic masses as benign or malignant.
Materials and Methods: Our study used a dataset of 829 cases of masses found on full field digital mammography that were pathologically confirmed as benign or malignant at Institute of Radiology of the University Erlangen-Nuremberg between 2003 and 2006. Each case that was used had four predictive attributes (mass margins, mass shape, mass radiodensity, and patient age) and a classification attribute (benign vs. malignant). Performance of the algorithms was measured using correct classification rate, Area Under the Receiver Operator Curve (AUC), and Kappa statistic. Stratified ten-fold cross validation allowed for the use of one dataset for both training and testing of the classifier. Weka machine learning platform was used for all analyses. ZeroR was used as the control algorithm.
Results: The highest performing algorithm was ClassificationViaRegression, with a correct classification rate of 80.7%, AUC of 0.860 and Kappa of 0.615. The control algorithm, ZeroR, had 51.5% correct classification, AUC of 0.496 and Kappa of 0. Algorithms BayesNet, Logistic, MultilayerPerceptron, and NaiveBayes also had performance measures comparable to ClassificationViaRegression. The worst performing non-control algorithm was VotedPerception with 72.9% correct classification, AUC of 0.779, and Kappa of 0.463. RandomTree, IBk, OneR, and RandomCommittee also had similarly low performance. SGD, SimpleLogistic, SMO, and Bagging performed slightly less well than the best algorithms.
Conclusion: ClassificationViaRegression was the best performing machine learning algorithm for this task in this dataset, but several algorithms showed similarly high performance.

Using Machine Learning in Radiologhy: An Introduction for the Non-Programmer

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Learning Objective: Introduce machine learning principles to those with no programming experience.
Background: Machine learning and data mining techniques have proven to be extremely powerful tools to in many fields, including medical imaging. Freely available software packages such as WEKA now make advanced machine learning techniques accessible to the non-programmer clinician. If clinicians learn the basic principles of machine learning, they will be better equipped to identify problems that can be solved with machine learning techniques. This can lead to more fruitful collaboration between clinicians and machine learning experts.
Findings and/or Procedure Details: The fundamental task of machine learning will be defined and explained. General features of problems which are best suited to machine learning methods will be discussed. Using a concrete example of a Computer Aided Diagnosis system and a real-world dataset, an example of machine learning will be illustrated using the freely available multi-platform WEKA software package. Methods to evaluate the performance of machine learning algorithms such as the Receiver Operator Curve and Kappa Statistic will be explained and illustrated. The stratified tenfold cross-validation method will be illustrated. Internet links to the WEKA software and related resources will be provided.
Conclusion: After viewing this exhibit, the clinician should have a basic understanding of what machine learning is and what sorts of problems can be approached with machine learning methods. The clinician will also be able to experiment and explore machine learning using the WEKA software and understand how to evaluate the effectiveness of a machine learning system.

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Which Side Is Which? Audit to Assess Radiographic Image Labelling

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Learning Objective: To assess the local practice of anatomic side markers placement at radiology department of RMI. To ascertain the placement of legible markers. To assess the accuracy of marker placement and to verify whether markers were placed during pre-exposure or in post processing.
Background: Anatomic side markers are radiopaque markers containing letters "R" and "L" to mark the anatomy imaged on the radiographs. They are divided into pre- and post-exposure types.
Findings and/or Procedure Details: A hospital based descriptive prospective study was conducted at Rehman Medical Institute from July to October 2020. The sample size was set for 100 consecutive x-ray images of each chest, musculoskeletal, kidney ureter and bladder (KUB), paranasal sinuses and pelvis. The Australian Institute of Radiography guidelines and 'Best practices in digital radiography' were taken as a standard. Each image was assessed for placement of a legible anatomic side marker, missing markers and errors in their placements. For images where pre-exposure marker was used documentation of placement of marker in primary or secondary beams were made. A close ended questionnaire was distributed among the radiographers to assess their knowledge related to standard guidelines.
Conclusion: We found errors of missing markers in 6 images (1.2%), erroneous placement of markers in 9 radiographs (1.8%) and a heavy practice (79.8%, n= 399) of post processing marker placement. Pre-exposure markers were placed mostly by senior radiographers. 4 out of 11 radiographers were aware of standards. We intend to have a re audit after discussion regarding to methods that can be applied for the improvements.

Bacteriological Examination of Computer Keyboards Used for Diagnostic Imaging in a Tertiary Hospital in the Philippines

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Objective: Diagnostic imaging keyboards can serve as reservoir for healthcare-associated infections (HAIs). Growth of a single pathogen may mean that (i) healthcare staff pay more attention to disinfecting "real" medical devices; (ii) easier to disinfect smooth surfaces, than surfaces with indentations and protrusions; and (iii) healthcare staff underestimate the possibility of keyboard-associated contamination. Since neglecting the disinfection of keyboards and long survival of some microorganisms are critical in hospitals nowadays, the investigator seeks to conduct the study in a tertiary, end-referral hospital in the Philippines.
Materials and Methods: All eighteen keyboards were grouped into three depending on their room locations. A total of 66 specimens (n = 66) were needed for statistical analysis. Sampling and swabbing of the "backspace", letter "e" and "spacebar" were done (most commonly used keys). The swabs were sent to the Department of Pathology for culture, isolation and identification (using the VITEK®2 machine.
Results: The prevalence of bacterial growth was highest in room 5 (13.6%) (n = 3), followed by room Escandor (9.1%) (n = 2) and reading room (4.5%) (n = 1). However, the observed differences were not statistically significant (p-value = 0.577). Of the three rooms, two rooms showed isolates of Acinobacter lwofflii, two rooms showed Staphyloccoccus sp., while the other growth included micrococcus, Aeromonas and Sphingomonas species.
Conclusion: Minimal growths of bacterial organisms were demonstrated in the workplace of the Department of Radiology, PGH. Though the growths were not significant clinically, it still warrants appropriate disinfection and decontamination measures, for these organisms contain potential pathogenic and health risks.

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Artificial Intelligence in Automated Triaging of Chest X-Ray During COVID 19 Pandemic: Our Early Experience on Early Adopter in Malaysia

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Learning Objective: This was a pilot study to determine the technology adoption rate of a new automated artificial intelligence (AI) system called "Putralytica" after a webinar promoting the AI system
Background: Chest X-Ray being the commonest imaging examination performed and the commonest medical imaging examination backlogs in the medical fraternity. We develop an artificial intelligence triaging system called "Putralytica" based on Convolutional Neural Network that can reliably triage normal from abnormal chest X-ray. Early adopters are essential to provide feedback to help the innovators refine and promote the product. The early adopter is defined as the second cohort of individual or entity who start early using a new technology.
Findings and/or Procedure Details: The newly developed AI system was introduced during a local but with nationwide view distribution virtual webinar entitled "Artificial Intelligence: Can it help in diagnosing Tuberculosis?". The viewer of the particular seminar at the time of this manuscript was written was 7128. The login user details were rising from 22 users (prior to introduction) to up to 231 users within 3 months. The adoption rate was 90.4% based on Product Adoption Rate formula (New Users ÷ Total Users) x 100%. The main limitation of this study was the formula only measure system activation rate but not measuring utilization per users.
Conclusion: The technology adoption rate of automated Chest X-Ray "Putralytica" was relatively higher than expected in a post-introductory lecture of a local widely distributed single webinar.

Intracranial Hemorrhage Detection in CT Scan Using Artificial Intelligence

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Objective: Missed detection of intracranial haemorrhage in Head CT scan has significantly impacted patient morbidity and mortality. Early detection of intracranial haemorrhage enable patient to received appropriate treatment which in result give a better outcome. The advancement of computer science in artificial intelligence will help to aid the doctor in the detection of haemorrhage in head CT scan. We develop an algorithm model capable of detecting intracranial haemorrhage in head CT scan.
Materials and Methods: This was a cross-sectional study using secondary data, in which the 200 data were collected from picture archiving communication system (PACS) in Hospital Serdang and HPUPM. The primary data will be anonymized and will be coded to secondary data. The data is divided into train, validation, and test sample. The algorithm model is trained using deep learning via Jupyter Notebook platform. To analyze the algorithm model performance, we are using confusion matrix to measure the accuracy, sensitivity, specificity, precision, and F1 score.
Results: From 162 training data, 80 samples show true positive, 80 samples show true negative, 2 samples show false positive, and 0 samples show false negative. This algorithm model shows high sensitivity (1.000), high specificity (0.9591), high precision (0.9591), and high accuracy (0.9791) with F1 score of 0.9791.
Conclusion: We have proved that deep learning by using CNN enables us to create an accurate classifier that can differentiate between head CT scan with haemorrhage and without haemorrhage.

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Artificial Intelligence Evaluation of Intracerebral Haemorrhage in Computed Tomography

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Objective: AI-based techniques can be used to localize and measure the intracerebral hemorrhage (ICH) in computed tomography (CT). This study aims to develop an automated detection algorithm with higher sensitivity in ICH evaluation in comparison to the conventional method. This indirectly influences the patient's prognosis by reducing the risk of delay or misdiagnosis.
Materials and Methods: Selected 50 CT brain images with primary ICH were used for three different measurement approaches 1) conventional Kothari-method, 2) AI-based method and 3) manually by radiologist marking, which is the ground truth. In the automated system, a convolutional neural network (CNN) is used to localize the ICH, followed by a thresholding technique to segment the ICH, and finally, the measurements are computed. The segmentation performance is measured using the Dice similarity coefficient. The automated ICH measurements are compared against the ground truth (automated-ground truth). Concurrently, the ICH measurements calculated using the conventional method are also compared against the ground truth (conventional-ground truth). The t-test analysis is performed between the sum squared error (SSE) of ICH measurements from the automated-ground truth and the conventional-ground truth.
Results: The mean volumetric Dice similarity coefficients for the automated segmentation algorithm when tested against the ground truth is 0.859 ± 0.135. The *t* test analysis of the SSE between conventional-ground truth (median = 5.45, SD = 3.96) and automated-ground truth (median = 0.73, SD = 0.78) achieved *p*-value < 0.001 (p = 5.10E-9).
Conclusion: The automated AI-based algorithm significantly improved the ICH surface area measurement from CT brain with higher accuracy and efficiency in comparison to the conventional method.

Artificial Intelligence- A Friend or Foe in CT Pneumonia Analysis for Typical COVID-19

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Objective: In view of the pandemic situation with high turnover of COVID-19 patients, this automated tool for quantification of lung involvement could be used for rapid interpretations, understand the temporal evolution of COVID-19 and monitor the disease progression. This approach could potentially eliminate the subjectivity in the initial assessment and follow up of pulmonary findings in COVID-19.
Materials and Methods: A cohort of 2500 RT- PCR positive patients with HRCT chest were analyzed by three radiologists and dataset obtained was used for deep learning evaluation. The aim of the study is to demonstrate the findings related to COVID-19 based on Lung Severity Score (LSS) by AI algorithm and to compare with the actual CT severity scores. A linear relationship between automated and actual values was demonstrated by using Pearson's correlation coefficient (r). Inter-Class Correlation (ICC) coefficient based on single rater, consistency and two-way random effect model was used for the assessment of the degree of correlation. The level of agreement between two methods of LSS was further assessed using Bland?Altman analysis.
Results: The quantitative CT parameter calculated by the deep learning method showed comparable results among three clinical severity types (p < 0.001). Lung opacification percentage may be used to monitor disease progression and help understand the course of COVID-19.
Conclusion: CT Pneumonia analysis showed comparable results as compared with conventional evaluation quantitatively by skilled radiologists for analysis of the severity of pulmonary manifestations of the typical category of COVID-19.

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Radiomics Study of Hepatocellular Carcinoma (HCC) Based on MR Images with Support Vector Machine (SVM) as Classifier

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Objective: Hepatocellular Carcinoma (HCC) is a complex disease and is the most common cancer in Malaysia ranked as the eighth-highest mortality rate with a prevalence of 2.4 percent. Although MRI acknowledges for its advantages, the false-negative diagnosis from the examinations is inevitable although several quantitative techniques have been introduced which mostly in regard to MR study.
Materials & Methods: In this study, MR images from 97 patients diagnosed with HCC are used to evaluate a proposed algorithm for radiomics study of machine learning and to improve the accuracy and quality rate of Support Vector Machine (SVM) as a classifier. The relevant features were extracted from the segmented MR images of HCC. There are three types of features extraction used for this study which are Higher Order Statistics (HoS), Shape Feature (SF) and Textural Feature (TF).
Results: The experimental results of the proposed technique have been evaluated and validated for performance and quality analysis on the data, based on accuracy, sensitivity and specificity. The accuracy of SVM classifier on both training and test images are ranged from 0.80–0.90 which considered as significant. Moreover, the proposed algorithm demonstrates its effectiveness compared with the other machine learning recently published techniques. Features selection yielded several relevant features.
Conclusion: Therefore, the proposed algorithm improves radiomics quantification and possibly increase the survival prediction accuracy when added to input images and tumour volumetric features.

Application of Text Mining in Narrative Breast Radiology Reporting for Audit and Research in University Malaya Medical Center

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Objective: Radiology reporting is narrative and the information of reports is unstructured and detailed. Extracting information for auditing and research is time consuming. The aim of this study is to develop an artificial intelligence (AI) based radiology reporting system that will enable structured narrative breast radiology reporting using text mining for information extraction in the clinical and research settings.
Materials & Methods: A total of 147 ultrasound and mammogram reports for model building and 150 reports for model testing from patients of University Malaya Medical Centre in free text format were used. The programming languages used for the text mining were R, while PHP. HTML and JavaScript together with the XAMPP and MySQL platforms were used to develop the front-end to insert new reports and to view and edit existing reports. The text mining with information extraction was developed based on a rule-based system. The system was evaluated by calculating the precision, recall and F1-score using confusion matrix.
Results: Twenty important variables were successfully mined from free text into a structured format. The evaluation of the system using the training set data showed 0.9691 of precision, 0.9918 of recall and 0.9804 of F1-score calculated using the confusion matrix, while the testing set results showed 0.9778 of precision, 0.9880 of recall and 0.9829 of F1-score.
Conclusion: The text mining algorithm developed and tested in this study was highly accurate. In the future, it can turn unstructured data into validated structured form which can provide useful insights for employing AI and big data tools.

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The Impact of Contrast Limited Adaptive Histogram Equalization as Image Enhancement on Breast Segmentation

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Objective: Breast cancer is one of the most common cancers among women in both developing and developed country. It is notable that numbers of diagnosis have a higher error rate of false-negative (FNs) and false positives (FPs), technological improvement needs to be developed to reduce the error rate. In this study, 100 datasets of the mammographic images with lesion obtained from The Cancer Imaging Archive (TCIA) in DICOM format is used to evaluate the percentage difference between two semi-automatic segmentation techniques using Contrast Limited Adaptive Histogram Equalization (CLAHE) as an enhancement.
Materials & Methods: There are three sets of images which ROI was adapted with; Contrast Limited Adaptive Histogram Equalization (CLAHE) and Adaptive Histogram Equalization (AHE), only Contrast Limited Adaptive Histogram Equalization (CLAHE) and with no enhancement. Segmentation process from two sets of enhanced images was performed by using Seeded Region Growing Algorithm (SRG) to be compared with manual segmentation.
Results: The experimental results of the proposed technique for enhanced image have been compared with manual segmentation by evaluating Dice-Sørensen coefficient for both sets. The percentage difference between segmented images enhance with CLAHE and AHE is smaller than images enhanced with CLAHE only. The value of Dice-Sørensen Coefficient for images enhanced with CLAHE only is between 0.7 to 0.9 while for images enhanced with CLAHE and AHE are between 0.9 to 1.0.
Conclusion: The results suggest that segmented images enhanced with CLAHE and AHE have higher similarity with manual segmentation compared to non-enhanced.

Avoiding Radon Inhalation in Radiology Department

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Objective: Most of the x-ray rooms are design to avoid any possibility of x-ray radiation to penetrate its wall. The rooms usually have no windows and its walls are totally coated by barium plaster. There is the possibility for radon to be accumulated inside these rooms. Long staying in the room that has a high amount of radon may cause significant health effects. The World Health Organization (WHO) reported that radon is the main cause of lung cancer for non-smoker persons.
Materials & Methods: In this study, short term measurement was applied to monitor the concentration of radon inside general x-ray and mammography rooms at the Medical Imaging Department in University Selangor (UNISEL). The amount of radon was monitored hourly through a passive diffusion chamber and detected by using Alpha Spectrometry.
Results: The test results showed that each room has a different graph and the amount of radon accumulation. Their maximum reading of Radon concentration was recorded 338 Bq/m^3 and 150 Bq/m^3 respectively. Its concentration was higher during the weekend's time when the door is totally closed and dissipates gradually on the next working day to a healthy level below 100 Bq/m^3 when the door is open for the whole working day.
Conclusion: It is strongly recommended to monitor the radon in these rooms to avoid inhalation of this type of natural radioactive gas and protect our body from unnecessary naturally occurring radiation beside man-made radiation.

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Deep Learning in Medical Imaging – A Bit of Demystification

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Learning Objective: For practitioners in the field of medical imaging to gain basic understanding about the technique of deep learning (DL); to understand its basic premise, approach, and implementation.
Background: Artificial intelligence (AI) – specifically DL – has exploded in popularity in the past five years, demonstrating paradigm-shift levels of performance in various fields including medical imaging. It is likely to bring about significant changes to clinical practice as its adoption increases. Compared to traditional AI techniques, DL makes almost no assumptions about the specific means of solving a problem; using only stacked layers of simple equations trained on data to derive a solution. This flexibility largely explains why DL is generalizable to many problem domains.
Findings and/or Procedure Details: To utilize DL, practitioners have to (1) define their problem numerically, both for the input (e.g. image or lab result) and desired output (e.g. probability of disease outcome), and (2) collect large quantities of data for training and testing. The actual DL frameworks are of comparatively minor importance; the field has settled on a few design variants for each class of problems (e.g. "U-nets" for image segmentation). In DL, the data is what matters.
Conclusion: DL is an AI technique where computers are trained to solve a problem by iterating millions of times over a set of training examples. If a practitioner can define their problem's inputs and desired outputs numerically and collect large quantities of example data, then DL is relatively easy to implement and will likely give good results.

Interactive Exploration of Deep Learning Related to Radiology in a Web Browser

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Objective: Deep learning for radiology is a multidisciplinary field, requiring expertise in clinical radiology, statistics, computer science and data science. Radiologists without a data science background occasionally struggle to understand deep learning despite the need to grasp basic concepts required for judicious use of this new technology. A web-browser based application was developed to facilitate understanding of deep learning for radiologists by using a hands-on approach.
Materials & Methods: CNNPlay (http://isodense.com/cnnplay) uses the ConvNETJS library to allow interactive development, training and testing of novel neural networks in a single interface. For assessment of the practicability of this application, a series of networks were developed, trained and tested on a classification dataset of chest and abdominal radiographs. Total images in the dataset were 16 (training set), 4 (validation set) and 21 (testing set). The hidden layers in the tested networks ranged from 1 fully connected (FC) layer to 7 mixed (convolutional [CONV], pooling [POOL] and FC) layers. Each model was trained for 50 epochs.
Results: Pure FC networks with low neuron numbers trained fastest (1144 ± 58 ms, 1180 ± 28 ms) but had the lowest accuracies (72.4%, 72.4%). The most complex tested network (CONV-POOL-CONV-POOL-CONV-POOL-FC) trained slowest (31176 ± 257 ms) but had excellent accuracy of 92.4%. Interestingly, a 2-layer FC network of high neuron numbers showed similar accuracy (92.4%) but with faster training time (7247 ± 15 ms).
Conclusion: CNNPlay can be used to develop and train simple networks of up to 7 layers fairly quickly and may be of use to facilitate understanding of deep learning among radiologists.

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Artificial Intelligence in the Evaluation Of Proptosis on Computed Tomography

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Objective: Study evaluates the potential of a deep learning algorithm for evaluation of proptosis with convolutional neural network (CNN).

Materials & Methods: Computed tomography (CT)scans of head was conducted at tertiary hospital between May-17 & April-19 with equivocal findings excluded resulting in 190CT- scans. Test set of 45images was randomly selected from initial sample (27-abnormal,18-normal) & it was not used in training process. Further 37-abnormal scans were randomly excluded resulting in training set of 54-normal & 54-abnormal CT- scans. Equal numbers were required in each group for optimal network training & converted to JPEG-image format. Initial sample was amplified 26-fold using combination of horizontal flip, size alteration & rotation. Pre-trained Inception-v3 network was then retrained using amplified CT-scans. Training data was randomly split with 80% for training, 10% for validation & 10% for final testing. Model was trained over 2000-iterations with learning rate of 0.01. Area under Receiver-operator-curve (ROC) was calculated using a web-based analysis tool.

Results: Area under ROC for this CNN was 0.87 demonstrating high levels of diagnostic test accuracy. Output from CNN produces a continuous score of between 0 (abnormal) & 1 (normal). Setting output score threshold to 0.395 results in test sensitivity of 96.3%, specificity of 66.7%, positive predictive-value of 81.3% &negative predictive-value of 92.3%.

Conclusion: This proof of concept study demonstrates that high diagnostic test accuracy can be achieved in an automated analysis of head CT. Results obtained from this study may help ophthalmologists & radiologists to objectively evaluate patients with proptosis and can be adopted across many different imaging.

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Study Ultrasound Imaging and Effective Treatment in Varicose Veins of Lower Limbs by Combined Foam Sclerotheraphy, Endovenous Theraphy and Microphlebectomy

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Objective: Investigate clinical features, Doppler ultrasound characteristics and evaluate treatment efficacy of foam sclerotherapy in combination with endovenous therapy and microphlebectomy for patients with lower extremity varicose veins.
Materials and Methods: A longitudinal prospective uncontrolled intervention study, with a convenient sample size of 33 patients diagnosed with varicose veins of lower extremities, who were then treated with foam injection in combination with endovenous therapy and microphlebectomy at Hue Central Hospital from 3/2018-8/2020.
Results: The average age of the research group is 52.2 ± 10.96 years, ranging from 25–83 with the female: male ratio of 4.5:1. Pain, severity, numbness, leg fatigue, and cramps were symptoms for the majority of patients at grade C2 and a mean VCSS score of 4.51 ± 1.47. The mean diameter of the great saphenous vein in the mid-thigh position was 5.4 ± 1.21 mm, the superficial tributary veins were 3.7 ± 0.56 mm with the venous reflux time greater than 0.5 s. After 1 month of treatment, functional symptoms, CEAP and VCSS resolution and venous diameter all decreased significantly. 100% of the intervention veins had no reflux flow on Doppler ultrasound. Complications reported after the intervention were skin paresthesia, skin pigmentation disorder and interventional pain with the prevalences of 42.6%, 12.8% and 8.5%, respectively.
Conclusion: Doppler ultrasound plays an important role in the diagnosis and follow-up after treatment in patients with varicose veins of the lower extremities. The foam sclerotherapy in combination with endovenous therapy and microphlebectomy is a safe, non-invasive and highly effective procedure with acceptable complications in the treatment for this disease.

Transradial Access in Neurointervention – A Single Team Experience

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Objective: Transradial access is becoming a more popular technique for neurointerventionalists worldwide. This once unorthodox approach is now becoming the go to access for neuroendovascular procedures. In coronary intervention, research shows transradial access to have less complications and better patient comfort than transfemoral access. The objective of this study is to assess a single team experience of transradial access in neurointervention.
Materials and Methods: A retrospective analysis involving 16 patients was carried out from July 2020 till Jan 2021 by the neurointervention team in Hospital Sungai Buloh. Cases were initially performed on follow-up angiogram patients but subsequently done for diagnostic angiograms and those requiring intervention. The time required to puncture and sheath insertion, vessels cannulated, fluoroscopy time, conversion to femoral access and complications were analysed.
Results: The right radial artery was accessed for all cases. The average time for a radial puncture and sheath insertion was 4.2minutes. 50% of cases were bilateral vessel studies, followed by right (38%) and left (12%). 44% of cases were reassessment angiograms, 31% for diagnostic angiography and 25% for embolisation. Vasospasm encountered in 15 patients that was treated with IA verapamil. 1 patient had conversion to transfemoral access due to bovine arch anatomy and 1 patient sustained skin blistering from the compression plaster. No cases of pseudoaneurysm, vascular occlusion or haematoma formation noted.
Conclusion: Transradial access is a safe and effective technique for diagnostic neuro-angiography and therapeutic neurovascular interventions with low risk of complications and femoral conversion.

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Tunneled Adult Peripherally Inserted Central Catherer (PICC) for Central Venous Access in Peadiatrics: A Single Centre Experience

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Objective: Long term intravenous access in pediatrics has been challenging in terms of ease of procedure, maintenance of catheter and complications that may arise. Our center adopted the use of tunneled adult Peripherally Inserted Central Catheter (PICC) for central venous access in paediatrics with the hope to improve these challenges. We describe a single institute 3-year experience of this technique.
Materials and Methods: Retrospective medical records were reviewed for pediatric patients aged less than 12 years old who had tunneled PICC insertions from January 2018 till December 2020. The following data were recorded: indication, diagnosis, reason for removal, duration of PICC, vessel inserted, PICC device type and complications.
Results: Eleven adult PICCs were inserted from this technique in 10 children. The average age was 35.7 months and average weight was 13.2 kg. The youngest patient was 3 months old at 6.9 kg. Most common indication for insertion was for long term antibiotics (82%) and the remainder were for difficult intravenous access. The procedure was done under local anesthetic with sedation in 90% of cases. Average duration of PICC was 24.4 days. Out of 11 PICCs only 1 had line related infection that required premature removal of the catheter. 45% completed the intended duration while 27% PICCs had dislodged.
Conclusion: Tunneled adult PICC for central venous access in the paediatric age group at our institution has a lower risk of infection. However, almost a third of the catheters inserted still suffered dislodgement.

Adrenal Venous Sampling: A Practical Guide to Improving Success Rates

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Learning Objective: By viewing this educational exhibit, the viewers will be able to (1) describe the anatomical variations of the adrenal veins; (2) describe the detailed procedure steps of adrenal venous sampling (AVS); (3) understand the “Do’s & Don’ts” for a reliable specimen collection; and (4) explain how to interpret the sampling results.
Background: Primary aldosteronism (PA) is a group of disorders in which aldosterone production is inappropriately high. PA is more common than previously thought and has been increasingly recognized as a cause of secondary hypertension. The majority of PA cases are caused by either unilateral aldosterone-producing adenoma or bilateral adrenal hyperplasia. Differentiation of the underlying condition is crucial for the treatment of patients with PA because unilateral disease can be cured by laparoscopic adrenalectomy, while cases of bilateral aldosterone secretion will be medically treated with mineralocorticoid receptor antagonists.
Findings and/or Procedure Details: The role of AVS in PA is to localize the source of aldosterone excess, and determine surgical vs. medical management of PA. The following topics will be discussed in this exhibit: anatomy and variations, pre-procedural imaging, medications to be avoided prior to sampling, procedure steps, technical tips and troubleshooting, how to interpret the results, and complications.
Conclusion: Although AVS largely contributes to the definitive diagnosis and treatment planning in PA, AVS is a technically demanding interventional procedure even in experienced institutions. This educational exhibit is expected to be a practical guide to improve AVS success rates.

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Effect of Music on Anxiety and Pain During Ultrasound Guided Core Needle Breast Biopsy: A Randomized Controlled Trial

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Objective: Interventions to reduce anxiety are important for high quality health services during ultrasound guided core needle breast biopsy (UGBB). The purpose of this study was to evaluate the effect of music intervention on anxiety and pain levels of patients undergoing UGBB.
Materials and Methods: In a prospective randomized-controlled design, patients who will undergo UGBB were invited to the study and randomized into the intervention group who received standard care with classical music intervention before and during the biopsy procedure, and the control group who received only standard care. The Spielberger State-Trait Anxiety Inventory and the Visual Analogue Scale were used for measuring anxiety and pain levels after the procedure. One-way multivariate analysis of variance test was used to find the effect of the music intervention on patient anxiety and pain.
Results: There were 31 (48.4%) patients in the intervention group, 33 (51.6%) in the control group that were similar in terms of sociodemographic characteristics and trait anxiety levels. The patients in the music intervention group had significantly lower state anxiety levels (42.3 ± 6.5) than the control group (46.2 ± 4.5) with the mean difference of 3.8 (95% CI: 1.0–6.6, $p = 0.008$). The mean difference of pain levels measured was 6.0 (95% CI: 2.2–14.2) and not statistically significant between intervention and control groups (19.6 ± 15.0 and 25.5 ± 17.6, $p = 0.150$).
Conclusion: Music reduced anxiety, but not pain during UGBB. The results especially imply to low and middle-income countries where low cost and easily implemented interventions are needed to address patient anxiety during breast biopsy procedures.

Case-Based Illustration of Imaging Findings of Tuberous Sclerosis Complex (TSC) and Emergency Interventional Treatment of Associated Life-Threatening Renal Bleed

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Learning Objective:
- TSC imaging findings and risk for renal bleeding.
- The overall role of Interventional Radiology (IR) in TSC management, particularly for renal embolisation.

Background: Tuberous Sclerosis Complex- LymphAngioMyomatosis (TSC- LAM) is a rare autosomal dominant condition with multisystem hamartomas and/or tumours. These patients commonly have Renal AngioMyoLipomas (AMLs) and rarely exhibit interlobar renal artery aneurysms, both of which may predispose them to renal bleeding. This poster demonstrates neurological, pulmonary, renal and skeletal imaging findings. It also discusses how to tackle a renal bleed in these patients and touches upon ablation for small renal tumours.
Findings and/or Procedure Details: A young female with known TSC-LAM presented with an acute right renal bleed on a background of intermittent haematuria. She was tachycardic and anaemic with a dropping haemoglobin (6.2 g/dL). Plain CT as well as CT renal angiography and Digital Subtraction Angiographic imaging demonstrated multisystem TSC-LAM findings and specifically an acute right renal bleed, massive bilateral AMLs and multiple interlobar and distal renal artery aneurysms. Urology referred the patient for emergency nephron-sparing embolisation. The massive right sided AMLs were embolized with 500 to 700 micron PVA particles. Subsequently the, likely culprit, right interlobar renal artery aneurysm as well as other renal artery distribution aneurysms greater than 5mm in diameter were coiled.
Conclusion: TSC-LAM has characteristic imaging findings and these patients are at high risk of renal bleeding. Prompt imaging must be done to specify bleeding etiology and site. Interventional Radiology has a crucial role in prevention and treatment of renal bleeding.

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Pioneering Experience of MRI-Guided Microwave Ablation of Hepatocellular Carcinoma in a Single Centre in Hong Kong

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Learning Objective: To illustrate the procedure of magnetic resonance imaging ("MRI")-guided microwave ablation of hepatocellular carcinoma ("HCC"), with references to our experience of five cases over the period of 10 months.
Background: Heat-based ablation technique is a good alternative to surgery for small HCC in appropriate patients. Occasionally faced with guidance issues when lesions are not visible on ultrasound and cannot be stained/are contraindicated to lipiodol staining, we started using MRI as a guidance tool for accurate placement of the antenna.
Findings and/or Procedure Details: Total of five tumours in five patients were selected for ablation under MRI guidance due to non-visualisation on other imaging modalities. The mean age was 71.2 years old (61–83); mean tumour size was 1.6 cm in long axis (0.8–2.7 cm). All procedures were performed under conscious sedation. Microwave ablation (80 W) was used for 5–8 minutes, up to two cycles, depending on size of the lesion. A 1.5-T MRI scanner and prototype balanced steady-state free precession sequence (BEAT interactive real-time tracking) were used to guide the placement of microwave antennas in real time. All procedures were successful with no complications observed. For the four cases with follow-up imaging at time of writing, no local recurrences at the ablation zones were identified with a mean follow-up period of 3 months (1–6 months).
Conclusion: Our initial experience showed that MRI is a safe and effective imaging modality for guidance of microwave ablation of HCC and provides a good alternative image guidance method for those where CT and US guidance is not feasible.

Endovascular Management of Hepatic Artery Aneurysm and Pseudoaneurysm - A Rare Cause for Gastrointestinal Bleed

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Objective: To analyze the demographic profile and to evaluate the effectiveness of endovascular management in the treatment of Hepatic artery aneurysm/pseudoaneurysm and its immediate and short-term outcome.
Materials and Methods: This is a retrospective study in which etiologies, presentations, procedures rendered, and outcome were analyzed. Amongst 560patients evaluated with diagnostic visceral angiography on Universal angiography system (Axiom Artis FA, Siemens Medical Systems, Germany) over 10 years (2011–2020), Visceral-artery aneurysm/pseudoaneurysm were detected in 140patients with 30 patients having hepatic artery involvement. Following angiographic localization of bleeding source, sub-selective cannulation with embolization of feeding branch-artery was done with pushable micro-coils or particulate embolics. Endosaccular coiling was done in selected cases with detachable micro-coils. Immediate success was noted as cessation of hemorrhage and/or exclusion of the aneurysm/pseudoaneurysm on control angiogram (100%). Patients were followed up for 3 months to evaluate short-term efficacy.
Results: Most common age-group was 20–40 years, males were more common (84%). 27 patients (90%) had solitary lesion. Majority were 1–2 cm (40%) and Intrahepatic (73%) with right hepatic artery most commonly involved (50%). Most common clinical presentation was pain abdomen (75%) with Blunt-Abdominal Trauma being most common etiology (47%). Embolization of the feeding artery with micro-coils was done in 20/28 (71.4%); particulate embolics in 2/28(7.1%). Endosaccular coiling was done in 6/28 (21.5%). Endovascular management was not done in 2/30 patients (6.6%). Immediate success was seen in all 28 patients. No short-term complications were observed.
Conclusion: Endovascular management by transcatheter embolization is highly effective and should be considered as preferred treatment modality for Hepatic artery aneurysm/pseudoaneurysm.

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Acquisition Protocol CBCT in Acute Stroke and Neurovascular Intervention: Our Early Experience

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Learning Objective: Cone Beam Computed Tomography (CBCT) is an alternative imaging method which can be used for imaging of acute stroke and neurovascular pathologies such as large vessel occlusion (LVO) and intracranial atherosclerotic disease (ICAD)
Background: CBCT of 15 patients who presented with acute stroke; underwent thrombectomy has been assessed. CBCT pre-thrombectomy done as a baseline while post CBCT is to assess any bleed or new infarct after thrombectomy. CBCT was performed with bi-plane angiographic system. Images were acquired using 20.7 seconds, 30 frames per second. The acquired data will be transferred to an interventional workstation (IW). VasoCT, which is the high resolution CBCT, was performed in 16 patients. The optimal injection protocol achieved with dilation of 20% normal saline and 80% contrast. The injection rate of 0.5ml/s for a total volume of 16 mL with 12 second delay of arrival time using power injector.
Findings and/or Procedure Details: XperCT pre and post thrombectomy significantly give added value for interventional radiologist to justify the outcome for thrombectomy procedure. The dose for both pre and post Xper CT is lower compared to the repeated normal plain CT. For image quality, four radiologists were satisfied and agreed they can assess for bleed in the CT brain images produced by XperCT. The contrast dilution and long delay protocols in VasoCT give optimal visualisation of collaterals and perforators.
Conclusion: Acquisition protocol of CBCT gives added information in acute stroke and neurovascular intervention patient management. It helps in better decision making to treat and manage the patient.

