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SCR'21

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Suprapatellar Fat Pad MRI Abnormalities in asymptomatic subjects: What is normal?

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Purpose: To study the prevalence of supra-patellar fat pad (SPFP) MR alterations in a cohort of asymptomatic subjects,in correlation with a wide range of clinical/radiological evaluations, including muscle performance tests and physical activity data.
Methods and Materials: We prospectively included 110 asymptomatic subjects from 7/19 to 9/20 as part of a cohort study. Inclusion criteria were no knee pain in the last year.Exclusion criteria were any previous knee disorder, including osteoarthritis. Subjects underwent knee and low-dose posture radiographs [EOS®],3T MRI,clinical examination including quadriceps and hamstrings performance tests and physical activity quantification, monitored digitally for 1 week.
Study groups were based on presence/absence of SPFP alterations: hyperintensity and mass effect (qualitative evaluation in consensus) on fluid-sensitive sequences.Correlations were tested with a total of 55 categorical/continuous clinical/radiological variables, including SPFP relative-T2-signal, trochlear/patellar/lower-limb morphologic measurements. Mann-Whitney and Chi-square test were used to compare sub-groups.
Results: SPFP alterations were common in asymptomatic subjects: 57% (63/110) hyperintensity and 37% (41/110) mass effect, with 27% (30/110) showing both. Among the 55 variables tested, a correlation was found only between SPFP mass-effect and increasing patellar tilt angle (p=0.02); SPFP hyperintensity and younger age(p=0.04). No other radiological, clinical or activity variable showed correlation with the SPFP alterations.
Conclusion: SPFP high signal abnormality and mass effect are common findings at knee MRI of asymptomatic subjects (57% & 37%, respectively). Their presence was correlated with only one parameter related to patello-femoral morphology, and age (for isolated SPFP hyperintensity). No other correlations were found, including with muscle power or physical activity. Therefore, they most likely represent normal variants and care should be taken not to overcall them as pathological findings.

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Medial meniscal extrusion evaluated with weight-bearing ultrasound in correlation with MRI: Differences in meniscal morphologies and patient symptoms

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Purpose: Compare medial meniscal extrusion as seen on weight-bearing ultrasound compared with MRI under consideration of the meniscal morphology and patient symptoms.
Methods and Materials: IRB-approved study with informed consent. Patients with routine knee MRI were prospectively evaluated with supine and weight-bearing ultrasound (US) of the medial meniscus. Position of the outer boundary of the medial meniscus on US images was measured relative to the tibia by two fellowship-trained musculoskeletal radiologists. Correlation was made to the presence or absence of reported meniscal degeneration or tear on MRI, as well as patient symptoms („Knee Outcome Survey Activities of Daily Living Scale"). Statistical significance was calculated via ICC and ANOVA.
Results: 99 knees from 95 subjects (50 males, 45 females; mean age 45±15 years) were included. The mean medial meniscal extrusion for a normal meniscus on MRI (n=36) with supine US was 0.8 mm (1.6 mm on weight-bearing US). In the 20.2% (20/99) knees with mucoid degeneration of the meniscus on MRI, the mean medial meniscal extrusion with US was 1.6 mm supine (2.3 mm weight bearing), and for the 43.4% (43/99) of knees with meniscal tear on MRI 1.6 mm supine US (2.3 mm weight bearing). Inter-reader reliability showed ICC values between 0.853 and 0.940.
Patients with meniscal tears vs. normal meniscus had on average higher symptom scores regarding: stiffness (3.7 vs. 3), limping (3.7 vs. 2.8), squatting (4.2 vs. 3.3), and sitting with bent knees (3 vs. 2.2), with p-values=0.003-0.049. Mucoid degeneration only showed higher scores for squatting (3.9), but not the other parameters. Symptoms such as pain, swelling, etc. were not significant to differentiate between the three groups.
Conclusion: A normal medial meniscus shows lesser mobility between supine and upright position, then a pathologic meniscus. Mucoid medial meniscal degeneration shows laxity or extrusion in the supine and weight-bearing positions with US even in the absence of meniscal tear at MRI.

A-166

High-Resolution 3D MRI for chondrocalcinosis detection in the knee – A prospective cohort study comparing 7 Tesla and 3 Tesla MRI with CT

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Purpose: To assess the detection of chondrocalcinosis in knee joints with a 3D Dual-Echo-Steady-State (DESS) sequence at 7T MRI in comparison to 3T MRI, versus CT as current cross-sectional imaging standard.
Methods and Materials: CT and 7T MRI (DESS) of knee joints in 42 patients with radiographically known chondrocalcinosis (13 of 42 bilateral) were prospectively acquired for all included patients (N=55 knee joints). Additionally, 3T knee-MRI (DESS) was performed (N=20 knee joints). Two fellowship-trained musculoskeletal radiologists scored the images regarding presence and extent of cartilage calcification, diagnostic confidence level and sharpness of calcific deposits. As ultimate reference standard for calcifications, micro-CT of the menisci was acquired after knee arthroplasty procedure (N=1). Nonparametric tests were used to compare the different modalities. A P-value <.05 was considered to represent statistical significance.
Results: Compared to both 7T MRI and CT, 3T MRI detected significantly fewer cartilage calcifications (reader 1: P=.008; reader 2: P<.001). For both readers, the diagnostic confidence was significantly higher for 7T MRI than for 3T MRI (P<.001) and significantly higher for 7T MRI than for CT (P=.03). Both readers rated the delineation of calcific deposits significantly sharper in 7T MR images compared to either 3T MR) or CT (P<.001) images. Micro-CT in one patient suggested that standard-CT partly failed to detect meniscal calcifications that could be identified both in 7T MRI and micro-CT.
Conclusion: 3D-DESS imaging at 7T MRI is superior at detection and accurate delineation of chondral calcific deposits compared to lower field strength MRI and CT.

A-191

Signal intensity and echogenicity variability of the proximal lateral collateral ligament of the knee: Findings on MRI and ultrasound with histologic correlation

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Purpose: To determine the prevalence of increased signal intensity of the proximal lateral collateral ligament of the knee (LCL) on MRI and ultrasound (US), and compare with cadaveric histologic evaluation.
Methods and Materials: IRB approval was obtained including informed consent for this prospective study. Patients with scheduled knee MRI were examined additionally with US. Signal intensity on MR images (low, intermediate, high), echogenicity on US images (hyperechoic, hypoechoic, anechoic), and extent of finding length were retrospectively determined by two readers. Patients with a history of trauma were excluded. Descriptive statistics, Wilcoxon signed ranked test and intraclass correlation coefficient (ICC) were calculated. Two cadaveric knees were imaged with MRI and US including histologic evaluation of the LCL.
Results: 73 subjects were included (39 males, 34 females; mean age 48±14 years) with 77 knee examinations. On MRI, low, intermediate, and high signal was present in 21% (16/77), 75% (58/77), and 4% (3/77), respectively. On US, hyperechoic, hypoechoic, and anechoic echogenicity was present in 62% (48/77), 38% (29/77), and 0% (0/77), respectively. The mean length of increased signal was 8.6 mm (±4.9) on MR, and 6.5 mm (±4.8) on US. Although this area was not as commonly appreciated on US as on MRI (0.445-0.511), if present the ICC showed a good intermodality reliability (0.735-0.899) with no statistically significant difference for interreader measurements (p=0.163-0.795). Histology evaluation showed transition of ligament fibers to fibrocartilage with increased connective tissue mucin staining with alcian blue corresponding to findings on MRI and US.
Conclusion: Increased signal intensity of the proximal LCL on MRI is common and corresponds to normal connective tissue mucin, and is better appreciated on MRI compared with decreased echogenicity on US.

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Three-dimensional quantification of knee joint space narrowing with weight-bearing CT: Comparison with non-weight-bearing CT and weight-bearing radiography

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Purpose: To assess the effectiveness of 3D quantification of knee joint space narrowing with weight-bearing computed tomography (WB-CT), in comparison with non-weight-bearing CT (NWB-CT) and weight-bearing radiographs (WB-XR).
Methods and Materials: Following IRB approval and informed consent, 26 participants were prospectively included. All participants underwent supine NWB-CT, upright WB-CT, and WB-XR of the knee joint. Using dedicated software, the average and minimal joint space width (JSW) was quantified with a 3D analysis of the minimal distance between the medial and lateral tibial articular surface to the femoral condyles on WB-CT and NWB-CT. Associations with mechanical leg axes were evaluated. Minimal JSW was further compared to WB-XR.
Results: Significant differences existed between the average medial JSW (p=0.028) and lateral JSW (p=0.008) between WB-CT (medial: 4.7 mm, lateral: 6.3 mm) and NWB-CT (medial: 5.1 mm, lateral: 6.8 mm). On average, the minimal JSW on WB-XR (medial: 3.1 mm, lateral: 5.8 mm) were significantly wider (all p<0.001, respectively) when compared to WB-CT and NWB-CT (both medial: 1.8 mm, lateral: 2.9 mm), but not significantly different between WB-CT and NWB-CT (all p≥0.869). For participants with varus knee alignment, the average medial JSW and the minimal medial JSW were significantly different between WB-CT and NWB-CT (p=0.004 and p=0.011). For participants with valgus knee alignment, the average lateral JSW was significantly different between WB-CT and NWB-CT (p=0.013). On WB-CT, 25% of the medial and lateral knee compartments showed bone-on-bone apposition, which was significantly higher when compared to NWB-CT (10%, p=0.008) and WB-XR (8%, p=0.012).
Conclusion: Significant differences exist for JSW between WB-CT, NWB-CT and WB-XR. The combination of 3D quantification and WB-CT demonstrates knee joint space narrowing in more detail than NWB-CT and WB-XR, and thus may serve as a more accurate X-ray-based biomarker for the assessment of knee cartilage that avoids understaging of osteoarthritis.

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Bone mineral density estimation from a single CT topogram using photon-counting CT – Comparison to dual-energy X-Ray absorptiometry and effect of patient size in a porcine phantom

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Purpose: To assess the impact of imaging modality and simulated patient size on bone mineral density (BMD) estimation from a single CT topogram acquired with photon-counting CT (PCCT) and with dual-energy x-ray absorptiometry (DEXA).
Methods and Materials: The lumbar back of a piglet was used to simulate osteopenia of the lumbar spine. Four additional fat layers were consecutively wrapped around the phantom (each with a thickness of 3 cm) to emulate a total of five different sizes. Each size of the phantom was repeatedly imaged on (A) a conventional DEXA scanner, (B) a prototype PCCT system at 120 kV with energy thresholds set to 20 and 70 keV, and (C) a prototype PCCT at 140 kV with thresholds set to 20 and 75 keV. Topograms of different energy bins were reconstructed for (B) and (C). BMD was measured for three lumbar vertebrae (L2-L4). The impact of imaging modality and simulated size on BMD was assessed using multiple linear regression including an interaction term.
Results: The multiple linear regression model (adjusted R2=0.65) demonstrated no significant impact of image modality (P=0.7) and simulated size (P=0.67) on BMD. BMD decreased significantly from L2 to L4 (both P<0.0001). Averaged across the three vertebrae and five sizes, mean BMD was 0.559±0.03, 0.550±0.02, 0.552±0.02 g/cm^2 for modality (A), (B), (C), respectively. BMD was on average 0.574±0.02, 0.557±0.01, 0.529±0.01 g/cm^2 for L2, L3, L4, respectively.
Conclusion: Bone mineral density estimation from a single CT topogram of photon-counting CT is feasible and comparable to DEXA over a range of simulated sizes. This could potentially enable opportunistic osteoporosis screening.