Saline: A Cost-Effective Biopsy Tract Sealant in Lung Biopsy

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Objective: The aim of this article is to discuss the indications for CT guided lung biopsies, identify the technical factors important in performing the procedure, and explain the complications and the techniques which we have undertaken to reduce the complications associated with the procedure.
Materials and Methods: This is a retrospective descriptive study of patients with undiagnosed lung pathologies who underwent CT guided biopsy. The underlying disease, lesion location, size, depth, biopsy related complications and biopsy outcome were recorded. The patients' position during the procedure, complication during and after procedure, discharge timeline were documented. Care was taken to seal the biopsy tract with saline in almost all of the patients who had a long biopsy tract i.e. more than 4 cm while the sheath was being withdrawn. All the cases were done on OPD basis and even those with complications only required day care admission.
Results: 110 patients underwent CT guided lung biopsies. 56.4% of the sample population had peripheral lesions and 30% were central lesions. 13.6% of the population had lesions large enough to encompass both the central and peripheral lung fields. 50.9% of the cases had a large mass (> 5 cm) and 32.7% had a mass ranging between 3–5 cm. Complication rate was 13.6%, of these 20% resolved spontaneously and in cases that needed intervention 83% of them were managed by small bore catheters.
Conclusion: In a resource constricted setting, saline proves to be an effective choice in sealing the biopsy tract after image guided biopsy of lung lesions.

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Outcome and Safety of Selective Internal Radiation Therapy (SIRT) Using Yttrium-90 Microspheres for the Treatment of Unresectable Primary and Secondary Hepatic Tumours: A Single Center Experience

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Objective: Selective internal radiation therapy (SIRT) with Yttrium-90 (Y-90) is a treatment option for unresectable primary or secondary tumors of the liver and many studies have demonstrated the improvement in survival. This study aimed to assess the survival outcome and toxicity of patients following treatment with selective internal radiation therapy.
Materials and Methods: The data of eighteen patients who underwent SIRT with Y-90 in a single institution were analyzed retrospectively. Survival was analyzed by Kaplan-Meier curve and log-rank tests while toxicities were evaluated and described.
Results: The 1-year overall survival (OS) for patients treated with SIRT was 46.7% (9/15 patients). The median OS was 10 months (range 3–47 months). Sixteen patients reported at least one adverse event. Majority of adverse events were Grade 1 and 2 (84.7%) which include nausea, vomiting, abdominal pain and anorexia. Two patients developed severe adverse events (Grade 3). Two patients died of hepatic failure that was possibly treatment-related. One patient developed radioembolization-induced liver disease (REILD). Five patients reported Grade 3 or 4 laboratory toxicities. Child-Pugh classifications, liver function test, prior and subsequent transarterial treatment were associated with toxicities grading.
Conclusion: In conclusion, SIRT is a safe and well-tolerated procedure with a modest overall survival (OS). The adverse events are usually mild. REILD is a rare but potentially fatal adverse event, therefore patient selection is utmost important. SIRT can be considered as a first line treatment for unresectable or inoperable liver cancers. Further randomized controlled trials need to be conducted to determine patients who will benefit the most from SIRT.

Emergency Carotid Stenting in Acute Ischemic Stroke: Case Series of Early Hpupm Neurointerventional Center Experience

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Objective: Tandem vessel occlusion remains a big challenge for the neuro interventionalist in the current era. We presented case series from our early experience starting a new neuro intervention center.
Materials and Methods: 3 cases of emergency internal carotid artery stenting in which the ICA persistently re-occluded despite thrombectomy were done. We achieved good revascularization of Thrombolysis In Cerebral Infarction (TICI) score of 2b and 3 in all cases. 2 out of 3 were discharged well, while the other one transferred out due to logistic reasons. She was subsequently succumbed due to infection post total hysterectomy.
Results: Presence of ICA occlusion or tandem occlusion during mechanical thrombectomy for AIS is approximately around 10%–20% and associated with poor outcome. In the case of ICA occlusion, emergency intracranial stenting has been proven to be feasible achieving revascularization up to 90% (TICI 2b and above). Main patient criteria that are eligible for acute stenting is mainly persistent re-occlusion of ICA despite good perfusion of the brain. No symptomatic intracranial haemorrhage (sICH) occured.
Conclusion: Emergency stenting can achieve revascularization in AIS during emergency thrombectomy. Patient selection criteria and angiographic findings are important criteria. sICH remains a concern, however, the rate of occurrence is acceptable. Further data collections and the long-term outcome will be obtained for evaluation.

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Assistant Interventionist Workflow Efficiency in Acute Stroke Thrombectomy: Early Experience in a Teaching Hospital

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Learning Objective: To evaluate the efficiency of workflow arrangement in reducing time delays for thrombectomy in acute ischemic stroke.
Background: Thrombectomy is a procedure for patient with acute ischemic stroke due to large vessel occlusion. Rapid activation of team member including assistant interventionists (AI) such as paramedics, nurses and radiographers, is crucial to ensure flow restoration can be achieved as soon as possible. Optimal workflow plays a very important role in a thrombectomy procedure.
Finding and/or Procedure Details: Early activation of the team with clear workflow improve decision to puncture time. The average door to puncture time however still poor as the delay mainly due to financial related disruption. Our centre uses MRI as the first-line imaging tool for acute stroke. Once decision for thrombectomy achieved from multi-disciplinary team, patient will be passed over by emergency department personnel to AI. The passing over process will take place when patient in the MRI. Consent will be obtained from patient's relative by medical officer. Second AI will start preparing necessary equipment in the angiography suite. After MRI, patient will be immediately transferred to the angiography suite. Minimum of three functional AI which include nurses and paramedics are required. They are responsible for monitoring patient's vital signs, preparing and handling of sterile equipment, and circulating personnel. Third person also need to assist intubation if required.
Conclusion: Clear workflow and time optimization is crucial for the efficiency of thrombectomy. Task distribution among AIs should be emphasize as it helps in reducing time for effective treatment plan.

Factors Affecting Response to Transarterial Chemoembolization in Hepatocecllular Carcinoma Treatment

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Introduction: Varying response to Transarterial Chemoembolization (TACE) in Hepatocellular carcinoma (HCC) treatment has been reported. This study aimed to identify factors affecting objective response to TACE to help better HCC treatment stratifications.
Materials and Methods: A retrospective study of 100 HCC patients who underwent TACE in University Malaya Medical Centre (UMMC) and Hospital Selayang from 2014–2020. Patients demographics, clinical profile, laboratory results, imaging characteristics, and TACE agents used were collected from Picture Archiving and Communication System (PACS) and Electronic Medical Records (EMR). The response to TACE was assessed on follow up imaging based on Modified Response Evaluation Criteria in Solid Tumour (mRECIST).
Results: Overall Objective Response to TACE was 34% (Complete Response = 12%; Partial Response = 22%). Multivariate logistic regression analysis revealed Hepatitis B (odds ratio [OR] 16.48; 95% confidence interval [CI] 2.20, 123.40), Hepatitis C (OR 20.66; 95% CI 1.45, 265.42), smaller lesion size (OR 0.60; 95% CI 0.41, 0.87), homogenous enhancement (OR 127.40; 95% CI 10.39, 1561.63), heterogenous enhancement with septation (OR 9.49, 95% CI 1.31, 68.65), single lesion (OR 8.96, 95% CI 1.53, 52.48), and larger feeding hepatic arterial diameter (OR 7.50, 95% CI 1.88, 30.00) as significant predictors of Objective Response to TACE ($p < 0.050$).
Conclusion: Uninodularity, smaller target lesion size, enhancement characteristics, Hepatitis B/C status, and a larger target hepatic artery were significant predictors of Objective Response to TACE. These factors can be used as guidance for TACE decision making in HCC patients.

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Analysis of Mechanical Thrombectomy for Elderly Patients in Our Hospital

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Objective: The effectiveness of mechanical thrombectomy (MT) for ischemic stroke is obvious. Large registries also suggested that there were treatment limitations for severe and elderly cases. We are actively treating severe elderly patients, and we think it is important to evaluate the results of our treatment. The purpose of this study was to clarify the efficacy and safety of MT for the elderly.
Materials & Methods: We divided patients into the elderly group (over and equal to 80 years old) and the non-aged group (under 80 years old), analyzed in terms of the characteristics, treatment details, effectiveness, and safety of MT in our institution.
Results: There was no difference in neurological severity and targeted arteries in two groups, but the proportion of cardiogenic emboli was higher in the elderly group (100%/71%, $p = 0.043$), and the severity was slightly higher in the non-aged group (NIHSS 18/23). Regarding the time course, the non-aged group tended to be faster from onset to arrival at the hospital (99 minutes/74 minutes), but the reperfusion time was not different between the two groups (254 minutes/248 minutes). Defining the modified Rankin Scale ≤ 2 at 3 months after treatment as good outcome, we couldn't find difference between the two groups (41%/43%).
Conclusion: There were differences in patient background, MT is effective for elderly people over 80 years old.

Renal Artery Embolization for Renal Hemorrhage and Impending Hemorrahge

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Objective: To review the effectiveness of therapeutic trans-arterial embolization in controlling renal hemorrhagic emergencies irrespective of the cause of emergencies.
Materials & Methods: 10 vascular angiographies were performed in 10 patients (8 males and 2 females, age ranging from 15–70 years old) who were referred with hemorrhagic urological emergencies to the interventional radiology suite of Rehman Medical Institute Peshawar from July 2015 to December 2018. Embolization was performed with coils, polyvinyl alcohol particles and gel foam according to the clinical indication. Data on clinical indication, technique, site and type of bleeding lesions were obtained from a retrospective review of medical records. Success rate, clinical outcome and complications of the procedure were analyzed.
Results: Indications of procedure including renal artery pseudo-aneurysm (3 patients), angiomyolipoma (3 patients), residual renal tumor (1 patient), renal cell carcinoma (1 patient), renal injury due to RTA (1 patient) and severe arterial stenosis (1 patient). Following renal artery embolization, complete hemostasis was achieved in all ten patients. All examinations were negative for active extravasation on post-embolization angiogram. There were no immediate or late serious complications.
Conclusion: Trans-arterial renal Emergency embolization is a safe, effective, minimally invasive treatment for renal hemorrhage. Because of the diversified arteriographic presentation of acute renal hemorrhage, proper selection of the embolic agent is a key to successful hemostasis.

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Early Experience with Woven Endobridge (WEB) System for the Treatment of Intracranial Aneurysm in Malaysia

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Objective: The safety and efficacy of the Woven Endo Bridge (WEB) device for the treatment of cerebral aneurysms has been investigated in several studies. Our objective was to report early experience with the WEB device in the treatment of intracranial aneurysms, including the technical feasibility and safety as well as short term MRI, angiographic and clinical follow-up-results
Materials & Methods: We performed a retrospective analysis of all 5 aneurysms treated with a WEB device (WEB Single-Layer and Single-Layer Sphere) recently. Primary outcome measures included the feasibility of implantation and the angiographic outcome. Secondary outcome measures included the clinical outcome at discharge and procedural complications
Results: Five unruptured intracranial aneurysms in 3 patients were treated with the WEB device. Implantation was successful in all aneurysms. Additional devices (stents/coils) were necessary for 1 of the aneurysms. One patient had acute thrombosis side branch vessel which successfully reversed with deployment of stent and antiplatelet agent. No other complication seen. MRI and Angiographic follow-up at 1 and 3 months respectively, showing complete occlusion. Delayed aneurysm ruptures have not been observed during the follow-up period to date.
Conclusion: The WEB device offers a safe and effective treatment option for intracranial aneurysms with or without the need for antiplatelet therapy.

Decisive Technical Factors in the Therapeutic Success of Pulmonary Ablation

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Learning Objective: This essay aims to elucidate the technical principles, current indications and specific care that contribute to the optimal development of percutaneous lung thermal ablation techniques.
Background: Percutaneous thermal ablation is a minimally invasive approach to treat pulmonary malignancies not eligible for surgical resection. The procedure is performed using technologies that may involve radiofrequency, microwave or argon gas (cryoablation).
Findings and/or Procedure Details: Thermal ablation aims to destroy the target tissue using heating (radiofrequency and microwave) or cooling (cryoablation). Lung tissue peculiarities must be considered for successful treatment, such as thermal insulation, lower conductivity, respiratory movement, accentuated heat sink effect and vicinity to vital structures. The tumor relationship with adjacent structures, access route, target-skin distance (a predictor of complications) and needle location should be observed in the initial procedure planning. In terms of local control, lesion size is the most relevant factor (up to 3 cm in radiofrequency). Cryoablation and microwaves are alternatives in larger lesions, as well as using more than one probe or its repositioning during the procedure. The intent is to obtain a margin of tissue necrosis wide enough to avoid therapeutic failure and restricted enough to prevent critical structures injuries. A minimum of 5 mm (ideal 10 mm) margin should be respected in patients with curative intent (an independent predictor of failure).
Conclusion: Several factors are decisive for pulmonary ablations success. The interventionist, in addition to excellent training, is responsible for meticulously understanding the techniques' indications and contraindications, with adequate patient selection.

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Radiation Dose to the Patient's Eye Lens Through Neuro-Interventional Radiology Procedures: What Every Interventional Radiologist and Radiographer Should Know

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Learning Objective:

- Overview of current statements and recommendations on radiation dose limits for the lens of the eye.
- Review the literature concerning radiation dose received by the patient's eye lens during neuro-interventional procedures.
- Discuss the causes of high eye dose levels in fluoroscopic-guided interventional procedures and techniques to reduce radiation exposure to the patient without compromising the quality of diagnostic and/or treatment.

Background: Fluoroscopic-guided interventional radiology procedures are generally regarded as beneficial, however long radiation exposure during these procedures exposes patients to the potential for tissue reactions. One of the organs at risk is the eye lens as it is one of the most radiosensitive organs. Familiarity with the factors leading to cataract formation and awareness of the means to mitigate the over-exposure problems are crucial for the interventional radiologists and radiographers.
Findings and/or Procedure Details: We will review guidelines and recommendations on organ doses limits and methods for radiation dose reduction during fluoroscopic-guided interventional procedures. Latest developments in fluoroscopy technology and dose reduction techniques will be reviewed. The effect of various exposure parameters (e.g. frame rate, tube angle, imaging magnification) and accuracy of indirect dose measurement techniques (e.g. air kerma, kerma-area product [KAP]) will be explained.
Conclusion: Interventional radiologists and radiographers should have sound knowledge of radiation protection of patients and radiation risks. This will ensure radiation dose optimization to reduce the patient dose as well as scattered dose to the operators.

Endovascular Treatment for Intracranial Dural Arteriovenous Fistula with Liquid Embolic Agents

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Objective: Intracranial dural arteriovenous fistula (DAVF) are condition when there is abnormal arteriovenous communication in the dura. Patients might come with variable symptoms from asymptomatic to haemorrhagic symptoms. Treatment of this condition are depending various patient's factor. Endovascular embolization is currently the mainstay treatment for this condition. In this study, we will review the outcome of patients who underwent this treatment.
Materials & Methods: This retrospective study reviewed 10 patients who were diagnosed with dural arteriovenous fistula from 2009 to 2019. Clinical information was extracted from medical records, radiographic data, complications and follow-up records. Demographic and clinical data, angiographic features of the dural arteriovenous fistulas, procedural parameters, complications, treatment success, follow-up imaging, and clinical outcome were assessed.
Results: From 10 subjects, there were 6 men and 4 women included, presenting symptoms were haemorrhagic with neurological deficits in 6 patients (60%), non-haemorrhagic neurologic defects (NHNDs) in 4 patients (40%). There were 9 patients who received trans-arterial embolization, 1 patient had failed Trans-arterial approach and then switched to Transvenous approach and had partial embolization with 50% nidus remaining. One patient had post-embolization intracranial bleed and died. The 8 other patients (80%) had complete obliteration of the fistula.
Conclusion: Endovascular embolization has been proved an effective and safe method treating these complex cerebrovascular conditions with the integration of advanced endovascular devices, embolic materials and angiography.

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Early Experience in Endovascular Therapy for Acute Ischaemic Stroke without General Anaesthesia

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Objective: Acute ischaemic stoke patients requires timely restoration of cerebral perfusion to minimize damage and salvage ischaemic brain tissue prior to infarction. Endovascular therapies are the first line treatment for large vessel occlusion patients. General anaesthesia is preferred initially, however local anaethesia & sedation is now the new mainstay of patient control in view of shorter time to treatment initiation, reduced risk of intraoperative hypotension, reduced risk of postoperative respiratory complications and allows quicker neurologic assessment post endovascular therapy.
Materials & Methods: All 14 patients that are eligible and underwent endovascular therapy for large vessel acute ischaemic stroke in 2019 are recruited into this study. The thrombuses are retrieved using either A Direct Aspiration First Pass Technique (ADAPT) or stent retriever. All patients were sedated and given local anaesthesia by the on-duty neurologist.
Results: Mean age is 63 years(range from 37 to 79). 10 (71.4%) of the large vessel occluders involves the MCA (M1 or M2), 3 involves the terminal ICA (21.4%) and 1 involves the right vertebral artery (7.1%). Endovascular therapy - total of 7 (50%) are done using ADAPT only, 3 (21.4%) using combination of ADAPT/retriever and 4 (28.6%) solely on stent retrievers. Endovascular therapy is successful in 12 cases (85.7%) and failed in 2 (14.3%) despite combination technique. No procedure related complications recorded.
Conclusion: From our early experience, endovascular treatments in acute ischaemic stroke without general anaesthesia shows favourable results with no procedure related complications recorded in all cases.

Efficacy of MRI Correlated CT Guided Bone Biopsies in Suspected TB Spondylodiscitis

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Objective: The spine is the most frequent location of musculoskeletal TB. Drug resistance is a serious problem and one of the reasons for primary treatment failure. To prevent patient morbidity & mortality, it is important to diagnose them earlier and initiate specific treatment. To ensure effective treatment against spinal tuberculosis is to confirm diagnosis and testing for drug resistance. However, many times it is difficult to get adequate sample for histopathology and microbiological testing, especially in cases of Tuberculous spondylodiscitis where no paraspinal soft tissue is present. In this study we present efficacy of CT guided biopsy from vertebral body when there is no targetable paraspinal soft tissue is present
Materials & Methods: It is a retrospective evaluation and analysis of 28 Patients who had undergone CT guided Biopsy for suspected Tuberculous spondylodiscitis. All of these patients had MRI findings consistent with subacute/chronic spondylodiscitis with no paraspinal soft tissue. CT guided biopsy was done form para-discal bone/endplate which showed High signal on T2W MRI or Post gadolinium enhancement.
Results: The total success rate of MRI correlated CT guided vertebral biopsies performed was–88 per cent(25/28). Out of 28 patients, 23 of them had CBNAAT positivity, granulomatous inflammation was seen in 15 patients in histopathology, only 5 patients had culture positivity. Few patients had mild back discomfort, however, no major complications requiring treatment were seen.
Conclusion: MRI Correlated CT guided vertebral body biopsy is a safe and effective method in diagnosing Tuberculous spondylodiscitis and can be of great utility, especially in patients without paraspinal soft tissue.

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Intra-Procedural Coeliac Arterio-Portography Computed Tomography (ICAP-CT) for Transarterial Chemoembolization (TACE): A Malaysian Early Experience

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Learning Objective:
- Review advantages of hybrid angiography-computed tomography (CT) technology in interventional radiology.
- Review usage of CT arterio-portography (CTAP) and CT hepatic arteriography (CTHA) for the detection of hepatocellular carcinoma (HCC).
- Describe intra-procedural coeliac arterio-portography computed tomography (iCAP-CT) techniques and its advantages.

Background: Hybrid angiography-computed tomography (CT) system sees the integration of an angiography unit with a CT scanner that has been aligned using a common patient table. This hybrid setup enables interventional radiologists to perform conventional fluoroscopy, digital subtraction angiography and CT scanning for a patient without the need for multiple patient transfers thus minimizing risk of infection, catheter displacement and time loss in between. CT arterio-portography (CTAP) and CT hepatic arteriography (CTHA) is considered the most sensitive modality for the detection of hepatocellular carcinoma (HCC). For the CTAP and CTHA imaging, dual cannulation of the superior mesenteric artery and hepatic artery is required, which prolongs procedure time particularly where some institutions perform bilateral femoral artery punctures for cannulation and image acquisition. Furthermore, performing a CTHA after CTAP becomes delayed as it requires selective cannulation of the hepatic artery using a microcatheter.
Findings and/or Procedure Details: We describe the usage of intra-procedural coeliac arterio-portography computed tomography (iCAP-CT) prior to performing transarterial chemoembolization (TACE) for patients with hepatocellular carcinoma. Once iCAP-CT is performed, three-dimensional (3D) reconstruction of the hepatic vasculature and multimodality fusion imaging is performed.
Conclusion: iCAP-CT technique is a novel technique which reduces TACE procedural time, radiation and contrast exposure whilst improving intra-procedural tumour visualization and localization.

Demographics, Clinical Profiles, Imaging Findings, and Management Outcomes of Patients with Carotid Cavernous Sinus Fistula in Southern Philippines Medical Center from 2015 tO 2019

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Learning Objective: To establish the demographics, clinical profiles, imaging findings, and outcomes of patients with carotid cavernous sinus fistulas managed in a tertiary Philippine hospital.
Background: Carotid cavernous fistulae (CCFs) represent an abnormal communication between the carotid artery and the cavernous sinus. Clinically, they are difficult to diagnose, but may be suggested based on the patient's history and physical examination findings. Radiological imaging is crucial in cementing the diagnosis, while interventional radiology provides an opportunity for definitive management of the condition.
Findings and/or Procedure Details: Sixteen patients with CCF were referred to the Interventional Radiology Section of reporting institution from 2015 to 2019, and demographics, clinical profiles, imaging findings, and outcomes were assessed.Computed tomography was most widely used to diagnose patients, while MRI was utilized for complicated cases, prior to undergoing conventional angiography. A majority of the cases were post-traumatic and direct fistulae (87.5%), involving only one side (87.5%). Chemosis and proptosis were seen in all patients in the study, with several others complaining of headache and eye pain. Cavernous sinus distension was marked (average: 15.8 mm) as was the superior ophthalmic vein dilatation (average: 4.02 mm). Fistula occlusion was attained using coils (81.3%), coils with glue and liquid coil (6.3%), flow diverter (6.3%), and coils with gel foam (6.3%). Twelve of the patients showed immediate improvement post-embolization, with three (n = 16) improving within a week, and one complicated case that needed a second embolization.
Conclusion: CCF cases in this institution present with large and complex fistulae. Management outcomes compare favorably with available international data.

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Artifacts in Abdominal CT: They All Look the Same To Me! Let's Recognize It and Eliminate It!

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Learning Objective:

- Identify various types of artifacts that can appear in abdominal CT images
- Discuss the physics behind these artifacts
- To describe how we can eliminate or suppress these CT artifacts

Background: Artifacts can seriously degrade the quality of computed tomographic (CT) images, sometimes to the point of making them diagnostically unusable. To optimize image quality, it is necessary to understand why artifacts occur and how they can be prevented or suppressed. CT artifacts originate from a range of sources. Design features incorporated into modern CT scanners minimize some types of artifacts, and some can be partially corrected by the scanner software. However, in many instances, careful patient positioning and optimum selection of scanning parameters are the most important factors in avoiding CT artifacts.

Findings and/or Procedure Details:

- Physics-based artifacts - Beam-hardening, Streaking or Dark bands, Cupping artifact, Partial-volume artifact, Photon starvation, Undersampling
- Patient-based artifacts - Metal Artifact, Patient motion, Incomplete Projection
- Scanner-based artifacts - Ring artifact
- Helical and multisection artifacts - Cone Beam Artifact, Windmill Artifact, Stair Step Artifact, Zebra Artifact, Noise

Conclusion: Identification and recognizing type of artifact is very important. Design features incorporated into modern CT scanners minimize some types of artifacts. Most of the artifacts are corrected by scanner software. Careful patient positioning and selection of scan parameters are most important parameters in avoiding CT artifacts.

Comparative Analysis of Patient's Entrance Surface Dose between Screen-Film and Computed-Digital Radiography Against Diagnostic Reference Level for Adult Chest X-Ray Examination at Batangas Medical Center

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Objective: Assessment of entrance skin doses in conventional and computed-digital radiography should be made as a means for the optimization of the radiation protection of the patients. This study would like to compare the mean ESD for adult chest x-ray examination at Batangas Medical Center against the International Atomic Energy Agency (IAEA, 1996) diagnostic reference level.

Materials & Methods: A descriptive comparative design, retrospective chart review, employing total enumeration of adult patients undergone chest x-ray in one-year period (2015 to 2016) in Batangas Medical Center was used. Patients' demographic characteristics such as age and gender and radiographic characteristics as thickness (cm), kvp, mAs, focus-to skin distance (cm) and dose rate (mGy) were included in data collection. ESD was measured based on the x-ray equipment output obtained from a SHIMADZU 320/500 mA dose rate meter. The mean for ESD for chest PA and AP views were determined and was compared to IAEA (1996) diagnostics reference level.

Results: Out of 710 study participants, 55.2% were males and 44.8% were females. Their ages ranged from 18 to 94 years old. Radiographic characteristics were as follows: mean thickness was 20.49cm, tube potential (kVp) and tube current-time product (mAs) were 75.4275 and 3.225, respectively. The distance between the x-ray source and the film in diagnostic radiography was 145.85 centimeter. The mean ESD obtained in this study was 0.146 mGy while the ESD published by the IAEA (1996) was 0.3 mGy.

Conclusion: The mean ESD obtained in this study was two times lower than IAEA (1996) recommendation.

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Understanding the Role of Medical Physicist in Healthcare

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Objective: Medical physics is a professional academic program that involves the use of physics knowledge to be applicable in the healthcare delivery system. Many professionals in healthcare have less or no knowledge about the significant role play by medical or health physicists to maintain the optimal health level to the public. The purpose of the study to describe the important role play by this professional to ensure the community provided with maximum healthcare services.
Materials and Methods: There are three main levels of healthcare systems that involve healthcare practitioners. In this study, the role of medical or health physicists will be discussed at each level of the healthcare system that involves primary, secondary, and tertiary care. These roles may range from radiation survey and monitoring to developing treatment plans and supervisory.
Result: It was found that many published articles discussed the role of medical physics in healthcare systems. These articles stated clearly the significant role play by medical or health physicists in providing maximum healthcare to the community that should be understood by the public and other healthcare professionals. It should keep in our mind that medical and health physicists are always involved for decades in many activities of prevention, diagnosis, and treatment of human diseases.
Conclusion: It is very important to enhance the public perception regarding the vital role play by medical and health physicists in the healthcare sector. It should be praiseworthy and meritorious as one of the healthcare professionals that should not be underestimated.

Development of Complex Shielding Sheet for Mammography Using Monte Carlo Simulation

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Objective: We aim to evaluate the performance of a complex shielding sheet made of eco-friendly materials with laminated structures that can be utilized in the 30–40 kV range, which is mainly used for mammography, through GATE.
Materials & Methods: A complex shielding sheet of non-mixing laminated structures was determined by the principle that radiation with reduced energy due to scattering from high atomic number materials is absorbed by low atomic number shielding. The sheet size is 200 x 200 mm^2 and the distance from the X-ray tube is 200 mm, using SRS-78 software to calculate the energy spectrum, with an anode angle of 9 degrees, and an inherent filtration of 0.03 mmMo. For performance evaluation, we calculate the rate of shielding by dividing the energy range into low, medium, and high zones.
Results: Considering that it is one of the most used substances as an eco-friendly shield and high atomic number of bismuth 0.01 mm and the mammography is conducted closely to the skin, it used silicon 2.0 mm that is less irritated and harmless. Simulations conducted under the conditions of tube voltage of 30 kV showed relatively high shielding rates of 81.85%, 97.66%, and 99.02%, respectively, with individual use of bismuth and silicon in the low-energy (0–9 keV) and complex shielding. in the medium-energy (10–20 keV), 66.94%, 82.51%, 94.29% were confirmed, and 40.30%, 42.84%, and 65.42% were confirmed in the high-energy (21–30 keV), respectively.
Conclusion: Finally, we propose a complex shielding sheet consisting of bismuth and silicon, an eco-friendly material, confirming efficient shielding performance in mammography.

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Patient Skin Dose of Four-Dimensional Digital Subtraction Angiography: How Is It Different from the Three-Dimensional Technique?

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Objective: Digital subtraction angiography (DSA) has long been recognized as the gold standard of arteriovenous malformation (AVM) diagnosis and treatment planning. However, the traditional two-dimensional (2D) DSA is insufficient for stereotactic radiosurgery (SRS) which requires highly accurate target contours. In recent years, three-dimensional (3D) DSA and even four-dimensional (4D) DSA consisting of a series of time-resolved 3D-DSA volumes have been developed to provide higher temporal and spatial resolution. Despite the better visualization of cerebral vasculature, patient radiation dose is yet to be explored. In this study, patient skin dose of 4D DSA was compared with that of 3D DSA.
Materials & Methods: Gafchromic XR-RV3 films were wrapped around the surface of a Rando anthropomorphic head phantom. Acquisitions were performed using Siemens Artis Q biplane angiography system. Skin dose distribution was measured and peak skin dose (PSD) was identified for both 3D and 4D DSA. The 3D-DSA protocol acquired 133 projections over a 200-degree rotation in 5 seconds, whereas the 4D-DSA protocol acquired 173 projections over a 260-degree rotation in 6 seconds.
Results: Seven acquisitions were performed for each protocol. The mean PSD measured using Gafchromic films was 18.4 mGy and 26.5 mGy for the 3D and the 4D protocol, respectively. The PSD was located at the upper back of the phantom for both protocols.
Conclusion: With comparable PSD and skin dose distribution, 4D DSA can replace 3D DSA in the assessment of AVMs, which can decrease the number of 2D DSAs required during the examination.

Blood Irradiation KIT: An Update on Local Blood Irradiation Technique Using Medical Linac

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Objective: Blood irradiation is a procedure of irradiating blood and its component using ionising radiation prior to blood transfusion. The purpose of blood irradiation is to prevent the risk of Transfusion Associated Graft versus Host Disease (TA-GvHD) to the receiver. The objective of this study is to improve blood irradiation technique that has been employed previously and increase the amount of irradiated packed cells to cater for increasing local demand.
Materials & Methods: In this study, plastic acrylic was assembled into a box and a homogeneous material was then used to increase dose homogeneity around the packed cells. A treatment plan was then created and the dose distribution around the box was evaluated. The dose delivered to the box was measured using Optically Stimulated Luminescent Dosimeter (OSLDs) to compare between calculated dose and measured dose.
Results: The dose distribution calculated was within 95% to 106% of prescribed dose inside the blood irradiation kit. The box can fill up to 7 units of packed cells and irradiation time was 20 minutes per box. Furthermore, the measured dose using OSLDs were within 5% of the prescribed dose.
Conclusion: The box provides better dose homogeneity and better dose accuracy compared to previous technique adopted. It also simplifies the workflow and is easy to understand by the operators.

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Evaluation of Paediatric Patient Size for Size-Specific Dose Estimate

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Objective: The purpose of the study is to evaluate paediatric patient size distribution in head and abdominal computed tomography (CT) for implementation of size-specific dose estimate.
Materials And Methods: In this retrospective study, we used CT images of 302 children (164 head and 138 abdomen CT) aged 0–12 years and they were further classified into four age groups of < 1, 1– 5, 6–10 and 10–12 years. The patient size was estimated using attenuation based; water-equivalent diameter (Dw) and geometry-based; anteroposterior (AP) and lateral dimensions to estimate effective diameter (Deff) using manual measurement on CT image viewer tools. A comparative study was performed to determine the difference between our study and other studies on the population's estimated children sizes.
Results: From the findings, for head size, the range, mean and standard deviation of Dw and Deff were 9.4–16.9 cm (14.5 ± 1.8) and 9–16 cm (14.8 ± 1.7) respectively and for the abdomen, Deff was 7–22 cm (16.3 ± 3). From the comparative study, the Dw and Deff of this study are smaller, the overall difference between our study and other studies was between 1.7 and 6.2 cm and $p = 0.025$ at 95% confidence interval.
Conclusion: For this population, the distribution of typical patient sizes for SSDE implementation was estimated in line with AAPM recommendation and our value differs with other population to within 6.2 cm.

Correlation between Scattered Radiation Dose and Height of the Staff's Eyes at Different Positions in an Angiography Room

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Objective: Scattered radiations could reach the angiographic staff's eyes during procedures and causes radiation induced cataract. The aim of this study was to correlate between scattered radiation doses and the heights of staff's eyes at several positions in an angiography room.
Materials and Methods: An anthropomorphic Kyoto Kagaku PBU-31 phantom (Kyoto, Japan) which simulated a male patient's torso was exposed using Siemen's Artis Q (Erlangen, Germany) angiographic system. Technical factors were set for percutaneous transhepatic biliary drainage procedure in posteroanterior projection. Exposures were done in digital subtraction angiography acquisition for durations of 4 s, 10 s and 20 s. For each duration, 96 nanodot optically stimulated luminescence (OSL) dosimeters (Landauer, Inc., Glenwood, USA) were used to record the scattered radiation dose. The nanodots were placed at 8 heights from the floor (135, 140, 145, 150, 155, 160, 165 and 170 cm) and on twelve paper tubes which simulated twelve different positions. The recorded radiation doses were read in mGy units and were normalised to the dose area product (mGym2) of each exposure duration. A non-parametric Spearman rank correlation test was used since the data were not normally distributed.
Results: For the overall locations, scattered radiation dose and eye heights were found to be moderately negative correlated, rs (288) = -0.499, p-value = < 0.001. However, different strengths of correlation were found for the individual positions.
Conclusion: This study found that stronger correlations were observed near the patient but weaker or no correlations were seen towards the patient's feet.

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Germanium-Doped Optical Fibres: A New Radio Photoluminescence (RPL) Dosimeter in Clinical Computed Tomography

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Objective: In studies based on clinical computed tomography (CT), wasted dose and the added risk of radiocarcinogenesis has been a particular concern. Accordingly, effective means of dosimetry are required. Current study examines the dosimetric properties of germanium (Ge)-doped optical fibers utilizing a real-time system (model LS-2000, Lumisyns) applied to a Somatom Definition Flash dual-source 128-slice CT scanner (Siemens Healthcare), measuring beam quality, dose linearity and exposure time accuracy.
Materials and Methods: Comparison has been made with a RaySafe X2 test device (Unfors RaySafe) and Black Piranha (RTI) QA meter. Irradiations involved tube currents from 50 to 300 mA, exposure durations of 750 to 2000ms, and acceleration potentials from 80- to 140 kVp.
Results: The LS-2000 system has been found effective, beam quality maximum discrepancies from RaySafe X2 and Black Piranha measurements being 1% and 5%, respectively; the coefficients of linearity of the RaySafe X2, Black Piranha and LS-2000 were 1%, 0.4% and 1.4%, respectively; the maximum deviations for the time accuracy test were 0.5%, 2% and 1.3%, respectively. Furthermore, a statistical analysis showing insignificant difference between the three sensors, with p-values of > 0.050 for all tested parameters.
Conclusion: Real-time dosimetry assessment of the LS-2000 with a Ge-doped fiber optical scintillator supports its future use in clinical CT dosimetry.

Development of Multi-Modality Renal Phantom

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Objective: In the medical imaging field, calibration of the machine, training of operators, surgical planning, and simulation are conducted using a phantom. This study aims to create tissue-mimicking phantoms appropriate for Computed Tomography Texture Analysis (CTTA) and ultrasound for calibration of modality, training of operators and surgical planning.
Materials and Methods: Polydimethylsiloxane (PDMS) (Sylgard 184, Dow Corning) and Silicone Elastomer (SE) (Ecoflex 00–20, Smooth on, PA, USA) were synthesized using various series of compound to mimic kidney tissue. The phantom was moulded in the round container with a separation between the base tumour and stone for the texture analysis purpose. After data acquisition from both CT and U/S, the signal data was recorded and analyzed via ImageJ.
Results: SE records a CT number of 60–80 HU while CT number of PDMS range from 100 to 140 HU. In addition, the CT number for the tumour which made of Aldrich is consistent at 40 HU. We observed that the mean signal of SE and PDMS under U/S are 74.5 ± 43.2 and 75.88 ± 48.78, respectively.
Conclusion: In summary, SE is superior to PDMS in term of fabrication process while PDMS supersede the SE in term of stability of the sample. Due to its similarity in human tissue features both materials are considered to be suitable for building a phantom especially used in various multi modalities imaging.

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A Cross-Sectional Study Assessing the Knowledge, Attitude and Practice of Resident Physicians in Batangas Medical Center on Radiation Exposure in Diagnostic Imaging

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Objective: The WHO and International Atomic Energy Agency (IAEA) proposed the Bonn Call-for-Action. It seeks to foster coordinated work to address issues arising in radiation protection in medicine. Studies from other countries have shown that there is a gap in knowledge regarding the risks of ionizing radiation to patients. The main objective of the study is to document the baseline knowledge, attitude and practice of the resident physicians with regards to radiation exposure in patients undergoing diagnostic imaging in Batangas Medical Center.
Materials and Methods: A cross-sectional study using convenience sampling among resident physicians in the hospital was conducted. The questionnaire that was utilized was one that had been used in the literature with permission from its investigator.
Results: There is a statistical difference (*p* value = 0.000) in the average baseline knowledge assessment score between resident physicians of different departments. Tukey post hoc test revealed that the physicians' baseline knowledge assessment score is significantly higher for Obstetrics & Gynecology and General Surgery departments. There is no significant difference in how often x-ray or CT scan examination is requested between resident physicians of different departments. There is a significant association between the physician's department and the attitude towards ordering a routine x-ray, fluoroscopy and CT scan examinations if there is proven increase in lifetime risk of cancer.
Conclusion: Resident physicians have areas where they are deficient in radiation exposure knowledge. Further training will help improve this and would provide the patients a safer and cost-effective health care.

Development of an In-House Protocol for the Quality Assurance of Digital Breast Tomosynthesis System by Adopting Different International Standards

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Objective: In recent years, more digital breast tomosynthesis (DBT) systems become available on the market. The use of DBT with conventional two-dimensional (2-D) full-field digital mammography (FFDM) in breast cancer diagnosis is expected to increase substantially. Therefore, a reliable quality assurance (QA) program is required for DBT to have an accurate diagnosis.
Materials & Methods: Published protocols including the 2018 ACR Digital Mammography Quality Control Manual (ACR2018), European Breast Tomosynthesis Quality Control Protocol version 1.03 (EUREF1.03) and NHS Breast Screening Programme Equipment Report 1407 (NHSBSP1407) were reviewed and compared.
Results: All of the protocols were similar in terms of test items, but with different levels of details and action limits. Average glandular dose (AGD) test in EUREF1.03 and z-resolution test in ACR2018 were adopted in our QA program for the following reason respectively: (i) Compared with ACR2018 which only provided the limiting value of AGD for a standard compressed breast thickness (CBT) at 42 Mm, EUREF1.03 provided limiting values of AGD for CBT from 21 mm to 90 mm. This is especially important for Asian women whose CBT tends to be smaller than standard; and (ii) Inter-plane resolution was regarded as a baseline measurement in all three protocols. The presence of small-sized spheres to quantify artefact spread in terms of full width at half maximum in our ACR DM phantom for FFDM QA test already fulfilled this purpose.
Conclusion: A QA program according to in-house requirements is developed for DBT after taken reference to the published protocols.

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Establishing Diagnostic Reference Levels for Computed Tomography Examinations in Terengganu: Head, Thorax and Abdomen

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Objective: Computed Tomography (CT) is commonly used for various diagnostic examinations. Despite constant improvements to imaging technologies, the radiation dose to patients remains a concern. Diagnostic reference levels (DRLs) are used to identify any facility when using high radiation dose during CT. This study aims to assess current patient dose and establish new local diagnostic levels (LDRLs) for Computed Tomography (CT) examinations of brain, thorax, and abdomen at multiple sites in Terengganu, Malaysia.
Materials and Methods: A comprehensive booklet survey was designed to record patient data and scanning protocols for three CT examinations. Data were collected retrospectively from the participating centers. LDRLs were defined as the values within 75th and 50th of volumetric CT dose index (CTDIvol) and dose length product (DLP). Data sets collected were related to 82 of CT brain, 96 of CT thorax, and 120 of CT abdomen.
Results: LDRLs for CTDIvol and DLP for CT brain, thorax, and abdomen were 52.08 ± 7.62 mGy/960.57 ± 756.67 mGy·cm, 14.58 ± 7.49 mGy/960.57 ± 756.67 mGy·cm and 17.97 ± 11.35 mGy/842.67 ± 541.59 mGy·cm, respectively.
Conclusion: As compared to national DRLs, the LDRLs are comparable and within the range of acceptable percentiles, except for DLP values for thorax and abdomen are slightly exceeded. Major variations in patient dose during CT examination occur due to differences in CT scanners, scanning protocols, and modes.

Assessment of 3D Printed Phantom Material for Quantification Accuracy, Repeatability, and Variation of Material Decomposition with Pre-Clinical Photon-Counting Spectral CT

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Objective: Photon-counting spectral CT scanner is an advanced imaging modality capable of multi-material decomposition. The objectives of this study are 1) to investigate the effect of using 3D printed material in the phantom by comparing quantification of materials derived from different types of known contrast agents with conventional phantom material PMMA and 2) to investigate the repeatability of quantifiable materials between different scanning sessions.
Materials and Methods: A pre-clinical photon-counting spectral CT scanner with 5 detectors and multi-energy range was used (MARS Bioimaging Ltd, New Zealand). PMMA (density = 1.18 g/cm^3) and 30% ABS (density = 1.05 g/cm^3) were the two phantom materials used. 15 contrast vials were placed consisting of Gold (2 mg/mL, 4 mg/mL, 8 mg/mL), Iodine (4 mg/mL, 8 mg/mL, 16 mg/mL), Gadolinium (2 mg/mL, 4 mg/mL, 8 mg/mL), Calcium (35 mg/mL, 70 mg/mL, 140 mg/mL), water and lipid into respective phantoms with prior calibration. To investigate the repeatability, experiment was repeated 5 times. Regions of interests were placed in different contrast vials in 5 consecutive slices. Average values, standard deviation, coefficient of variation (CV) and root mean square error (RMSE) were calculated.
Results: RMSE of PMMA phantom and ABS phantom were 1.5% and 1.3% compared to reference value. The CV was in the range of 1.3–46% depending different materials and concentration (with average being 14%). This was similar between PMMA and ABS material. The full results will be presented at the meeting.
Conclusion: Similar accuracy in quantification and repeatability can be expected when using custom-made phantoms.

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Dual Energy CT: Principles and Applications

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Learning Objective:

- To discuss the basic Physics and Principles of Dual Energy CT
- Using a case-based review, to study in details various applications of Dual Energy CT.

Background: Dual Energy CT is state of the art technology that has widespread applications in Clinical Radiology.
Findings and/or Procedure Details: Basic Principles of Dual Energy CT will be discussed in brief. Using cases done on Single Source Dual Energy CT Scanner available to the authors, an explicit discussion of applications of Dual Energy CT are detailed in the exhibit. Dual Energy CT has various applications like production of Virtual Non-Contrast images from Contrast enhanced scan, assessment of composition of renal stones, automated bone removal for angiographic studies, assessment of perfusion defects in Pulmonary Thromboembolism and assessment of cardiac Perfusion Defects. It has revolutionized imaging in Oncology by creating iodine overlay maps, thereby helping in more accurate evaluation of contrast uptake and infiltration by the neoplastic masses like pancreatic adeno carcinoma etc. Using Virtual Non-Contrast images, unnecessary radiation exposure can be avoided. Comparison of Dual Energy CT with conventional CT including advantages and disadvantages is also discussed in the exhibit.
Conclusion: Dual Energy CT is state of the art technology that has revolutionized the field of Imaging. Radiologists should be well versed with the applications and how to use them to take maximum benefit from this wonderful Technology. It is indeed a step towards "Precision Medicine".

How Can Three-Dimensional Printing Facilitate the Quality Assurance in Nuclear Medicine?

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Objective: Routine quality control tests of single-photon emission computed tomography (SPECT) system traceable to standard protocols, such as the National Electrical Manufacturers Association NU 1-2018 (NEMA) and International Atomic Energy Agency Human Health Series No. 6 (IAEA) are performed by radiographers or physicists on a periodic basis to verify the system performance. However, some of the measurements in these protocols require source holders and test fixtures of specified dimensions which are often not provided by the system manufacturer. To ensure the reproducibility and ease of the measurement setup, the feasibility of using three-dimensional (3D) printing to tailor-make them is studied.
Materials & Methods: The Ultimaker S5 3D printer was selected due to its low cost, compact size, dual extrusion to print complex structures with water-soluble material and capability to support filaments of materials with different properties. All models were designed in Autodesk Fusion 360 and printed by Polylactic Acid (PLA) filament.
Results: Three 3D-printed prototypes were fabricated: (i) a pair of support stands each with two designated places of height 10 cm spaced 10 cm apart to hold the glass capillary tubes for the measurement of system spatial resolution without scatter, (ii) a mask with circular patterns located at nine specific points for the measurement of multiple window spatial registration and (iii) a support plate of three point source holders for the measurement of SPECT system alignment and reconstructed spatial resolution without scatter.
Conclusion: Acquisition of a 3D printer is a reasonable investment in the nuclear medicine department.

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Development of Patient-Specific 3D-Printed Breast Phantom Using Silicone and Peanut Oils for Magnetic Resonance Imaging

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Objective: To design a patient-specific 3D printed breast phantom and to identify the most appropriate materials for simulating the MR imaging characteristics of fibroglandular and adipose tissues.
Materials & Methods: A patient-specific 3D printed breast model was generated using 3D-printing techniques for the construction of the hollow skin and fibroglandular regions shells. Then, the T1 relaxation time of five selected materials (agarose gel, silicone rubber, fish oil, silicone oil, and peanut oil) were measured on a 3T MRI system to determine which could be used to represent the MR imaging characteristics of fibroglandular and adipose tissues. Results were compared to the reference value of T1 relaxation time of corresponding tissues; 1324.42 ± 167.63 and 449.27 ± 26.09 ms, respectively. Finally, materials that matched the T1 relaxation time of these tissues were chosen to fill in the 3D printed breast phantom.
Results: The silicone and peanut oils were found to resemble the T1 relaxation time and imaging characteristics of these two tissues; which are 1515.8 ± 105.5 and 405.4 ± 15.1 ms, respectively. Agarose gel had the longest T1 relaxation time.
Conclusion: A patient-specific 3D printed breast phantom was successfully designed and constructed using silicone and peanut oils to simulate the MR imaging characteristics of fibroglandular and adipose tissues. The phantom can be used to examine different MR breast-imaging protocols to identify the most appropriate protocol for the quantitative assessment of breast density.

Automatic Image Quality Evaluation for Mammographic Accreditation Phantom Using Machine Learning

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Objective: To correctly detect abnormalities on mammographic images, the image quality (IQ) is crucial for clinical diagnosis. In the quality assurance process, the IQ evaluation in phantom images is conventionally scored manually by experienced medical physicists, which is labor-intensive and time-consuming. Furthermore, the scores tend to be subjective and deficient in repeatability. Many recent studies have thus focused on IQ evaluation automation development. Our objective is to develop an automatic mammographic phantom IQ evaluation framework under the basis of support vector machine (SVM) algorithm.
Materials & Methods: The model 015 mammographic accreditation phantom (CIRS, Inc. Norfolk, VA, USA) consists of 16 patterns (six fibers, five specks, and five masses). In our study, 461 phantom images were acquired using ten vendors of machines, and IQ scores were labeled in consensus by two experienced medical physicists. The 80% and 20% of phantom images were randomly selected as training and testing datasets, respectively. After segmenting each phantom image into 16 pattern images, 159 features were identified for each pattern image. The patterns were labeled as visible, invisible, and semi-visible according to manual scores. The multi-class SVM models were trained with the one-vs-one strategy for each type of pattern.
Results: With regarding manual evaluation as ground truth, the accuracies of fiber, speck, and mass patterns were 90.2%, 98.2%, and 88.9%, respectively.
Conclusion: In this study, we proposed an automatic IQ evaluation framework for the mammographic phantom. This framework may assist medical physicists in improving the efficiency of the quality assurance process.

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Communicating Radiation Risk to Public

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Learning Objective: We aim to describe how to communicate radiation risk to the public, with particular emphasis on the method of comparing risk.
Background: In communicating risk to members of the public, risk comparison is often helpful but it could be challenging. We wish to convey complex concepts of radiation to laymen but often this is fraught with ambiguity, confusion and maybe even contradictory. It is essential to know our audience and the situation. As the media, especially social media, is playing an important role in influencing public opinion, it is imperative for radiation protection specialists to educate and work with them.
Findings and/or Procedure Details: We will review some principles of comparing risk, such as using analogies, comparing to standards, and comparing to other estimates of the same risk. In this educational exhibit, we will give some examples of the use and abuse of risk comparison and explain the principles behind these. The examples will cover, amongst others, radiological examinations, Fukushima nuclear reactor accident and rare earth refineries.
Conclusion: Improper management of risk communication may lead to unnecessary public outrages. Risk comparison can be a useful tool in communicating radiation risk.

Devising Real – Time Radioluminescence Dosimetry System for Megavoltage (MV) Photon

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Objective: Radioluminescence (RL) dosimetry has been one of the options to determine the accuracy of radiotherapy beam. When ionising radiation strikes a scintillating material, light photons will be produced and counted. Hence relationship between ionising radiation and light signal can be established. This study explored the RL dosimetry principle by assembling a basic single point RL dosimetry system and verify the functionality of the assembled system in megavoltage (MV) photon range.
Materials & Methods: The system consists of photomultiplier (PMT), a counter and a power supply. The sensor was made out of blue emitting plastic scintillator with 1 mm diameter and 3 mm length. The light signal generated was carried to the PMT by using Poly (methyl methacrylate) (PMMA) fibre optics of 1mm diameter. Two sets of fibre optics cables were prepared to eliminate Cerenkov noise by means of parallel subtraction. Multiple doses of MV photon were delivered by using Linear Accelerator (LINAC) and the measured doses were analysed using Matlab.
Results: The system was able to perform dose measurement in MV photon range and pure signals generated by the plastic scintillator were extracted. Parallel subtraction method had successfully eliminated the contribution of Cerenkov noise. The dose measured was also within 2% of delivered dose.
Conclusion: The RL dosimetry system was assembled and able to perform accurate dose measurement in MV photon range. Further development and verification of the system will be carried out to study the characteristics of the system.

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Medical Physics Postgraduate Programme - Master of Medical Physics at University of Malaya

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Learning Objective: We present the postgraduate training programme for medical physicists in Malaysia, with emphasis on the Master of Medical Physics programme at the University of Malaya.
Background: In 1998 the University of Malaya (UM) launched the Master of Medical Physics (MMedPhys) programme to meet this growing need for qualified medical physicists to manage and monitor the medical usage of radiation in Malaysia. This programme was housed under the Faculty of Medicine. Since then, over 130 students have graduated from this programme. The UM MMedPhys programme is currently the only master programme accredited by the Institute of Physics and Engineering in Medicine (IPEM) outside the United Kingdom and British Isle.
Findings and/or Procedure Details: The MMedPhys programme has recently undergone a new curriculum review in 2018. The new curriculum was launched in the 2019/2020 academic session. Here we present the new curriculum, noting the change in the curriculum to address the clinical needs and changing landscape of medical physics in the country while maintaining standards required by the IPEM, UK.
Conclusion: The UM MMedPhys programme has been running for 20 years producing medical physicists and leaders in the medical physics field. With the new curriculum, it should only strengthen the quality of the medical physics graduates both within and outside of the country.

Establishment of Quantitative Metrics for Assessing IMRT Plan Complexity: A Virtual Phantom Study

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Objective: In IMRT treatment planning, there has been little interest in defining metrics to assess the quality of the treatment plan quantitatively. This work was carried out for the first time to assess the IMRT planning complexity on virtual phantoms.
Materials & Methods: A series of virtual phantoms were designed by using MATLAB® software (MathWorks, Natick, MA, United States), IMRT techniques: step-and-shoot IMRT (SSIMRT), volumetric modulated arc therapy (VMAT) and helical tomotherapy (HT) were investigated. Later, dose profile and 3-D surface plot for 120 plans were plotted. The wiggliness of dose profile was quantified as spatial complexity matrix (SCM) to represent plan complexity. The second, 1-D power spectral density for dose surface was generated to characterise the high and low frequency components of the dose surface. Proportion of rapidly varying dose with distance in a plan was used to predict the plan complexity, namely spatial frequency ratio (SFR).
Results: For SCM analysis, the dose profiles and 3-D plots for 7-field SSIMRT plans presented a noticeable seven dose peak with higher value of maximum dose compared with VMAT and HT. The calculated SCM value for SSIMRT was higher than VMAT and HT. For SFR analysis, HT was having the highest SFR, followed by VMAT and SSIMRT. The higher SFR indicated that the high frequency dose was varying rapidly with the distance.
Conclusion: The results have shown for the first time, the feasibility of using the self-developed metrics of SCM and SFR on virtual phantoms for assessing plan complexity.

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Fabrication of Bismuth Microparticles-Loaded Polymer Composite for Additive Manufacturing of Radiation Shielding

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Objective: Lead-based radiation shielding is being replaced by non-toxic alternatives specifically bismuth-based compounds that share similar radiation attenuation properties as lead. Material extrusion additive manufacturing, commonly known as fused deposition modelling, is targeted as a viable option to fabricate medical equipment with customizable geometry and radiation attenuation properties using filler-based polymer composite filaments. This study aimed to study the feasibility of using a bismuth (Bi) and polyactic acid (PLA) composite material to fabricate customizable radiation shields through material extrusion additive manufacturing.
Materials & Methods: The effects of Bi powder concentration in the Bi-PLA composite material and sample thickness on the radiation attenuation ability of the radiation shield were studied. Samples containing 10 to 50 wt% of Bi powder and thicknesses up to 7 mm were printed from Bi-PLA filaments using a material extrusion printer. The filaments were prepared by mixing Bi powder in a PLA matrix and extruded using a single screw extruder.
Results: Bi-PLA samples up to 50 wt% Bi content and thickness up to 7mm have been successfully fabricated using in-house material extruder and 3D printer. The radiation shielding properties of the Bi-PLA composite will be studied through radiation tests of controlled exposure to X-ray and gamma ray radiation (results are pending at the time of this submission).
Conclusion: A novel 3D printing filament made of Bi-PLA (50:50) composite material has been successfully fabricated. The filament can be used to print customized radiation shielding designs as a substitute to conventional lead-based materials.

Development of a Tissue-Equivalent Abdominal Phantom for CT-Guided Biopsy Training

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Objective: Image-guided biopsy has become an indispensable tool in personalized cancer care. The procedure requires extensive knowledge and skills. This study aimed to develop a cost-effective, tissue-equivalent abdominal phantom for CT-guided biopsy training.
Materials & Methods: A phantom mimicking the design of the standard CIRS abdominal phantom was developed. It was made of soft tissue equivalent resin and 3 mm opaque silicone skin. Twelve lesions (5–12 mm diameter) were positioned in different locations in the phantom. Nine interventional radiologists and residents with different years of experience (1–5, 6–10, > 10 years) were recruited to perform CT-guided biopsy on each lesion using a 18 G tru-cut biopsy needle. The biopsy time and total radiation exposure (DLP, mGy) for each lesion were recorded and compared using ANOVA test. The participants were then asked to rate the usefulness of the phantom for training purposes (1–5: Not useful-Very useful).
Results: Statistically significant difference ($p < 0.050$) was observed in term of biopsy time between groups of participants but no significant difference was found in term of radiation exposure. Radiologists with 6–10 years of experience spent the least time, followed by > 10 years and 1–5 years groups. The average score for the usefulness of the phantom was 4.4 ± 0.5.
Conclusion: A cost-effective, tissue equivalent abdominal phantom containing 12 lesions was developed for CT-guided biopsy training. Nine participants gave an average score of 4.4 out of 5.0 for the usefulness of the phantom for biopsy training purposes.

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Determining Optimum Post-Processing Parameters of ^{177}Lu-Dotatate Xquant Images in Peptide Receptor Radionuclide Theraphy (PRRT) Imaging

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Objective: Patient-specific-dosimetry in Nuclear Medicine is essential to determine the outcome of treatment in Peptide Receptor Radionuclide Therapy (PRRT). Image reconstruction for Lu-177 imaging is one of key factors to ensure the accuracy of the patient-specific-dosimetry. To obtain a reliable information of Lu-177 DOTATATE therapy dosimetry, it is crucial to obtain accurate and precise quantification by SPECT/CT. The aim of this study was to determine in a clinical context, the optimum image reconstruction for Lu-177.

Materials & Methods: NEMA 2007/IEC 2008 phantom was used and prepared with total activity of 1414 MBq of Lu-177 source, lesion-to-background ratio of four. Clinical acquisition was performed on the phantom using Symbia Intevo 16. A series of post-processing parameters were applied in phantom's image reconstruction. Five parameters were selected based on quantitative assessment; accuracy of activity concentration and image noise that were calculated on phantom images. They were then applied in five selected clinical cases of PRRT images and phantom image to be qualitatively evaluated by our nuclear medicine physician.

Results: Among all five selected parameters, 12 mm Gaussian filter and 8ix16s showed the best feature as it has the good quantitative accuracy (> 80% accuracy), acceptable image noise (< 20%) and satisfactory quality on actual clinical cases according to clinician assessment.

Conclusion: The optimum parameter selection was 12 mm Gaussian filter and 8ix16s based on quantitative and qualitative evaluation. This post processing parameter will be used post-image reconstruction for Lu-177 DOTATATE PRRT SPECT/CT imaging in our centre.

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Multiparametric MR Imaging of Early Tumour Response to Immune Checkpoint Inhibitors

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Objective: Immune checkpoint inhibitors have shown great promise in the treatment of cancers. There is an unmet need for the development of predictive biomarkers of tumour response at early timepoints for patient monitoring and treatment selection. The aim of this study was to investigate early changes in the function, microstructure and heterogeneity of the tumour microenvironment following immune checkpoint blockade using multiparametric MRI.
Materials & Methods: Metastatic melanoma patients on treatment using immune checkpoint inhibitors were imaged longitudinally at Baseline, Post Cycle 1 and Post Cycle 4 of treatment using T2WI, diffusion-weighted/ kurtosis imaging (DWI/DKI) and dynamic contrast enhanced (DCE) MRI.
Results: Different patterns of response to treatment: 70% of patients showed immediate reduction in tumour volume whilst 30% of patients demonstrated pseudoprogression as early as 3 weeks after the start of treatment. Intra- and inter-tumoural heterogeneity in vascular permeability was observed in all lesions, with decreased Ktrans and ve measured in the majority of the responding lesions including the pseudoprogressive lesions at Post Cycle 1. This suggests that tumour vasculature remodelling may facilitate T-cell recruitment into tumours in response to immunotherapy. Histogram analysis of the ADC, apparent diffusivity Dapp, and Kapp showed wider spread of diffusion signal and greater heterogeneity within the responding lesions, which may reflect underlying cellular alterations such as immune cell infiltration and cell death during the course of therapy.
Conclusion: In this study, we have demonstrated early changes in the microstructure, vascular permeability and heterogeneity of the tumour microenvironment following immunotherapy using multiparametric MRI.

Estimation of GFR by Radioisotope Camera Method (DTPA) and Correlation with Creatinine based Formula (MDRD) of GFR Estimation in Healthy Donors- Institutional Experience

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Objective: To assess correlation of GFR as calculated by Radioisotope camera method (Tc-99m- DTPA) against MDRD formula using serum creatinine in healthy donors.
Materials & Methods: Study was conducted in 64 healthy prospective kidney donors over the periods of 3 years. The study includes prospective renal donors. These patients undergone DTPA scan for GFR estimation. Each subject, after formal consent for the study was subjected to detail clinical history and thorough physical examination, including weight and height. Serum creatinine was done in each subject on same day. Correlation with MDRD formula of GFR estimation was done.
Results: Among 64 patients out of which 36 (56.2%) are females and 28 (43.8%) are males. We estimated GFR with the mGFR (99mTc DTPA by Gates method) in all cases and compared with abbreviated MDRD formula. In donor, mean normalized GFR by DTPA is 104.39 ± 17.26 (range 67.4–144.8) mL/min/1.73 m^2,whereas mean GFR by Abbreviated MDRD is 99.40 ± 25.14 (range 51–161) mL/min/1.73 m^2. In our study GFR by DTPA method is significantly positive correlation with GFR by MDRD (p value: 0.002).
Conclusion: For the renal transplantation, it is not important to know the GFR precisely, it being enough to know that which kidney is doing well. Even though MDRD formula and Gamma camera method gives matching results about GFR, Gamma Camera method gives several added information's and hence it is justified to be used in centers where the facility is available.

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Institutional Experience and Review of Kidney Scarring Depicted on Renal Dmsa Scintigraphy among Children with Prior Urinary Tract Infection

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Objective: Urinary tract infection (UTI) is common in children. Vesicoureteric reflux (VUR) is a well-recognised risk factor for recurrent UTI and renal scarring. Renal DMSA scintigraphy is being advocated to evaluate kidney function and cortical morphology. Hence, caution needed when interpreting scintigraphy of susceptible children. Our study objectives were to examine DMSA scintigraphy findings of children with prior UTI and identify factors associated with cortical scarring/abnormalities.
Materials & Methods: Retrospective observation of children (≤ 18 years) who underwent DMSA scintigraphy after ≥ 6 months of documented UTI between June 2016 and May 2018 in Hospital Kuala Lumpur. Children with congenital absent, dysplastic or polycystic kidneys were excluded. Altogether 82 children were included. They received intravenous 99mTc-DMSA followed by static 2-hour planar and SPECT imaging. Cortical findings and differential functions of the worst affected kidney were categorised (graded) accordingly. Compiled data were statistically analysed.
Results: Majority were boys (65%). Mean age was 3.87 years. Recurrent UTIs were predominant (59%). 58 children had congenital urinary tract anomaly with majority were VURs (61%). Scintigraphy showed abnormalities in 62 children affecting unilateral (65%) or both kidneys (35%). There were 34 children respectively in the extensive cortical scarring/damage category (grade III–IV) and the substantially impaired differential renal function category (function < 40%). VURs were significantly associated with abnormal scintigraphy ($p < 0.050$). Significant association found between extensive scarring and substantially impaired differential function ($p < 0.050$).
Conclusion: Significant association demonstrated between VURs and abnormal DMSA scintigraphy besides between extensive scaring and impaired differential function. Special attention needed during scintigraphy reporting of these cases.

Use of Gallium-67 Scan with Single Photon Emission Computed Tomography (SPECT) with Contrast CT in Evaluation & Monitoring of Mycotic Abdominal Aortic Aneurysm with Endovascular Aortic Repair (EVAR): A Case Series of Our Initial Experience

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Objective: To report our experience with the use of computed tomography angiography (CTA), together with Gallium-67 SPECT with contrast CT in the evaluation and monitoring of mycotic abdominal aortic aneurysm (MAAA).
Materials and Methods: We performed a retrospective cohort analysis of prospectively collected data involving all patients experiencing mycotic aneurysms referred to a radiology unit from a large territory hospital in Hong Kong between the years of 2010 to 2020. Patients were identified from the Radiology Information System (RIS) with Gallium-67 SPECT with contrast CT performed for mycotic aneurysm during the years 2010 to 2020. Cases with another intra-abdominal infective/inflammatory foci that might lead to a false positivity in Gallium-67 scan were excluded.
Results: All 5 patients had proven MAAA by CT. Among them, 3 patients were further supported by positive blood culture results. Gallium-67 SPECT with contrast CT was useful in the detection of residual disease, monitoring, and detection of recurrence.
Conclusion: Our results indicate that Gallium-67 SPECT with contrast CT is helpful in evaluating MAAA. It plays a central role in guiding management especially in the long-term follow-up.

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4D-CT Versus Tc99m-Mibi Spect/CT in Localisation of Parathyroid Disease - A Pilot Study

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Objective: In the workup for primary hyperparathyroidism, 4DCT is gaining popularity with emerging evidence of superior performance. However, it does impart a higher radiation dose. There is still no consensus on the optimal localization pathway as different institutes vary in preference between modalities, alone or in combination. We aim to compare the diagnostic efficacy of 4DCT and sestamibi-SPECT/CT and assess its value in the initial workup of hyperparathyroidism.
Materials and Methods: We performed a single-institution retrospective review of patients referred to us for hypercalcaemia and hyperparathyroidism. We included those who underwent both sestamibi-SPECT/CT and 4DCT in a single setting from March 2018 to September 2019 with subsequent pathological confirmation. Imaging results were based on consensus of two blinded radiologists with more than 10 years of experience, who reviewed the images independently.
Results: Out of 14 patients with pathological diagnosis of parathyroid abnormality (12 adenomas, 1 lipoadenoma, 1 hyperplasia), 4DCT gave positive results in all 14 patients versus only 12 with sestamibi. 4DCT appears to have a higher sensitivity (100% vs. 85.7%). We also note that sensitivity of sestamibi-SPECT/CT seems to deteriorate with the size of parathyroid lesion.
Conclusion: So far in our pilot study, we see that 4DCT could be superior to sestamibi-SPECT/CT in terms of diagnostic efficacy, likely due to better spatial resolution and hence detection of smaller sized lesions.

18 F-Flurocholine (FCH) PET-CT is a Potential Predictor for Breast Cancer Aggressiveness and the Quality of Life (QOL) : A Preliminary Result

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Objective: To determine the potential of 18 Flurocholine (FCH) PET-CT as a predictor of breast cancer aggressiveness phenotype markers and the quality of life (QOL) post-treatment surveillance.
Materials & Methods: Seventeen consecutive patients with breast carcinoma underwent 18 F-FCH PET-CT for pre-treatment staging. All subjects were dichotomised into single hormone receptor(HR)- HER-ve and single HR (HER+ve) immunohistochemical markers (phenotype). Analysis utilising the standardised uptake value (SUVmax/g/dL) was used to predict the two groups of phenotype markers and the quality of life (QOL). The QOL domains –Global Health Status (GHS), Physical function (PF), Role Function (RF) and Social function (SF) were evaluated for the satisfaction scoring based on the EORTC and Quality of life (QOL) (The SF-25v2®Heal-copyrighted by Quality Metric Incorporated).
Results: There were 17 females with mean age of 52.82 ± 10.71 years. Fourteen patients had malignant disease (82.35%) with eight (47.1%) with single HR -HER-ve phenotype. There was a significant different between 18F-FCH SUVmax of the single HR-(HER-ve) and the single HR-(HER+ve) positive group (1.99 ± 1.52 g/dL vs. 0.2g ± 0.22/dL; $p < 0.050$). Eight patients (cohort 8/17) are alive at 2 years close-out date. The low 18F-FCH SUVmax (mean, 0.053 ± 0.49 dL/mL)of the primary tumour predicted the good scoring satisfaction on the QoL SF at 6 months ($p < 0.050$) but it was insignificant at the 2 years follow-up.
Conclusion: The SUVmax FCH PET-CT is potentially a good predictor for breast carcinoma aggressiveness and it has an important role in predicting the quality of life parameters on the disease surveillance.

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Samarium-153 Polyhydroxybutyrate Microspheres for Transarterial Radioembolization of Hepatic Malignancies

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Objective: Transarterial radioembolization (TARE) is a minimally invasive procedure involving intraarterial administration of radioembolic microspheres for the treatment of hepatic malignancies. This study aimed to synthesize a biodegradable radioactive samarium-153 (153Sm) polyhydroxybutyrate (PHB) microspheres and evaluate its physicochemical properties after neutron activation.
Materials & Methods: The 152Sm PHB microspheres were synthesized using solvent evaporation method. The synthesized microspheres were irradiated in a nuclear reactor, converting 152Sm to 153Sm (Emax = 807.6 keV, half-life = 46.3 hours) through 152Sm (n, γ) 153Sm reaction. Physicochemical characterization, gamma spectroscopy and in-vitro retention efficiency studies were carried out to study the properties and stability of the develop microspheres before and after neutron activation.
Results: The 153Sm PHB microspheres achieved a specific activity of 4.20 ± 0.06 GBq.g-1 after 6 hours of neutron activation. Scanning electron microscope (SEM) and particle size analysis showed that the microspheres remained spherical with diameters within 20–60 µm after neutron activation. The EDX spectroscopy and gamma spectrometry suggesting no elemental impurities present in the irradiated microspheres. The 153Sm PHB microspheres achieved retention efficiency of more than 95% in both saline and human plasma over the duration of 480 hours.
Conclusion: The 153Sm PHB microspheres are potentially useful for transarterial radioembolization of hepatic malignancies in view of its biodegradability, favourable physicochemical characteristics and excellent retention efficiency added with post-procedural imaging capability.