A-181

Differentiation of benign and malignant vertebral compression fractures using qualitative and quantitative analysis of a single fast spin echo T2-weighted Dixon sequence

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Purpose: To determine and compare the qualitative and quantitative diagnostic performance of a single sagittal fast spin echo (FSE) T2-weighted Dixon sequence in differentiating benign and malignant VCFs, using multiple readers and different quantitative methods.
Methods and Materials: From July 2014 to October 2019, 90 consecutive patients with spine MRI performed prior to cementoplasty for acute VCFs were retrospectively included. VCFs were categorized as benign (n=61, mean age=76±13 years) or malignant (n=29, mean age=63±13 years) based on the reference standard, biopsy and/or ≥9 months clinical and imaging follow-up. Qualitative analysis was independently performed by four radiologists by categorizing each VCF as either benign or malignant using only the image sets provided by FSE T2-weighted Dixon sequences. Quantitative analysis was performed using two different regions of interest (ROI1-2), and three methods (signal drop, fat fraction (FF) from ROIs, FF from maps). Diagnostic performance was compared using ROC curves analyses. Interobserver agreement was assessed using kappa statistics and intraclass correlation coefficients (ICC).
Results: The qualitative diagnostic performance ranged from area under the curve (AUC)=0.97 (95% CI: 0.92-1.00) to AUC=0.99 (95% CI: 0.98-1.0). The quantitative diagnostic performance ranged from AUC=0.82 (95% CI: 0.72-0.92) to AUC=0.96 (95% CI: 0.92-0.99). Pairwise comparisons showed no statistical difference in diagnostic performance (all p≥0.002, Bonferroni corrected p<0.0011). All five cases with discordance among the readers, were correctly diagnosed at quantitative analysis using ROI2. Interobserver agreement was excellent for both qualitative and quantitative analysis.
Conclusion: A single FSE T2-weighted Dixon sequence can be used to differentiate benign and malignant vertebral compression fractures with high diagnostic performance using both qualitative and quantitative analysis, which can provide complementary information.

A-309

Qualitative rating vs. quantitative machine learning-supported texture analysis for detection and grading of lumbar spinal stenosis

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Purpose: To investigate the performance of texture analysis (TA) in detecting and grading of lumbar spinal stenosis (LSS) in MRI of the lumbar spine.
Methods and Materials: 343 images of 82 patients from a nationwide study cohort, who underwent MRI of the lumbar spine due to neurogenic claudication, with a single-level severe central LSS were included (1-5 images of levels L1/2-L5/S1 per patient). One expert radiologist rated LSS as reference standard using a four-point Likert scale (normal-severe) and the eight-point Schizas grading scale , additionally evaluating epidural fat. Two independent readers analogously performed qualitative assessment and additional TA in all images, placing two regions of interest (ROI): Once encircling the dural sac only, another one additionally including the epidural fat and bilateral recesses. Interreader agreements for qualitative and quantitative parameters were calculated. TA features with intraclass correlation <.75 were excluded for feature reduction. Remaining features were analysed with machine learning (ML) algorithms (Weka 3) for correlation with qualitative LSS grades using test and training datasets and tenfold cross-validation.
Results: Qualitative ratings showed moderate reproducibility for both LSS classification systems, but high correlation with cut-off cross-sectional area (CSA) <130 mm^2 for severe LSS (AUC=.722-.916). For both ROIs, ML-evaluation of TA with a decision tree classifier revealed higher performances for LSS grading (AUC=.097) compared to qualitative assessments using the reference CSA cutoff, respectively.
Conclusion: Qualitative grading of LSS is moderately reproducible. ML-supported TA shows highly reproducible quantitative assessment that increases diagnostic performance for severe LSS detection, with limited dependence from qualitative scoring system and CSA border definition.

A-132

Posterior extraarticular ischiofemoral impingement can be caused by the lesser and the greater trochanter in patients with increased femoral version during dynamic 3D-CT based impingement simulation

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Purpose: Patients with increased femoral version (FV) can present clinically with lack of external rotation (ER) and extension and with a positive posterior impingement test. Posterior impingement is poorly understood.
We evaluated patient-specific 3D-CT and asked whether (1) range of motion (ROM); (2) location of osseous posterior intra-and extraarticular impingement; (3) and the prevalence of posterior impingement differ between hips with increased FV and a control group using patient-specific 3D-CT.
Methods and Materials: Osseous 3D-models based on 3D-CT scans were reconstructed of 52 hips (38 symptomatic patients) with positive posterior impingement test and increased FV(>35°). They were mainly female patients (96%) with a mean age ranging from 23 to 38 years. These included 26 hips with an increased McKibbin instability index >70. The control group consisted of 20 hips with normal FV, normal AV and no valgus (CCD-angle<139°). Validated 3D-CT based collision-detection software for impingement-simulation was used to calculate impingement-free ROM and location of hip impingement.
Results: (1) Hips with increased FV had significantly ($p<0.001$) decreased extension and ER in 90° of flexion compared to the control group.
(2) Posterior impingement was located (92%) extraarticular in hips with increased FV and valgus hips with increased FV and AV had combined intra-and extraarticular impingement.
(3) Posterior hip impingement occurred between the ischium and the lesser trochanter in 20° of extension and 20° ER. Impingement was located between the ischium and the greater trochanter or intertrochanteric area in 20° of flexion and 40° ER(FABER test).
Conclusion: Posterior extraarticular hip impingement can be caused by the lesser and the greater trochanter or the intertrochanteric region. Posterior impingement is an additional cause for hip pain in female patients with high FV. 3D-CT can help for surgical planning such as femoral derotation osteotomy and/or hip arthroscopy.

A-364

Dual-energy computed tomography versus ultrasound, alone or in combination, for the diagnosis of gout: A prospective study of accuracy

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Purpose: To examine the accuracy of dual-energy computed tomography (DECT) versus ultrasound or their combination for the diagnosis of gout.
Methods and Materials: Using prospectively collected data from an outpatient rheumatology clinic at a tertiary-care hospital, we examined the diagnostic accuracy of either modality alone or their combination, by anatomical site (feet/ankles and/or knees), for the diagnosis of gout. We used two standards: (1) demonstration of monosodium urate crystals in synovial fluid (gold), and (2) modified (excluding DECT and ultrasound) 2015 ACR-EULAR gout classification criteria (silver).
Results: Of the 147 patients who provided data, 48 (33%) had synovial fluid analysis performed (38 were MSU-crystal positive) and mean symptom duration was 9.2 years. 100 (68%) patients met the silver standard. Compared to the gold standard, diagnostic accuracy statistics for feet/ankles DECT, feet/ankles US, knees DECT, and knees ultrasound were: sensitivity, 87%, 84%, 91%, 58%; specificity, 100%, 60%, 87%, 80%; PPV, 100%, 89%, 97%, 92%; NPV, 67%, 50%, 70%, 33%; AUC, 0.93, 0.72, 0.89, 0.66. Combining feet/ankles DECT with ultrasound or knees DECT with ultrasound led to a numerically higher sensitivity compared to DECT alone, but overall accuracy was lower. Similarly, combining imaging knees to feet/ankles also yielded a numerically higher sensitivity and NPV compared to feet/ankles DECT alone, without differences in overall accuracy. Findings were replicated compared to the silver standard, but with lower numbers.
Conclusion: Feet/ankles or knees DECT alone had the best overall accuracy for gout diagnosis. DECT/US combination or multiple joint imaging offered no additional increase in overall diagnostic accuracy.

A-326

Insertion of implantable vascular access devices (IVAD) in the upper arm with lateral placement of reservoir

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Purpose: To improve quality of insertion of IVAD in the upper arm by standardisation of lateral placement of reservoir, and investigate feasibility, outcome and use.
Methods and Materials: Patients unsuitable for thoracic IVAD received port implantation in the upper arm. After selection of the most suitable vein, ultrasound-guided puncture was performed in middle third of the upper arm. Reservoir-pocket was created laterally between triceps and biceps muscle over humerus as counterfort. Catheter position was verified with fluoroscopy. Reservoir was stitched to the deep subcutaneous tissue with two sutures to avoid flipping. Wound was closed with resorbable stitches on two layers.
Data was analyzed prospectively; descriptive statistics were used.
Results: From October 2017 until January 2019, thirty-one IVAD's were implanted in the proximal upper extremity (20 right-sided, 11 left-sided). 4 patients passed away due to underlying disease. All IVAD were inserted through the basilic vein, except for one (brachial vein). Mean indwelling time was 325 days (±181 days). Six had complications (Deep vein thrombosis (n=1), occlusion (n=1), cellulitis (n=1), discomfort (n=2), catheter puncture (n=1). Nine were removed (3 complications, 6 therapy completed). Removal was uneventful for all. Lateral position of reservoir was reported to be easily accessible and simple in use and was well accepted by patients and nursing staff.
Conclusion: Quality improvement of insertion of IVAD in the upper arm was achieved by standardisation of lateral placement of reservoir, proving feasible, providing safe outcome and enabling simple use.