Comparison of Neck-Thigh Ratio of Planar Thyroid Scintigraphy with Quantitative SPECT/CT Standardised Uptake Value (SUV) & Technetium Thyroid Uptake (TcTU) in Assessing Hyperfunctioning Thyroid Gland

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Objective: Functional status of thyroid gland can be assessed using Tc99m-pertechnetate thyroid scintigraphy. In Malaysia, neck-thigh-ratio (NTR) of planar thyroid scintigraphy is the preferred method but the validated Tc99m-pertechnetate thyroid uptake (%TcTU) measurement has gained acceptance in our daily practices. We aim to investigate the correlation of quantitative parameters from single photon emission computed tomography/computed tomography (SPECT/CT) thyroid scintigraphy with NTR and %TcTU.
Materials & Methods: We retrospectively analysed quantitative thyroid scintigraphy with SPECT/CT of 169 patients (45 males & 124 females; age 44+/-13.036-years-old) with hyperthyroidism referred for radioiodine therapy. Standard thyroid planar imaging with 185MBq of Tc99m-pertechnetate followed by SPECT/CT acquisition of the neck performed. NTR and %TcTU of planar scintigraphy, as well as quantitative SPECT/CT parameters such as %TcTU and standardized uptake value (SUV) were described and correlation analysis performed.
Results: NTR, planar & SPECT/CT %TcTU as well as SUVmean and SUVmax were consistently highest in Graves' disease. NTR correlated well with planar & SPECT/CT %TcTU (r = 0.904 & 0.928, p < 0.050). Only fair correlations were observed between %TcTU with SUVmean/max (r = 0.462 & 0.329, p < 0.05) and NTR with SUVmean/max (r = 0.584 & 0.458, p < 0.050). No significant correlations were observed between quantitative Thyroid SPECT/CT SUVmean/max with serum T4 & TSH.
Conclusion: NTR is as accurate as %TcTU in assessing functional status of thyroid gland. Although SUVmax & SUVmean of quantitative Thyroid SPECT/CT in this study were consistent in stratifying hyperthyroidism aetiology, it did not show good correlation with values from the conventional NTR and %TcTU of planar thyroid scintigraphy.

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Radiation Shielding Efficiency Studies of Tungsten Carbide/ Epoxy Composite at 140 kev and 356 kev in Nuclear Medicine

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Objective: For many years, lead was the primarily used radiation shielding material. Recently, concern has been growing that the use of lead poses safety and health hazards. Researchers are working on finding a non-toxic radiation shielding material. The main objective of this study was to validate the efficacy of tungsten carbide/epoxy composite as environmentally friendly, lead-free radiation shielding material in nuclear medicine at different energy ranges.
Materials & Methods: Tungsten carbide/epoxy composite discs were fabricated by mixing pure tungsten carbide powder with epoxy resin and hardener (E-110I/H-9) at different weight percentages (90% WC-10% Epoxy), (85% WC-15% Epoxy), (80% WC-20% Epoxy), (75% WC-25% Epoxy), (70% WC-30% Epoxy) respectively. In this study, gamma radiation attenuation behaviours of tungsten carbide/ epoxy composites have been investigated and compared with lead. 99mTc and 133Ba radionuclides were used as gamma radiation sources. The radioactive sources used to test the shielding efficiency of tungsten carbide/epoxy composites by placing the sample between a shielded vial contained the radioactive source and detector. The attenuation of gamma photons narrated by the reductions in the counts' rate.
Results: The experimental attenuation coefficient of tungsten carbide/epoxy composites were compared with the attenuation coefficient of pure tungsten carbide and lead. Good agreement has been observed in attenuation coefficient values of tungsten carbide/ epoxy composites specially (90% and 85% WC) with pure tungsten carbide and conventional shielding material (Lead).
Conclusion: This study shows that tungsten carbide/epoxy composite has the potential to replace lead as a lead-free radiation shielding material in diagnostic imaging and therapy.

To Evaluate the Use of FDG PET-CT in Assessing Disease Activity in Large Vessel Vasculitis

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Objective: To evaluate the use of FDG PET-CT in the assessment of disease activity in large vessel vasculitis (LVV).
Materials & Methods: 54 PET-CT scans were performed in 19 pts with suspected and diagnosed LVV(Takayasu arteritis,giant cell arteritis,or idiopatic aortitis). The amount of vascular uptake was graded with the help of a 4-point scale
0 = no uptake 1 = less than liver 2 = similar to liver 3 = higher than liver
Grade 0–1 was negative, 2 was moderately positive and 3 was markedly positive.
This PET/CT was correlated with clinical indices of

- ITAS (Indian Takayasu Activity Score) and
- Kerr/National Institute of Health (Kerr/NIH)
- Serum acute-phase reactants ESR
- C-reactive protein [CRP]) levels
- Interleukin-6 (IL-6)
- Soluble IL-6 receptor (sIL-6R).

Results: 43% of 54 PET-CT were negative,31% were moderately positive and 26% were markedly positive. A significant correlation between the SUV uptake and both ESR and CRP levels was found and correlated. Significantly higher ESR values were observed in patients with markedly positive PET-CT (49.4 + 36.5 mm/1st h) compared with moderately positive (27 + 21 mm/1st h, $p = 0.0001$) and inactive scans (22.7 + 15.9 mm/1st h, $p = 0.0001$). CRP levels was 0.8 + 1.0 mg/dL, 1.3 + 2.2 mg/dL and 3.0 + 3.6 mg/dL in inactive scans in patients with moderately positive ($p = 0.001$) and in patients with markedly positive scans ($p = 0.0001$) respectively. Patients with markedly positive scans resulted in higher levels of IL-6 (10.0 + 8.9 pg/mL) compared to those with inactive scans (8.1 + 18.5 pg/mL, $p = 0.013$).We could not find any association between sIL-6R levels and vascular FDG uptake. There was a significant association between vascular FDG uptake and both ITAS and Kerr/NIH scores.
Conclusion: The above findings of PET-CT is a very useful tool for evaluating disease activity in patients with LVV.

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Evaluate the Efficacy of 68Ga-DOTA-TOC and 18F-FDG PET-CT in the Follow-Up of Patients with Neuroendocrine Tumor Treated with the First Full Peptide Receptor Radionuclide Therapy Cycle

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Objective: To evaluate efficacy of 68Ga-DOTA-TOC and 18F-FDG PET-CT for initial and follow-up evaluation of patients with neuroendocrine tumour (NET) treated with peptide receptor radionuclide therapy (PRRT).
Materials & Methods: We evaluated 33 histologically proven NET patients. All these patients underwent both PRRT and three combined 68Ga-DOTA-TOC and 18F-FDG PET/CT studies. 68Ga-DOTA-TOC PET-CT was performed before starting PRRT then at 3 months and after 6–9 months after completion of PRRT. 18F-FDG PET-CT was done within 2 months of 68Ga-DOTA-TOC PET-CT. Follow-up was carried out between 11.8 to 80.0 months (mean 34.5 months).
Results: All patients were 68Ga-DOTA-TOC PET-positive initially and at follow-up after the first PRRT cycle. Overall 31 of the 99 18F-FDG PET studies (31%) were true- positive in 19 of the 33 patients (58 %). Of the 33 patients, 14 (3 grade 1, 11 grade 2) were 18F-FDG-negative initially. During follow-up (group 1), 12 (3 grade 1, 6 grade 2, 3 grade 3) were 18F-FDG-positive initially and during follow-up (group 2). 5 patients (1 in grade 1, 3 in grade 2, 1 in grade 3) were 18F-FDG-negative initially but 18F-FDG-positive during follow-up (group 3), and 3 patients (all grade 2) were 18F-FDG-positive initially but 18F-FDG-negative during follow-up (group 4). 18F-FDG PET showed more and/or larger metastases than 68Ga-DOTA-TOC PET in three patients of group 2 and two patients of group 3, all with progressive disease. In two patients with progressive disease who died during follow-up tumour SUVmax increased by 41–82% from the first to the last follow-up investigation.
Conclusion: In patients known to have NET, the presence of 18F-FDG-positive tumours correlates strongly with a higher risk of progression. Thus FDG PET-CT and Thus FDG PET-CT & 68Ga-DOTA-TOC PET-CT are complimentary to each other in evaluation and follow up after therapy.

Hybrid Gamma Camera for Intraoperative Imaging: Looking with New Eyes

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Objective: There is an increasing interest of the applications of handheld gamma cameras in intraoperative imaging in cancer management. The objective of the study was to translate the hybrid gamma camera (HGC) technology from laboratory studies to clinical application. We also reported the feasibility of the modified HGC for both gamma and near-infrared fluorescence (NIRF) imaging.
Materials & Methods: The HGC consists of a CsI:Tl columnar scintillator coupled to an electron multiplying charged coupled device (EMCCD), a 1.0 mm diameter tungsten pinhole collimator and an optical camera. The performance of the optical-gamma imaging was assessed utilising bespoke phantoms and in house developed protocol. Clinical studies were undertaken at Nuclear Medicine Clinic, Queen's Medical Centre. The HGC was modified with an addition of a band-pass filter and an external excitation light source for gamma-NIRF imaging. Preliminary study was undertaken using a range of bespoke phantom experiments containing hybrid tracer (CW800-111In).
Results: The camera system was able to provide real-time, high resolution fused optical-gamma images in both phantom and clinical settings. The modified HGC has been shown to successfully image dual NIR-gamma tracers for the first time.
Conclusion: The results show that the system would be suitable for use at patient's bedside and could be used intraoperatively. Further development in hybrid gamma-NIRF imaging would offer added values of gamma imaging at deep-seated tumours and high-resolution surface NIRF imaging in compact small field of view imaging system.

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Reliability of Supraspinatus Pennation Angle Measurement Using Fibre Tractography at 3-Tesla MRI

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Objective: Several attempts have been made to measure supraspinatus pennation angle using different modalities, however with many limitations and not consistent results. This study aims to determine the reliability of supraspinatus muscle pennation angle measurement using DTI fiber tractography.
Materials & Methods: Diffusion tensor images of 38 healthy volunteers were included in this study. Muscle fiber tract of supraspinatus muscle was generated using a tractography software and pennation angle were measured. Mean measurements by the raters were compared. Interclass correlation (ICC) was used to determine agreement between first and second measurement by the first rater (intra-rater agreement) and between the first and the second rater's measurement (inter-rater agreement) with values lesser than 0.50, between 0.5 and 0.75, between 0.75 and 0.90, and greater than 0.90 are indicative of poor, moderate, good and excellent reliability respectively.
Result: Mean pennation angle measured by the first rater were 14.70° (± 1.83°) and 14.32° (± 1.18°) respectively. Mean pennation angle measured by the second rater was 14.76° (± 1.07°). There was no significant difference between measurements by first rater (p-value > 0.050) and between the first and the second rater's measurement (p-value > 0.050). Supraspinatus pennation angle measurement using fibre tractography yielded good (0.82, 95% CI) intra-observer and moderate (0.54, 95% CI) inter-observer reliability.
Conclusion: Supraspinatus pennation angle can be reliably measured using fiber tractography. This method has an advantage over conventional MRI sequences as each individual muscle fibers can be visualized, making the measurement possible even for an unexperienced individual.

FGF23-Related Hypophosphatemic Osteomalacia: Current Views on Etiopathogenesis, Diagnostic Modalities, and Therapeutic Options

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Learning Objective: By viewing this educational exhibit, the viewers will be able to (1) describe the pathophysiological actions of fibroblast-growth factor 23 (FGF23) on phosphate homeostasis; (2) recognize the clinical and biochemical profile of patients with FGF23-related hypophosphatemic osteomalacia; (3) describe a stepwise diagnostic approach for localizing FGF23-producing tumors; and (4) discuss the role of functional imaging and venous sampling and acknowledge their pitfalls and limitations.
Background: FGF23 is a hormone that regulates phosphate metabolism, and excessive FGF23 activity causes hypophosphatemic osteomalacia. The major acquired form of FGF23-related hypophosphatemic osteomalacia is tumor-induced osteomalacia, which is caused by an ectopic overproduction of FGF23 from a mesenchymal tumor.
Findings and/or Procedure Details: Complete surgical removal of the ectopic FGF23-producing tumor is the current standard of care and is the only definitive therapy of FGF23-related hypophosphatemic osteomalacia. However, pre-surgical localization of FGF23-producing tumors can be quite challenging, because these tumors are typically small, slow growing and can arise in bone and soft tissue of almost any part of the whole body. Therefore, a stepwise diagnostic approach is suggested for localizing FGF23-producing tumors, which utilizes functional imaging (somatostatin receptor imaging and/or 18FDG-PET), followed by anatomical imaging (CT and/or MR) and venous sampling.
Conclusion: Identification of FGF23-producing tumor as the responsible lesion for osteomalacia is crucial because complete excision of the tumor leads to resolution of the osteomalacia. Radiologists play a profound role in the diagnosis and treatment planning of FGF23-related hypophosphatemic osteomalacia.

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Overview of Generalized Lymphatic Anomaly

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Learning Objective: To present generalized lymphatic anomaly (GLA), such as terminology, pathological features, clinical presentation, radiological findings, management, and prognostic.
Background: GLA is a congenital benign neoplasm but not an inherited disorder characterized by diffuse proliferation and dilation of lymph vessels. GLA represents embryologic remnants that fail to connect with normal lymph channels or arise from lymph sacs sequestered during development. GLA is common in infants and children but can occur at any age.
Findings and/or Procedure Details: GLA is frequently associated with other lymphatic anomalies and can involve individual organ or multiple organs where lymphatics are found. GLA is a current term that replaces the 'lymphangiomas' or 'lymphangiomatosis' term. The term 'generalized' means the entity involving multiple organ systems. Clinical features depend on the location and extent of organ involvement. Radiologically, most GLAs showed as sharply defined, multiloculated, septa, non-enhanced cystic lesions with clear fluid, blood, or pus inside. Surgical excision has been recommended for localized GLA, even though there is no specific treatment for GLAs. Other palliative procedures can be medical therapy with interferon-alpha, draining the pleural effusions, or symptomatic treatment. Biotherapies and upregulation of tyrosine kinase are being further researched.
Conclusion: GLA is a rare entity that the prognosis depends on the severity of the disease. Diagnosis is based on clinical, radiological, and histological findings.

Chronic Patellofemoral Instability – Anatomical Variants, MRI Considerations and Will Differing Knee Flexion/Extension on MRI Affect Our Reporting?

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Learning Objective: This educational exhibit provides a review of anatomical considerations and standardised MRI measurements for evaluating chronic patello-femoral instability (CPFI). Imaging features of typical associated injuries, complications, and updated management techniques will be discussed. We will also explore how different degrees of knee flexion/extension on MRI may affect our measurements and evaluation of this condition.
Background: Recurrent patellar dislocations tend to occur with anatomical variants/risk factors that affect patellar stability, such as patella alta, trochlear dysplasia, increased tibial tubercle -trochlear groove (TTTG) distance, femoral anteversion and ligamentous laxity. MRI is useful for assessing such variants/risk factors, for visualising the extent of injury and for guiding tailored management. Surgical correction of anatomical variants may help reduce the risk of CPFI.
Finding and/or Procedure: We provide a pictorial review of normal anatomy and variants, with description on how to accurately perform measurements including inclination angle, facet ratio, trochlear depth, Insall-Salvati ratio, TTTG distance. Latest management techniques are discussed. We also performed MRI with knee in various degrees of flexion for changes in standard measurements. We found slight changes in the measurements involving patella alta and TTTG distance, but no significant change to the overall ratios that would affect diagnosis.
Conclusion: Understanding the typical injuries, anatomical variants and measurement techniques are essential for Radiologist in evaluating CPFI on MRI. Changes to degrees of knee flexion during MRI should not significantly alter our evaluation. Understanding treatment options will help provide a more tailored and useful report for our referring surgeons.

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Modified CT Skeletal Muscle Index Nomogram

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Objective: Sarcopenia, an indicator of morbidity and mortality among post-chemotherapy and bed-ridden patients, has limited nomograms for comparison. The aim is:

- To create age- and sex-matched nomogram for sarcopenia assessment by modified Skeletal Muscle Index (SMI) analysis, by measuring Total Abdominal Muscle Area (TAMA) in Cross Sectional Area at L3 level in the CT Abdomen/KUB studies and assess the average range of the muscle area for standardization purposes. Conventional SMI uses height-parameter which is mostly unavailable practically, thus we use height-independent modified SMI.
- To evaluate correlation between tissue attenuation and muscle size in abdominal wall muscles at L3 level.
- To emphasize that Modified SMI is as effective as conventional SMI.

Materials and Methods: Randomized set of 3000 patients referred for CT abdomen/KUB in the age group 21–80 years, between 2018–2020, were included in this retrospective cross-sectional study, excluding those with chronic debilitating illnesses. From the images, attenuation HU of selected area and Total Abdominal Muscle Area (TAMA) at L3 level were measured by Freehand-ROI tool and recorded. Conventional Skeletal Muscle Index was calculated for 118 participants and compared with modified SMI to assess their correspondence.

Results: Categorized into six sex matched-age groups, TAMA at L3 level and its corresponding average HU were noted, for each scan. The nomogram was constructed using SPSS software. There was also significant correlation between

- TAMA and HU across age groups ($p < 0.001$).
- SMI and modified SMI ($p < 0.050$).

Conclusion: Modified CT skeletal muscle index is an easy, non-invasive method to assess sarcopenia, as effective as conventional SMI, and our study has prepared a nomogram for reference values.

SUB-Regional Biochemical Assessment of Knee Articular Cartilage on 3T MRI

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Objective: To assess biochemical changes in the sub-regions of knee articular cartilage by automated computation of T2* relaxation time in patients with healthy cartilage as well as those with pathologic/degenerative/traumatic disease. In-turn facilitating early detection and consequent timely interventions.

Materials & Methods: Prospective observational study was designed to assess 36 cases: 15 with normal cartilage and 7 patients each of Chondromallacia patellae (CP), osteoarthritis (OA) and traumatic injuries.MR scanning was performed on 3T MRI MAGNETOM Vida (Siemens Healthineers, Germany) using 18-channel knee coil. Post processing was done using MR Chondral health (Version 2.1) work-in-progress (WIP) package provided by Siemens Healthineers. Automated segmentation of the entire knee articular cartilage was done into 21 subregions and corresponding T2* relaxation time values were generated for biochemical analysis.

Results: Mean T2* relaxation time values for femur, patella and tibia of normal subjects are 21.87 ± 2.53 ms, 26.25 ± 4.35 ms, and 19.48 ± 5.29 mm respectively. In CP, a slight increase in mean T2* values were found at patella (34.91 ms) and tibia (21.76 ms). In cases of OA, the mean T2* relaxation time for femur was 21.63 ms, for patella was 29.39 ms and for tibia was 19.78 ms. In cases with traumatic etiology, slight increase in mean T2* values were noted at patella (34.10 ms) and tibia (21.76 ms). Further a significant *p* value was obtained in the lateral anterior sub-region of femur when comparing osteoarthritis with normal group.

Conclusion: Automated cartilage segmentation with generation of T2* relaxation time values has significantly reduced time and has facilitated accurate analysis of biochemical structure of cartilage at subregional level.

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Effectiveness of Hydrodilatation in Adhesive Capsulitis of Shoulder: Does It Offer Added Advantage Over Intra-Articular Steroid?

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Objective: Role of ultrasound guided hydrodilation in management of adhesive capsulitis.
Materials and Methods: Prospective, randomized, case-control study. Two groups of 30 patients through randomization. The Study group (n = 30) underwent hydrodilation with the help of ultrasound guided injection through the rotator interval approach with 10–20 mL of saline on the top of LA and steroid (40 mg triamcinolone acetonide) was used depending on the stiffness of the joint and intraarticular tension. Control group (n = 30) was managed with the routine treatment method of image guided steroid injection and physiotherapy. The patients were then followed prospectively for clinical improvements which was assessed by visual analogue scoring (VAS), oxford shoulder score (OSS) and range of movement (ROM) for each patient.
Results: Data was analysed using the SPSS v20.0, compared using the paired t test. Study group showed a mean of 4.3-point reduction in pain on VAS, mean of 14.1-point improvement on OSS with improved ROM (mean improvement –20 degrees). Means improvement is the control group were 2.6 in VAS, 7.9 in OSS and 12 degrees in ROM which was significantly lesser than study group ($p < 0.050$ in each of the 3 parameters). In our study, patients presenting with shorter duration of symptoms respond well than the patients presented with > 6months of duration of symptoms. 3 of the patients required repeated injections due to minimal improvement.
Conclusion: Ultrasound guided Hydrodilation along with steroid injection leads to significant improvement in adhesive capsulitis when compared to intraarticular steroid injection alone.

Focal Lesions of Hand and Wrist: A Smooth MR Roadmap for Imaging the Lumpy Bumpy Hand

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Learning Objective: To briefly review role of MR imaging in pathologies presenting as masses of the hand/wrist and highlight key imaging characteristics that pinpoint diagnosis.
Background: Focal masses and pseudomasses of the hand and wrist ,which are frequently encountered entities, pose a clinical dilemma due to non-specific presentation and require imaging to facilitate appropriate management. Plain radiography demonstrates calcification while ultrasound assesses whether the lesion is solid/cystic. MRI is the modality of choice as it can accurately determine the nature of the lesion, enhancement pattern and exact location in relation to surrounding tissues given its high contrast and spatial resolution.
Findings and/or Procedure Details: Standard pulse sequences were performed with small field-of-view and high-resolution matrix using necessary orthogonal planes on a 1.5T Siemens scanner. MR imaging findings of diverse etiologies including neoplastic, infective/inflammatory, degenerative presenting as masses and pseudomasses of the hand/wrist region are described using a simple sequence-based approach. Benign masses are categorised based on content into cystic, fat containing and fat free solid lesions. Common swellings like ganglia, GCTTS and lipomas have typical MR imaging features which are highlighted. Role of MRI in narrowing the differentials is also discussed.
Conclusion: The radiologists should be familiar with various lesions and potential mimics which present as lumps and bumps of the hand as they are routinely encountered. In many circumstances, a specific diagnosis can be made on MRI by taking into account lesion location and signal characteristics.

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Correlation of Clinical, MRI and Arthroscopic Findings in Diagnosing Ligament Injuries of the Ankle Joint

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Objective: An ankle injury has been one of the commonest joints injured especially in sports which contribute to significant morbidity and time lost from work. The aim of the study is to determine the accuracy of clinical findings and magnetic resonance imaging (MRI) in relation to surgical findings in patients presenting with chronic ankle pain and/or instability.
MAterials & Methods: MRI images and surgical reports were performed for all patients from 2015 until 2018 who underwent arthroscopic treatment of chronic ankle instability at two different institutions. Forty-two (42) patients met inclusion criteria. However, only 20 patients underwent surgery. Surgical findings were considered as a gold standard.
Results: MRI showed 100% sensitivity for the diagnosis of Anterior Talo-Fibular Ligament (ATFL) and 85.7% sensitivity for the diagnosis of calcaneofibular ligament (CFL) tears. Specificity was low particularly for CFL tears. High accuracy of clinical tests particularly tenderness on palpation and anterior drawer test (ADT) which showed high sensitivity in diagnosing ATFL tear. The most frequently injured ligament at the ankle was ATFL (76.2% on MRI, 77.8% on surgery), followed by CFL (76.2% on MRI, 52.4% on surgery), deltoid tear (52.4% on MRI and 4.8% on surgery) and Posterior Talo-Fibular Ligament (PTFL) tear (50% on MRI, none described on surgery).
Conclusion: MRI has high sensitivity and positive predictive value in diagnosing ATFL and CFL. However, the specificity is low. ADT and tenderness on palpation accurately denote ATFL injury with high sensitivity and positive predictive value. Clinical correlation based on tenderness and ADT is important when reporting MRI to avoid overdiagnosis.

Morphological of the Articular Cartilage Thickness of the Knee Using 3 Tesla MRI in Normal Young Adult

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Objective: Aim of this study is to measure cartilage thickness and to determine the association between gender, body mass index (BMI) and knee joint compartment using magnetic resonance imaging (MRI) in normal young adult. The purpose of this study of cartilage thickness is as a baseline measurement for the cartilage treatment.
Materials & Methods: Thirty subjects of a normal young adult from age of 18 to 40 year undergone imaging on bilateral knee joint using standard MRI Knee Joint protocol including proton density-weighted sequences. The 3.0T Siemen Magnetic Resonance Imaging machine was used. Cartilage thickness was then measured by two qualified radiologists. The association of cartilage thickness among BMI groups, genders and side of knee compartment were obtained.
Results: Based on gender, the average cartilage thickness of male was larger than female in all compartment (right femoral cartilage [male: 2.78 mm, female: 2.63 mm]). While, according to knee joint compartment, medial cartilage thickness was thinner than lateral cartilage (medial compartment [right: 2.61 mm, left: 2.67 mm]); lateral compartment (right: 2.69 mm, left: 2.725 mm) and patellofemoral compartment have the thickest average cartilage thickness (right: 4.2 mm, left: 4.2 mm). For body mass index, the underweight category yields the greatest average cartilage thickness (3.14 mm) while normal weight (3.04 mm), overweight (2.85 mm) and obesity (2.94 mm).
Conclusion: This study demonstrates that male has greater average cartilage thickness than female, medial compartment has thinner average cartilage thickness than lateral compartment and underweight category have the greatest average cartilage thickness among all other BMI groups.

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Functional Imaging of Bone Tumors: What More It Can Offer

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Objective: The diagnostic performance of functional MRI in bone tumors have remained largely unexplored. Role of functional MRI techniques, i.e., Diffusion Weighted imaging (DWI) and Dynamic contrast enhanced (DCE) imaging offer better understanding of nature (benign or malignant) and behavior (low grade or aggressive) of the lesions as well as their response to therapy. The role of multi parametric evaluation has been well established in cancers like breast and prostate and form a part of routine assessment, hence similar approach can be followed in assessment of bone tumors.
Materials & Methods: A cross sectional study was conducted in our institute over a period of two years including patients who had radiological suspicion of tumor, were biopsy proven cases or post chemotherapy cases. Apart from routine sequences, DWI along with ADC map and DCE sequences were taken. ADC values were determined for most cellular part of tumor. A signal intensity versus time curve was created. We attempted to correlate these parameters with the histopathological diagnosis.
Results: Different types of DCE-curves were obtained (e.g. rapid washout, progressive enhancement) which well correlated with nature of lesion. DWI with ADC values were indicative of behavior of lesion. They indicated cellular and microvascular properties of the lesion. Both entities were also useful as baseline data in follow up imaging.
Conclusion: Functional MRI techniques have diagnostic, prognostic as well as response assessment values as they depict physiological alterations as well as morphological changes. Hence, they must be incorporated in routine assessment of bone tumors.

MR Imaging of the Scapholunate Ligament: Normal Anatomy and Clinical Examples

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Learning Objective: Knowledge of the MR imaging appearances of the scapholunate ligament and common patterns of carpal instability allows more precise diagnosis in cases of wrist pain.
BAckground: The scapholunate ligament is a critical stabiliser of the wrist. Disruption of this ligament may result in carpal instability and pain. The most common causes of sacpholuante instability are fractures of the scaphoid, scapholunate dissociation, and radiocarpal arthritis. Scapholunate instability can be diagnosed on static MRI scan by direct visualisation of ligament tear or widening of the scapholunate ligament. There may be associated injuries such as scaphoid fracture, proximal pole avascular necrosis, scaphoid tubercle contusion, ganglion cyst, synovitis, radiocarpal osteoarthrosis and intercalated segmental instability.
Findings and/or Procedure Details: 65 consecutive MRI scans of the wrist were retrospectively reviewed for scapholunate ligament pathology. Proton density sequences with and without fat saturation, as well as a novel high resolution intermediate weighted sequence with ulnar deviation in the evaluation of wrist pain. Scan images are obtained on a 1.5T extremity magnet (GE Healthcare, Milwaukee, WI).
Conclusion: Disruption of the scapholunate ligament is a major cause of wrist pain and accounts for a high proportion of indications for hand surgery. Accurate diagnosis of ligament tears and associated co-morbidities are important in staging and reducing intra-operative exploration time.

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MINI-Audit of Technical Adequacy of Magnetic Resonance Imaging of the Shoulder

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Learning Objective: This is a mini audit of a single institution multi-centres MRI facility located at geographically distinct areas. The authors recognise the need for standardised protocols and performance of MRI of the shoulder at both centres. The aim of the mini audit was to establish the adequacy of MRI shoulder and identify areas for improvement.
Background: Retrospective review of 30 randomly chosen MRI shoulder scans performed at both centres from 2018 through 2019 was performed. Images were examined by an experienced team of radiographers to identify imaging inconsistencies and perform root cause analysis.
Findings and/or Procedure Details: Imaging inconsistencies identified included flipped images in 3 cases, internally rotated shoulders and movement artefact in 7 cases. Suggestions for improvement and successful results of the mini audit are provided in this presentation.
Conclusion: A mini audit is useful in maintenance of image quality across different imaging sites. We present our findings for quality improvement in this poster.

MRI Evaluation of Anterolateral Ligament of The Knee: A Cross-Sectional Study in Malaysia

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Objective: Anterolateral ligament (ALL) of the knee has been demonstrated to be an important secondary restrainer in providing rotational stability to the knee. ALL stabilizes the internal tibial rotation with increasing knee flexion. ALL injuries with concomitant anterior cruciate ligament (ACL) injuries have a higher grade of pivot shift. Magnetic resonant (MR) studies on ALL have been performed but there is no such data among the Malaysian population. We aim to investigate the reproducibility of ALL identification on 1.5T MRI and the association with other ligamentous injuries.
Materials & Methods: Magnetic resonant imaging of the knees with suspected ligamentous injuries from 1st January 2017 to 30th June 2017 were reviewed for suitability of this study. Post-operative MRI and MRI of patients with suspected tumour at the knee region were excluded. 1.5T MRI (Siemens Medical Solution) was used for assessment of all the knees. All MRIs were double read and approved by a consultant radiologist.
Results: A total of 36 knee MR images were obtained from 31 patients during the study period. 5 patients were excluded (3 for suspected tumour and 2 for post-operative). Mean age of the patients was 29.44. All three components of ALL were identified in 20 MRIs (55.6%): femoral component (75%); meniscal (69.4%) and tibial (58.3%). There were 11 knees identified to have ALL injury, which was associated with ACL injury.
Conclusion: ALLs of the knees are delineated in more than half of the MR images. There is an association between ALL injuries and ACL injuries.

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To Determine the Value of Apparent Diffusion Coefficient (ADC), and Fractional Anisotropy (FA) of the Rotator Cuff Muscles Using a 3-Tesla MRI in Healthy Subjects and Comparing Its Differences

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Objective: To determine the value of apparent diffusion coefficient (ADC), and fractional anisotropy (FA) of the rotator cuff muscles using a 3-Tesla MRI in healthy subjects and comparing its differences.
Materials & Methods: Diffusion parameters measured from Diffusion Tensor Imaging (DTI) data are used to characterize the relative probability of motion of water molecules. Thirty-eight healthy volunteers were included in this prospective study to determine the mean values of ADC and FA of the rotator cuff muscles. DTI of the rotator cuff muscles was performed with single-shot spin-echo echo-planar imaging sequences in 32 diffusion directions with a b-value of 400 s/mm^2 (the higher signal-to-noise ratio for this study). Values were calculated from the regions of interest drawn on sagittal oblique view of the shoulder using 3D fiber track analysis application on Philips Extended-MR-WorkSpace 2.6.3.5. Statistical analysis performed using SPSS-ver24 one-wayANOVA. Mean and SDs were obtained for each DTI parameters, and level of significance was determined ($p < 0.050$).
Results: The mean of ADC between subscapularis (1.74 [± 0.15]) and supraspinatus muscles (1.63 [± 0.12]) as well as infraspinatus (1.61 [± 0.09]) were significantly different based on One-Way ANOVA post-hoc Scheffe test. The mean of FA between supraspinatus (0.45 [± 0.05]), infraspinatus (0.41 [± 0.36]) and subscapularis (0.47 [± 0.55]) muscles weresignificantly different. Intraclass Coefficient for FA and ADC between 2 raters ranges good to excellent results.
Conclusion: Our study showed that the water diffusivity values of rotator cuff muscles were significantly different which may reflect differences in muscular architecture. The techniques used was highly reliable and potentially be applied to evaluate muscular pathology.

Surgical Site Infection of Total Hip Replacement and Role of Dual Radionuclide Imaging Studies in Evaluating Treatment Response

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Learning Objective: Recognising the role and scintigraphy findings of dual radionuclide imaging studies using triple-phase bone scan and besilesomab monoclonal antibody labelled scan in evaluating chronic musculoskeletal infection.
Background: A 63 years-old male underwent total hip replacement in 2008 for left femoral neck fracture. However, he presented with infected implant in late 2018. Explantation surgery to remove the prosthesis was done in February 2019. He developed post-operative collection at surgical site requiring joint washout and insertion of antibiotic-loaded cement spacer in March 2019. He was prescribed with prolonged course of ciprofloxacin and clindamycin antibiotics completed in November 2019. Biochemical parameters showed improvement with no apparent clinical signs of ongoing infection. Orthopaedic team planned for re-implantation arthroplasty.
Findings and/or Procedure Details: Dual 99mTechnitium-based imaging studies were offered to accurately assess the patient and treatment response in view of disease chronicity with no prior scintigraphy for baseline comparison. Triple-phase bone scan (20.1.2020) demonstrated subtle tracer accumulation at left hip during blood flow and pool phases with mildly increased tracer uptake at left trochanteric region on delayed-phase images. Besilesomab scan with single photon emission computed tomography-computerised tomography (SPECT-CT) of pelvis (22.1.2020) showed diffuse faint tracer accumulation at the trochanter extending distally to mid-shaft of displaced left femur likely due to altered marrow activity or reactive changes. No abnormal increased tracer uptake seen elsewhere to suggest focus of infection.
Conclusion: Correlation between both radionuclide imaging studies indicated favourable findings with no obvious scintigraphy evidences of significant residual ongoing infection at the left hip.

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Primary Spindle Cell Sarcoma of Bone: Imaging Features in 37 Patients

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Objective: To determine clinical and imaging features of primary spindle cell sarcoma of bone (1° SCSB).
Materials & Methods: Retrospective review of patients with histologically proven diagnosis of 1° SCSB between January 2007 and September 2018. Data collected including age, sex, site of lesion, radiographic features and magnetic resonance imaging (MRI) findings.
Results: 37 patients were included (males = 20, females = 17; mean age 48 years, range 10–85 years). Thirty-two lesions (86.5%) arose in the long bones, in which 27 (73.0%) involved the lower limbs while 4 cases (10.8%) arose in flat bones and 1 (2.7%) in the spine. Radiographs were available in 30 cases (81.1%), in which 5 cases (16.7%) showed a non-aggressive pattern of bone destruction while 25 cases (83.3%) showed an aggressive pattern of bone destruction. Matrix mineralisation seen in only 1 case, while 8 cases demonstrated cortical destruction. MRI demonstrated non-specific signal characteristics of solid soft-tissue mass, with only 2 cases demonstrating small internal cystic components manifest as fluid levels. The mean length of marrow involvement was 100.4 mm (range 15–253 mm). Skip metastases in the same long bone seen in 4 (10.8%), and extra-osseous mass was demonstrated in 32 cases (86.5%). Lung metastases were diagnosed during staging of the disease in 9 (24.3%) patients.
Conclusion: 1° SCSB should be considered in adult patients presenting with an aggressive lytic lesion without matrix mineralisation, especially cases involving long bones with large intramedullary and extra-osseous solid soft-tissue components.

MRI Bilateral Thigh in Quantifying Obesity and Sarcopenia in Elderly and Its Relation to Fall and Fall-Related Outcomes

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Objective: Falls affect one in four individuals aged 65 years and above annually, while the prevalence of obesity is increasing in this age group. Thus, both posing a significant public health issue in Malaysia and worldwide. Obesity may precipitate sarcopenia, hence increasing the risk of fall. With the advent magnetic resonance imaging (MRI) technique, more accurate measures of body fat and lean body mass are now available. This study will determine the appropriate indices for excess body fat in older persons, methods of evaluating muscle loss in older persons with excess body fat, how excess body fat is related to increased risk of falls, and more specifically how muscle volume and quality influences falls outcomes.
Materials & Methods: A total of 80 individuals age between 60–80 years of age with no contraindications to MRI scans are selected. These patients then subjected to MRI of bilateral thigh as well as other tests. Muscle, subcutaneous fat, and intramuscular fat were automatically segmented using MRI machine learning based segmentation method. The muscle and fat at cross-sectional area at 50% femur length and middle third of both thighs are segmented and measured.
Results: Both fallers and non-fallers individuals with BMI < 25 have almost similar mean of BMI, WHR and WC but slightly lower body fat-to-muscle ratio noted among the fallers (p = 0.097). Higher body fat-to-muscle ratio seen as the age advances (p = 0.092).
Conclusion: MRI is more sensitive to measure body fat and muscle mass in elderly people compared to other methods. Sarcopenia increases as age increases.

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Direct MR Arthrogram of the Shoulder: How We Do It

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Learning Objective:

- Demonstrate CT guided puncture technique for MR arthrogram
- Describe indications and contraindications
- Demonstrate optimization of radiation dose
- Demonstrate spectrum of pathology at our institution

Background: The shoulder joint inherent instability is well known. Direct MR arthrography of the shoulder is considered as an investigation of choice for shoulder instability especially in postoperative shoulders. In Direct MR arthrography, the distension of the shoulder joint capsule enhances the accuracy of diagnosis as the glenoid labrum, articular cartilage, glenohumeral ligaments, articular surface of rotator cuff and long head of biceps tendon are better visualized. Intra articular contrast for arthrography can be injected under ultrasound, fluoroscopy and CT guidance.
Findings and/or Procedure Details: We describe a CT guided needle placement technique that is feasible, more accurate and has less complications with special emphasis on optimization of radiation dose.
Conclusion: Direct MR arthrography enhances the diagnostic accuracy of shoulder pathology through better visualization of the intra-articular structures. CT guided intra-articular contrast injection is an alternative feasible technique to ultrasound and fluoroscopy guided puncture.

Correlation between Hounsfield Unit Derived from Computed Tomography of a Head, Thorax, Abdomen, Spine and Pelvis and T-Scores from Dual Energy X-Ray Absorptiometry

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Objective: Computed Tomography (CT) examination can potentially be utilized for early detection of bone density changes with no additional procedure and radiation dose. We hypothesize that the Hounsfield Unit (HU) measured from CT images are correlated to the t-scores derived from Dual Energy X-ray Absorptiometry (DEXA) in multiple anatomic regions.
Materials & Methods: Data were obtained retrospectively from all patients who underwent both CT examinations - brain (HU obtained from frontal bone), thorax (T7), abdomen (L3), spine (T7 & L3), or pelvis (left hip) and DEXA. To ensure comparability, the period between CT and DEXA studies must not exceed one year. Correlations between HU values and t-scores were calculated using Pearson's correlation. A receiver operating characteristic (ROC) curve was generated, and the area under the curve (AUC) was used to determine threshold HU values for predicting osteoporosis.
Results: Total 1043 of CT examinations fulfilled the inclusion criteria (head, thorax, lumbar, and left hips). The left hip consistently provided the strongest correlations and the best AUC (0.875–0.893). Meanwhile, thorax T7 and lumbar L3 shows average correlations and moderate AUC (0.680–0.783). Frontal bone shows poor correlation and weak AUC with $r < 0.5$, AUC = 0.538–0.655, all $p > 0.050$.
Conclusion: HU values derived from the hip, T7, and L3 provided good to moderate correlation to t-scores with a reasonable predilection for osteoporosis. The suggested optimal thresholds may be used in clinical settings after external validations are performed.

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Role of Magnetic Resonance Imaging in the Evaluation of Spinal Tuberculosis

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Objective: Spinal tuberculosis (TB) is the commonest clinically important extra-pulmonary form of the disease. Early recognition of the disease is necessary to minimize residual spinal deformity and/or permanent neurological deficit. Hence, the study was performed to evaluate the usefulness of MRI as a non-invasive diagnostic tool in spinal tuberculosis
Materials & Methods: Thirty proven patients with spinal TB were included. MRI images of the patients were retrospectively analyzed to determine the site and pattern of the lesions and extent of vertebral and soft tissue involvement. Post-operative and follow up cases were excluded from the study.
Results: Majority of the patients had two vertebral involvement (56.6%) followed by multilevel involvement (36.7%). Single vertebral involvement was seen in 2 cases only. Thoracic spine was the commonest site of the disease (43.3%) followed by lumbar region (36.7%). Vertebral end plate involvement seen in 86.7% cases followed by disc involvement (83.3%). Majority of cases had pre and paravertebral collections and anterior epidural component. 90.0% patients had thecal sac compression with cord compression in 36.7% and cord edema in 20% patients causing neurological complaints.
Conclusion: MRI is a highly sensitive technique in the detection of various pathological processes of spinal tuberculosis. MRI is also helpful to determine cord compression, osseous and non-osseous involvement and extent of the disease. The extent of soft tissue involvement is best assessed by MRI which helps in guiding the surgical treatment as well as to monitor the response to treatment during follow up.

Aseptic Lymphocyte Dominated Vasculitis-Associated Lesions Secondary to Metal-On-Metal Hip Prosthesis

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Learning Objective: To evaluate the diagnostic performance of a thyroid ultrasound computer-aided diagnosis (CAD) software in comparison with computer-assisted subjective analysis for thyroid nodule differentiation.
Background: The term AVLAL is synonymous and interchangeable with ARMD, pseudo tumours and metallosis which occurs in metal-on-metal prostheses. Essentially, this soft tissue mass can present in a spectrum of imaging findings and can lead to debilitating destruction. It is postulated that the condition occurs because of a type IV delayed hypersensitivity related to shedding of metal ions secondary to excessive wear especially in high loading joints.
Findings and/or Procedure Details: CR can help exclude periprosthetic loosening and infection. However, CR has a low sensitivity in excluding AVLAL. Radiologists need to be aware of the range of imaging findings from postoperative findings to infection and ALVAL. Currently, there is no universal grading system but we can stratify findings to aid management. The key finding is that it is periprosthetic. Imaging findings are dependent on lesion type which can be predominantly cystic or solid. The lesion is typically contiguous with the femoral component and confined by a thick ragged capsule. The Anderson staging system can be used to grade AVLAL lesions into mild, moderate or severe.
Conclusion: Early identification of AMRD is important in guiding management.

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Landscape: An MRI-Based Project for Computational Neuromodulation

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Objective: Neuromodulation is increasingly used as a probe of brain function and potential therapeutics in experimental neuroscience and neurorehabilitation. Scalp to cortex distance (SCD), as a key parameter, has been shown to potentially impact on the neuromodulation-induced electric field. This study aimed to examine the region-specific SCD in the context of age-related brain atrophy.
Materials & Methods: We launched an MRI-based project named as "Localized Analysis of Normalized Distance from Scalp to Cortex and Personalized Evaluation" (LANDSCAPE). We analysed the SCD of left primary motor cortex (M1) and dorsolateral prefrontal cortex (DLPFC) in 643 cognitively normal adults from the Cambridge Centre for Ageing and Neuroscience (Cam-CAN). Computational head model was developed to simulate the impact of SCD on the electric field.
Results: We found age-related increased SCD in the left DLPFC ($p < 0.001$), but not M1 ($p = 0.134$). The electric field induced by stimulation was consequently decreased with the increased SCD across normal aging individuals.
Conclusion: Age have differential impacts on the SCDs of left DLPFC and M1. The findings suggest that it is important to be aware of region-specific distance measures when conducting neuromodulation in individuals with old age.

The IVY Sign in Adult Moyamoya Disease

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Learning Objective: Moyamoya disease is an idiopathic cerebrovascular occlusive disorder characterized by progressive stenosis of the distal internal carotid arteries and by collateral vessel formation. The leptomeningeal Ivy sign observed on post contrast T1-weighted and FLAIR images are a characteristic finding in Moyamoya disease. This sign signifies the formation of leptomeningeal collateral development and increased numbers of pial vascular networks in association with the progressive steno-occlusive disease of the distal internal carotid arteries.
Background: We presented a case of a young gentleman who presented with new onset headache associated with right-sided body weakness.
Findings and/or Procedure Details: Initial CT brain depicted intraventricular hemorrhage. Subsequent DSA demonstrated the characteristic angiographic pattern puff-of-smoke which is diagnostic of Moyamoya disease. Diffuse leptomeningeal ivy sign was exhibited on MRI.
Conclusion: Ivy sign in Moyamoya disease may be under recognized and should not be confused with other leptomeningeal abnormalities. Recognizing Ivy sign as part of Moyamoya disease will avoid misdiagnosis, confusion with other differential diagnosis and eliminate potential unnecessary investigations.

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Changes in Vertebral Body Height and Spinal Canal Diameter Due to Aging and BMI

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Objective: The spine contains numbers of structures, responsible for maintaining its mobility, flexibility and stability. These normal structures change during lifetime due to aging. The purpose of our study is to determine how spinal canal diameter (SCD) and vertebral body height (VBH) change with age and BMI.
Materials & Methods: This is a retrospective study including 127 patients undergone whole spine MRI on 1.5T magnet from January 2017 to October 2018. We have chosen patients aged from 30–79 which was divided into 4 age groups. We reviewed whole spine axial and sagittal MRIs of 127 patients, from which 22 patients were excluded due to bone lesions, fracture, and spinal severe stenosis at the chosen levels. We have compared the demographic parameters such as age, gender, weight, height and BMI with SCD (sagittal) and VBH (sagittal) at C4, C5, T5, T6, L4, L5 levels due to most and least flexible parts. We also evaluated all parameters with age groups and between groups.
Results: VB height is significantly correlated with aging at C4 (11.6 mm vs. 9.0 mm, $p = 0.030$), C5 (9.6 mm vs. 9.2 mm, $p = 0.010$), L4 (23.4 mm vs. 20.5 mm, $p = 0.020$) and L5 (24.3 mm vs. 22.3 mm, $p = 0.030$) levels, while not correlated with BMI. SC diameter is significantly correlated with aging at C4 (12.2 mm vs. 12.5 mm, $p = 0.008$), C5 (12.5 mm vs. 13.6 mm, $p = 0.010$), and T5 (13.8 mm vs. 15.7 mm, $p = 0.010$) levels, significantly correlated with BMI at T5 (13.8 mm vs. 15.7 mm, $p = 0.040$) and L4 (12.9 mm vs. 14.0 mm, $p = 0.040$) levels.
Conclusion: The mid-VBH decreased with aging while SCD doesn't significantly change with aging.

Central Nervous System Tuberculosis: Literature Review for Imaging Modalities and Protocols

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Learning Objective:
- To enumerate the imaging features of various manifestations of tuberculosis in central nervous system on various medical imaging modalities.
- To learn the role of various imaging modalities in imaging of patients with suspicion/diagnosis on CNS TB.
- To describe the features differentiating clinically closely mimicking disorder of central nervous system.
- To learn about recent advances and guidelines on imaging of central nervous system.

Background: Tuberculosis is an endemic global infectious disorder with burden of 10 million new cases each year. 30 high burden countries, mostly Asian, with poor socioeconomic conditions of their population make up 87% of total cases. Prevalence of CNS involvement amongst them is 1% and is associated with poor outcome. Despite poor outcome, there is scarcity of data available to suggest the imaging protocols and recent guidelines on when to use what tool when it comes to medical imaging.
Findings and/or Procedure Details: Basic Screening tools such as Chest X ray, fluoroscopy are used for screening purposes as well as guiding procedures to obtain tissue/fluid sample for definitive diagnosis. MRI is superior to CT scan when diagnosing and determining the complications of CNS tuberculosis, with advanced MR techniques including angiography, venography, spectroscopy and radiomics adding substantial targeted information in ambiguous cases.
Conclusion: CNS involvement in tuberculosis results in devastating outcome. Diverse presentation presents with a challenge in deciding course of imaging. Plain radiography and CT scan can help as a modality for screening while conventional MR can help in further characterization.

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Resting-State Default Mode Network Functional Connectivity and Executive Dysfunction in Spinocerebellar Ataxia Type 3: A Preliminary Study

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Objective: Executive dysfunction has been reported in spinocerebellar ataxia type 3 (SCA3). Default mode network (DMN) is a resting-state, functional magnetic resonance imaging (fMRI) network associated with cognitive function. This preliminary study aims to correlate executive dysfunction in SCA3 with DMN connectivity.
Methodolgy: Ten SCA3 patients (Age: 41.9 ± 11.4 years, 6 Male 4 Female) underwent executive function (EF) tests, namely Matrix Reasoning (MR) and Digit Span (DS). Participants underwent a 10-minute, resting-state 3T fMRI scan and the data were processed using dynamic causal modelling. Posterior cingulate cortex (PCC), medial prefrontal cortex (mPFC), left (LIPC) and right intraparietal cortices (RIPC) were selected as DMN nodes. Pearson's correlation was used to determine the strength of association between EF and DMN.
Results: Increased connectivity between RIPC and mPFC was correlated with better MR performance (r = 0.696, 95% CI = [0.118, 0.922]). Increased connectivity between mPFC and PCC was correlated with better DS forward performance (r = 0.776, 95% CI = [0.286, 0.944]). Reduced connectivity between LIPC and RIPC was correlated with better DS forward (r = -0.716, 95% CI = [-0.928, -0.153]) and backward (r = -0.773, 95% CI: [-0.943, -0.279]) performances.
Conclusion: Disrupted connectivity in the prefrontal regions (PCC and mPFC) within the DMN might be associated with executive dysfunction in SCA3. This disruption may in turn lead to the inability to downregulate posterior regions (LIPC and RIPC), thereby impinging on the EF. Inclusion of larger samples and healthy controls are needed to confirm the findings.

The Importance of Pre-Operative CT Localization of the Anterior Ethmoidal Artery for the Prevention of Injury During Endescopic Sinus Surgery

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Learning Objective: Improve awareness of the surgical significance of the anterior ethmoidal artery (AEA) among radiologists.
Background: When the AEA lies below the skull base, it is at risk of injury during endoscopic sinus surgery. If the AEA is injured during sinus surgery, it may retract into the orbit and results in orbital hematoma which in turn can potentially cause blindness. When the AEA is identified preoperatively on CT scans, the risk of injury to the AEA can be decreased.
Findings and/or Procedure Details: The relevant anatomy of the AEA will be reviewed and illustrated with CT images. The AEA canal in the ethmoid region is more likely to be below the skull base when Supraorbital Ethmoid Air Cells (SOEC) are present. The AEA foramen can be identified on coronal CT images as a bony outpouching along the medial wall of the orbit near the inferior margin of the superior oblique muscle. The CT imaging landmarks which can be used to identify the AEA will be illustrated using CT image examples.
Conclusion: After viewing the exhibit, the radiologist should understand the surgical significance of the AEA and be able to identify the AEA foramen and AEA canal on sinus CT studies. They should also be able to determine when the AEA is at increased risk of injury when SOECs are present.

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Its Not Over Yet: A Review of Cerebal Tuberculosis and Its Complications

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Learning Objective:
- To illustrate the panoramic spectrum of imaging features of CNS tuberculosis.
- To demonstrate intracranial complications of tuberculosis.

Background: Tuberculosis is regarded as a major worldwide health problem, it keeps on recurring and has never subsided despite the advances in medicine. The underlying pathogen - Mycobacterium tuberculosis can involve any organ. The most common being lungs, however the most devastating form of the disease occurs with central nervous system (CNS) involvement. CNS tuberculosis is a potentially life threatening condition. If it is diagnosed early and being treated aggressively, it can be cured even at initial stages. Clinically and radiologically, CNS manifestations of tuberculosis often mimic other neurological conditions of infectious and noninfectious etiology. Hence, recognizing the imaging appearances of various forms of CNS tuberculosis is necessary for timely diagnosis and management of this disease.
Findings and/or Procedure Details: We compiled all the cases CT and MRI brain performed from January 2018 to December 2019 at Shifa international hospital, Islamabad, Pakistan with diagnosis of CNS tuberculosis and/or its complications. These include:
- Meningitis(leptomeningits or pachymeningitis) further complicated by infarcts and hydrocephalus
- Tuberculomas
- Focal cerebritis/encephalitis
- Intracranial abscesses/ empyema
- Tuberculous encephalopathy
- Ischemic infarcts due to vasospam
- Midline shifts
- Brain herniations
- Subdural empyema
- Secondary osteomyelitis

Conclusion: Familiarity with the spectrum of imaging manifestations of CNS tuberculosis is vital for the timely diagnosis, thereby reducing the morbidity and mortality of this potentially life-threatening disease.

Intracranial Hemorrhage Detection and Classification Using Sequenced Deep Learning Model

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Objective: Intracranial Hemorrhage (ICH) is an emergency condition that requires quick and accurate detection which depends on radiologists. Due to the acuteness of ICH, an improvement in interpretation time with reliable accuracy would be preferable. Deep learning algorithm has been continuously developed and now it can achieve comparable and quicker results compared to doctors. This study was conducted with the approval of the Ethics Committee.
Materials and Methods: In this study we proposed a method using prebuilt Convolutional Neural Networks (CNNs) in combination with Gated Recurrent Units (GRUs) for detection as well as classification of ICH on brain computed tomography (CT) scans. Particularly, we used a modified EfficientNet-B6 architecture for extracting image features in tandem with GRUs to connect features between slices. The model was trained with RSNA Intracranial Hemorrhage Detection Challenge's dataset, which includes about 25,000 both normal and ICH-positive CT scans. Additionally, we proceeded 5-fold validation on the dataset. After fine-tuning the model's parameters to achieve a good result with that dataset, we collected 300 cases (205 positive, 95 negative) from our hospital to test its performance with real-world data.
Results: The result when training with RSNA dataset achieved an average result of 98% accuracy. After testing process with our hospital cases, we achieved an average accuracy of 92.7% and F1-score of 94.5% for detecting ICH cases, with a maximum of 95.2% accuracy for sub-arachnoid hemorrhages. We also measured the inference time with an average of 1.8 seconds per case.
Conclusion: The study has shown superior speed and reasonable accuracy in detecting ICHs compared to radiologists.

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Spinal Dysraphism: Imaging Signs of Cross-Sectional Imaging

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Learning Objective:

- To review the embryology development of spinal cord and its pathologies
- Illustration of clinic-radiological classification of spinal dysraphism

Background: Spinal cord development and its embryological knowledge are important for a better understanding of various pathologies. Spinal dysraphism is a group of congenital anomalies leading to various malformation of the spinal cord and the spine. The basic defect occurring during early embryological stages (gastrulation, primary neurulation, secondary neurulation) of spinal development.
Findings and/or Procedure Details: Sonography and radiography are the basic primary modality for any spinal anomalies. However, MRI is the best modality for evaluating spinal cord anomaly and spaces and CT assists in the evaluation of the spine specifically. According to their clinical-radiological features, the anomalies can be broadly classified into open and closed spinal dysraphism. The open category includes myelocele, myelomeningocele, hemimyelocele and hemimyelomeningocele. The closed category can again be subdivided into two categories - with or without subcutaneous mass. Examples of those with subcutaneous mass include lipomyelocele, lipomyelomeningocele, meningocele, myelocystocele and etc. The closed category without subcutaneous mass include various simple patterns like intradural lipoma, filar lipoma, and dermal sinus, etc. and the complex pattern includes diastematomyelia, neurenteric cyst, caudal regression, and segmental spinal dysgenesis, etc.
Conclusion: Spinal dysraphism is the result of the defective closure of the neural tube in early embryogenesis. Few spinal dysraphism may cause progressive neurological deterioration culminating in the socioeconomic and emotional toll to the family and society worldwide. Hence, early intervention and detection of pathology are necessary.

Interactive Cases Illustrating the Anatomy and Pathology Deforming the Fourth Ventricle

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Learning Objective: The main objective is to describe the anatomical structures bordering the fourth ventricle and to highlight pathology that deformed its shape via a collection of interactive cases. Our goal is to enhance the ability to recognize the subtle changes in shape or configuration of the fourth ventricle, enabling early detection of pathology.
Background: The fourth ventricle in the posterior cranial fossa has a diamond-shaped configuration and bordered by a few vital structures. By understanding the anatomical boundaries of the fourth ventricle, the potential pathologic processes that resulted in the abnormal shape of the fourth ventricles could be differentiated and aid in diagnostic.
Findings and/or Procedure Details: The pathologic processes that may cause deformation of the fourth ventricle range from congenital to acquired pathology. These could be due to pathology arising within the ventricle or in relation to the surrounding structures of which the latter would be our focus. Description of the disease entities would be achieved via interactive cases and correlation with the anatomical landmarks. Some of these deformations are known to radiologists as “aunt Minnie” diagnosis whilst the subtle ones will necessitate a more thorough search.
Conclusion: An understanding of the anatomic relationship and effect of various pathologies on the shape of the fourth ventricle is key in image evaluation. Some pathologies resulted in characteristic shape changes whilst others may be subtle asymmetry or change in the shape, volume and position of the fourth ventricle.

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Association of Teaching Institutions with the Usage of Fluoroscopic-Guided Lumbar Puncture in the United States: A Healthcare Cost and Utilization Study

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Objective: Fluoroscopic-guided lumbar punctures are performed when a patient may be a difficult candidate for conventional techniques or when there is a prior unsuccessful bedside attempt. On average, the United States spends $2.6 billion yearly in healthcare cost for this procedure. This study assesses whether there is a higher propensity to utilize image-guided lumbar punctures in teaching hospitals over non-teaching hospitals in the U.S.
Materials & Methods: Fluoroscopic-guided lumbar puncture procedure frequency was obtained from the Healthcare Cost and Utilization Project database, using the International Classification of Diseases, Tenth Revision (ICD-10) as a principal diagnosis during 2016 and 2017. The cohorts were dichotomized to teaching hospitals and non-teaching hospitals, using the Z-test to analyze significance.
Results: 373858 primary hospital admissions for fluoroscopic-guided lumbar punctures were recorded during 2016–2017. The mean patient age was 37.68 years old, with 50.64% being female. The mean procedure frequency in teaching institutions was 146,600 (± 3,512SD), while usage in non-teaching institutions was 32,298 (± 943SD), $p < 0.001$. The mean aggregate charges for the teaching hospitals were $8,954,640,822 (± 320,188,434SD), which was significantly higher compared to non-teaching hospitals with $1,890,380,970 (± 72,953,863SD), $p < 0.001$.
Conclusion: There is significantly higher utilization of fluoroscopic-guided lumbar punctures in urban teaching hospitals over non-teaching hospitals in the U.S. This could be attributed to higher performance capabilities and increased resource availability. Teaching hospitals also provide more care for minorities and are likely to receive patient transfers from off-site hospitals. Further studies are warranted to assist healthcare radiology administrators in building appropriate infrastructures.

Skull Base Anatomy and Pathology Educational Exhibit: Key Concepts Via Interactive Digital Modern Imaging Software Through Series of Cases

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Learning Objective: The learning objective of this exhibit is to familiarize readers with skull base anatomy via:
- Interactive, scrollable, side by side normal vs pathology 'illustrating' anatomy images sets
- Both 'without' and 'with' annotations

Background: The anatomy of the skull base is complex and ability to localize the pathology to the anatomical landmark is pivotal, not only in making diagnosis but also in identifying involvement of the surrounding structures which may affect management.
Findings and/or Procedure Details: The skull base is formed by five bones that shape the floor of the cranial cavity and contains numerous foramens and canals. Given the complexity of the skull base anatomy, variety of pathology can occur, affecting the osseous, neurovascular structure, soft tissue and muscles. These can be categorized into anterior, middle and posterior compartments of skull base with pathology that can occur in this area range from neoplastic, infectious, inflammatory, vascular and congenital in etiologies. Description of disease entity via series of cases will be covered. CT and MR will be used to illustrate the anatomical structures and delineate the compartments of the skull base.
Conclusion: The skull base is an important anatomical landmark that hosts diverse pathology. A structured anatomical approach will aid in diagnostic and offer a guidance to surgeons preoperatively.

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Pictorial Review: Different Diseases Causing Ischaemic Infarction in Young Adults and Their Radiological Features

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Objective: Ischaemic stroke in young adults (18–45 years old) are debilitating and increasingly frequent. Comparing with older adults, young adults have different etiologies. Young adults have fewer ischaemic infarcts from large- or small-vessel diseases, but more from cardioembolism and other causes. The purpose of this pictorial review is to illustrate radiological features of different pathologies that can cause ischaemic infarcts in young adults.
Materials and Methods: Retrospective review of young adults with ischaemic stroke, with their underlying disease, imaging findings of CT, MRI and angiogram reviewed.
Results: Radiological features of various disease which can cause ischaemic infarcts in young adults are discussed, namely arterial dissection, cerebral autosomal dominant arteriopathy with subcortical infarcts and leukoencephalopathy (CADASIL), mitochondrial encephalopathy, lactic acidosis, and stroke-like episodes (MELAS), moyamoya disease and reversible cerebral vasoconstriction (RCVS). Their imaging findings and subsequent management are discussed.
Conclusion: Ischaemic stroke in young adults is increasingly frequent. Early recognition by radiologists can help patient with correct diagnosis and early treatment.

Determination of Cut-Off Values for Hippocampal Volume Via Automated Segmentation on MRI Brain for Identification of Hippocampal Atrophy in Hippocampal Sclerosis

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Objective: Hippocampal sclerosis is diagnosed on MRI brain by hippocampal volume reduction with presence of hippocampal hyperintensity on T2-weighted and FLAIR images. We attempted to delineate the cut-off values for hippocampal volume on MRI brain via automated hippocampal volumetry using FreeSurfer software, in order to facilitate diagnosis of hippocampal sclerosis.
Materials & Methods: This is a cross-sectional study of 40 anonymized control subjects and 43 patients with temporal lobe epilepsy. MRI brain acquisition was performed with GE Signa EXCITE 3.0T MRI scanner and 16-channel head coil using standard epilepsy protocol of University Malaya Medical Centre. Hippocampal atrophy and hyperintensity on axial T2 FSE/coronal FLAIR CUBE sequences were identified on MRI by two neuroradiologists. MRI images on axial FSPGR 3D were converted from DICOM to NIFTI format. Hippocampal volume was obtained via automated segmentation on FreeSurfer software version 6.0. Statistical analysis was performed with SPSS.
Results: Median right hippocampal volumes are greater than left side in both control subjects and patients. Mann-Whitney test showed that hippocampal volume in control group was statistically significantly higher than patient group ($p < 0.001$). The optimal cut-off values obtained with Receiver operating characteristics (ROC) curve and Youden index for left and right hippocampal volumes are 3257 mm^3 (sensitivity: 0.692, specificity: 0.968) with area under curve (AUC) of 0.850 (95% CI: 0.746–0.955) and 3761 mm^3 (sensitivity: 0.9, specificity: 0.957) with AUC of 0.950 (95% CI: 0.876–1.0) respectively.
Conclusion: The cut-off values of hippocampal volume determined in this study would be valuable in diagnosis of hippocampal atrophy in hippocampal sclerosis, in combination with MRI visual assessment by neuroradiologists.

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MRI Lipid Signatures and SREBPs Gene Expression Profiling for Characterisation of Glioma: A Preliminary Study

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Objective: We aim to investigate the relationship between lipid-imaging profiles and sterol regulatory element binding proteins (SREBPs) gene expression in diffuse gliomas.
Materials and Methods: A total of 24 glioma patients with grade II (n = 12) and grade IV (n = 12), and 6 control samples were studied in this preliminary study. All patients underwent a standard pre-operative MRI tumour protocol. The lipid fractions (LF) were derived from the segmented non-enhancing tumour regions overlaid on the constructed lipid map. SREBPs gene expression analysis was performed using quantitative real-time PCR.
Report: The LF of the solid non-enhancing region was slightly higher for grade IV than grade II. Statistical analysis revealed negative correlation between LF value with SREBP1 expression (r = -0.731, p = 0.025) and SREBP2 expression (r = -0.636, p = 0.066). In contrast, LF value was positively correlated with SREBP1 expression (r = 0.196, p = 0.709) and SREBP2 expression (r = 0.262, p = 0.616). Additionally, there was a significant difference between the SREBP1 and SREBP2 gene expression in grade II and grade IV glioma with p-value of 0.024 and 0.021 respectively. Our analysis shows that the expression of SREBP1 is 10-fold higher in grade II in comparison with grade IV. SREBP2 expression is 6-fold higher in grade II than in grade IV.
Conclusion: Overall, upregulation of SREBP in grade II glioma suggest that lipid and cholesterol metabolism is highly activated due to excessive demands of low-grade glioma cells to proliferate while these activities are suppressed in the late stage of glioma. SREBP1 and SREBP2 may serve as radiogenomics marker for glioma.

An Update of Distinguishing Hemorrhage and Calcification in Brain Parenchyma by Dual-Energy Computed Tomography

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Learning Objective: To differentiate calcification from a hemorrhage in brain parenchyma using dual-energy computed tomography (DECT).
Background: Focal hyperattenuation in brain parenchyma is a common finding on non-contrast-enhanced head CT scans, in which intracranial calcification and hemorrhage are the main causes. Precisely differentiating these two entities is important for diagnosis and treatment. In most cases, it is easy to distinguish them on conventional CT images. However, some confusing cases can be misdiagnosed, leading to inaccurate treatment. Several techniques can help differentiate them, such as conventional CT or magnetic resonance imaging, DECT, gradient-echo phase imaging or phase susceptibility weighted imaging and quantitative susceptibility mapping. Based on the advantages and disadvantages of the techniques, DECT is selected for emergencies with benefit of low cost and minimal radiation dose.
Findings and/or Procedure Details: The principle of this method is based on the inherent differences in the spectral signature of blood and calcium at different energies. Diagnostic algorithm by observing on three types of images include non-contrast CT, calcium overlay and virtual noncalcium (VNC) images. On non-contrast-enhanced CT images, focal intracranial hyperattenuating lesions are calcification if they expressed hyperattenuation on calcium overlay images, and they do not appear clearly on VNC images. In contrast, the focal intracranial hyperattenuating lesions are hemorrhage if they do not appear on the calcium overlay images and have high attenuation on VNC images.
Conclusion: DECT may be used as a complement to conventional CT to distinguish intraparenchymal hemorrhage or calcifications with high sensitivity, specificity and accuracy.

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Imaging Pattern and Arterial Signal Labelling (ASL)Perfusion in Posterior Reversible Encephalopathy Syndrome (PRES)

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Objective: PRES is a clinico-radiological disorder characterised mainly by vasogenic edema in the posterior parietal and occipital poles. Two theories are proposed as mechanism - one being hypertension with autoregulation failure and hyperperfusion and another being vasoconstriction and hypoperfusion. Our purpose was to identify various imaging patterns, ASL perfusion characteristics and to extrapolate associations, if any with etiology.
Materials and Methods: The lesion distribution, diffusion restriction, hemorrhage and perfusion characteristics of PRES along with the various clinical presentation and etiologies were analyzed retrospectively in 26 patients from Jan 2018 to Jan 2021, at tertiary care center in Bangalore, India.
Results: Out of the 26 patients evaluated(M:F 4:22), most common clinical presentation was seizures (21/26–80%). Most common etiology was found to be hypertension (15/25 [60%]; 10 accelerated hypertension [66%], 5 eclampsia [33%]) followed by drug induced (6/25–24%), followed by post-partum period (5/25–20%). Most common imaging feature was superior frontal sulcus pattern (12/26–46%) followed by posterior parieto–occipital pattern (10/26–38%). 10 cases had asymmetrical distribution and 13/26 (50%) had central involvement along with other areas. 4/25 had associated hemorrhage. ASL: 12 patients perfusion imaging was performed and all showed elevated perfusion corresponding to the areas of lesion with only 4 having hypertension at presentation. MRI with contrast was done which showed Dural Enhancement in various regions of the spinal cord as well as thickening and enhancement of the left facial nerve.
Conclusion: Lesion distribution was seen beyond the typical location of parieto-occipital lobe in majority of cases, most cases showed ASL hyperperfusion irrespective of presence of hypertension at presentation.

MRI Stroke Protocol as First Line Neuroimaging in Acute Stroke

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Learning Objective: Stroke represents the third leading cause of mortality in Malaysia as reported by Institute for Health Metrics and Evaluation. Early diagnostic-imaging allows for introduction of fibrinolytic therapy and evaluation of ischemic penumbra. CT brain is the first line imaging for acute in most centres compared to MRI. Acute stroke protocol in our centre uses MRI as the first line imaging tools. Comprehensive MRI protocol with fast imaging techniques proved valuable to the management of acute stroke
Background: MRI scan was performed in 131 patients who presented with acute stroke, from May-Dec 2020. Our protocol starts with DWI, followed by FLAIR and MRA. The susceptibility weighted imaging (SWI) will be performed as 2nd sequence if suspected haemorrhage in DWI. Other sequences include 3D Arterial Spin Labeling (ASL), perfusion, carotid MRA and black blood imaging. However, other sequences only performed after treatment decision has been achieved
Findings and/or Procedure Details: Total of 112 patients had MRI with above protocol. There were 112 acute stroke and 19 stroke mimics. Almost all cases had treatment decision after 3rd sequences and average scan to decision time is 12 minutes. DTN time is not significantly delayed. There were 25 cases acutely treated representing 22% treatment rate compared to typical rate of 5-10% in majority of other centres. MRI clearly diagnosed stroke mimics in 19 cases.
Conclusion: MRI with appropriate protocol doesn't significantly delay treatment. Our protocol able to achieve treatment decision not later than-3rd sequence and do not significantly delay the decision time. MRI with appropriate protocol increases the treatment rate.