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Comparison of two ECG guided PICC insertion techniques: Interim analysis of randomized controlled trial

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Purpose: PICC (Peripherally Inserted Central Catheter) is a very commonly used medical device. The PICC tip position has been shown to be a major determinant in PICC function and related complications.
While the gold standard for optimal tip position is fluoroscopy guidance, recent advances introduce ECG guidance techniques that use no x-ray and might be used as a bedside approach.
The aim of our study is to compare two ECG techniques for guiding PICC in terms of accuracy of the final position of the catheter tip.
Methods and Materials: A total of 320 participants will be enrolled in a randomized open study using 1:1 allocation.
One PICC guidance technique uses ECG signal transmission with saline water and allows external catheter length adjustment (ECG1) while the other technique uses a guidewire for signal transmission thus requiring prior catheter length adjustment (ECG2). These techniques will be compared using chest X-rays (CXR) as a gold standard.
Primary outcome is the distance from catheter tip to cavo-atrial junction (DCAJ) measured on CXR. Secondary outcomes are length of the outgoing catheter at the entry point and hemostasis time at the puncture site.
Results: Seventy patients are included. The interim analysis showed that PICC tip precision in the superior vena cava are equivalent for both techniques (ECG1: DCAJ mean 1.06 cm; 95% CI: 0.79-1.39; ECG2: DCAJ mean 0.93 cm; 95% CI: 0.70-1.17; p=0.61).
ECG1 is significantly better than ECG2 regarding the length of the outgoing catheter at the entry point (mean 0.027 cm vs. 1.73 cm; p=0.001).
ECG2 is significantly better than ECG1 regarding the hemostasis time at the puncture site (no delay hemostasis in achieved in 88% cases vs. 62%; p=0.027).
Conclusion: ECG guiding technologies are comparable regarding the tip placement. Nevertheless, each technique has an important drawback at PICC insertion point, the length of the outside catheter for ECG2 or a delayed hemostasis ECG1.

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Silicone based PTCD Simulator

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Purpose: To develop a percutaneous transhepatic cholangiography (PTC) simulator with technical and anatomical accuracy that can be used in the set of fluoroscopic and ultrasound guided interventions training, using the same tools as in real life practice.
Methods and Materials: We created a 3D printed silicon liver model with hollow intrahepatic bile ducts based on a manual segmentation of a triphasic computed tomography (CT) scan. The simulation was performed in the angio-suite using all relevant radiological protection, the participants were able to puncture the biliary tree with ultrasound or with fluoroscopic guidance, using different angles of the C-arm. For the puncture we used a 20G Chiba needle attached to an extensor tube and a syringe with iodine contrast. After a successful puncture of the biliary tree, the normal workflow of a PTC procedure was performed under the instructions of the authors, this included the use of the NEFF set, the exchange of guidewires and placement of a drainage catheter. Every trainee was protected by a lead apron and was able to practice the eye-hand coordination fluoroscopically seeing the image on the monitor in real time. The simulator was tested in Switzerland with 20 participants from different hospitals. The experience of the participants varied from no previous experience in IR to several years of experience. After using the model, the participants evaluated the simulation through a questionnaire.
Results: The silicone based PTC simulator was significantly better rated in terms of applicability and closeness to reality than our previous efforts. Most of the participants felt more confident and better trained for performing a PTCD in a real patient.
Conclusion: This proves the importance of simulation devices for helping the medical trainees to achieve skills and manage situations without putting a patient on risk.

A-168

Efficacy and feasibility of navigated percutaneous thermoablation of Kkdney tumors

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Purpose: Standard treatment of renal tumor stage T1 (< 7 cm) is surgical exstirpation. However, less invasive treatment options are becoming increasingly safe and effective, especially in the case of surgical contraindications. Thermoablation provides an alternative to nephron-sparing surgery in patients with comorbidities precluding surgery, multiple tumors in one kidney or solitary kidney. The purpose was to evaluate the outcome of thermoablation executed in our hospital.
Methods and Materials: Between 2016 and 2019 5 patients were treated with Microwave Ablation and 4 patients with Radiofrequency Ablation: 8 Renal Cell Carcinomas (6 patients with pre-interventional tumor nephrectomies: 2 relapses in ipsilateral renal bed, 4 contralateral tumors) and 1 Von-Hippel-Lindau-Syndrome with multiple tumors and the purpose of reducing tumor volume. Mean patient age was 65 years (5 female, 4 male), mean tumor diameter 24 mm, mean ablation time 8 minutes, mean wattage 90 W.
All Patients received pre-procedure clinical consulatation and imaging with contrast-enhanced CT/MRI. The thermoablation was performed under general anesthesia in a CT suite. For accurate antenna placement a planning scan and the CAS-One System (CAScination) were used. Emprint Ablation Antennas (Medtronic) were placed with the guidance of multiplanar views, ablation needle-eye and needle trajectory views. With the fusion of pre-ablation planning and post-ablation control scans the antenna placement and tissue destruction were monitored.
Results: In post-procedure contrast-enhanced CTs (6 patients, 3–11 months post-ablation) no residual enhancing area, vital malignant tissue or new tumor masses were detected. All lesions were stable or decreasing in size. No complications (Clavien-Dingo grade I–V) were observed in clinical follow-ups.
Conclusion: Thermoablation is a minimally invasive, feasible, effective and safe treatment option for patients with small renal tumors and a reasonable alternative to surgery.

A-292

Safety of Viabahn endoprosthesis for endovascular exclusion of common femoral artery pseudoaneurysm: A single-center study

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Purpose: To demonstrate the safety and efficacy of Viabahn stent-graft for exclusion of common femoral artery pseudoaneurysm as a complication of vascular access.
Methods and Materials: We retrospectively evaluated all patients who underwent Viabahn stent-graft placement for endovascular treatment of common femoral artery pseudoaneurysm following groin vascular access from January 2016 until March 2019.Patients without follow-up (F/U) in our department, were excluded from the study. The technical success, hospitalization day, 30-day mortality rate, and long-term F/P were reviewed. The patency of stent-graft was evaluated based on color duplex ultrasound results and symptoms of lower limb ischemia according to Rutherford classification, during F/U.
Results: A total number of 16 patients (14 men) were recruited in the study. The age of the patients ranged between 67-79 years-old (66±17). All patients underwent a Viabahn stent-graft deployment as the primary intention with the technical success rate of 100%. All patients were discharged 6 hours after the procedure as a routine out-patient protocol in our department without need for further hospitalization and no 30-day mortality was observed among patients. Long-term F/U revealed recurrent claudication in 2 patients, due to external iliac artery stenosis with Viabahn patency. Duplex ultrasound was unremarkable with no stent occlusion/stenosis, kinking or fracture.
Conclusion: Viabahn stent-graft deployment is safe and efficient in the treatment of common femoral artery pseudoaneurysm. It can be considered as an accepted method to replace the surgical approach especially in medical high-risk patients, morbid obesity and severe groin scar.

A-359

Thermal ablation of the posterior nerve roots using MR-HIFU to treat refractory Sacroiliac Joint Dysfunction

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Purpose: The sacroiliac joint (SIJ) is the culprit in 15–30 % of patients with chronic lumbar back pain. For SIJ dysfunction refractory to conservative therapy, thermal ablation of the posterior lumbosacral nerves innervating the affected joint has proven to be effective. This is classically performed by radiofrequency ablation. We conducted a retrospective study to assess the feasibility, safety, and effect of MR-HIFU in the treatment of SIJ pain.
Methods and Materials: Patients with chronic moderate refractory SIJ dysfunction with appropriate temporary response to CT-guided intraarticular anesthetic injection (i.e. ≥2 points) were treated. Treatment success was evaluated by changes in the visual analogue score (VAS) as well as changes in medication. Adverse events were also recorded. Parameters were assessed at baseline and 1 month after treatment.
Results: Thirteen patients and 16 SIJs were treated at our institute between June 2018 and September 2020. Patients included 9 females and 4 males with an average age of 70 [34-80]. Eight out of 13 (62 %) had prior back or hip surgery. All interventions were performed using spinal anesthesia. Mean VAS was 61.7 +/- 21.9 before intervention and 27.4 +- 23.3 after intervention (p=0.004 using the Wilcoxon Signed-Rank Test). Of the patients that chronically used to take pain medication, 5/8 (62.5 %) took none or less medication post-interventionally. There were no adverse events.
Conclusion: MR-HIFU is a safe and effective treatment for chronic low back pain resulting from SIJ dysfunction and due to its non-invasive nature should be considered as first-line thermal ablation method.

A-215

Evaluation of possible effectiveness and detriment of using patient lead pad for reducing staff dose in interventional radiology

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Purpose: To evaluate the usefulness of commercially available scatter reduction lead pads on staff radiation exposures in interventional radiology.
Methods and Materials: For this study an Alderson radiation therapy phantom, was irradiated in our Siemens Artis Icono angiograph device in three scenarios of protective pad usage (no use of the protective pad, correct use of the pad and incorrect use of pad). Different levels of incorrect pad positioning (pad covering the FOV) were also evaluated: 5 %, 15 % and 50 % of the FOV. A Raysafe i3 real-time dosimeter system was used to evaluate accumulative dose (mSv) and dose rates (mSv/h). Dosimeters positions simulated operator's left eye (closer to the x-ray tube), over the lead apron, and thyroid. Doses and dose rates were compared in respect to its usefulness (dose reduction) or detriment (higher dose). Additionally, patient exposure was evaluated by the procedure DAP.
Results: Operator doses ranged from 3.15 ± 0.04 µSv to 67.89 ± 2.92 µSv (over the lead apron); from 0.43 ± 0.01 to 16.43 ± 0.91 µSv (thyroid); and from 1.52 ± 0.08 to 44.77 ± 1.83 µSv (left eye). In terms of dose, at the perfect positioning of the pad (no FOV obstruction) we obtained in average 68 % dose reduction compared to 67 % (5 % FOV obstruction), 63 % (15 % obstruction) and an average dose increase of 779% (50% obstruction). This pattern was observed for all dosimetry locations. Similar order of magnitude was observed to the patient exposure.
Conclusion: Our results showed that exposure reduction (around 60 %) for the operator is possible when these protective pads are used, however, the incorrect use may introduce a detriment in both operator and patient exposure.

A-227

Deep learning for automatic quantification of lung abnormalities in COVID-19 patients: First experience and correlation withclinical parameters

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Purpose: To demonstrate the first experience of a deep learning-based algorithm for automatic quantification of lung parenchymal abnormalities in chest CT of COVID-19 patients and to correlate quantitative results with clinical and laboratory parameters.
Methods and Materials: We retrospectively included 60 consecutive patients (mean age, 61 ± 12 years; 18 females) with proven COVID-19 infection undergoing chest CT between March and May 2020. Clinical and laboratory data (within 24 h before/after chest CT) were recorded. Prototype software using a deep learning algorithm was applied for automatic segmentation and quantification of lung opacities. Percentage of opacity (PO, ground-glass and consolidations) and percentage of high opacity (PHO, consolidations), were defined as 100 times the volume of segmented abnormalities divided by the volume of the lung mask.
Results: Automatic CT analysis of the lung was feasible in all patients (n=60). The median time to accomplish automatic evaluation was 120 s (IQR: 118–128 s). In four cases (7%), manual corrections were necessary. Patients with need for mechanical ventilation had a significantly higher PO (median 44%, IQR: 23–58% versus 13%, IQR: 10–24%; p = 0.001) and PHO (median: 11%, IQR: 6–21% versus 3%, IQR: 2–7%, p = 0.002) compared to those without. The PO and PHO moderately correlated with c-reactive protein (r = 0.49– 0.60, both p < 0.001) and leucocyte count (r = 0.30– 0.40, both p = 0.05). PO had a negative correlation with SO2 (r=– 0.50, p = 0.001).
Conclusion: Preliminary experience indicates the feasibility of a rapid, automatic quantification tool of lung parenchymal abnormalities in COVID-19 patients using deep learning, with results correlating with laboratory and clinical parameters.