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Molecular and Radiological Characterization of Glioblastoma Multiforme Using MRI

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Objective: Glioblastoma multiforme (GBM) is the most malignant, aggressive and common form of primary brain cancer. Currently, GBM is considered to be a homogenous mass as all of its margins are treated equally at the time of resection. However, it is not known whether radiologically distinct regions of GBM are also distinct at molecular level. We conducted this study to see if radiologically distinct regions were also different at the molecular level.
Materials & Methods: In 20 patients, MRI derived variance known as Apparent Diffusion Coefficient (ADC) was plotted against Contrast Enhancement (CE). Four radiologically distinct regions were identified: 1) high ADC and low CE, 2) low ADC and low CE, 3) high ADC and high CE and 4) low ADC and high CE. Biopsy samples were collected from these four regions of interest in each patient and immunohistochemistry was conducted to characterize cellular features and identify oncogene and stem cell marker expressing cells.
Results: Markedly increased nuclear pleomorphism, cellularity and necrosis were seen in region 2. Oncogene IDH was expressed in all regions, however, it was highest in region 4. Stem cell marker, CD44 expression was highest in region 1 and lowest in region 2 and 3. The expression of CD133 was highest in region 3.
Conclusion: This study shows that ADC/CE plot can divide GBM into four regions, whose heterogeneity is evidenced by differential expression of nuclear pleomorphism, necrosis, cellularity and mitotic rate as well as the expression of oncogene and stem cell markers.

Relaxation-Enhanced Angiography without Contrast and Triggering (REACT) Versus Conventional Magnetic Resonance Angiography (MRA) for Imaging of Extracranial Arteries in Acute Ischemic Stroke at 3T

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Objective: To evaluate a novel flow-independent MRI sequence (REACT) compared with conventional MRA for the imaging of extracranial arteries in acute ischemic stroke (AIS).
Materials and Methods: This was a retrospective study of patients who underwent a stroke protocol at 3T including REACT and conventional MRA of the extracranial arteries. Two radiologists evaluated scans regarding vessel delineation, signal, and contrast; and assessed overall image quality for treatment decisions.
Results: Compared to conventional MRA, REACT successfully provide clinically relevant information for treatment decisions in patients referred for acute ischemic stroke (AIS) in our center.
Conclusion: Given its fast acquisition, comparable image quality to conventional MRA and high sensitivity and specificity for the detection extracranial vascular pathology, REACT was proven to be a clinically applicable method to assess extracranial arteries in AIS.

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Preoperative Role of ADC Values in Differentiating Grade IV Glioblastoma Grade IV Tumor from Fungal Brain Abscess

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Objective: To differentiate fungal brain abscess from grade IV glioblastoma on the basis of mean ADC values.
Materials & Methods: A retrospective study of 90 patients (47 male and 43 female; age range from 10–70 years) with aggressive grade IV brain lesion and fungal abscess was conducted. The mean ADC value and standard deviation of glioblastoma and fungal abscesses were calculated. The Levene's Test for Equality of Variances was applied. The analysis of data was done to test statistically the significant differences between glioblastoma and fungal brain abscess. To compare between the two groups, independent Student's *t* test was used. Receiver operating characteristic (ROC) curve was used to determine the cut-off point with highest accuracy that was used to differentiate high grade neoplasm from fungal infection. The $p < 0.001$ was considered significant at 95% confidence interval. The statistical analysis of data was done using SPSS® v. 19 .
Results: When an ADC value of 1006.500 x 0.001 mm^2/s used as a threshold value for differentiating fungal abscess from glioblastoma, the best result was obtained with an accuracy of 100%, sensitivity of 100%, specificity of 100%, negative predictive value of 0%, positive predictive value of 0% and area under the curve of 1. There was a significant difference in the ADC value between fungal brain abscess and glioblastoma ($p < 0.001$).
Conclusion: We concluded that ADC value is a non-invasive promising imaging parameter that can be used for differentiation of fungal abscess and glioblastoma on preoperative scan.

Imaging the Neural Bridge-Ultrasound and MRI in Corpus Callosal Dysgenesis and Agenesis

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Learning Objective:

- To understand the normal anatomy and development of the corpus callosum and the malformations that resulted from its interruption.
- To discuss role of imaging techniques in the evaluation of corpus callosum genesis/dysgenesis and enumerate the various radiology signs encountered in such disorders.

Background: The corpus callosum is a broad band of white matter located along the midline between the two cerebral hemispheres of the brain and it has a close relation to other midline structures. The embryological development of this structure takes place in a specific order, which is essential for understanding of congenital anomalies. While ultrasound is the initial screening modality in suspected cases, MRI is the most useful imaging method in the evaluation of the corpus callosum since it provides excellent visualization of anatomic features and lesions which aids in understanding the etiology and makes diagnosis easier.
Findings and/or Procedure Details: A retrospective evaluation of 500 paediatric patients who underwent neonatal cranial ultrasound/MRI brain was carried out. 96 patients had corpus callosum related developmental anomalies. The corpus callosum has a fundamental role in the formation and connection of the two hemispheres and is an essential indicator for normal brain formation. The present study has discussed on the embryological development of the corpus callosum and illustrated schematically ultrasound and MR imaging findings of its congenital abnormalities.
Conclusion: The corpus callosum is a midline cerebral structure with a unique embryological development pattern. Many developmental corpus callosal pathologies have characteristic appearances on ultrasound and magnetic resonance imaging. As their therapeutic approaches are different, the neuroradiologist should be aware of them.

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Utility of Apparent Diffusion Coefficient, Chemical Shift Imaging and Diffusion Tensor Imaging of Tumor Centre and Peritumoral Zone in Differentiating Glioblastoma Multiforme and Primary Central Nervous System Lymphoma from Metastasis Preoperatively

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Objective: Glioblastoma, primary CNS lymphomas and metastasis may appear quite similar on convention MRI. Objective of this study was to determine effectiveness of diffusion weighted imaging, diffusion tensor imaging and spectroscopy in preoperative differentiation of these tumors.
Materials & Methods: Forty patients with solitary enhancing brain tumors were studied retrospectively. All cases were histologically proven (20 GBMs, 10 PCNLs, 10 metastasis). All patients underwent 1.5 or 3.0 Tesla MRI scanner with standard head coil. Diffusion weighted imaging, DTI and spectroscopy were performed. We drew region of interest for ADC value and MRS at the center of lesion and in peritumoral zone and assessed fiber configuration for deviation, disruption, edema and infiltration on tractography.
Results: In the centre of lesions, ADC values were lowest in PCNLs followed by GBMs and mets. While in peritumoral region, ADC values were low in GBMs, +/- in PCNLs and normal in mets. On MRS tumor core showed raised choline and low NAA in GBMs and PCNLs while in mets all metabolites were low. Choline peak was also raised in peritumoral zone of GBMs and it was equivocal in cases of PCNLs and normal in mets. Tractography showed fibre disruption and infiltration within the centre and surroundings of GBMs. Disruption and infiltration also noted within the core of PCNLs, however, in these cases, peritumoral zone showed edema or infiltration. In cases of mets, centre showed deviation and edema of fibres and perilesional area showed deviation and also edema.
Conclusion: ADC value, DTI and MRS are reliable parameters to differentiate GBMs and PCNSLs from metastasis and can be used as useful tool.

Artificial Intelligence in the New Millenia: Deciphering the Mystery of Dementia by Functional Magnetic Resonance Imaging

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Objective: Alzheimer's disease (AD) is a type of dementia that afflicts millions of people worldwide. Early detection using resting state-functional magnetic resonance imaging (rs-fMRI) has promising prospects particularly with the development of artificial intelligence (AI) techniques such as machine learning (ML). AD is characterized by impaired functional connectivity (FC) of the default mode network (DMN) on rs-fMRI. The objective of our study was to evaluate the utility of AI in identifying the rs-fMRI FC features of AD.
Materials and Methods: We source published literature, with particular medical-databases that evaluated the utility of AI in identifying rs-fMRI FC features of AD. Inclusion criteria were articles in English, original research and had controls for comparison. Exclusion criteria included review articles and articles that evaluated other dementias apart from AD.
Results: Twenty-two articles were eligible, of which 13 articles evaluated AD alone and 9 articles evaluated AD and mild cognitive impairment. Our study revealed that the multiple classifiers method achieved a specificity of up to 95% for identifying and differentiating features of AD from healthy controls. The commonest method was multimodal support vector machine (SVM). Multiple kernel SVM was utilized for both FC pathway-based approach and region-based approach. FC was significantly decreased in nodes of the DMN, e.g, posterior cingulate cortex and medial prefrontal cortex in AD.
Conclusion: Machine learning is at the brink of achieving relevance in the clinical setting for diagnosing AD. Despite, technical advances in AI, much work is needed for replicable results in multi-scanner and multicentre studies.

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Tuberous Sclerosis Complex (TSC) in the Brain – A Pictorial Review

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Learning Objective: This pictorial review demonstrates the spectrum of neuroimaging findings in tuberous sclerosis complex (TSC) in different ages of the brain, which include fetal imaging. The imaging characteristics and the clinical implications of these pathologies will be discussed.
Background: TSC is an autosomal dominant neurocutaneous disorder. It is a multisystemic disorder and characterized by a variety of hamartomatous lesions in various organs. Central nervous system is commonly affected in TSC and patients can present with epilepsy and mental retardation which is incapacitating. Radiological images were selected from confirmed TSC cases from St George's Hospital.
Findings and/or Procedure Details: Cortical tubers are developmental abnormalities of the cerebral cortex which are responsible for many of the neurologic manifestation of TSC. Subependymal nodules are hamartomatous change in the subependymal tissue. Some of these nodules may progress into Subependymal Giant Cell Astrocytoma (SEGA) and cause obstructive hydrocephalus. White matter abnormalities of TSC include radial bands and cystic lesions. Radial bands represent altered development along the migratory pathways of neurons. White matter cystic lesions are rare and usually located at the deep white matter. Other than intracranial abnormalities, patients of TSC will typically demonstrate some osseous lesion in the calvarial.
Conclusion: TSC can have a wide variety of imaging findings in the brain and neuroimaging plays an important role in the diagnosis and management of TSC. This review does not only show the constellation of neuroimaging findings in TSC, it also demonstrates the radiological findings in unmyelinated brain which can aid early diagnosis.

Intratumoral Microhemorrhages Depicted on MRI as a Predictor of Histological Grade of Primary Brain Tumors

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Objective: To determine the frequency of intratumoral microhaemorrhages among patients with primary brain tumour and its correlation with histopathological grading.
Materials & Methods: A retrospective cross-sectional study was conducted at tertiary care hospital in Karachi, Pakistan. The study was conducted from March 2019 to September 2019. A total of 76 suspected patients were included in the study. MRI brain was performed to look for intratumoral microhaemorrhages and grading of brain tumour was assessed using histopathology reports
Results: In current study, patients were between 18–70 years of age and their mean age was 46.2 ± 14.8 year. Majority of the patients were male 52 (68.4%) and remaining 24 (31.6%) were female. Intratumoural microhaemorrhage seen in 52 patients (68.4%). Out of these 52 patients, histopathological examination showed 22 patients (42.3%) of grade IV followed by 18 patients (34.6%) of grade III, 10 patients (19.2%) of grade II and 2 patients of grade I. Most of the patients were having supratentorial tumour site - 70 (92.1%) while in 6 patients (7.9%), the tumour site was infratentorial. Stratification for age, gender, size of tumour and site of tumour was also carried out.
Conclusion: In conclusion, on MRI, intratumoural microhaemorrhage revealed in 60.5% patients and majority of the patients correlated with histopathological grade IV followed by grade III.

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Posterior Reversible Encephalopathy Syndrome in Children: The Association of Blood Pressure with Imaging Severity

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Objective: To evaluate the association and correlation between blood pressure (BP) and posterior reversible encephalopathy syndrome (PRES) imaging severity in the paediatric population whom radiological features and pathophysiology remains obscure.
Materials & Methods: A retrospective evaluation of paediatric patients diagnosed with PRES over the last 10 years was performed. Findings were reviewed by two paediatric radiologists along with the clinical profile and outcome. Imaging severity was categorised into mild, moderate and severe. The distribution of lesions, enhancement, diffusion restriction and haemorrhage were assessed. Various conditions that may resemble PRES were excluded.
Results: Out of 43 children, 20 were males and 23 were females with a mean age of 10.7 years. The most common primary disease was malignancy (28%) out of which lymphoma predominated. The mean systolic BP was 131.5 (70–205) mm Hg and diastolic was 82.9 (35–170) mm Hg. 14 children had hypertension higher than autoregulatory limits. Imaging showed a parieto-occipital lobe involvement pattern in 42% of cases, holohemisphereic pattern in 30.2%, cerebellar involvement in 23.3% and superior frontal sulcus pattern in 2.3%. 4.7% had a haemorrhage, 25.6% had contrast enhancement and 27.9% had a positive diffusion restriction (cytotoxic oedema). No statistically significant association of imaging severity with BP (p = 0.700), imaging severity with haemorrhage (p = 0.300) and diffusion restriction (p = 0.640) with imaging severity and with each other (P=1.000) was seen.
COnclusion: We did not find any significant association of blood pressure with imaging severity, haemorrhage and diffusion restriction. Further prospective studies are needed to determine the pathophysiological mechanisms and correlation with imaging findings in paediatric PRES.

Correlation of Mild Spondylolisthesis with Ligamentum Flavum Thickening in Low Back Pain Patients Based on MRI

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Objective: To investigate the correlation between mild spondylolisthesis' grade according to Meyerding with ligamentum flavum thickening based on lumbosacral MRI examination in patients with low back pain.
Materials & Methods: The research was conducted in the Radiology Department Dr. Wahidin Sudirohusodo Hospital, Makassar. This research design used the Spearman's diagnostic test. The total samples comprised 39 patients with lumbosacral spondylolisthesis. Lumbosacral MRI examination was conducted in order to evaluate the degree of spondylolisthesis and to measure the thickness of ligamentum flavum. The collected data were analyzed with Spearman's correlation test.
Results: The results indicated that there was a significant correlation (p < 0.050) between the spondylolisthesis' mild grade and ligamentum flavum thickening.
Conclusion: Lumbosacral MRI was the primary modality in evaluating spondylolisthesis' grade and to measure ligamentum flavum thickness.

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Hemorrhagic Stroke on DWI; MRI as the First Line Neuroimaging for Acute Stroke

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Objective:
- To evaluate the usefulness of DWI in identifying haemorrhage in acute stroke
- To compare the sensitivity of DWI to SWI in detecting haemorrhage in acute stroke MRI
- To support MRI as an option for first line neuroimaging in acute stroke
- To highlight the effectiveness of MRI detecting haemorragic stroke without delaying the management of acute stroke

Materials and Methods: We retrospectively reviewed all hemorrhagic stroke cases who had MRI as the first line neuroimaging, together with non-hemorrhagic stroke, in a double-blind manner. Two radiologists and neuroradiologist evaluate the DWI (b1000 + ADC) and SWI (SWIsequences) to determine if there is haemorrhage seen on DWI or SWI.

Results: A total of 139 cases presented as acute stroke in 2020. All cases had MRI as the first line neuroimaging except for 2 cases. There were 19 stroke mimics, 104 ischemic and 14 hemorrhagic stroke. All 14 cases demonstrate central hyperintensities with rim of hypointensities on DWI (b1000) with corresponding low ADC values. All 14 cases showed MRI changes in keeping with haemorrhage on SWI. The 4 cases who had CT performed showed hyperdensities in keeping with haemorrhage.

Conclusion: DWI is able to assist with identification of hemorrhagic stroke, thus MRI as the first line neuroimaging for acute stroke did not delay the diagnosis of hemorrhagic stroke. DWI and SWI are to validate presence of haemorrhage. MRI as the first line neuroimaging for acute stroke did not hinder the detection of intracranial haemorrhage. DWI as the first sequence in MRI for acute stroke did not delay diagnosis of hemorrhagic stroke.

Duplication of Pituitary Gland Plus Syndrome

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Learning Objective: Understand the embryological, anatomical and pathological association of syndromic entities.

Background: Pituitary gland duplication is a rare entity. When it is associated with other blastogenic defects, it is known as Pituitary gland plus syndrome. It is mainly a craniofacial developmental anomaly which happens during the process of blastogenesis. The postulated etiologies are incomplete twinning, teratogens, syndrome of median cleft face and splitting of the notochord.

Findings and/or Procedure Details:

(i) Clinical presentation

Can present at any stage of life due to variable midline abnormalities. Can present with endocrine abnormalities, seizures (hamamrtomas), facial anomalies amd chemical meningitis due to ruptured dermoid. They can also present with skeletal abnormalities such as cleft palate, scoliosis or short stature.

(ii) Key diagnostic features

Duplicated sella, oropharyngeal tumours ,vertebral malformations, agenesis or hypoplasia of the corpus callosum, duplicate odontoid process, absent olfactory bulbs/tracts, tubomammillary fusion and fenestrated basilar artery.

(ii) Differential diagnosis

Duplicated sella is diagnostic. The associated anomalies with plus syndrome are increasingly reported in literature.

(iv) Treatment

Resection of dermoid and conservative management for the chemical meningitis. Pharamcological treatment ,if any hormonal issues. Skeletal corrections, for deformities if compromising.

Conclusion: Imaging plays a pivotal role in diagnosis of the underlying associations.

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Decoding Region-Specific Cortical Complexity with Multi-Scale Morphometric Analysis

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Objective: Quantitative Magnetic Resonance Imaging (MRI) analysis has greatly contributed to quantify age-related anatomical changes. However, little is known about the regional cortical complexity in the context of brain atrophy. We aimed to examine the age-related changes of the cortical complexity of bilateral dorsolateral prefrontal cortex (DLPFC).
Materials & Methods: Six hundred and eleven right-handed cognitively normal adults (aged from 18 to 88 years) drawn from the Cambridge Centre for Ageing and Neuroscience (Cam-CAN) were divided into four age groups: young, middle-aged, young-old and old-old. Surface-based morphometry was addressed to decode the cortical complexity with multi-scale measurements including cortical thickness (mm), surface area (mm^2), grey matter volume (mm^3) and cortical folding.
Results: Advancing age was associated with reduced grey matter volume, white matter volume and pial surface area of bilateral DLPFC but correlated with increased cortical thickness and GI. Volumetric measures, CSF volume in particular, showed better performance to discriminate young-old adults from old-old adults; while cortical thickness and GI can differentiate young-old adults from middle-aged adults and old-old adults.
Conclusion: This is the first demonstration that chronological age has a pronounced and differential effect on the cortical complexity of bilateral DLPFC. Our findings suggest that surface-based measures of cortical region, thickness and gyrification in particular, could be considered as valuable imaging markers for the studies of aging brain and neurodegenerative diseases.

Comparative Retrospective Study of HRCT, CT Cisternography and MRI in Evaluation of CSF Leak

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Objective: Localizing and repairing CSF leaks needs robust radiological work up. HRCT & CT Cisternography are the routinely used investigations, sometimes complemented with heavily T2W MRI in localizing the bony/dural defects. The sensitivity and specificity of HRCT, CT Cisternography and MRI needs further validation. Aim is to evaluate the utility of HRCT, CT Cisternography and MRI, individually and in combination, in localizing CSF fistula and compare the results with intra-operative findings.
Materials & Methods: Retrospective evaluation of radiological procedures of 40 patients with clinically suspected CSF rhinorrhea/otorrhea was carried out in JSS hospital, JSS Medical college Mysore. HRCT was done in all 40 patients, while CT cisternography in 38 patients and MRI in only 18 patients. Endoscopic evaluation/repair was carried out on 38 patients and was used as gold standard for statistical analysis.
Results: Among 40 patients evaluated for CSF leak by radiological imaging, total of 38 patients underwent surgical / endoscopic exploration. Most common presenting symptom was CSF rhinorrhoea with cribriform plate and lateral lamella showing maximum number of defects. Sensitivity and specificity of imaging techniques improved significantly when used in combination.
Conclusion: HRCT of skull base is simple, fast, non-invasive and cost-effective choice of examination in the workup of CSF leak. However, when used in adjunct with CSF cisternography and heavily T2W MRI the accuracy improves significantly, justifying the additional efforts and cost.

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MRI - Apparent Diffusion Coefficient (ADC) in Defining Stages of Cerebral Infarction

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Objective: To study the ADC changes in hyperacute, acute and subacute ischemic stroke with time and space, and to provide the evidence in defining the acute/subacute infarction. Diffusion-weighted magnetic resonance (DWMR) imaging provides image contrast that is superior to what is provided by conventional MR techniques. It is particularly sensitive for detection of hyperacute/acute ischemic stroke.
Materials & Methods: Prospective study of 170 cases with clinical diagnosis of cerebral infarction were imaged with both conventional MRI (1.5T) and diffusion weighted imaging. The ADC values from the center of the lesion were calculated. Cases with hemorrhagic stroke were excluded in this study.
Results: Out of 170 cases of ischemic strokes, 22 were hyperacute, 65 acute, and 83 subacute infarcts. The average ADC values in hyperacute and acute infarctions were less compared to normal values and increased progressively to become "pseudo normal" in approximately 8 to 14 days. Further, ADC values became greater than normal in chronic stages.
Conclusion: The ADC values in infarction evolves with time. The evolution rules with time can be helpful to decide the clinical stage and to guide the clinician regarding treatment and judging the prognosis.

Prominent Cortical Vein Sign on Susceptibility-Weighted Imaging (SWI) in Large and Distal Arterial Occlusion During Hyperacute Stroke as an Indirect Marker to Evaluate Ischemic Penumbra

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Objective: Susceptibility-weighted imaging (SWI) is sensitive to detect presence of deoxyhemoglobin within cortical and medullary vein during acute stroke. The prominent vein sign (PVS) in hyperacute stroke indicates compromised cerebral perfusion. We aimed to evaluate presence of PVS in large and distal arterial occlusion.
Materials and Methods: We select all acute stroke cases presented within thrombolysis and thrombectomy window who had MRI scan done less than 12 hours from stroke onset. Presence of large and distal vessel occlusion were determined by Magnetic Resonant Angiogram (MRA) and relative cerebral flow were assessed by arterial spin labelling (ASL) perfusion scan. The presence of PVS were graded independently by two radiologists and one neuroradiologist. The correlations between PVS and perfusion markers were determined.
Results: There are total of 137 cases presented as acute stroke triggering acute stroke red code in 2020. All cases had MRI as the first line neuroimaging. Out of 137 cases, 16 (11.7%) patients received intravenous thrombolysis (IVT), 6 (4.4%) had mechanical thrombectomy (MT) and 7 (5.1%) had combined IVT and MT. The pattern of PVS were seen among 29 cases of large and distal arterial occlusion with fair interobserver agreement for grading of PVS within the area of compromised cerebral perfusion.
Conclusion: There is a correlation between the presence of prominent cortical vein sign (PVS) within the area of compromised perfusion in cases of large and distal arterial occlusion in hyperacute stroke.

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Contrast-Enhanced MR Imaging of Brain Tumors: Comparison with T1-Cube and 3D Fast Spoiled Gradient Recall Acquisition in Steady State Sequences

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Objective: We compared the gadolinium enhancement characteristics of a heterogeneous population of brain tumors imaged by T1-Cube and 3D FSPGR at 3-T MRI with time-dependent changes.
Materials & Methods: A total of 91 lesions from 52 patients {(17 with metastasis [51 lesions], 17 with high-grade glioma [HGG] - 9 lesions, 7 with primary central nervous system [CNS] lymphoma [10 lesions], and 11 with meningioma)}. The two sequences in 3T MRI (Discovery 750, GE Healthcare, Milwaukee, WI) were examined after administration of contrast agent (Gd-DTPA, 0.1 mmol/kg). Fifty-one (metastasis 32, HGG 11, meningioma 5, PCNSL 3) of the 91 lesions were depicted with T1-Cube first and 40 (metastasis 19, HGG 8, meningioma 6, PCNSL 7) lesions, with 3D FSPGR first. We measured the CNR which is the SI of a tumor and normalized by SI of the WM for each sequence on the pre- and post-contrast 3D FSPGR and post-contrast T1-Cube images.
Results: The mean CNR was significantly higher on T1-Cube images than 3D FSPGR images for the total tumor population ($p < 0.0001$) and the histologic types, i.e., metastasis ($p < 0.001$) and HGG ($p < 0.050$). By the analysis concerning with sequence order, the first T1-Cube: mean CNR was slightly larger ($p < 0.0001$) and the first 3D FSPGR: mean CNR significantly higher ($p < 0.014$) on T1-Cube than on 3D FSPGR.
Conclusion: Gd enhancement of the same heterogeneous population of tumors was higher using T1-Cube than 3D FSPGR and suggest the superiority of T1-Cube to 3D FSPGR for the detection of metastatic brain lesions.

Imaging Dementia: Computer-Aided Automated Hippocampal Volume Calculation and Its Correlation with Clinical Cognitive Performance

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Objective: To evaluate the correlation of automatically segmented and calculated hippocampal volume with clinical cognitive performance.
Materials & Methods: Forty subjects clinically diagnosed as dementia were taken from memory clinic's patients. Hippocampal volume and its ratio to intracranial volume were automatically segmented and calculated from 3-dimensional T1-weighted gradient-echo brain magnetic resonance images (MRI) using unedited pipeline of Harvard's FreeSurfer software suite (Massachusetts, US). Cognitive performance was evaluated using Montreal Cognitive Assessment Indonesian version (MoCA-Ina) by two neurologists.
Results: Mean age of participants were 61.73 ± 11.73 years consisted of 29 males and 11 females. The average MoCA-Ina scores were 18.13 ± 7.54. Bivariate Spearman correlation revealed statistically significant moderate positive correlation between total hippocampal volumes and MoCA-Ina scores ($r = 0.51$; $p = 0.001$). Adjusting hippocampal volumes to intracranial volumes also resulted in moderate positive correlation with MoCA-Ina scores ($r = 0.46$; $p = 0.003$).
Conclusion: These findings supported the association between hippocampal volumes and cognitive performances. Total hippocampal volumes and their ratio to intracranial volumes provides a better understanding about cognitive decline in demented patients. Therefore, MRI with automated segmentation and brain volumetric processing could be a helpful tool to evaluate and follow-up dementia patients.

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Role of Diffusion Tensor Imaging (DTI) in Seizure Patients

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Objective: Diffusion Tensor Imaging (DTI) is a new noninvasive MRI technique providing insight into the white matter microstructure. DTI has been found to be useful in demonstrating the focus of epileptiform activity in brain especially in white matter, hence it can be used to plan successful epilepsy surgery. Hence, we conducted a pilot study on seizure patients where focal organic brain lesions were ruled out on conventional MRI. We aimed to assess the role of DTI in various portions of the brain in patients with seizure.
Materials and Methods: We evaluated twenty patients with seizure disorder using DTI, conventional MRI and clinical parameters. We compared the final diagnosis achieved by DTI and conventional MRI and correlated with EEG localization.
Results: Fourteen out of twenty patients revealed abnormality on DTI that correlated with EEG correlation. Ten patients had mesial temporal sclerosis while four had focal white matter disease adjacent to focal cortical dysplasia.
Conclusion: DTI can serve as an important radiological tool in presurgical evaluation of epilepsy patients which often considered as idiopathic and refractory to medical treatment.

DTI - Connecting the Dots - White Matter Tract Anatomy

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Learning Objective:

- Basic principle of diffusion tensor imaging.
- White matter tract normal anatomy and functions.
- Normal orientation of white matter tracts using DTI images.
- Patterns of fibres tract destruction in tumors and demyelination.

Background: This educational exhibit will discuss normal anatomy of the white matter tract mapped using diffusion tensor imaging (DTI). Diffusion tensor imaging is a magnetic resonance (MR) imaging technique that can be used to characterize the anisotrophy and orientational properties of the diffusion process of water molecules. Orientation based color coding is a visualization approach in which the image brightness represents diffusion anisotropy, while a red-green-blue color scheme indicates tract orientation. White matter tracts in the brain, also known as white matter fibers, are classified into three categories 1) projection fibers, 2) association fibers and 3) commissural fibers.
Findings and/or Procedure Details: Color fractional anisotropy images and fiber tractography can be used to understand the location of normal white matter tracts, infiltration and distortion of tracts, and the relationship between lesions and surrounding pathways.
Conclusion: Understanding the normal orientation of white matter tracts is important in order to recognise the fibre affected in disease like tumors and demyelination.

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A Working Memory Study on Smartphone Addiction Using fMRI

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Objective: To assess the brain regions that were activated among smartphone addicted group (SMA) and non-smartphone addicted group (NSMA) during working memory (WM) tasks.
Materials & Methods: Thirty-six first-year undergraduate students of Universiti Putra Malaysia (aged: 19–22) were classified as SMA and NSMA based on their scoring in the Smartphone Addiction Questionnaire. Three conditions of WM task (numbers, visuospatial and alphabets) were given to participants during fMRI. We used Statistical Parametric Mapping 12 software to analyse the fMRI data. Voxels surviving with the uncorrected threshold of $p < 0.001$ were considered significant.
Results: The main effect of group (SMA vs. NSMA) showed significant differences. Right inferior frontal gyrus showed significantly higher activation in SMA than NSMA. While right superior frontal cortex, right middle temporal gyrus, right superior temporal gyrus, right angular gyrus, left precuneus and left superior parietal lobule activated significantly in NSMA than SMA. The comparison of brain activation during visuospatial task indicates significantly higher activation in the left superior parietal lobule (SPL) in SMA than NSMA. Number and alphabet condition showed no significant difference in the brain activation between both groups
Conclusion: SMA has higher activation in brain regions involving making precise phonological decisions, perceptual tasks and inhibitory control but less activation during decision making, cognitive processing, attention, information processing, awareness and consciousness. SMA gave high attention in visual spatial where SPL processes and preserves visual attention and shift the attention from one item to another.

A Comparison of Neurite Orientation Dispersion and Density Imaging (NODDI) with Diffusion Tensor Imaging (DTI) Parameters as Predictors of Cognitive Outcome in Mild Traumatic Brain Injury (MTBI) Patients

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Objective: DTI can detect changes of microstructural brain damage in mTBI, however subtle changes in recovery process remains a challenge. NODDI measures Orientation Dispersion Index (ODI), Neurite Density Index (NDI) and Isotropic Volume Fraction (ISOVF) which may elucidate the process in mTBI recovery.
Materials & Methods: 56 mTBI and 19 healthy controls (HC) were recruited. Neuropsychological Assessment Battery-Screening Module (S-NAB) performance were assessed 2 weeks post-trauma and at 3 months. The mTBI group was then divided into recovered (REC; S-NAB ≥ 85) and non-recovered (NREC; S-NAB < 85), whereby domains affected were mainly attention and language. DTI and NODDI were done at 3 months. Using Tract-Based Spatial Statistics (TBSS), DTI and NODDI parameters were obtained for 50 white matter tracts (WMTs). Data was analysed using SPSS.
Results: NODDI demonstrated significant changes ($p < 0.050$) in multiple WMTs. Significantly lower NDI was demonstrated in REC (0.4260, 0.4034) versus NREC (0.4540, 0.4389) in both cingulate gyri suggestive of ongoing reparative process in the still-recovering NREC WMTs. Significantly higher ISOVF was seen in REC (0.0716, 0.1349) than NREC (0.0526, 0.0983) in the right external capsule and left fornix/stria terminalis, which may represent increased CSF surrounding tracts which have completed healing. No significant difference between REC and NREC was found in DTI.
Conclusion: NODDI detected more microstructural WMT changes in mTBI 3 months post-injury than DTI, largely involving WMTs in the limbic system which has significant function in attention and language. The recovery process, however, could not be readily explained, suggesting the need for further research in this area.

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MR Perfusion Can be the Little Key to Open the Heavy Door of CNS Lymphoma

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Objective: Primary CNS Lymphoma (PCNSL) accounts for 1–5% of all brain tumors. The incidence rates are increasing among immunocompetent patients. Immunocompromised patients have an increased risk. Early diagnosis of CNS lymphoma is helpful for proper management in both immunocompetent and immunocompromised individuals. Although CNS lymphomas may have characteristic imaging findings on traditional MR imaging, none of these will unequivocally differentiate CNS lymphoma from other intraaxial brain neoplasms (eg, metastases, malignant gliomas etc.). The importance of revascularization through angiogenesis for tumor growth has led to a growing interest in novel imaging techniques to assess tumor vascularity.
Materials & Methods: The retrospective study included 20 patients with intraaxial brain tumours who are referred to the department of radiology & imaging of a tertiary care hospital. Histopathologically, 7 patients were diagnosed as glioblastoma, 10 as metastasis and 3 patients as primary CNS lymphoma. Perfusion-weighted DSC-MRI was performed with 3D echo-planar principles of echo shifting with a train of observations applied for perfusion studies, with acquisition of images before, during, and after rapid administration of a contrast bolus. The maximum rCBV were recorded by ROI method.
Results: On evaluating different coordinates generated by ROC analysis, rCBV cut-off came to be 1.5 to differentiate PCNSL from metastasis and glioblastoma. Furthermore, maximum relative CBV being typically lower in lymphomas than in other brain tumors can help to differentiate glioblastomas and metastases from lymphomas.
Conclusion: MR perfusion will play an important role in the planning of new targeted therapies and for the monitoring of treatment response.

Brain Tumor Characteristic in MR-Tractography

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Objective: Visualization of white matter (WM) tracts by DTI is increasingly being used for neurosurgical planning. The precise location of the WM tracts in relation to the lesion helps the neurosurgeon in preoperative planning by defining the surgical access point and identifying the extent of tumor resection while preserving vital motor, visual, or language brain functions. This study was to examine brain tumor characteristics in MR-tractography.
Materials & Methods: We performed a retrospective-analytical study of 35 pathologically proven primary intracranial tumor patients which had been examined with DTI in 1.5T MRI before surgery. At the workstation, the homologous ROI was used as the "seed" in the tractography analysis. Tracts were then classified as displaced, infiltrated and disrupted.
Results: 35 patients were included in this study, 21 females, 14 males with age range from 4 until 67 years old; 22 (63%) were extra-axial tumors and 13 (37%) were intra-axial tumors. 50% of low-grade glioma showed infiltration of surrounding WM tract whereas another 50% showed displacement. All 3 high-grade glioma samples showed disruption of adjacent WM tracts and 1 high-grade immature teratoma showed infiltration. All high-grade PCNSL and metastatic processes showed displacement. In the extra-axial tumor category, all grades I and 3 of grade II meningioma showed displacement and 1 sample of anaplastic meningioma showed disruption of adjacent white matter.
Conclusion: MR-tractography can be used for neurosurgical planning. Intra and extra-axial lesion, low and high-grade tumors both can give a characteristic of displaced, infiltrated and disrupted adjacent WM tracts.