A-298

AI software for the detection of pulmonary embolism on CT angiography – A preliminary study

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Purpose: To evaluate the proficiency of an AI software in the detection of pulmonary embolism (PE) on pulmonary CT angiography (CTA).
Methods and Materials: All consecutive pulmonary CTAs performed in our emergency radiology unit for clinically suspected PE over a 12-weeks period of time were automatically sent to an AI software, which highlighted the AI-detected positive cases. Retrospectively, the results from the AI software were compared to the final CTAs interpretations made by the attending radiologists, considered the reference standard.
Results: 231 CT examinations were included in the analysis, 15% (34/231) of them were positive for PE at final interpretation. AI software had a sensitivity of 85% (29/34, (95% CI 68%–94%)) and a specificity of 100% (197/197, (95% CI 98%–100%)) in detecting pulmonary embolism. The 5 false-negative cases from the AI software were related to concomitant lung pathologies (N=3), distal sub segmental localization of the PE (N=1) and unsatisfactory vessel opacification (N=1).
Conclusion: The AI software shows promising results for the automatic detection of PE and may be a valuable tool in assisting the radiologist for a fast and reliable diagnosis of this pathology.

A-304

Automated pulmonary vessel segmentation in chest CT: Morphology analysis in SARS-CoV-2 and influenza virus.

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Purpose: To assess whether small vessels volume analyses could be used to differentiate Covid-19 from Influenza and normal lungs patients.
Methods and Materials: The retrospective study was approved by the institutional review board.
All consecutive patients who underwent a non-enhanced pulmonary CT (NECT) within 7 days before or after being diagnosed for COVID-19 using RT-PCR have been included as group 1 (time period: 01.03.2020–06.11.2020). All consecutive patients RT-PCR positive for Influenza A or B who underwent NECT were also included as group 2 (time period: 14.01.2014–03.04.2020). A control group (3) includes patients with normal lungs according to the radiology report and RT-PCR negative for COVID-19 and Influenza A/B. All CT images were processed by an algorithm for lung segmentation (Retina-U-Net) and interpolated to the same resolution (0.7 mm isotropic). A vessel segmentation algorithm to trace pulmonary vessels and a « neighbours counting » algorithm to assess the vessels size were applied. The « neighbours counting » algorithm performed a cube of 7 x 7 x 7 voxels size around every central voxel in the vessels. Small vessels were defined by a total neighbour count lower than 50. The mean ratio of small vessels volume/all vessels volume (SVV/AVV) was compared between the three groups.
Results: During the study period, 155 patients were included in group 1 (mean age = 60), 85 in group 2 (mean age = 60) and 217 in group 3 (mean age = 50). The mean SVV/AVV was: 0.19 in group 1, 0.22 in group 2 and 0.27 in group 3. The observed differences between group 1 and 2, group 1 and 3 and group 2 and 3 were all significant (p<.005).
Conclusion: Our data suggests that the mean SVV/AVV was significantly lower in COVID-19 patients when compared to patients with Influenza or normal lungs. This observation supports the notion that COVID-19 might be a combination of both pulmonary and vascular disease. Moreover, it could open new perspectives for CT diagnosis of this disease.

A-231

Automated CT lung density analysis of viral pneumonia and healthy lungs using deep learning-based segmentation, histograms and HU thresholds

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Purpose: To evaluate common histogram parameters and Hounsfield Unit (HU)-thresholds from scientific literature for the assessment of lung opacities in atypical pneumonia.
Methods and Materials: Patients with a positive RT-PCR-test for SARS-CoV-2 or Influenza A/B between 01/2014–07/2020 and a chest CT scans without contrast (NECT) acquired maximally seven days before or after the RT-PCR result were included into the analysis. Additionally a matched healthy control group was established. CTs were processed with a deep convolutional neural network (DCNN; Retina-U-Net) to segment the whole lung and histogram analysis was performed. Subsequently, multiple HU-thresholds (a) -600 to 0; b) -600 to -250; c) -700 to -250; d) -800 to -500) were applied to the lungs to determine the ratio of lung affected by lung opacities [in %]. The results were correlated with the laboratory marker CRP and a WHO clinical severity scale based on the patients` need for oxygen therapy (1-no oxygen therapy; 2-oxygen mask; 3-non-invasive ventilation; 4-mechanical ventilation; 5-ECMO). For statistical analysis, mutual information modelling, Kruskal-Wallis-test and Spearman rank correlation were used.
Results: The mean % lung opacities for the HU thresholds in AP were as follows: a) 13.3%; b) 9.3%; c) 15.7%; d) 26.7%. Mutual information identified a) HU and b) HU respectively as the strongest classifying thresholds. Standard deviation, skewness, kurtosis, mean and median were the strongest histogram derived parameters to classify between normal and atypical pneumonia. Both CRP and the clinical severity scale showed the highest correlation with the opacity quantification resulting from threshold a) (r=0.60 and r=0.56, respectively).
Conclusion: Several histogram parameters and HU-thresholds classify best between healthy lungs and those affected by AP. There is evidence that threshold a) shows the highest clinical relevance.

A-195

Postmortem CT features of lungs of COVID-19 cases

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Purpose: Being aware of the clinical imaging features of the new coronavirus disease (COVID-19), we were curious to analyze post-mortem CT features of SARS-CoV-2 pneumonia cases and compare them with those encountered on living patients.
Methods and Materials: In our study we analyzed ante- and post-mortem CT-images of SARS-CoV-2 pneumonia cases in a medico-legal (N=15) and clinical pathology collective (N=5). It was a retrospective interpretation of prospectively acquired data between March and October 2020, still in progress when submitting abstract.
Results: As observed in living cases, ground-glass opacities and consolidations are the most frequent observations on post-mortem MDCT, with air bronchogram. But the detection of ground-glass opacities is not rare in postmortem imaging and this is mainly related to the presence of hypostasis (livor mortis).
Conclusion: Post-mortem MDCT is useful to screen SARS-CoV-2 pneumonia cases, prepare the autopsy and guide samples. But caution is required since one of the major signs, namely ground-glass opacities, are frequently encountered in post-mortem imaging as the manifestation of livor mortis. However, one of the discriminating criteria seems to be the frank and decline distribution.

A-330

Coronary calcium score: Incremental prognostic value for all-cause mortality after transcatheter aortic valve replacement

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Purpose: To determine the value of the coronary artery calcium (CAC) score for the prediction of 30-day and one-year mortality in patients undergoing transcatheter aortic valve replacement (TAVR).
Methods and Materials: In this IRB-approved study of a prospective registry, we retrospectively evaluated patients undergoing non-enhanced cardiac CT before TAVR between May 2008 and September 2019. Clinical data including the composite EuroSCORE-II (European System for Cardiac Operative Risk Evaluation; consisting of 18 patient, cardiac and operation-related factors) was recorded. The CAC score was determined in all patients without prior coronary revascularization using a commercially available software platform. 30-day and one-year all-cause mortality were assessed using Kaplan-Meier and Cox regression analyses.
Results: Totally, 564 patients (median age 81 years; interquartile range 77-85 years; 293 men). 255 of the 564 patients (45%) had coronary revascularization prior to TAVR. Patients with previous revascularization had a 51% lower risk of mortality than patients without (hazard ratio (HR) 0.49, 95% CI 0.27-0.89, p=0.019). In the 309/564 patients (55%) without revascularization, those with a CAC score ≥1000 (n=77) had a higher 30-day and one-year mortality (log-rank p<0.001, both). A CAC score ≥1000 (HR 4.54, 95% CI 1.51-13.6; p=0.007 and HR 4.33, 95% CI: 1.47-12.73; p=0.008 compared to patients with CAC <1000 and 0-99, respectively) and the EuroSCORE-II (HR 1.22, 95% CI 1.1-1.36; p<0.001 and HR 1.16, 95%CI 1.08-1.25; p<0.001) were independent predictors of 30-day and one-year mortality. Adding the the CAC score provided incremental prognostic value for one-year mortality after TAVR over the EuroSCORE-II alone (p=0.004).
Conclusion: In patients without foregoing coronary revascularization, the CAC score represents an independent predictor of 30-day and one-year all-cause mortality after TAVR.

A-164

Deep neural network provides human reader level accuracy in quantifying vessel-specific coronary artery calcium scoring

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Purpose: To validate a fully automated, deep-learning (DL) based branch-wise coronary artery calcium (CAC) scoring algorithm.
Methods and Materials: We retrospectively included 1173 patients from three different centers who were referred for a CAC computer tomography (CT) examination. Each dataset was fully automatically evaluated by the DL-based software solution. The total CAC score and sub-scores per coronary artery (CA) branch were outputted for RCA, LM, LAD and CX. Total CAC scores for each case were manually evaluated by a human reader. Established CAC cut-offs were used for risk group assignments: < 1, 1-10, 11-100, 101-400 and > 400. Furthermore, three readers independently manually scored the CAC for all CA branches for 300 case and formed the consensus using a majority vote rule, serving as the reference standard. The accuracy of branch labeling was evaluated using Cohen's kappa statistic and the intraclass correlation coefficient (ICC).
Results: The DL-based software solution yielded a class accuracy of 93% (1086/1173) (< 1: 93%, 1-10: 80%, 11-100: 93%, 101-400: 98% and >400: 94%) with a sensitivity, specificity and accuracy of detecting non-zero coronary calcium being 97%, 93% and 95%. The median error between the two methods was 0 (IQR 0-1.3). The overall accuracy for branch label classification was 94% (LM: 89%, LAD: 91%, CX: 93%, RCA: 100%) with a Cohen's kappa of k = 0.91.
Conclusion: As vessel-specific CAC scoring is not routinely performed in many centers, the DL-based may enable such procedures in a consistent manner. Reporting on a vessel-specific level enables superior risk stratification of patients, especially with regards to left main CAC.

A-336

Whole heart cardiac cine radial MR image reconstruction using Deep Neural Network (DNN)

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Purpose: Cartesian acquisition multi-slice, multiple breath-hold ECG-gated cine MRI is standard in clinical CMR. Undersampled non-Cartesian (NC) acquisitions reduce imaging time but need an extra gridding step. We propose an efficient U-Net with GROG and NUFFT for multislice whole heart, accelerated radial cardiac cine MRI to reconstruct artifact-free images.
Methods and Materials: Non-uniform fast Fourier Transform (NUFFT), uses interpolation with min-max kernel, and GRAPPA Operator Gridding (GROG), uses self-calibrated multi-coil weight sets, to map NC data onto a Cartesian grid.
The DNN U-Net was trained on 7200 cine images resampled with an acceleration factor between 7 and 13. Convolutional layer weights are set to zero with standard deviation 0.05. The loss function minimized via RMSProp with learning rate of 1×10-4 on Python 3.8 (Keras) using TensorFlow, batch size =5, epochs =400 with early stopping criteria and 10 hours training.
The proposed NUFFT U-Net was tested on 4 patients data and compared with the GROG U-Net. Image quality was evaluated by AP, RMSE and SSIM. A blinded expert assessed image quality, accuracy, sharpness, blood-to-myocardium contrast, temporal contraction, (ranked 1-5; Poor-Excellent) and artifacts (1-5 Absent-Severe).
Results: The average score for visual assessment was better for the proposed method (3.69±0.90) than for the GROG U-Net (3.63±1.09) ($p< 0.05$). A myocardium wall distortion was visible in GROG U-Net while NUFFT U-Net recovers maximum details. The proposed NUFFT U-Net has an improvement of the imaging quality parameters of 31% in AP, 22% in RMSE and 4% in SSIM by comparison to the GROG U-Net ($p < 0.05$).
Conclusion: The deep learning-based reconstruction NUFFT U-Net recovers cardiac images better than the GROG based approach and is a promising method for highly accelerated cardiac cine.

A-354

Analysis of segmental strain for the detection of chronic ischemic scars in non-contrast cardiac MRI cine images

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Purpose: Tissue strain-based techniques for detecting scar tissue after myocardial infarction should be further developed, since gadolinium is contraindicated in some patients groups. The aim was to investigate detection of impaired segmental strain of infarcted tissue based on non-contrast cine images.
Methods and Materials: Global (global peak circumferential [GPCS], longitudinal [GPLS], radial [GPRS] strain) and segmental (peak segmental circumferential [PSCS], longitudinal [PSLS], radial [PSRS]) strain was calculated in 46 patients with chronic scars (5 female, 52 ± 19 years) and 24 controls (2 female, 47 ± 13 years) in cine sequences (Segment CMR, Medviso, Sweden). Two independent readers localized potentially infarcted segments from PSCS calculations (endo-/epicardial contoured cine short axis stack and resulting polar plot strain map) blinded to LGE images.
Results:
GPCS, GPLS and GPRS were reduced in patients compared to controls (p= 0.02, p= 0.04, p= 0.01). PSCS was impaired in subendocardially (- 5,4% +/- 2) and transmurally infarcted segments (- 1,2% ± 3) compared to remote myocardium (-12,9% +/- 3, p= 0.02 and 0,04). ROC analysis revealed an optimal cut-off for PSCS for discriminating infarcts from remote tissue of -7,2% (sensitivity 89,4%, specificity 85,7%). PSRS was impeded in transmurally infarcted segments compared to remote myocardium (15,9% +/- 6 vs. 31,4% +/- 5; p= 0,04) with optimal cut-off value for discriminating scar from remote myocardium of 16,6% (sensitivity 83,3%, specificity 76,5%). 121 from 147 infarcted segments (82,3%, ICC 0.904) diagnosed in LGE images were correctly localized by two independent readers in circumferential strain calculations.
Conclusion: Ischemic scars show impaired segmental circumferential and radial strain compared to remote myocardium and can thus be intraindividually recognized in circumferential strain calculations based on non- contrast short axis cine and resulting polar plot strain maps.

A-234

Primary staging in patients with intermediate- and high-risk prostate cancer: Multiparametric MRI versus ^{68}Ga-PSMA-PET/MRI – Is there an added Value of ^{68}Ga-PSMA-PET?

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Purpose: To compare multiparametric prostate MRI (mpMRI) and ^{68}Ga-PSMA-PET/MRI in primary TNM staging of prostate cancer (PCa).
Methods and Materials: 49 patients with histologically confirmed PCa who underwent PET/MRI and mpMRI within 6 months were included. Four radiologists rated extraprostatic extension (≥T3), regional lymph node metastasis (N1), non-regional lymph node metastasis (M1a) and bone metastasis (M1b) on a Likert-scale. A fifth reader measured tumor volume (V_T2), maximum diameter (d_T2), capsular contact length on T2-weighted images (l_T2), mean ADC value (ADCmean), tumor volume on ADC maps (V_ADC). Interobserver-agreement was assessed and diagnostic accuracy was determined using radical prostatectomy (35/49 patients) as reference standard.
Results: Interobserver-agreements for mpMRI and PET/MRI were: ≥T3: k=0.58/0.47; N1: k=0.55/ 0.74; M1a: k=0.46/0.70; M1b: k=0.41/1. Diagnostic accuracy for mpMRI readers vs PET/MRI readers were: ≥T3: AUC 0.72, 0.62 vs 0.71, 0.72 (p>0.38); sensitivity, 0.69, 0.53 vs 0.54, 0.62; specificity 0.81, 0.82 vs 0.87, 0.77. N1: AUC 0.39, 0.55 vs 0.72, 0.78 (p<0.05); sensitivity 0.00, 0.33 vs. 0.44, 0.56; specificity 1.00, 0.81 vs 1.00, 1.00. Significantly different quantitative parameters were V_T2, d_T2, l_T2 and V_ADC for both stages ≥ T3 and N1 resulting in a diagnostic accuracy of: ≥ T3: AUC 0.70, 0.71, 0.72, 0.72; sensitivity 0.80, 0.60, 0.67, 0.80; specificity 0.58, 0.77, 0.66, 0.62. N1: AUC 0.71, 0.73, 0.72, 0.73; sensitivity 1.00, 0.64, 0.82, 0.91; specificity 0.37, 0.80, 0.67, 0.60.
Conclusion: Interreader-agreement regarding ≥ T3 was slightly higher for mpMRI than for PET/MRI while for N1, M1a and M1b, it was slightly higher for PET/MRI. There was no added value of PET/MRI for diagnostic accuracy of stage ≥T3 while diagnostic accuracy for N1-status was higher in PET/MRI than mpMRI. Quantitative measures from mpMRI demonstrated similar or higher AUC and sensitivity than PET/MRI in ≥ T3 and N1.

A-178

Improving image quality of DWI of the prostate: Enema vs. catheter preparation

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Purpose: To compare image quality of diffusion-weighted imaging (DWI) of the prostate in patients undergoing either a preparatory laxative enema or suction through a small catheter immediately before the exam.
Methods and Materials: Two hundred consecutive patients were retrospectively enrolled with 100 patients each undergoing either enema or catheter preparation before imaging. Two blinded readers (R1 = 4 years and R2 = 5 years of experience in pelvic MRI) independently evaluated three aspects of image quality using five-point Likert scales. The level of inter-rater agreement was determined using Cohen's kappa. Image quality scores were compared between groups using Wilcoxon rank sum tests and multivariable logistic regression was utilized to determine the influence of potentially confounding factors. Image distortions were quantified by comparing the maximum diameters of the prostate on DWI and T2-weighted imaging.
Results: Significantly higher image quality was observed in patients with enema preparation with regard to the severity of susceptibility-related artifacts (R1: 0.34 ± 0.77 vs. 1.73 ± 1.34, R2: 0.38 ± 0.86 vs. 1.76 ± 1.39), the differentiability of the anatomy (R1: 3.36 ± 1.05 vs. 2.08 ± 1.31, R2: 3.37 ± 1.05 vs. 2.09 ± 1.35), and the overall image quality (R1: 3.66 ± 0.77 vs. 2.26 ± 1.33, R2: 3.59 ± 0.87 vs. 2.23 ± 1.38). The level of inter-rater agreement was almost perfect for all image quality scores. Neither age, prostate volume, nor prostate specific antigen values were significant predictors for either of the image quality scores and significantly fewer substantial image distortions were observed in the enema group, with odd ratios of 0.051 and 0.084 for the two readers. In patients with enema preparation, the quantitative analysis revealed a higher agreement of the prostate diameters in the phase encoding direction.
Conclusion: Enema preparation immediately before the exam is superior to catheter preparation and yields substantial improvements in image quality of DWI of the prostate.

A-154

Value of bowel preparation techniques for prostate MRI

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Purpose: To investigate the value of hyoscine N-butylbromide (HBB), microenema (ME) and 'dietary restrictions' (DR) for artifact reduction and image quality (IQ) in multiparametric MRI (mpMRI) of the prostate.
Methods and Materials: Between 10/2018 and 02/2020 treatment-naïve men (median age, 64.9; range 39.8-87.3) who underwent mpMRI of the prostate at a 3T MR scanner at our institution were included in this retrospective study. The total patient sample comprised of n=180 patients, who received either HBB, ME, were instructed to adhere to DR, or received a combination of those measures prior to the MR scan. A radiologist specialized in urogenital imaging (R1) and a senior radiology resident (R2) visually assessed IQ parameters on transversal T2w, DWI and ADC maps on a 5-point Likert-like scale. Group comparison between IQ parameters was performed on reader level using Kruskal Wallis and Mann-Whitney-U tests. Binary univariate logistic regression analysis was used to assess independent predictors of IQ.
Results: 'DWI geometric distortion' was significantly more pronounced in the HBB+/ME- (R1, 3.6 and R2, 4.0) as compared to the HBB-/ME+ (R1, 4.2 and R2, 4.6) and HBB+/ME+ (R1, 4.3 and R2, 4.7) cohort, respectively. Parameters 'DWI IQ' and 'Whole MRI IQ' were rated similarly by both readers. ME was a significant predictor of 'good IQ' for the whole MRI for R1 (b=1.09, OR 2.98 [95% CI: 1.29, 6.87]) and R2 (b=1.01, OR 2.73 [95% CI: 1.24, 6.04]), respectively.
Conclusion: ME seems to significantly improve image quality of DWI and the whole mpMRI image set of the prostate. HBB and DR did not have any benefit.