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Correlation between Fractional Anisotropy and Mean Diffusivity on Diffusion Tensor Imaging with Histopathology Grading in Primary Intracranial Tumor

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Objective: Diffusion tensor imaging (DTI) has been studied to evaluate pathological changes in brain tumors. This study was to examine whether there is a correlation between fractional anisotropy (FA) and mean diffusivity (MD) on DTI with histopathology grading in the primary intracranial tumor.
Materials & Methods: We performed a retrospective-observational analytical study of 35 primary intracranial tumor patients which had been examined with DTI in 1.5T MRI. FA and MD values were measured by placing ROI in intratumoral (IT), peritumoral (PT) and normal area. Tumor's histopathologies were classified into low and high grades. A correlation test was performed to examine whether there is a correlation between FA and MD with tumor histopathology grading and AUC ROC test was done to evaluate whether there is significance cut off value.
Results: There was a strong correlation between FA IT and weak correlation between MD IT with primary intracranial histopathology tumor grading. Cut off value of FA IT was 0.1196 (p = 0.002), MD IT was 1.0397 (p = 0.004) and conversely, there was no correlation between FA PT and MD PT with tumor histopathology grading. Meningioma and glioma samples were separately calculated and the obtained cut off value for FAIT in meningioma was 0.153 (p = 0.007), MDIT was 0.9503 (p =0.005), FAIT in glioma was 0.1038 (p = 0.015) and MDIT was 1.8950 (p = 0.048).
Conclusion: FA IT and MD IT values can be used to differentiate between low and high-grade primary intracranial tumors with different cut off values for each histopathology tumor type.

Brain Cortical Thickness (BCT) Following Mild Traumatic Brain Injury (MTBI)

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Objective: The main objective is to evaluate the BCT differences in between healthy subject and mTBI patient and its correlations with neurocognitive performances.
Materials & Methods: 65 mTBI patients (3 months post injury) and 20 healthy controls (HC) underwent MRI brain and Neuropsychological Assessment Battery-Screening Module (S-NAB) in term of 5 cognitive domains (attention, language, executive function, memory and visual spatial). mTBI group was divided into recovered (R) (S-NAB > 85) and non-recovered (NR) (S-NAB < 85). Data were processed using FreeSurfer Software. The relations between BCT and neurocognitive deficit were measured with Spearman Correlation.
Results: At 3 months, there are reduced language (82.4) with borderline attention (90.6) and executive function (87.27) for mTBI group. Abnormal language (78.48), attention (85.45) and executive functions (83.66) in NR group. For R and HC groups, all 5 cognitive domains remained normal. mTBI patients had significantly (p < 0.050) thinner cortex in left inferior parietal (4658.60 mm^2 vs. 5037.70 mm^2), left paracentral (1523.40 mm^2 vs. 1624.30 mm^2), right fusiform (3017.27 mm^2 vs. 3262.45 mm^2) and right pars triangularis (1497.72 mm^2 vs. 1643.50 mm^2) structures compared to HC. There is a trend of decreasing BCT in the R vs. NR in the above structures. Thinner cortex of left inferior parietal and right pars triangularis which coincides with language deficit as well as in right fusiform which affecting attention function. We found a significantly positive correlation between left inferior parietal cortex thickness and language function (r = 0.428, p = 0.030).
Conclusion: Our findings imply that at 3 months post mTBI, thinner cortex is seen in areas coinciding with neurocognitive deficit.

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MDCT Angiography Characteristics of Intracranial Aneurysms in Patients Suspected with Sub-Arachnoid Hemorrhage

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Objective: To describe the MDCTA characteristics of intracranial aneurysms in patients suspected with subarachnoid hemorrhage (SAH) from a tertiary hospital in South India and its importance in identifying and management of unusual aneurysms.
Materials & Methods: This is a retrospective review of 550 patients who underwent MDCT angiography at 0.625mm detector width from 2011 to 2020. One radiologist reviewed the images using a workstation. Images were reconstructed in MIP and 3D volume rendering images in addition to axial 5 mm thick slices.
Results: Patients presented with headache (78%), seizures (20%), focal neurological deficit (35%) loss of consciousness (28%) and other symptoms (4%) with overlap symptoms. SAH seen in 82% cases, infarcts in 7% cases and intraparenchymal hemorrhage in 10%. CTA was positive for aneurysm in 515 patients. 56% of patients were female. The most common locations of the aneurysm were ACOM (44%), MCA (28%), ICA (17%) and ACA (9.5%). Other locations included PCOM (0.1%),distal MCA (0.1%), basilar artery (< 0.1%), vertebral artery (< 0.1%) and PICA (< 0.1%). Single aneurysm was seen in 94%, two in 4% and three in 2%. Two patients had more than 3 aneurysms. Morphologically, 82% were saccular aneurysms and 18% were fusiform and 10% were lobulated. Kissing aneurysms were seen in 2 patients. The size varied from 1–10 mm in 35%, 11–20 mm in 39%, 21–25 mm in 12.5% and > 25 mm (giant aneurysms) in 13.5%. Bone erosions seen in 7 cases and thrombosed aneurysms in 11 cases. Five patients had additional AVMs.
Conclusion: The pattern of intracranial aneurysms in patients suspected of SAH from South India is described. This pattern is similar to that described in western population.

Detection of Alzheimer's Disease Using Statistical Likelihood Ratio Observer

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Objective: To present a decision support tool for the detection of Alzheimer's disease based on MRI T1 weighted images and the Hippocampus volumes calculated by the FreeSurfer software.
Materials & Methods: 600 T1 weighted healthy MRI images were downloaded from the brain-development.org (IXI dataset) and 46 Alzheimer's patients T1 weighted MRI images were downloaded from the XNAT (the MIRIAD dataset). The FreeSurfer software from MIT was employed to segment and calculate the volumes of anatomical regions of the brain. The volumes of individual's hippocampus were used to construct the probability density functions of healthy and Alzheimer diseased patients. The joint probability density functions were used by the statistical likelihood observer for the identification of diseased patients.
Results: The joint probability density functions show that the mean hippocampus volume of the healthy patients is 8528 mm^3 with a standard deviation of 744 mm^3. The mean hippocampus volume of Alzheimer's patients is 5860 mm^3 with a standard deviation of 971 mm^3. Alzheimer's mean volume of the hippocampus is much smaller than that of the healthy patients. Alzheimer' images from the IDA image & data archive (the ADNI data set) and the normal control patients from the MIRIAD data set were tested by the statistical likelihood observer. An estimated area under the curve Az = 0.985 was achieved.
Conclusion: The statistical likelihood ratio observer is a useful tool in the detection of Alzheimer' disease. Further work is to detect the developmental stages of Alzheimer' disease.

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Neuroradiology Diagnostic and Interventional Angiography Radiation Exposure at Hospital Sungai Buloh Malaysia

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Objective: Extended exposure time due to the complexity of the neurological system is a contributing factor for imposing high radiation exposure to patients during neuroradiology-angiography (NA) procedure. A majority of patients experienced deterministic effects post procedure. This study aims in evaluating the integrity of embedded Dose Area Product (DAP) meter, observing tissue alteration of patient post procedure while also developing the local diagnostic reference level (DRL) specifically for NA.
Materials & Methods: The integrity of the modality embedded DAP meter was assessed via calibration with multimeter. The patient radiation dose data (n = 206) were collected retrospectively for all NA procedure conducted at Hospital Sungai Buloh Malaysia in 2018. The bivariate and univariate statistical method were used to develop the local DRL. Whereas the tissue alteration of patient post irradiation (doses > 3 Gy) was evaluated through macroscopic observation
Results: The DAP values had a deviation equivalent to 7.30% and 5.90% for plane 1 and plane 2 of the biplane modality respectively, lower than the standard value. The local DRL values developed are approximately 8.279 $mGym^2$ and 23.316 $mGym^2$, for diagnostic and interventional neuroradiology respectively, whereby it is higher than the general national DRL by 59.21% and 168.00%. Nevertheless, there were no apparent tissue alteration observed on patients.
Conclusion: The requisite of a correction factor for displayed DAP values were not required. Furthermore, through this study, the local DRL for neuroradiology procedure was developed with additional insights that the procedure did not impose any observable deterministic effects on patients.

Body Fat Mass and Bone Mineral Density in Parkinson's Disease

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Objective: Parkinson's Disease (PD) is a neurodegenerative disease with unintentional weight loss and fracture as common clinical problems. Studies had demonstrated PD patients mostly had body fat and BMD reduction, but current literature is limited, and some had given contradicting results. Our main objective is to examine the body composition in PD patients focusing on body fat mass and bone mineral density.
Materials & Methods: Selected subjects underwent a Dual-Energy X-ray absorptiometry scan for body composition and bone mineral density (BMD), subsequently trabecular bone score (TBS) will be derived from the spine BMD.
Results: Compared to control group, PD patients have significantly lower weight, BMI, regional fat percentage, regional fat mass, android/gynoid ratio, visceral adipose tissue (VAT) mass & volume, subcutaneous adipose tissue mass, and Z-score of total & radius BMD ($p < 0.050$). The weight loss in the PD patient group predominantly is from fat mass. The rest of the regional BMD and TBS is statistically non-significant in both groups. When correlating the VAT mass with BMD/TBS, there is a moderate positive correlation between VAT mass and all regional BMD as well as TBS in both groups (correlation coefficient: 0.229–0.531).
Conclusion: PD patient has significant weight loss compared to the control group, which mostly contributed by fat loss as demonstrated in this study. The positive correlation of VAT mass with regional bone mineral density/TBS could be due to underlying nutritional status. However, VAT may have some protective effect over bone demineralization in the elderly.

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Different Imaging Features of Pilocytic Astrocytoma: Correlation with Tumor Location and Histopathology Case Series

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Learning Objective: To describe the imaging features of pilocytic astrocytoma and to correlate these imaging features with tumor location and to describe its histopathology: CASE SERIES
Background: Pilocytic astrocytoma is the most common CNS tumor in children and adolescence and accounts for 15.5% of all cases. According to WHO classification, it is considered as low grade, WHO grade I CNS tumor. It can arise from anywhere throughout central nervous system, however, it most commonly arises from cerebellum, with second most common location being optic chiasm. Other less common location includes brain stem, hypothalamus, cerebral hemispheres and spinal cord. Imaging features typically consist of well-defined usually cystic lesion with solid enhancing nodular component but these features may vary.
Findings and/or Procedure Details: In this study, we describe the five cases of histopathologically proven pilocytic astrocytoma of different regions of central nervous system. Three of these are seen in children below 16 years and two cases are of adult of age 22 and 23 respectively. Histopathology of these cases is also described. Locations of these fives lesions includes cerebellum, suprasellar region and optic chiasm, cerebral hemisphere, brain stem and fourth ventricle.
Conclusion: Pilocytic astrocytoma has a wide spectrum of neuroradiological presentations. Besides its classical appearance as low-grade glioma, a more atypical/aggressive presentation makes the diagnosis challenging. The best method to achieve the pre-operative diagnosis is the combination of morphological and non-morphological MR features as well as site base approach of this tumor.

Comparison of Phase Contrast and Time of Flight (TOF) MR Cerebral Venography in the Depiction of Normal Intracranial Venous Anatomy In 3T MR

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Objective: Our primary aim is to compare the cerebral veins conspicuity using phase-contrast (PC) MRV and TOF MRV in 3T MR. We also aim to compare the artefactual flow void between these techniques.
Materials & Methods: A total of 31 healthy volunteers with age group between 18–35-year-old and no contraindication to MRI were recruited in the study. They were imaged on 3 Tesla MR using a standardized parameter for PC and TOF MRV with the addition of routine MRI brain sequences. All MRV source images were post-processed using the maximum (pixel) intensity projection (MIP) images which were then reviewed by a neuroradiologist. The intracranial venous system was divided into 7 vessels groups which include superior sagittal sinus, inferior sagittal sinus, straight sinus, transverse sinus, sigmoid sinus, internal cerebral vein and vein of Galen. A neuroradiologist determine whether the named veins could be identified at PC or TOF MRV and later assessed for any presence of flow void artifact in each vein.
Results: PC MRV showed better vessels conspicuity than TOF MRV in the assessment of superior sagittal sinus and internal cerebral veins ($p < 0.050$) with no significant difference in other veins. It is also superior to TOF MRV with lesser evidence of flow void artifact in superior sagittal sinus ($p = 0.001$) and transverse sinus ($p = 0.002$).
Conclusion: PC MRV is a better tool than TOF MRV for assessing the intracranial cerebral veins and should be utilized more in the future for better accuracy of diagnosis.

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Advance Imaging as Biomarker for Mild Traumatic Brain Injury Cognitive Outcome: An Intervention Study

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Objective: To measure the white matter tract (WMT) changes via Diffusion Tensor Imaging (DTI) and Neurite Orientation Dispersion Density (NODDI) following cognitive intervention in mild traumatic brain injury (mTBI) adult population.
Materials & Methods: Adults (18–60 years old) with mTBI due to road traffic accident, no previous history of head trauma and abnormal cognition at 3 months injury, were included. They were assigned to treatment groups 1) structured cognitive rehabilitation (IG) and 2) best-care group (BG). Neuropsychological Assessment Battery (S-NAB), DTI/NODDI and functional outcomes performed at pre- and post-treatment.
Results: Treatment groups improve overall cognitive functions (IG $p < 0.000$, Cohen's d 0.84; BG $p = 0.020$, Cohen's d 0.51). At 3 months injury, DTI and NODDI parameters were all low for IG ($p < 0.050$), as compared with healthy controls, reflecting axonal degeneration and possible remyelination. At 6 months, more established microstructural damages had occurred with low FA and AD, high MD and RD, low ICVF, ODI and ISOVF ($p < 0.050$). CG had delayed but similar changes to IG with high FA at 3 months injury but persistently low for other parameters at 6 months ($p < 0.050$). Comparatively, spontaneously recovered group, reported highly myelinated and aligned WMT (high FA and AD, low ODI; $p < 0.050$) but with a mild degree of axonal degeneration/demyelination (high MD and RD, low ICVF; $p < 0.050$) at 6 months injury.
Conclusion: Both DTI and NODDI were highly responsive to microscopic changes of WMT at different injury timelines for mTBI.

Intracranial Gadolinium Deposition for Gadolinium Based Contrast Agents (GBCAS) in Pediatric Population Seen on MRI

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Objective: To assess intracranial gadolinium deposition within the dentate nucleus in pediatric MRI brain using both linear and macrocyclic gadolinium contrast agents (GBCAs) by automated analysis.
Materials & Methods: This is a single centre study of pediatric patients that underwent 3 or more GBCAs enhanced MRI for both linear and macrocyclic GBCAs. Out of 80 patients acquired, 60 patients underwent linear GCBAs and 20 patients underwent macrocyclic GBCAs. Data for the study was collected from year 2009 to July 2017 for linear GBCAs and from August 2017 to 2019 for macrocyclic GBCAs. Dentate nucleus to pons ratio signal intensity was evaluated on an unenhanced T1 weighted MR images using an automated analysis (Spatially Unbiased Atlas Template- SUIT Toolbox). Data was analysed using SPSS v25.0.
Results: Statistical analysis using Repeated Measure analysis, considering patient's gender, age, exposure to chemotherapy, radiotherapy as well as interval between initial and last scan, it shows significant different (p value = 0.010) in the dentate nucleus to pons (DN/P) ratio (mean = 1.027 and 1.063 in the initial and last scans respectively) in the left dentate nucleus of linear GBCA group, in keeping with gadolinium deposition. In macrocyclic GBCA group, no significant different of DN/P ratio to suggest intracranial gadolinium deposition.
Conclusion: Automated quantitative analysis evaluation of the dentate nucleus to pons ratio done in the pediatric brain demonstrate evidence of gadolinium deposition in linear GBCA but not in macrocyclic GBCA after multiple administration of contrast agent.

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CT Swirl Sign in Spontaneous Intra-Cerebral Haemorrhage and Its Association with Hematoma Expansion

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Objective: To assess ratio of hypodense regions ('Swirl Sign') versus hyperdense regions in intracerebral hemorrhage and its association with hematoma expansion and to explore functional outcome of intracerebral hemorrhage patients with 'swirl sign' using modified Rankin score (mRS).
Materials & Methods: 34 patients who had spontaneous intracerebral hemorrhage with initial (CT1) and repeated CT (CT2) within 96 hours were included. Presence of 'swirl sign', its volume and hematoma volume in initial and repeated CT were calculated using semi auto-segmentation from 'ITK snap'.
Results: 23 patients (67%) had swirl sign present in the hematoma with the mean initial and follow up hematoma volumes of 42.5 cm^3 and 54.5 cm^3 respectively. Hematoma expansion of 11.9 cm^3 was documented for this group. 11 patients (33%) had no swirl sign present with the mean initial and follow up hematoma volumes of 9.7 cm^3 and 4.4 cm^3 respectively. The mean hematoma expansion of this group was 4.4 cm^3. The *p*-value of correlation between ratio of swirl volume/hematoma with percentage of hematoma expansion ([CT2-CT1]/CT1) was 0.041 with significant correlation at 0.05 level whilst the correlation co-efficient (*r* value) was 0.45. 20 patients (87%) with 'Swirl sign' had poor mRS (3–6). While only 5 patients (45%) had poor mRS (3–6) without presence of 'Swirl sign'.
Conclusion: Swirl sign is associated with hematoma expansion in patients with spontaneous intracerebral hemorrhage and can be used as a predictor of functional outcome of patients.

Clinical Role of Diffusion Tensor Tractography in Compressive Myelopathy

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Objective: Magnetic resonance imaging (MRI) is the gold-standard imaging tool for evaluation of compressive myelopathy. These cases reveal signs of spinal cord compression with or without alteration in parenchymal signal alteration. Though, diffusion tensor imaging has been described to be superior to routine MRI in predicting prognosis and urgency of decompression yet fewer studies have been conducted to demonstrate it especially in developing world.
Materials & Methods: Thirty patients with clinical signs of CSCM were randomly selected for our study for conventional MRI and DTI examination with a high-resolution matrix on 1.5T magnet system. 3D-color coded maps were obtained on sagittal & coronal planes. Patient with traumatic spine & severe spinal pain were excluded from study.
Results: Out of thirty, six patients were excluded from the study due to suboptimal DTT. In sixteen out of twenty-four patients with no spinal cord parenchymal signal alteration on T2W images, DTT revealed significant alteration in color code both at and above the level of compression signifying altered diffusion.
Conclusion: DTT may be used as a more sensitive indicator of spinal cord compression than conventional MRI by revealing color alterations in 3D color-coded maps, thinning and loss of integrity of spinal nerve fiber tracts providing easy and fast tool to predict the need of surgical decompression. DTT is a very good tool in objective assessment of patients with clinical signs of compressive myelopathy without obvious imaging signs on conventional MRI.

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Imaging the Nigrosome-1 in the Substantia Nigra Using Susceptibility Weighted Imaging and T2* Gradient Recalled Echo 3D Sequences: An Application to Parkinson's Disease

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Objective: Parkinson's disease is a neurodegenerative disease with loss of dopaminergic neurons in the nigrosome-1 territory of the substantia nigra. This is a retrospective study to investigate the feasibility of nigrosome-1 detection using 3T-susceptibility weighted imaging and T2* gradient recalled echo 3D sequences as well as the diagnostic accuracy that can be achieved.
Materials & Methods: A group of 28 controls was used to characterize the appearance of the N1 sign and train the raters. Subsequently, 28 patients with PD and 28 controls were blindly analyzed for the presence or absence of the N1 sign on SWI and T2* GRE 3D sequences. First 5 caudal slices of the substantia nigra were reviewed.
Results: From the group of 28 controls, N1 has variable appearance including the swallow tail sign. 17 (62.9%) cases showed the N1 sign bilaterally. Of the 8 PD patients whose SWI images were reviewed, 6 (75%) cases showed bilateral loss of the N1 sign, 1 (12.5%) case showed the N1 sign unilaterally and 1(12.5%) case showed the N1 sign bilaterally. Of the 20 PD patients whose T2* GRE 3D images were reviewed, 12 (60%) cases showed bilateral loss of the N1 sign, 4 (20%) cases showed the N1 sign unilaterally and 4 (20%) cases showed the N1 sign bilaterally.
Conclusion: The N1 has variable appearance including the swallow tail sign. It can be visualized using SWI in the non-PD controls and is not visualized in most patients with PD.

Probabilistic Fibre Tracking in High-vs Low-Grade Glioma

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Objective: We investigated the white matter (WM) tract distribution and diffusion tensor imaging (DTI)-derived tensor metrics in the tumour and peri-tumour regions between low- (LGG) and high-grade gliomas (HGG).
Materials & Methods: Magnetic resonance imaging (MRI) using a standard tumour protocol with DTI of forty-two glioma patients were acquired. The tumour region and peri-tumour mask were delineated using the snake model. Tractography was performed to evaluate the WM tracts in the selected regions via probabilistic tracking. DTI indices were investigated through mapping of WM tracts and tumoural masks in LGG and HGG.
Results: Significant differences were seen in the planar tensor (Cp) of peri-tumour regions in LGG and HGG. The mean diffusivity, axial diffusivity (AD) and pure isotropic diffusion demonstrated significant differences ($p < 0.05$) between LGG and HGG for the WM tracts in solid-enhancing regions. In the solid non-enhancing regions, fractional anisotropy, AD, pure anisotropic diffusion (q), total magnitude of diffusion tensor (L), relative anisotropy, Cp and spherical tensor (Cs) were significantly different for the affected WM tracts. Intra-lesional tracts seen suggesting preservation of the WM integrity in all grades. In most cases of GBM, the WM tracts were not completely destroyed but found intact inside the tumour.
Conclusion: Probabilistic fiber tracking revealed the existence of WM tracts inside tumour core for all grades of glioma. The preoperative identification of WM tracts and its characterization of the DTI-metrics provide insights into regional WM tracts impairment and facilitate neurosurgical planning in brain tumour.

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The Shrinking Brain: Voxel-Based Morphometry Reveals Effects of Problematic Instagram Use among Young Adults in a Malaysian Varsity

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Objective: Problematic Instagram use (PIGU) shares similarities with Internet addictions, which has been associated with grey matter density (GMD) abnormalities in the regions of the brain related to the default mode network (DMN), salience network (SN) and executive control network (ECN). The aim of this study is to compare the differences in GMD of brain areas related to these networks among PSU and healthy controls (HC), and to correlate GMD with severity of PSU and psychosocial parameters.
Materials & Methods: Simple random sampling was used to recruit subjects for MRI from a Phase 1 cross-sectional study in a Malaysian university. Smartphone-Addiction- Scale-Malay version (SAS-M), modified Instagram-Addiction-Test (IGAT), Barrett's impulsivity test (BIS-11), and DASS-21 questionnaires were used to evaluate the subjects (PIGU:SAS-M score ≥ 98, HC: score < 98). SPM VBM toolbox was used to measure GMD.
Results: Total of 40 subjects (20 PIGU, SAS-M score 98–179 [129.45 ± 25.35], 20 HC, SAS-M score 46–90 (69.15 ± 14.13]) were analysed. PIGU had significantly higher depression and impulsitivity scores than HC ($p < 0.050$). Paired t-test for contrast of PIGU > HC, noted significant smaller GMD in the right insula and right precentral gyrus ($p < 0.050$, corrected FWE).
Conclusion: Reduced insular and precentral gyrus GMD in PIGU is similar to online gaming addiction, which are related to the salience network and default mode network as in most resting state fMRI related study and can potentially act as a surrogate biomarker of the severity of this type of addiction. PIGU is also associated with impaired psychosocial behaviours.

Case Series: MRI Features of Hypertrophic Olivary Degeneration (HOD)

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Learning Objective: We described various MRI findings of hypertrophic olivary degeneration in 5 of our patients and discussed pathophysiology of hypertrophic olivary degeneration.
Background: Hypertrophic olivary degeneration is a rare transneuronal degeneration following dento-rubo-olivary pathway (also known as Guillian-Mollaret Triangle) disturbance. Various pathology has been described leading to the development of this rare condition, which include haemorrhage, infarction, tumour, trauma, surgery and even demyelination. Palatal tremor is the distinct clinical examination findings of the condition. However, majority of patients are asymptomatic. Typically, MRI shows T2-hyperintense signal of the inferior olivary nucleus with or without hypertrophic changes. Three imaging stages of the HOD had been described.
Findings and/or Procedure Details: The MRI characteristics of HOD are hyperintense signal on T2-weighted image with no signal change on T1-weighted image, no enhancement and no restricted diffusion. Hypertrophic olivary degeneration had been classified into three stages. Our case demonstrates the temporal relation and the characteristic MRI findings in each of the stages.
Conclusion: We described the typical MR findings and stages of HOD. HOD has three imaging stages but we proposed that in some cases, some of the stages will not be observed. We also described the different characteristic of inferior olivary nuclei hyperintensity in various stages of disease, which have not been reported in literature.

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MRI-Based Radiomics of Whole Tumor to Classify the Types of Pediatric Posterior Fossa Brain Tumors

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Objective: To investigate the noninvasive MRI-based radiomics analysis of whole tumor to classify the histologic tumor types of pediatric posterior fossa brain tumors and improve accuracy of discrimination by using random forest classifier.
Materials & Methods: A total of 99 histologically confirmed posterior fossa brain tumors (59 MBs, 13EPs, 27PAs) were retrospectively analyzed and divided into training set (80%) and a validation set (20%). MRI images of 99 patients confirmed by operation and pathology before treatments were enrolled in this retrospective study. Registration was performed among the three sequences and high-throughput features were extracted from manually segmented tumors in MR images of each case. Forest-based feature selection method was adopted to select the top ten significant features. Finally, the results were compared and analyzed according to the classification.
Results: The top ten contribution orders to classify wavelet features all came from the ADC sequence. The random forest classifier achieved 100% accuracy on training data and was validated best accuracy (0.938), sensitivity = 1.000, 0.948, 0.808, specificity = 0.952, 0.926, 1.000 for EP, MB and PA respectively.
Conclusion: Random forest classifier based on ADC sequence of entire tumor can provide more quantitative information than TIWI and T2WI in differentiating the pediatric posterior fossa brain tumors. Particularly, the histogram percentile value showed great superiority which add diagnostic value of diffusion MR imaging in pediatric neuro-oncology.

Predictive Performance of Quantitative CT Texture Features for MYCN Gene Amplification Status in Neuroblastoma

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Objective: MYCN oncogene amplification in neuroblastoma confers patients to the high-risk disease category for which prognosis is poor and more aggressive multimodal treatment is indicated. This study explores if quantitative tumour texture features on contrast-enhanced CT (CECT) can non-invasively predict MYCN gene status.
Materials & Methods: From 2009–2019, fifty consecutive patients treated for neuroblastoma at a tertiary paediatric hospital with pre-operative CECT and MYCN gene status were identified. MYCN amplification was positive in 16 tumours and negative in 34. Following manual whole tumour segmentation, 107 radiomic features were extracted. Feature selection was performed with univariate analysis, removal of highly correlated features and finally with a wrapper algorithm. Scan parameters (aortic enhancement, slice width, kV, mA, kernel, machine) were treated as potential confounding factors. Predictive accuracy of the machine learning algorithms was estimated with leave-one-out cross validation.
Results: None of the scan parameters were significantly associated with MYCN status. The final radiomics signature consist of 3 texture features: "MajorAxisLength", "Strength" and "Busyness". The eXtreme Gradient Boosting (XGBoost) algorithm returned the highest area under the receiver operating characteristics curve (AUC) of 0.86 [95% confidence interval (CI), 0.74–0.98]; at this threshold, sensitivity was 0.88 (95% CI, 0.64–0.97) and specificity was 0.79 (95% CI, 0.63–0.90); corresponding F1 score was 0.76 and informedness was 0.67.
Conclusion: The CT radiomics signature was able to reliably and non-invasively classify MYCN gene status. The main limitations of the study were small sample size which precluded data splitting and lack of a separate data set for external validation.

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Concordance of Chest Ultrasonography (US) with Contrast-Enhanced Chest CT Scan in the Detection of Mediastinal Lymphadenopathy among Pediatric Patients Ages 5–17 Clinically Diagnosed with Tuberculosis (TB) Disease: A Pilot Study

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Objective: To determine the agreement of chest sonography with contrast-enhanced chest CT scan in the detection of mediastinal lymphadenopathy in children with clinically diagnosed tuberculosis.
Materials and Methods: Twelve (12) patients (5 females and 7 males) with age range of 8–17 years old, clinically diagnosed TB disease were prospectively recruited and underwent chest ultrasound using standard sonographic protocol. CT scan was used as a gold standard to confirm the presence of mediastinal lymphadenopathy. The images were interpreted blindly by two pediatric radiologists. Concordance rate and measure of agreement between ultrasound and CT scan were measured.
Results: Sonographic zones showing the highest concordance with CT include those taken in the transverse suprasternal and left parasternal views namely, zones B (prevascular/left upper paratracheal, 91.7%), C (subaortic/AP window, 100%), G (prevascular, 100%) & H (pericardial, cardiophrenic, 100%). The sonographic zones that show lower concordance are zone A (83.3%), as well as those taken in the suprasternal oblique views namely, zone E (retrotracheal, 75%) and zones D (prevascular) and F (retrotracheal/subcarinal), both at 83.3% concordance. Overall, the level of agreement of ultrasound findings with CT scan findings is classified as "moderate agreement" (89.6%, 95% CI Concordance = [0.835, 0.957] Cohen's Kappa = 0.535**), and was found to be statistically significant.
Conclusion: Chest sonography shows moderate agreement with chest CT in detecting mediastinal lymphadenopathies in children with TB. Ultrasound may therefore be used as an initial tool to detect enlarged lymph nodes in children clinically diagnosed with TB and assess for disease progression.

Unravelling the Mystery Behind the Anomaly: A Multi-Detetor Computed Tomographic (MDCT) Imaging of Conginetal Pulmonary Artery Anomalies

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Learning Objective: This is a pictorial review that shall illustrate the MDCT imaging findings of the common and rare pulmonary artery congenital anomalies classified into major categories, including abnormalities of development or course, anomalous origin and abnormal caliber.
Background: A large number and variety of congenital abnormalities affect the pulmonary arteries. Many of these conditions are rare and their clinical features often overlap. Disruption of the pulmonary vasculature is often incompatible with life. Thus, efficient and accurate diagnosis are essential and critical. A myriad of imaging techniques are available to aid diagnosis however, Computed Tomography (CT) Angiography has been proven to be the most effective in demonstrating the anatomy and delineating the abnormalities. It provides optimal detail of the airways, lung parenchyma, and small vessels and has the advantages of speed and ease of access. In relation, awareness of these conditions is important for the radiologist in interpreting the chest CT as early recognition would be of significant benefit in the diagnosis and treatment.
FIndings and/or Procedure Details: MDCT imaging of 12 pediatric patients with pulmonary artery anomalies are reviewed, analyzed and set in this pictorial review. MDCT allows comprehensive noninvasive evaluation of pulmonary artery anomalies in neonates and children.
Conclusion: MDCT has proved to be effective in demonstrating anatomy and delineating congenital abnormalities of the pulmonary arteries namely anomalous origin of left pulmonary artery, interruption/agenesis, stenosis, dilatation and hypoplasia. This modality also provides an advantage of examining the lung parenchyma and osseous thoracic structures.

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Normogram on Transfontannelle Doppler Indices and Cerebral Blood Flow Velocities in Healthy Preterm and Term Neonates within 72 Hours of Life

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Objective: To generate normal reference data for anterior and middle cerebral artery blood flow velocity and resistance index in preterm and term neonates as a baseline. Grey-scale ultrasound for brain parenchyma is non-invasive, portable, inexpensive and gives realtime assessments. However, many cerebral lesions are circulatory in origin so it is important to study Doppler which provide ideal tool for diagnosis, follow-up and management of brain damage caused by perinatal asphyxia, infection, developmental and cerebro-vascular disorders.
Materials and Methods: An observational study of transfontanelle and transtemporal pulsed wave Doppler of 715 neonates born at gestational age 27–42 weeks within 72 hours of life. Parameters measured were peak systolic velocity (PSV), End diastolic velocity (EDV), time average maximum and mean velocities (TAMAX & TAMEAN), Pulsatility index (PI) and resistive index (RI) in anterior and middle cerebral arteries.
Results: The mean PSV, EDV and TAMAX were 27.78 ± 11.45, 7.69 ± 2.62, 15.56 ± 5.42 and 27.86 ± 0.16, 5.19 ± 0.87 and 20.95 ± 7.19 for ACA and MCA, respectively. The mean PI and RI were 1.50 ± 0.39, 0.76 ± 0.07 for ACA and 1.74 ± 0.16, 0.83 ± 0.005 for MCA.
Conclusion: This is the largest study to establish a normative database for above mentioned indices. CRBV are directly proportional to gestational age and birth weight. Higher RI seen in preterm as compared to term neonates. No statistically significant differences on Doppler parameters in relation to type of delivery, sex and postnatal age. No correlation was observed between Doppler indices and gestation as component velocities all increase with advancing gestation. These data are important for facilitating the correct interpretation of abnormal findings.

Cobweb of Culverts - An Insight into the Atypical Paediatric Vascular Malformations

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Learning Objective: The aim of this paper is 1) to highlight some atypical presentations of Paediatric vascular malformations, 2) to enumerate the imaging characteristics and 3) to entice the importance of awareness such entities.
Background: Complex atypical vascular malformations are often manifested in paediatric patients. Through this presentation, we are trying to highlight the imaging characteristics of three such entities; encountered in our institution. They are a) Parkes Weber syndrome b) Extensive veno lymphatic malformation pelvic cavity c) Arterial tortuosity syndrome.
Results: (i) Parkes Weber syndrome – 8 years old child with extensive high flow arteriovenous fistulous communications, predominantly at the periarticular regions in the right lower limb with limb hypertrophy, diagnosed on MRI and MRA. (ii) Extensive veno lymphatic malformation pelvic cavity – 4 years old child with extensive veno lymphatic malformation in the pelvic cavity and left gluteal region, showing macro cystic lymphatic components and tortuous dilated venous channels, diagnosed on MRI and MRA. (iii) Arterial tortuosity syndrome – 4 months old infant with dysmorphic features. CT Thoracic-abdominal angiography MIP image showed tortuous aorta and branches with right diaphragmatic hernia. On genetic studies, mutation in the SLC2A10 gene was seen.
Conclusion: Complex atypical vascular anomalies often present in the paediatric patients. Acquaintance of the imaging characteristics of such entities is imperative in precise diagnosis and proper clinical management.