A-182

Improving workflow in prostate MRI: Realtime AI-based decisionmaking on biparametric or multiparametric MRI

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Purpose: Discussions regarding the use of biparametric vs. multiparametric prostate MRI are ongoing in prostate imaging and no final decision has been reached. However, there is general agreement that biparametric MRI may only be considered if image quality of remaining sequences is adequate. The purpose of this study was to develop and validate an artificial intelligence algorithm to decide on the necessity of dynamic contrast-enhanced sequences (DCE).
Methods and Materials: This study was approved by the institutional review board and requirement for study-specific informed consent was waived. A convolutional neural network (CNN) was developed on 300 prostate MRI examinations. Radiologists' decision on the necessity of DCE acted as reference standard. The CNN was validated in a separate cohort of 100 prostate MRI examinations from the same vendor and 31 examinations from a different vendor. Sensitivity/specificity were calculated using ROC curve analysis and results were compared to decisions made by a radiology technician.
Results: The CNN reached a sensitivity of 94.4% and specificity of 68.8% (AUC: 0.88) for the necessity of DCE, correctly assigning 44%/34% of patients to a biparametric/multiparametric protocol. In 2% of all patients, the CNN falsely decided on omitting DCE. With a technician reaching a sensitivity of 63.9% and specificity of 89.1%, the use of the CNN would allow for an increase in sensitivity of 30.5%. The CNN achieved an AUC of 0.73 in a set of examinations from a different vendor.
Conclusion: The CNN was able to decide on biparametric vs. multiparametric MRI protocol with high precision and would have correctly assigned 78% of patients to a biparametric or multiparametric protocol, with only 2% of all patients requiring re-examination to add DCE sequences. Integrating this CNN in clinical routine could render the requirement for on-table monitoring obsolete while maintaining diagnostic performance by performing contrast-enhanced MRI only when needed.

A-165

Autonomous detection and classification of PI-RADS lesions in an MRI screening population incorporating multicenter-labeled deep learning and biparametric imaging: Proof of Concept

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Purpose: To investigate if a deep-learning powered algorithm can be used for autonomous PI-RADS detection and classification in an image-guided, opportunistic PCa screening program.
Methods and Materials: We evaluated a prospectively enrolled cohort of 49 healthy men between 12/2018 and 06/2019 without prior clinical or laboratory suspicion for PCa, participating in a dedicated image-guided PCa screening trial. All participants underwent 3T MRI with a bpMRI protocol consisting of T2w and DWI sequences. The datasets were autonomously analyzed by an AI-based software solution using deep-learning (DL) designed to detect and characterize PI-RADS lesions. The algorithm had been trained on an independent dataset (2170 samples). AI results were automatically computed and compared with the clinically approved, written reports, serving as ground-truth. Agreement between the algorithm and the reports was compared on a per-case and per-lesion level using metrics of diagnostic accuracy and k statistics.
Results: The mean age ± standard deviation was 58 ± 8 years (range: 45-75) and the mean PSA-value was 2.68 ± 5.48 µg/ml (median: 1.07). The DL method yielded a 87% sensitivity (33/38) and 50% specificity (5/10) with a k of 0.42. 12/28 (43%) PI-RADS 3, 16/22 (73%) PI-RADS 4 and 5/5 (100%) PI-RADS 5 lesions were detected compared to the ground-truth. Targeted biopsy revealed PCa in six participants (Gleason Grade Group (GGG) 1: n=3, GGG 2 and 3: n=3), all identified correctly by both the human readers and AI.
Conclusion: The results of our study show that in our AI-assisted, image-guided prostate cancer screening the software solution was able to identify highly suspicious lesions and has the potential to effectively guide the targeted-biopsy workflow.

A-161

Gadoxetic acid MRI for assessment of HCC response to Yttrium 90 radioembolization: Correlation with histopathology.

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Purpose: To assess the diagnostic performance of gadoxetate-enhanced MRI for predicting complete pathologic necrosis (CPN) of hepatocellular carcinoma (HCC) after Yttrium 90 transarterial radioembolization (TARE), using histopathology as the reference.
Methods and Materials: This retrospective study included 48 consecutive patients (M/F: 36/12, mean age: 62y) with HCC treated by TARE followed by surgery (liver resection/transplantation: 14/34). All patients underwent gadoxetate MRI ≤90days of surgery. Two independent radiologists evaluated the following criteria: % of necrosis on subtraction images obtained during late arterial, portal venous and hepatobiliary phases, mRECIST, LI-RADS and apparent diffusion coefficient (ADC). Data were correlated to % necrosis on pathology. Inter-reader agreement for radiologic % necrosis was assessed using interclass correlation coefficient (ICC). ROC and DeLong analyses were used to determine and compare prediction of CPN. Correlation between radiologic and pathologic % necrosis was assessed using Pearson correlation.
Results: Histopathology demonstrated 71 HCCs (mean size: 2.8±1.7 cm) including 42 with CPN, 22 with partial necrosis and 7 with no necrosis. There was excellent inter-reader agreement for assessing radiologic degree of necrosis (ICC:0.82-0.89). Percentage of tumor necrosis, mRECIST, LI-RADS were all significant (p <0.0001) predictors of CPN (AUC: 0.80-0.82 for radiologic % necrosis and AUC: 0.71-0.73 for mRECIST and LI-RADS), with a significant difference observed between subtraction and LI-RADS (p=0.04) for reader 2. ADC was not a significant predictor of CPN (AUC: 0.63). Radiologic % necrosis was significantly correlated to histopathologic degree of tumor necrosis (r=0.66-0.8, p<0.0001).
Conclusion: Image subtraction, LI-RADS and mRECIST are all significant predictors of CPN in HCC treated with TARE, with superiority of subtraction over LI-RADS for one reader. Excellent correlation was found between radiologic and pathologic percentages of necrosis.

A-301

Multiparametric MRI for activity grading and staging of hepatic fibrosis: Role of T2-mapping, multi-gradient-echo MRI and MR elastography

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Purpose: To evaluate whether T2-mapping, multi-gradient-echo-sequence, and MR elastography (MRE) can diagnose activity grade and stage of hepatic fibrosis.
Methods and Materials: 60 patients with suspicion of hepatic fibrosis undergoing MRI at 3.0T - including T2-mapping, multi-gradient-echo-sequence for proton-density-fat-fraction (PDFF) and MRE - and liver biopsy between 2015 and 2019 were prospectively analyzed. ROIs were placed in the liver in the corresponding maps. Patients with probable iron overload were excluded (R2*>100s-1). Histologic inflammatory activity grading and fibrosis staging systems were applied according to underlying etiology and unified yielding activity grades G0-3 and fibrosis stages F0-4. The cohort was split into fatty liver disease (FLD) (n=26) and all other etiologies (non-FLD) (n=34). Descriptive statistics and ROC-analysis were performed.
Results: In the FLD group PDFF was significantly higher in G2-3 vs G0-1 (p=0.02) with an AUC=0.779. T2-values were not significantly different between grades (p=0.06). Stiffness was significantly higher when any fibrosis was present (p=0.008) with an AUC=0.887. T2-values (p=0.84) and PDFF (p=0.84) were not significantly different across F0-F4.
In the non-FLD group, PDFF and T2-values were similar across G0-3 (p=0.81; p=0.10) and F0-F4 (p=0.17; p=0.06). Stiffness was significantly higher when any fibrosis was present (p=0.02) with an AUC=0.827 and for clinically relevant fibrosis (F2-4 vs. F0-1: p<0.001) with an AUC=0.846.
Conclusion: PDFF may serve as marker for activity of FLD. MRE can identify fibrosis in FLD and in non-FLD. An independent role for T2-mapping could not be established.

A-172

T1 reduction rate with Gd-EOB-DTPA for liver function mapping in MRI – Comparison between 1.5T and 3T in a cross-sectional comparative study

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Purpose: To compare MRI T1 reduction rates between 1.5T and 3T for liver function mapping in a large cross-sectional comparative study.
Methods and Materials: 287 consecutive patients with liver MRI and T1 mapping before and 20 minutes after intravenous (i.v.) GD-EOB-DTPA administration were included (132 on 1.5T, 132 on 3T) between 09/2018–07/2019. Patients were grouped into no chronic liver disease, chronic liver disease (CLD) and cirrhosis Child-Pugh A-C. T1 reduction rate was calculated as (native T1 – post contrast T1) / native T1 and compared between 1.5T and 3T in every patient group using a Mann-Whitney U test with Bonferroni correction. The predictive value of T1 reduction rate and cutoff values to predict CLD and cirrhosis Child A-C were determined with a receiver operating characteristic (ROC) analysis. A p-value <0.05 was defined as statistically significant.
Results: T1 reduction rates showed no significant difference between 1.5T and 3T in all patient groups: for no CLD the reduction rate was 0.75 vs. 0.77 (p=0.623), for CLD 0.69 vs 0.70 (p>0.999), for Child A 0.65 vs 0.65 (p>0.999), for Child B 0.61 vs 0.56 (p=0.311) and for Child C 0.47 vs 0.49 (p>0.999). T1 reduction rate showed a good predictive value for CLD (AUC=0.83), cirrhosis Child A (AUC=0.81), Child B (AUC=0.84) and Child C (AUC=0.91), all with a p-value <0.05.
Conclusion: MRI T1 reduction rate allows an assessment of the liver function with comparable values between 1.5T and 3T.

A-293

Analyzing confounders and repeatability in multiparametric quantitative ultrasound liver assessment: Towards standardized measurements

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Purpose: To investigate the impact of confounding variables on liver ultrasound shear-wave elastography (elasticity (SWE, kPa)), dispersion (SWD, m/s/kHz) and attenuation imaging (ATI, dB/cm/MHz) and to assess repeatability of measurements.
Methods and Materials: The influence of region of interest (ROI) position, size and depth was assessed with Aplio i800 (Canon Medical Systems, Japan) in four isotropic elasticity phantoms (Shear Wave Liver Fibrosis Phantom Model 039, CIRS, USA) with certified stiffness values of 3.7, 12, 25, and 44 kPa. The right and left liver lobes of 20 volunteers were assessed in inspiration/expiration and fasting/non-fasting state. Coefficient of variation (CV) was used to compare measurement variability. Differences in mean were assessed using unpaired t-test, with a p-value lower than 0.05 indicating statistical significance.
Results: The phantom study showed lower SWE values compared to the certified values, except for the stiffest phantom (median: 1.9, 6.3, 18.5, and 45.1 kPa), which also showed the largest variances (CV: 12.1%, 9.3%, 14.4%, and 33.2%). SWD values (median: 6.6, 10.5, 18.8, and 24.3 m/s/kHz) showed the largest variances for the stiffest phantom (CV: 19.5%, 6.4%, 20.1%, and 38.6%). A significant decline in SWE and SWD ($p<0.001$, $p<0.02$) and increasing variances ($p<0.002$, $p<0.02$) were observed with increasing insertion depth. Unlike SWD, SWE significantly decreased ($p=0.02$) when changing the ROI position from left to right. Increasing the ROI size decreased variability ($p<0.03$, $p<0.02$), with highest CV values found for the smallest ROI. Preliminary in-vivo results showed higher SWE and SWD values in inspiration compared to expiration ($p<0.001$, $p<0.03$). Significantly higher ATI values were found for the non-fasting compared to fasting state ($p=0.04$) and for the left compared to the right liver lobe ($p=0.002$).
Conclusion: Multiparametric elastography is significantly affected by several confounders. We provide recommendations for further standardization.

A-224

Assessment of the stability and discriminative power of radiomics features in liver lesions using an anthropomorphic 3D-printed CT phantom

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Purpose: The variability of CT images from different hospitals can have a strong influence on the analysis and comparison of radiomics features computed in the images. This study analyses how different CT reconstruction parameter variations impact the stability and discriminative power of radiomics features extracted in an anthropomorphic CT phantom generated with real patient texture data.
Methods and Materials: A radiopaque 3D-printed phantom, designed to simulate clinical CT imaging, was built based on an abdominal section from a cancer patient. The liver presents a metastasis, benign cysts and a hemangioma. 240 CT series were obtained varying the reconstruction algorithm and kernel and the slice thickness and spacing. 86 standard radiomics features were computed in manually annotated regions of interest within the lesions and within normal liver tissue. In total 8 reconstruction parameter variations, each containing 30 distinct acquisitions, were evaluated in pairwise comparisons using Wilcoxon signed-rank tests.
Results: All the variations resulted in statistically significant differences in at least 60/86 radiomics features. In only 15% of the stability tests, the CT parameter settings had no significant impact on the radiomics features. On the other hand, the radiomics features had an average 84% successful pairwise tests when differentiating between liver lesions and normal tissue. The radiomics features were ranked based on the percentages of successful stability and discriminative power tests for this task.
Conclusion: All four liver tissue patterns remain linearly separable in this task-based radiomics study despite the CT reconstruction parameter variations. Understanding the scale of changes produced from variations in the acquisition and reconstruction process can help to identify stable radiomics features that also show strong discriminative power.

A-228

Is Hypnosis a valid alternative to pharmacologic sedation for claustrophobic patients undergoing MR exams? A preliminary retrospective study

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Purpose: Claustrophobia is a condition that prevents certain patients from completing magnetic resonance (MR) without sedation. The aim of this study is to assess the feasibility of medical hypnosis in helping claustrophobic patients to complete MR without compromising image quality.
Methods and Materials: This retrospective study was approved by the ethical committee. From December 2015 to February 2019, we included 40 patients who underwent MR with medical hypnosis. Every patient had previously interrupted an MR exam due to claustrophobia. As a control group, we included 40 consecutive patients that underwent MR with sedation. Two experienced radiologists assessed randomly, independently and blinded, the quality of the images of the two groups using a symmetrical Likert scale (0=non diagnostic images; 1=bad image quality; 2=fair image quality; 3=good image quality; 4=very good image quality). Descriptive statistics was performed. We also measured and compared time needed for each MR exam of both groups.
Results: The majority of the MR exams of both groups showed good or very good image quality (64/80=80 % and 61/80=76.25 % for reader 1 and reader 2, respectively). No significant difference was found in image quality between the two groups. The mean MR exam time was 44 min 30 sec. (range: 14 min. 30 sec to 118 min.) and 54 min (range: 16 min. to 133 min 30 sec.) in patients and control group, respectively.
Conclusion: Medical hypnosis is a valid alternative to pharmacologic sedation in patients unable to undergo MR due to claustrophobia, allowing good quality images, without affecting scanning time and workflow.

A-222

Classifying perspective and acquisition sequence for brain MRIs using neural networks on single slices

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Purpose: Neural networks for analyzing MRIs are oftentimes trained on particular combinations of perspectives and acquisition sequences. Since real world data is less structured and does not follow a standard denomination of acquisition sequences, this impedes the transition from deep learning research to clinical application. The purpose of this study was therefore to assess the feasibility of classifying perspective and acquisition sequence from a single MRI slice using convolutional neural networks.
Methods and Materials: 404 MRI slices from 63 patients were used retrospectively to train a pretrained convolutional neural network to detect perspective and acquisition sequence. 10 % of images were used as unseen test data. In a second step, the neural network underwent external validation on 179 slices from 19 patients provided by a different institution.
Results: The perspective classifier achieved a categorical accuracy of 1.00 on the internal test set and 0.97 on the external validation set. The sequence classifier achieved a categorical accuracy of 0.97 and 0.83 respectively. The implementation of Grad-CAM showed no clear pattern of focus for the perspective or the sequence classifier.
Conclusion: Automatically classifying perspective and acquisition sequence using neural networks seems feasible and could be used to facilitate the labelling of large MRI datasets.

A-313

Characterization of meningiomas with synthetic imaging

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Purpose: The purpose of this study is to characterize meningiomas with synthetic imaging, a novel quantitative and qualitative method.
Methods and Materials: This retrospective study approved by our review board ethical committee was carried out in our hospital included 35 patients with meningiomas (6 males, 29 females; mean age of 61±17 years; age range 21–90 years) which were followed-up between October 2019 and October 2020.
Synthetic imaging was performed in a 3T MR scanner (Siemens and Philips machines) in addition to the conventional sequences FSET2, FLAIR, DWI and T1 with gadolinium.
SyMRI software, Version 8 (SyntheticMR, Linköping, Sweden) was used to generate T1, T2, and PD quantitative images. OsirixMD was then used to measure quantitative values of T1, T2 and PD using a ROI. Descriptive statistics, independent samples T-test with Levene's test for equality of variances and Pearson correlation were applied.
Results: We analyzed 42 meningiomas from 35 patients, 8 of which were associated with edema and 5 contained calcifications. Mean values of signal intensities of meningiomas in Synthetic T1, T2 and PD at 3T MRI were 1382.6±391.7 ms, 95.6±36.5 ms and 89.1±9.7 pu, respectively. Signal intensities did not differ significantly between meningiomas with and without edema (p=0.994, p=0.356 and p=0.221, respectively) or between meningiomas containing and not containing calcifications (p=0.840, p=0.710 and p=0.455, respectively). A significant positive Pearson correlation was found between synthetic T1 and T2 mean values (r=0.768, p<0.001). T1 and T2 measured in the white matter of the patients included in our study approximated reference values found in the literature (our study: T1=801.14±68.4 ms, T2=74.28±4.5 ms; reference values: T1=832±10 ms, T2=79.6±0.6 ms. T1, T2 and DP values of white matter and meningiomas were significantly different (p<0.001).
Conclusion: The presented method seems to represent a valid option to characterize meningiomas through their relaxation parameters measured with a synthetic MR sequence.

A-213

Comparison between two commercial MR perfusion software for mechanical thrombectomy patients selection

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Purpose: Performance of different MR perfusion software in assessing and selecting patients with acute stroke and large vessel occlusion (LVO) for mechanical thrombectomy is unclear. We compared two commercial MRI softwares, Carestream in automated (package A) and semi-automated (package B) manner and Rapid (package C), for estimating core and hypoperfusion volumes, and its influence on patients' treatment selection and outcome.
Methods and Materials: 144 MRI from patients with anterior circulation LVO were retrospectively analyzed. All images were acquired on a Siemens VIDA 3T system and post-processed with the three packages. Standard thresholds were applied (core=ADC<620x10^{-6} mm^2/sec; hypoperfusion=T_{max}>6 sec; mismatch=hypoperfusion/core). Concordance for core and hypoperfusion volumes was assessed with the Lin's test. Agreement for mismatch-based patients' classification was assessed with the Gwet's AC1 and clinical outcome was compared between groups in patients who underwent late thrombectomy.
Results: Mean core volume was higher in package C than in packages A and B (36.8±52.2 ml versus 22.7±38.7 ml and 19.1±35.3 ml, respectively), while mean hypoperfusion volume was lower in package C than in packages A and B (84.5±74.0 ml versus 160.3±118.9 ml and 117.9±78.4 ml, respectively). Mismatch ratio was above 1.8 in 89/142 (62.7 %) using package C and in 130/142 (91.5 %) patients using packages A-B, resulting in a moderate agreement (Gwet's AC1: 0.55 between C and A-B). Of 42 patients who underwent a late thrombectomy with successful recanalization (TICI 2b/3), 16 (38 %) had a malignant mismatch profile using package C versus 2 (0.5 %) and 3 (0.7 %) using packages A and B. However, those 16 patients had a similar benefit than patients with a favorable mismatch profile.
Conclusion: MRI softwares for diffusion/perfusion analysis are not interchangeable and may influence patients' selection and outcome.

A-274

A challenging gap: Our experience in an artificial intelligence competition on aneurysms detection

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Purpose: Recently, artificial intelligence (AI) applications underwent huge advancements with high performance in a wide range of medical image analysis applications as reported in peer-reviewed papers[1-3] and extensively relayed in the public press. Nevertheless, is the performance of these algorithms so high when evaluated on data from another set in strict conditions? We participated to a challenge organized by the Medical Image Computing and Computer Assisted Intervention society (MICCAI) on aneurysm detection, and discuss the results here.
Methods and Materials: The Intracranial Aneurysm Detection and Segmentation Challenge (ADAM, http://adam.isi.uu.nl/) aimed to compare 11 algorithms selected in two different tasks, automatic detection and segmentation of unruptured brain aneurysms on MR images. The organizers provided a training and testing dataset composed of 113 and 142 subjects with the time of flight (TOF) and a structural sequence (T1, T2 or FLAIR) to evaluate the performance of algorithms.
Results: The results in the detection task with sensitivity and false positives (average; range) were 43.1% (2-70); 2.7 (0.01-22.62) and in the segmentation task (average and range) Dice Similarity Coefficient: 0.19 (0.01-0.41), Hausdorff distance: 23.2 (8.67-65.02), Volumetric Similarity 0.30 (0.01-0.5).
Conclusion: The highest sensitivity obtained is low compared to the literature (where 90% sensitivity is reported). What can explain this? What is the impact for treatment when missing aneurysms, since the most missed are the small aneurysms? What could we accept in term of false positives in a real-life tool for a radiologist? All these questions raised from the results will be discussed in this oral presentation.

A-318

Deep learning based prediction of meningeoma resection status: Added value in preoperative imaging

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Purpose: Meningeomas are the most frequently encountered extra-axial tumors of the Central Nervous System (CNS). They are derived from arachnoid meningothelial cells and make up almost a third of all primary brain tumors with an incidence of 7.8/100,000. In this retrospective analysis we investigated the predictive ability of transfer deep learning regarding incomplete Meningeoma resection in a multicenter cohort trial.
Methods and Materials: In this multicenter cohort trial 366 of 872 patients (41.9%) with intracranial meningeomas were included. Included patients had diagnostic magnetic resonance T1 post contrast sequence images prior and after surgery. Tumor resection status was graded according to the Simpson classification. Images were preprocessed and normalized to account for different imaging acquisition parameters. For deep learning analysis a transfer learning model based on 'Resnet50' was utilized using the Pytorch framework. The 366 mri data sets were augmented using vertical flipping, contrast enhancement, zoom and warp of varying degrees. The images were split into a training, testing and validation data set to account for overfitting.
Results: Based on the previously unseen validation data set following test characterisitcs were achieved: Sensitivity 0.78, Specificity 0.78, Positive Predictive Value (Precision) 0.79, Negative Predictive Value 0.77, False Positive Rate 0.22, False Discovery Rate 0.21, False Negative Rate 0.22, Accuracy 0.78, F1 Score 0.78, Matthews Correlation Coefficient 0.56. In a sub-analysis most of the correctly identified residual tumors showed bony infiltration at the skull base and complex growth patterns.
Conclusion: A deep learning analysis of preoperative MR images of meningeomas may add value by identifying patients with increased risk of incomplete resection.