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Relationship of Fetal Transcerebellar Diameter Measurement to Fetal Biometry-Derived Gestational Age of Filipino Pregnant Women on Second to Third Trimesters at a Tertiary Care Hospital in Makati

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Objective: Precise estimation of gestational age is important in order to give appropriate care to both the pregnant mother and fetus. While different biometric parameters exist, they are often affected by anatomic anomalies, molding and IUGR. Transcerebellar Diameter (TCD) is an emerging ultrasound parameter useful for the estimation of gestational age (GA). The study aims to determine the relationship of transcerebellar diameter with the ultrasound-derived gestational ages of pregnant women on second to third trimesters at a tertiary care hospital in Makati.
Materials & Methods: Transcerebellar diameter is measured in addition to the standard fetal biometry in patients coming in for routine pelvic ultrasound that satisfies the inclusion criteria. The TCD is then correlated with age of gestation by their last menstrual period, different biometric parameters (BPD, HC, AC and FL) and the ultrasound-derived gestational age.
Results: Results showed that the transcerebellar diameter has a strong statistical correlation ($p < 0.001$) with AOG based on LMP (0.95), BPD (0.95), HC (0.94), AC (0.95), FL (0.95), and ultimately, to the ultrasound derived AOG (0.94). The transcerebellar diameter also has a positive linear association with the ultrasound-derived gestational age, increasing its size as the age of gestation progresses.
Conclusion: The results presented herein shows that the transcerebellar diameter is a potential parameter in the estimation of gestational age.

Imaging Findings of Posterior Fossa Tumors in Children: A Case-Based Review

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Learning Objective: We aimed to evaluate the imaging findings of posterior fossa tumors in pediatric population based on retrospectively collected data emphasizing on magnetic resonance imaging (MRI).
Background: Posterior fossa is a compact space and tumors in this region commonly presented with symptoms of raised intracranial pressure. The imaging approach to diagnosis of these tumors is based on the age and they differ according to their location in the posterior fossa i.e. brainstem, cerebellum and 4th ventricle. These tumors are most common in pediatric population. Majority of the primary childhood brain tumors occur in the infratentorial compartment including pilocytic astrocytoma, medulloblastoma, ependymoma and pontine glioma. Rare tumors like atypical teratoid rhabdoid tumor (ATRT) can also be seen.
Findings and/or Procedure Details: MR examination was done on a 3T MR scanner (Magnetom Skyra, Siemens, Germany). Conventional MR sequences including T1, T2, inversion recovery sequence, gradient and post contrast images were obtained. Physiological features of the tumors were evaluated by using advanced imaging sequences like diffusion weighted imaging and spectroscopy wherever possible, helping in better preoperative characterization of the lesions. MR imaging characteristics of the common tumors involving the cerebellar hemispheres, brainstem and 4th ventricle will be discussed in this poster.
Conclusion: Few specific imaging findings along with patients' demographics and location in posterior fossa help in narrowing down the differentials and avoiding unnecessary interventions.

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MRI Evaluation of Evan's Index and Its Correlation with Callosal Angle in Pediatric Hydrocephalus

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Objective: Hydrocephalus is the imbalance between production and absorption of cerebrospinal fluid resulting into the enlargement of ventricular system. Knowledge of ventricular size is mandatory, for the early and precise diagnosis. Assessment of ventricular enlargement is subjective and based on the radiologist's experience. Linear indices, such as Evans Index (EI) and callosal angle have been proposed as markers of ventricular volume. The aim is to establish Evan's index (EI) and callosal angle values in paediatric hydrocephalus cases of varied etiology with respect to gender and age. Also, to study any significant correlation between EI and callosal angle.
Materials and Methods: Total 105 subjects of hydrocephalus aged between 0 to 12 years, comprising of 80 males and 25 females, were analysed using EI and callosal angle retrospectively on MRI Brain.
Results: The mean EI in our study population was 0.413 ± 0.06 in males, 0.425 ± 0.08 in females and an overall mean is 0.419 ± 0.04. A moderate inverse correlation (r = -0.699) was found between EI and callosal angle.
Conclusion: Mean EI of 0.41 ± 0.04 in our study supports the adaptation of international guideline cut-off value of EI > 0.30 in the diagnosis of hydrocephalus. EI and callosal angle is less technical, easily reproducible and less time consuming and shows significant correlation.

Sonographic Renal Length in Malaysian Infant Population - A Hospital Based Cross-Sectional Study

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Objective: The neonatal stage is an important period of organ development whereby an insult could result in organ impairment. The kidneys demonstrate similar predisposition. Renal ultrasonography is crucial in examining the kidneys, including the renal length. The lack of local data means Malaysian doctors are dependent on data from other populations, which may not be locally suitable. Therefore, the objective of this paper is to determine the range of normal sonographic renal length amongst infant up to 1 year old in IIUMMC and HTAA Kuantan, Malaysia, to investigate sonographic renal lengths differences between male and female infants and to propose simple mathematical equations to estimate ideal renal length based on infant's age.
Materials & Methods: All children under the age of 1 who had normal ultrasound of the kidneys were included. Five age groups were formed based on examples from previous studies. Data were mined from the Radiology Information Systems of both centres. 463 cases were selected. Important data were obtained – the infant's age, gender and their sonographic renal lengths for both kidneys. Their respective sonographic renal lengths were tabulated according to their age group, following which a group mean and 95% confidence interval were derived.
Results: We tabulated the means and 95% confidence intervals for both right and left kidneys separately for each group. No significant difference in the sonographic renal lengths between the genders identified. Two separate linear regression equations were formulated for the right and left kidneys.
Conclusion: We formulated a table of normal sonographic renal lengths according to age for infants, useful in day-to-day practice.

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Langerhans Cell Histiocytosis(LCH) in a Tertiary Paediatric Referral Centre - Case Series with Multimodality Imaging Findings

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Learning Objective: The aim of this paper is to illustrate the various radiological findings of LCH and to illustrate less common site of LCH with relevant radiological findings.
Background: Langerhans Cell Histiocytosis (LCH) is part of a group of disorders caused by overproduction of histiocytes, which in this case – immature Langerhans cells with wide range of manifestations. Definitive diagnosis often requires correlation of a combination of clinical features, histopathological, immunohistochemical and radiological findings. Radiology is also essential for treatment monitoring and follow-up as refractory LCH have poorer prognosis.
Findings and/or Procedure Details: Bone lesions are most common and occur in approximately 80% of patients. LCH has a predilection for flat bones. Osseos and extra-osseous imaging findings that are more specific for LCH (although not diagnostic) include lytic skull lesions with bevelled edges, vertebra plana and pituitary infundibular thickening. Extra-osseous involvement of the central nervous system, lung, liver, spleen and lymph nodes are better assessed on CT and MRI. We present 5 different patients with osseous and extra-osseous manifestations of LCH showing multiple osseous involvement - C1/C2 subluxation ,intrathoracic, abdominal, CNS involvement (middle cranial fossa, base of skull erosion, loss of posterior pituitary T1W bright spot) and lymphoid organs (lymphadenopathy).
Conclusion: LCH has various radiological findings and it is essential for radiologists to identify these at baseline for treatment monitoring.

Survey: Awareness of Medical Students on Diagnostic Radiological Examination Related Radiation Used in Paediatric Population

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Objective: Children are not small adults. They are generally more radiosensitive. In recent years, request for radiological examinations has increased concordant with the advancement of radiological investigation. Some radiological examinations utilise ionizing radiation such as CT scan. Hence, medical students who are our future clinicians play an important role in radiation protection. A survey was carried out in a local university to determine the level of knowledge in radiological examination related radiation among medical students.
Materials & Methods: A total of 204 medical students from 4th and 5th year participated in this survey. This survey was carried out in a form of questionnaire. The questionnaire was made up of two sections, which include demographic data and knowledge of diagnostic radiological examination related radiation.
Results: 88.7% of the participants were unaware and do not know about ALARA (as low as reasonably achievable). There were 10 questions, testing on the participants' knowledge regarding which radiological examinations utilise ionizing radiation. Out of the 10 questions, 68.1% of participants were able to correctly answered 6 or more questions. Only 21.6% of respondents were able to correctly determine the number of CXRs equivalent radiation dose for CT head in children.
Conclusion: In general, more than half of the medical students are aware of the usage of ionizing radiation in diagnostic medical examination. However, most of them are not exposed to the radiation protection concept i.e ALARA which need to be introduced to them in the medical curriculum for better understanding of radiation protection principle.

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Establishing Diagnostic Reference Levels for Computed Tomography of Head in Pediatric Population

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Objective: Pediatric CT has been increased with the advancements in CT. Radiation dose in CT pose major adverse effects in pediatrics. The purpose of study is to establish Diagnostic Reference Levels (DRL's) for pediatric population undergoing CT head in 128 slice CT and compare with Internationally recommended DRLs.
Materials & Methods: This is a prospective study. A total 60 pediatric patients referred for CT head was included in study and were divided into two age groups: < 1 year and 1–5 years. Uncooperative patients were excluded from study. Scanning was performed by 128 slice Philips Incisive CT scanner using standard pediatric head protocol. Dose indices such as Volumetric Computed Tomography Dose Index (CTDIvol) and Dose Length Product (DLP) was noted from CT console. Effective dose was calculated by multiplying DLP with conversion factor. 75th percentile of CTDIvol and DLP was calculated to establish DRL's and compared with Internationally recommended DRls.
Results: 75th percentile of CTDIvol and DLP for pediatric CT head was 15.11 mGy and 320.76 mGy.cm for < 1 year and 19.75 mGy and 543.59 mGy·cm for 1–5 years age group respectively. The mean effective dose was: 3.52 mSv and 3.58 mSv for < 1 year and 1–5 years age group respectively.
Conclusion: DRLs for pediatric CT head was higher for both the age groups compared to European and other Internationally recommended DRL's. Therefore, our study concludes that tailored protocol with optimum exposure parameters depending on the patient age and size must be used to obtain optimum diagnostic image quality with minimum radiation dose to the patients.

Assessment of Organ Dose and Image Quality of CT Chest-Abdomen-Pelvis (CAP) Examination Using 1-Year-Old Anthropomorphic Phantom

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Objective: Lack of awareness and optimization practice among radiology personnel also might increase the probability of higher radiation exposure to the patients. The purpose of this study is to investigate the radiation dose in the radiosensitive organ and image quality in CT Chest-Abdomen-Pelvis (CAP) examination.
Materials & Methods: We evaluate the organ dose by using 1-year-old anthropomorphic phantom and thermoluminescence dosimeter (TLD). The study was performed on 64 slices multidetector CT scanner (MDCT) Siemens Definition AS (Germany) by applying six different CT protocols (P1 to P6). The tube potential of P1, P2 and P3 were fixed at 100 kVp and P4, P5 and P6 were fixed at 80 kVp with various tube current reference value (ref.mAs). Three TLD chips were inserted into the phantom slab no 7, 9, 10, 12, 13 and 14 to represent thyroid, lung, liver, stomach, gonads and skin respectively. The image quality was assessed by using Radiant DICOM Viewer software to extract noise value from each protocol.
Results: As a result, a decreased organ dose was noted along with reducing tube voltage and tube current and slightly increase in the noise index value. The organ with the highest dose was found in the liver in all CT parameter setting with a mean range 10.5–3.6 mSv while the range of noise value in all CT parameter setting are 11.38 HU–23.4 HU.
Conclusion: Optimization of CT acquisition parameter led to reduced radiation dose in radiosensitive organ in CT examination.

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4D CT Aortogram: A Revolutionary Technique for Pre-Surgical Evaluation of Extra Cardiac Anomalies in Paediatric Patients

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Objective: To assess diagnostic yield of 4D CT Aortogram for pre-surgical evaluation of extra cardiac anomalies in paediatric patients.
Materials & Methods: 4D CT aortograms performed in paediatric patients in last 2 years were reviewed. We performed non ECG-gated 4D CT aortogram on 128 slice DECT scanner. Successive time frames were obtained by sequential scanning, followed by independent reconstruction of each 3D dataset. Post surgical outcomes were evaluated. Total number of aortic, other associated abnormalities and incidental findings like collaterals were calculated. This data was compared to the routine CT aortograms (42 cases) done in the previous years.
Results: 73 cases of 4D aortogram were analysed, out of which 8 cases of clinical suspicion were normal. 60 patients had aortic abnormalities. Out of these, 17 had associated pulmonary vascular and/or vena cava abnormalities. 4D acquisition helped in detection of small branch vessels and collaterals in 21 cases. Statistical analysis stated significant variance (p value <0.050) of detection of small vessels among both the techniques.
Conclusion: 4D CT gave very high spatial and temporal resolution of the anatomical variants. Cine viewing allowed selection of the best phase for a given abnormality and provided invaluable dynamic information that was not obvious on static images. Being a fully automated technique, this method is not operator dependent and helps in reducing radiation dose by tailoring dose to patient's morphology. In 28.7% of cases, 4D CT could identify small branch vessels and collaterals which would be difficult to identify on routine multislice CT angiography done on same scanner in previous years.

MRI of Corpus Callosum in Patients with Autism Spectrum Disorder in Kuantan

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OBjective: To study the integrity of the corpus callosum among autistic children population in Kuantan, Pahang, Malaysia, which is determined by MRI's diffusion tensor imaging (DTI) parameters, fractional anisotropy (FA) and radial diffusivity (RD). These parameters represent the direction dependence of water molecules diffusion within the measured tissues. As corpus callosum is saturated with brain white matter tracts, the water molecules diffusion here will be direction dependent. Studies involving foreign populations have shown that there is distortion in the corpus callosum's DTI parameters in autistic population indicative of microstructural distortion. Whether similar findings will be observed in our local autistic population still remains a question. Other gross corpus callosum parameters such as its thickness, length and size are also studied.
Materials & Methods: 28 randomly selected autistic children under the International Islamic University Malaysia Medical Centre (IIUMMC), Kuantan follow-up are subjected to MRI scan. Limited MRI sequences including DTI are obtained and analysed. FA, RD, midsagittal thickness at the genu, body and splenium of the corpus callosum as well as its midsagittal length and size are measured. Data are tabulated according to age followed by statistical analysis.
Results: A weak negative correlation is found between the age and the FA of the corpus callosum. Other parameters such as the thickness, length and size show weak positive correlation with age.
Conclusion: Although the correlation is weak, our study shows that there is evidence of distortion of corpus callosum white matter microstructure in children with autism spectrum disorder in Kuantan, Pahang.

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Second Generation of Dual Source Computed Tomography for Evaluating Coronary Artery Lesions in Vietnamese Pediatric Patients with Kawasaki Disease

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Objective: To evaluate coronary artery lesions (CAL) in pediatric patients with Kawasaki disease by DSCT 256 detectors then comparing with the measurements of 2D echocardiography (2DE).
Materials & Methods: 33 children (17 males, 16 females) with Kawasaki disease underwent DSCT 256 detectors at Bach Mai Hospital and Vietnam National Children's Hospital from December 2015 to September 2019. The average effective dose of DSCT and 4-point subjective imaging quality was collected. The location, number and size of coronary aneurysm were independently evaluated by DSCT and 2DE. Bland – Altman analysis was used to evaluate the agreement of aneurysms measurements between DSCT and 2DE.
Results: 96.7% (232/240) coronary artery segments had good imaging quality (score ≤ 3). Average effective dose of DSCT was 1.58 ± 0.56 msV (0.77÷ 3.20). Coronary aneurysm in 1 segment, 2 segments and 3 segments were 85.1%, 12.7% and 2.1%, respectively. The medium and giant CAA ratio was 72.3%. The mean ± SD aneurysm diameter measured by DSCT and 2DE was 7.18 ± 2.72 mm and 7.16 ± 2.55 mm, respectively. The mean ± SD aneurysm length measured by DSCT and 2DE was 13.49 ± 8.65 mm and 13.28 ± 8.58 mm, respectively. Bland – Altman plot showed a good agreement between DSCT and 2DE.
Conclusion: DSCT is a feasible modality with excellent imaging quality and low effective dose exposure for rapid and accurate assessment of CAL in infants and children due to Kawasaki disease.

Diagnosis of Retroperitoneal Tumors in Children by Using Ultrasound-Guided Core Needle Biopsy in a Retrospective Study on 52 Cases

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Objective: Ultrasound-guided biopsy technique has widely been applied in the diagnosis of adult abdominopelvic, mediastinal cavity and breast tumors. There are few reports on ultrasound-guided biopsy in pediatric retroperitoneal cavity tumors. This study was to evaluate the ultrasound features and the diagnostic value of ultrasound-guided core needle biopsy for pediatric retroperitoneal tumors.
Materials & Methods: The pediatric patients with retroperitoneal tumor that determined by ultrasound, CT or MRI examination and underwent ultrasound guided core needle biopsy from October 2018 to January 2020 were reviewed at VNCH. A minimum of five cores in each case was obtained. 13 patients were operated and had surgical pathology results. The ultrasound features and the diagnostic accuracy of ultrasound-guided core needle biopsy were evaluated.
Results: Fifty - two patients (25 males) with the mean age of (3.6 ± 3.3) years were enrolled into the study. Ultrasound examination showed irregular hypoechoic or mixed echo masses with calcification and liquefied necrosis. The quality of tissue sample enough to make diagnosis was 98.1% (51/52). Only one case was misdiagnosed because of inadequate tissue sample. The diagnostic accuracy of ultrasound guided core needle biopsy compared to surgical histopathology was 76.9% (10/13). Retroperitoneal tumor pathology varying with neuroblastic tumor was 86.3% (60.8% NB, 11.8% GNB and 13.7% GN), ACC was 5.9%, germ cell tumor was 5.9% (2.0% teratoma, 3.9% yolk sac tumor) and rhadomyosarcoma was 2.0%. No serious complication occurred.
Conclusion: Ultrasound-guided core needle biopsy seems to be an accurate, minimally invasive and safe diagnostic method of pediatric retroperitoneal tumor.

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Community Acquired Pneumonia in Children: Role of CXR on Admission in Predicting Outcome of Pneumonia

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Objective: To determine the association between chest radiograph (CXR) pattern with clinical severity of community acquired pneumonia (CAP) on admission and to identify the correlation between clinical outcomes in End Point Pneumonia (EPP) and complicated pneumonia groups.
Materials & Methods: A retrospective study of 245 healthy children (between age 2 months old to 12 years old) admitted due to CAP within 2-year period (January 2017–December 2018) with CXR on admission. CXR pattern was evaluated by a paediatric radiologist. End Point Pneumonia (EPP) was defined as presence of significant consolidation often containing air bronchogram. Complicated pneumonia categorized as presence either parapneumonic effusion, cavities, abnormal air locules, necrotizing component or empyema. Chi-square analysis was utilized to assess correlation of clinical/biochemical outcome parameters with radiological pattern of EPP versus non-EPP. CXR patterns of complicated pneumonia and its association with positive culture and pathogen isolation were also evaluated.
Results: There was significant association of EPP with longer hospitalization (three and more days) ($p = 0.002$), failure of first antibiotics ($p < 0.001$), positive culture ($p < 0.001$) and ICU support ($p < 0.001$). Both groups showed significant association with higher CRP value ($p < 0.001$). Surgical intervention and unilateral multifocal radiographic pattern proved to have significant association with complicated pneumonia group ($p = 0.020$; $p < 0.001$). EPP patterns were also observed mostly in bacterial etiology. No specific radiological pattern can be seen to differentiate between bacterial, viral or fungal pathogens.
Conclusion: Radiologically diagnosed pneumonia pattern-based approaches can be a useful tool to predict outcome of community-acquired pneumonia in paediatric population.

Imaging Spectrum of Common and Uncommon Renal Masses in Pediatric Population

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Learning Objective: The aim of this paper is to review the ultrasound and Multidetector computed tomography (MDCT) findings in benign and malignant pediatric renal masses and to emphasize the role of MDCT in paediatric renal masses.
Background: Incidence of pediatric renal masses has significantly increased in the last few decades owing to the widespread use of imaging modalities like USG and MDCT. Pediatric renal masses are mostly neoplastic in nature with Wilms tumour being the commonest. Earlier, most of renal masses were considered Wilm's tumour, however pathological updates revealed its several different subtypes including clear cell sarcoma, malignant rhabdoid tumor, mesoblastic nephroma and etc. This article aims at describing the clinical presentation and imaging findings of different pediatric renal masses.
Findings and/or Procedure Details: Common pediatric renal masses include Wilms tumour, nephroblastomatosis, Cystic nephroma and cystic partially differentiated nephroblastoma (CPDN), renal lymphoma and among others. Wilms tumour is the most common pediatric renal malignancy. Its uncommon malignant variants include mesoblastic nephroma (in neonates), clear cell sarcoma (frequently associated with skeletal metastases) and rhabdoid tumor of the kidney (associated with brain neoplasms). Nephroblastomatosis is difficult to differentiate from leukaemic infiltrates as both show low-attenuating focal parenchymal lesions. Meanwhile, cystic nephroma and cystic partially differentiated nephroblastoma (CPDN) are unilateral benign masses, grossly identical and cannot be distinguished at imaging alone, and hence needs histopathological correlation. Renal Lymphoma: B-cell type non-Hodgkin lymphoma is most common type and it may mimic renal cell carcinoma (RCC).
Conclusion: MDCT plays an important role in diagnosing pediatric renal masses as well as depicting their extent, involvement of vascular structures, pelvicalyceal system and status of contralateral kidney, thus helps in planning appropriate therapy and better management.

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Pilot Study: Longitudinal Study of Pituitary Gland, Hippocampus, Amygdala and Corpus Callosum Volume in Growth Hormone Deficiency Children Treated with Growth Hormones

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Objective: To assess volumetric changes in the pituitary gland, basal ganglia, corpus callosum, thalamus, hippocampus and amygdala in children with isolated growth hormone deficiency (IGHD) and its response to treatment.
Materials & Methods: This is a longitudinal study of eight IGHD patients (2 male, 6 female) with mean age of 10.7 ± 1 years and age-matched control group. Volume of pituitary gland, basal ganglia and limbic structures were obtained using 3T MRI (Siemens Magnetom, Munich or GE Signa HDxt, Boston) voxel-based morphology. Left hand bone age was assessed using the Tanner-Whitehouse method. Follow up comparison imaging was done after average of 1.84 ± 0.4 years on recombinant human growth hormone therapy (rhGH).
Results: Patient with IGHD have smaller mean volume of the pituitary gland, hippocampus and amygdala compared to control. On follow-up, these structures volume normalize after rhGH therapy. IGHD on rhGH therapy showed large effect size in volumetric changes across time for pituitary gland (d = 1.84), hippocampus (Lt: d = 0.88 and Rt: d = 0.93) and amygdala (Lt: d = 1.18 and Rt: d = 0.97). The right thalamus and corpus callosum also showed similar growing trend, however, not amounting to normal value (as compared to age-matched control) in response to rhGH therapy. There were changes towards normalisation of bone age deficit of IGHD in response to rhGH therapy (M = 1.07, 95% CI [0.35 to 1.79]), t(8) = 3.52, p = 0.010.
Conclusion: Pituitary gland, hippocampus and amygdala volume in IGHD population are smaller than age-matched control groups and show the most response to GH therapy.

Synchronic Synthesis of Schizencephaly: The Malformations and Mimics

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Learning Objective: This pictorial review aims to discuss the broad spectrum of the imaging appearances of schizencephaly, its related malformations and mimics.
Background: Schizencephaly is a gray matter-lined cleft that extends through the hemisphere, from the ependymal lining of the lateral ventricle to the cortical surface. This abnormality can be unilateral or bilateral with fused or separated lips, which are defined as closed-lip and open-lip schizencephaly.
Findings and/or Procedure Details: Among the imaging modalities, MRI is the method of choice as it is more sensitive in detecting the clefts as well as the associated abnormalities. Schizencephaly is often associated with various brain abnormalities such as absent of septum pellucidum, callosal malformation, polymicrogyria and heterotopic gray matter. Furthermore, the existence of schizencephaly is sometimes relevant to the septo-optic dysplasia and posterior fossa malformations. This article will discuss the key features of schizencephaly in different imaging modalities, which allow for a better understanding and assessment of the degree of involvement. Several conditions may have imaging findings that mimic schizencephaly, such as focal cortical dysplasia, gray matter heterotopia, hydranencephaly, and porencephaly. A practical approach will be demonstrated in this exhibit to distinguish these entities from schizencephaly.
Conclusion: Schizencephaly is always not alone; it is crucial to scrutinize the whole brain for the co-existence of other abnormalities. It is helpful to be familiar with the imaging characteristics specific to the schizencephaly and the mimics as it could provide reliable information to guide therapy, genetic counseling, accurately predicting prognosis and perhaps in time, contributing to their prevention.

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Effect of CT Head Referral Criteria Following Mild Head Injury on Diagnostic Performance

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Objective: Paediatric mild traumatic brain injury (TBI) is one of the common presentation in Emergency Department but there is no specific universally accepted guideline. Commonly used guidelines in our centre is the PECARN guidelines. We aim to evaluate retrospectively the effects of this guidelines on diagnostic performance and if the benefit varied according to level of experience of referring clinicians as well as time the referral was made.
Materials & Methods: 31 paediatric patients (age < 2) were retrospectively included in the study. Request forms were reviewed to determine whether the CT head met the criteria in line with PECARN guidelines. Additional information regarding time of referral as well as referring clinicians' particular were obtained. The positive predictive value (PPV) for the population before and after the criteria were applied were then calculated.
Results: Following retrospective application of the PECARN criteria, PPV improved from 19.4 to 40.0 (presence of fracture) and 16.1 to 42.9 (presence of haemorrhage). Following the retrospective application of the PECARN criteria, PPV for referrals made during working and on call hours improved from 7.2 and 29.4 to 14.3 and 62.5 (presence of fracture) and 21.4 and 11.1 to 42.9 and 25 (presence of haemorrhage). Following the retrospective application of the PECARN criteria, PPV for referrals made by the less and more experienced clinicians improved from 21.1 and 16.7 to 36.4 and 50 (presence of fracture) 21.1 and 8.3 to 36.4 and 25 (presence of haemorrhage).
Conclusion: CT head referral criteria following mild head injury improves the PPV for detection of intracranial haemorrhage or skull fracture. Benefit was equal for referrals made during oncall or working hours and from more or less experienced clinicians.

Radiology Review of Short Limb Skeletal Dysplasia in Paediatric Group

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Learning Objective: The aim of this paper is to review the diseases included in spectrum of the skeletal dysplasia and their radiological manifestations and to describe and recognise some of the radiological manifestations of limb shortening (rhizomelic, mesomelic and acromelic).
Background: We have encountered patients presented with rhizomelic dwarfism with the clinical features suggestive of achondroplasia in our centre. Pair of siblings who presented with mesomelic dwarfism.
Findings and/or Procedure Details: Short limb skeletal dysplasia are characterised by limb shortening includes (a) Rhizomelic dwarfism (proximal limb shortening) involving humerus and femur - achondroplasia, chondrodysplasia punctate, pseudoachondroplasia, thanatophoric dysplasia, (b) Mesomelic dwarfism (middle limb shortening)involving radius, ulna, tibia and fibula - dyschondrosteosis (Leri-Weil disease), (c) Acromelia dwarfism (distal limb shortening) including hands and feet. Images of the described conditions above will be further described accordingly.
Conclusion: This educational exhibit is to educate the trainee to recognise the clinical features of different types of short limb skeletal dysplasia.

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Radiological Review of Intestinal Obstruction in Neonates What Radiologists Need to Know?

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Learning Objective: To educate radiological manifestations of intestinal obstruction in neonates.
Background: Neonates with suspected intestinal obstruction are divided into upper and lower gastrointestinal obstruction (IO) based on clinical symptoms and radiological findings.
Findings and/or Procedure Details: In high IO, radiographic findings include distention of stomach, duodenum and jejunum and the common causes are midgut volvulus/malrotation, duodenal atresia/stenosis, duodenal web, annular pancreas and jejunal atresia. Meanwhile in lower IO, radiographic findings include dilated loops of bowels with abdominal distention and failure to pass meconium and barium enema shows microcolon. Common causes of this entity include Hirchsprung disease, meconium plug syndrome, ileal atresia, meconium ileus, anal atresia/ malformations and necrotizing enterocolitis potentially life-threatening in premature neonates.
Conclusion: Recognizing type of IO with imaging is important for early treatment and disease detection. Urgent referral to surgery is mandatory.

A Pictorial Guide of Voiding Cystourethrogram in Paediatric Vesicourethral Reflux: Indications, Technique, Anatomy of Urinary System, Grade of Vesicourethral Reflux and Anomalies of Urinary Systems

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Learning Objective: The purpose of this paper is to review the main indications as well as the basic technique of voiding cystourethrogram (VCUG), to identify the key features for each grade of vesicoureteral reflux (VUR) and to describe a wide spectrum of anomalies involving urethra, bladder, ureter and kidney in VCUG.
Background: VCUG has gained wide acceptance in the diagnosis of VUR and it is also the method of choice in evaluating various anomalies of the urinary system, particularly the urethra, urinary bladder and distal ureter as well as the kidney when there is associated high-grade reflux.
Findings and/or Procedure Details: VCUG is a fluoroscopically monitored examination involving retrograde instilling of a detectable substance into the bladder by urethral catheter in mimicking the process of filling and emptying of the bladder. The principle of "as low as reasonably achievable" (ALARA) was adhered to assure that radiation doses to the children are appropriate. Intermittent fluoroscopic monitoring was carried out throughout the entire examination to detect the presence and extent of the VUR, as well as the evaluation of both anatomic defects and functional anomalies of the urinary system. In this exhibit, anomalies involving urethra, bladder, ureter and kidney in VCUG including neurogenic bladder, Hutch diverticulum, posterior urethral valve, ureterocele, megaureter, ectopic ureter, ectopic kidney, and duplication of the urinary collecting system will be demonstrated
Conclusion: VCUG is an efficient, accurate and reproducible method to detect and characterize VUR and urinary tract abnormalities in children. Adherence to basic principles in performing the examination and interpretation are essential in establishing a diagnosis and treatment plan.

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Comparative Evaluation of MRI with Transfontanelle Neurosonography in Neonates with Hypoxic Ischemic Encephalopathy

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Introduction/Purpose: Perinatal asphyxia is one of the common cause of neonatal mortality and morbidity. Currently, many imaging modalities are available. Present study evaluates the neonates with hypoxic ischemic encephalopathy with neurosonography and MRI brain and compares both the imaging modalities.
Materials & Methods: This is a prospective study performed over 88 neonates. The study has been done for a period of 19 months ranging from March 2018 to September 2019. All hemodynamically stable neonates with history of birth asphyxia were evaluated with NSG & MRI.
Results: In the present study a total of 88 neonates with history of hypoxic ischemic encephalopathy were evaluated with transfrontanelle neurosonography and MRI. Out of 88 neonates, 24 were preterm neonates (27%) while 64 cases were term neonates (73%). Commonest imaging finding in preterm neonates in our study was white matter injury (75%) Most common imaging in term neonates with HIE in the present study was water shed infarct 20 cases (76%).
Conclusion: Neurosonography (NSG) is sensitive in detecting GMH grade II and above along with white matter injury grade II and above. NSG is less sensitive in detecting noncavitatory white matter injury, basal ganglion injury and small foci of GMH. NSG is also not sensitive in grading the GMH. MRI is superior in detecting mild to moderate and severe HIE injury in both preterm and term neonates. DWI is more sensitive in detecting HIE injuries than any other MRI sequences.

Magnetic Resonance Imaging Evaluation of Pediatric Leukodystrophies in North West India: A Prospective Study

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Objective: Leukoencephalopathies are disorders which selectively involve the cerebral white matter. The term “leukodystrophies” refer to the disorders with primary white matter involvement with demonstrable biochemical or molecular defect and usually with a progressive clinical course. The clinical and radiological clues may be very helpful in guiding the investigations of a child with suspected leukodystrophy. Hence, the study was performed to describe the pattern and radiological profile of leukodystrophies in North-West India using Magnetic Resonance Imaging.
Materials & Methods: Thirty cases of Pediatric Leukodystrohies diagnosed on Magnetic Resonance Imaging were evaluated and clinical findings were recorded. The leukodystrophies were categorised into following categories: a) Hypomyelinating disorders, b) White Matter Disorders with Demyelination, c) White matter disorders with vacuolisations, d) Cystic Leukoencephalopathies and e) Miscellaneous. Biochemical Analysis was performed wherever possible and diagnosis was correlated with MRI findings.
Results: Thirty cases of suspected Pediatric Leukodystrophies on MRI were evaluated. Majority of cases were seen less than 5 years of age. White Matter Disorders with Demyelination was the commonest category followed by cystic leukoencephalopathies and hypomyelinating disorders. Biochemical analysis was available in 12 cases only. MRI was able to correctly identify the pathology in 11 cases with a diagnostic accuracy of 91.2%.
Conclusion: Pediatric Leukodystrophies have no definite cure and has a progressive clinical course. A simplified approach to diagnose common leukodystrophies on MRI is required for early diagnosis, appropriate genetic counselling and further management.

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Imaging Findings of Branchial Cleft Anomalies: A Pictorial Review

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Leraning Objective: The purpose of this paper is to understand the embryological development of pharyngeal arches in relation to pathogenesis of branchial cleft anomalies, to identify and distinguish the variant and spectrum of branchial cleft anomalies in different imaging modalities and to correlate between the clinical information and imaging findings in suspicion of underlying branchial cleft anomalies.

Background: Branchial cleft anomaly is recognized as one of the commonest paediatric congenital lesions of head and neck which commonly presents with cystic masses of the neck. It falls under the umbrella of branchial apparatus anomalies in which they can also present as sinus tracts, fistulae or cartilaginous remnants. It is clinically challenging to establish diagnosis if the clinical suspicion is not set in. Therefore, radiological investigation has become one of important medical tools in assessment of patients with suspected branchial cleft anomaly especially when patients presented with recurrent neck abscess.

Findings and/or Procedure Details: CT and MRI provide excellent cross-sectional information and sometimes are able to even show the whole fistulous tract from the skin to the pharyngeal cavity. Thus, this article intends to demonstrate the spectrum of radiological manifestations of this anomaly using various radiological modalities that may facilitate the establishment of diagnosis. We will present a variety of imaging findings and discuss the role of each imaging modality emphasizing on the pearls and pitfall in diagnosing branchial anomalies. Several imaging modalities in a series of cases with variations of findings according to the clinical condition will be presented. Differential diagnosis of paediatric neck lesion will also be discussed to compliment this pictorial review.

Conclusion: Even though bronchial cleft anomalies is relatively common entity, basic knowledge of its variant and radiological manifestations is mandatory in every clinical radiologist.