A-232

Discriminating cognitive motor dissociation from disorders of consciousness through structural MRI

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Purpose: The aim of the study was to develop an MRI-based scoring system for brain lesion assessment to distinguish between behaviorally unresponsive patients with covert awareness (cognitive motor dissociation) and patients without (true disorder of consciousness) as defined by the novel Motor Behavior Tool.
Methods and Materials: In this retrospective study, approved by the cantonal ethics committee, we analyzed the brain MRIs of 128 patients with severe brain injury (77 men, mean age=51.1±17.2 years) acquired between November 2011 and November 2019. The data were randomly split into a development and validation sets. We qualitatively assessed the patients' MRIs (T1-weighted MPRAGE or GRE, T2-weighted SE, and diffusion weighted images) for lesions in 18 brain regions. Using logistic regression and support vector machine as two classifiers, we first identified a combination of damaged brain structures with a high relevance to discriminate between the patients with and without awareness in the development dataset. For each classifier we constructed an MRI-based score for lesion assessment and estimated its optimal diagnostic cut-off point. We evaluated the performance of the two classifiers on the validation dataset using ROC curves.
Results: The brain regions identified as relevant predictors of the negative outcome were highly overlapping between two classifiers. They included the left mesencephalon, right basal ganglia, right thalamus, right parietal cortex, and left frontal cortex. When tested on the validation dataset, support vector machine showed higher specificity (0.97, 95% CI: 0.85, 1) than logistic regression (0.90, 95% CI: 0.75, 0.97), whereas sensitivity level was at 0.67 for both classifiers (95% CI: 0.24, 0.94 and 0.22, 0.96, respectively).
Conclusion: The MRI-based score assessing brain lesions in patients with disorders of consciousness accurately detected patients with residual awareness. It can valuably complement behavioral evaluation as it is time-efficient and requires only a conventional MRI.

A-322

Significance of incidental findings on extended cervico-cranial CT angiography in patients with suspicion of acute stroke

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Purpose: To evaluate the prevalence and the clinical significance of intra-thoracic incidental findings on the extended cervico-cranial CT angiography in patients admitted with suspicion of acute stroke.
Methods and Materials: We conducted a retrospective analysis of all consecutive CT angiographies reports, performed in the emergency radiology unit, over a three-month period of time. All incidental findings, situated in the upper thorax, between the left atrium and the pulmonary apices, were recorded and classified, according to their clinical significance in major (requiring immediate treatment after CT), serious (requiring treatment or follow-up on a short-time span) and without clinical consequence.
Results: ICT reports of 202 patients (118 men, mean age: 67.3 years) were analyzed; 65 (32.2%) revealed thoracic incidental findings. 5% (10/202) were major pathologies (7 pulmonary embolism, 1 aortic dissection, 1 floating aortic thrombus, 1 pericardial effusion); 21% (43/202) were serious pathologies, and 6% (12/202) had no clinical consequence.
Conclusion: Extended coverage of the cervico-cranial CT angiography allows identification of significant pathologies, involving a management change in 26% of patients admitted in emergency with a suspicion of acute stroke.

A-194

Exposure of the Swiss population in 2018 from medical imaging

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Purpose: According to EURATOM 2013/59, nationwide surveys on radiation dose to the population from medical radiology are recommended in order to follow the trends in population exposure and such a survey are part the Swiss legislation. The goal of the extensive 2018's survey was to update the exposure of the Swiss population in a context where the radiological practice is rapidly evolving; the last limited survey having been organized in 2013.
Methods and Materials: The invoice coding information was collected in five university hospitals and nine large clinics allowing to get a reliable set of radiological procedures. For all other practices (general practitioners, dentists, and private radiological practices) a website was used to collect the data. To improve the estimation of the effective dose actually delivered in CT, we collected DLP (Dose Length Product) data from different DACS (Dose Archiving and Communication Systems) representing various type of practices (i.e. University centers and regional practices).
Results: On average we found 1.2 radiological examinations per year and per inhabitant (including dental radiographs). Among this, CT examinations represent 11%, general radiographs 36% and dental radiographs 48%. The average annual dose was 1.48 mSv per inhabitant (including the nuclear medicine); CT representing 64% of that dose, conventional radiography 9.5% and the nuclear medicine 7.2%.
Conclusion: Our results show an increase of 15% in the number of CT examinations compared to the 2013's survey. However, the part of the effective dose from CT had decreased by 17% in comparison to our previous survey in 2013, demonstrating the efficacy of optimizing protocols through technological developments and efforts by medical staff. The average annual dose has been stabilized since 2013.

A-278

Evaluation, comparison, and optimization of the effects of manual versus software-automated protocols on radiation dose and image quality in simulated paediatric chest computed tomography

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Purpose: The aim of this study was to verify that the subjective interpretation of the images allows to further optimize the imaging protocols in terms of dose by comparing the effects of switching from automated to manual acquisition parameters on image quality and radiation dose in simulated paediatric chest computed tomography (CT) scans. The comparison was made using a CT phantom in order to obtain the lowest possible dose–length product value while maintaining an adequate image quality. The scans were performed by manually reducing the dose below the lowest dose value proposed by automated software prior to the examination.
Methods and Materials: An anthropomorphic phantom underwent simulated paediatric chest CT scans using both automated and manual approaches guided by a radiologist for parameter optimization. Different CT acquisition protocols were used, varying kV, mAs, pitch, and adopting iterative reconstruction (IR). The subjective and objective image qualities were assessed by, respectively, radiologists and software. Specific CT dose indices were collected.
Results: CT dose indices were significantly lower adopting a manual approach. Through CT acquisitions, linearity and resolution were quite constant, whereas image noise and uniformity varied between scans, as observed by radiologists using a visual grading analysis. IR was associated with a further dose reduction.
Conclusion: Simulated paediatric chest CT studies performed with manual acquisition settings resulted in important dose reduction when compared to values generated with automated protocols.

A-286

Towards Monte Carlo simulations of clinical grating interferometry prototypes

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Purpose: Extend a previously developed Monte Carlo (MC) algorithm for grating interferometry (GI) with bent optics and demonstrate its potential for the simulation of a GI breast CT prototype.
Methods and Materials: MC simulations have great potential to support the development of clinical applications of phase sensitive imaging modalities, such as X-ray GI. However, current state of the art simulation frameworks are mainly limited to single flat grating setups using monochromatic sources and suffer from long computation times. In the past an extension library for EGSnrc has been developed reducing the simulation times enabling simulations of larger volumes. In this work bent gratings are added to the EGSnrc extension library for GI modules, enabling the simulation of GI modules using curved gratings and conventional x-ray sources.
The reference image of a cm-sized field of view of a GI breast CT prototype is simulated with the developed MC extension library, with the aim of demonstrating that the algorithm can efficiently handle large volumes, relevant for medical applications.
Results: The MC simulated interference patterns match the theoretically predicted period and the expected homogeneous visibility over the whole field of view.
Conclusion: Bent gratings have been added successfully to the GI extension library for EGSnrc. For the first time a cm-sized FOV of a clinical GI application prototype has been simulated in MC including two bent gratings and an incoherent source. The MC framework correctly predicts the periodicity of the interference patterns. Future validation will include the comparison with wave propagation methods that are capable to simulate the interference phenomena in simple GI setups.

A-170

Task-based evaluation of photon-counting-detector coronary CT angiography and comparison with energy-integrating-detector CT

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Purpose: To objectively evaluate photon-counting-detector (PCD) coronary CT angiography (CCTA) in vitro and investigate its image quality characteristics compared with a clinical energy-integrating-detector (EID) CT system.
Methods and Materials: A dedicated coronary artery module inserted into an anthropomorphic thorax phantom was scanned at regular dose (10 mGy) on a prototype clinical PCD-CT and a clinically available EID-CT under various conditions of simulated patient size (small, medium, large). Images were reconstructed using a filtered back-projection algorithm with a soft-tissue kernel. We assessed noise and contrast-dependent spatial resolution with noise power spectra (NPS) and target transfer functions (TTF), respectively. We further computed detectability indexes (d') of simulated non-calcified atherosclerotic plaques (contrast difference=300 HU) using the non-prewhitening with eye filter model observer.
Results: For all three patient sizes, PCD-CT provided markedly lower noise magnitude (33-37% lower NPS amplitude) and higher frequency noise (sharper noise texture). Furthermore, PCD-CT provided consistently higher spatial resolution than EID-CT (32-36% better TTF), depending on patient size. In the resultant d' analysis, PCD-CCTA outperformed the clinical EID-CT system in all investigated experimental conditions, providing superior detectability indexes. Of note, PCD-CT reached almost perfect detectability (accuracy≈95%) for simulated plaques measuring as low as 0.5-mm-thickness (for small-sized patients), whereas EID-CT had slightly less accuracy (≈85%).
Conclusion: PCD coronary CT angiography is feasible not only for small or medium-sized, but even for obese subjects. Furthermore, PCD-CCTA outperformed EID-CT in quantitative analysis and might enhance the diagnostic accuracy by providing lower noise magnitude, markedly improved spatial resolution, and superior plaque detectability.

A-217

Robustness and reproducibility of radiomics in virtual monoenergetic images of Dual-Energy CT

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Purpose: To evaluate the robustness and reproducibility of radiomic features from Virtual Monoenergetic Images (VMIs) of different energy levels and to assess their impact on machine-learning-based classification as a function of radiation dose and dual-energy CT (DECT) approach for dual-source (DS-DE) and split-filter DECT (SF-DE).
Methods and Materials: Our phantom consisted of 4 kiwi fruits, 4 onions, 4 apples and 4 oranges, chosen to reflect different HU, shapes, and tissue textures. It was imaged in dual-energy mode on a DS-DE and SF-DE at two different radiation doses of 5 and 15 mGy. To assess test-re-test robustness, all scan setups were repeated after repositioning the phantom. For each setup, VMIs were reconstructed at five different energy levels (40, 50, 75, 120, and 190 keV). Datasets were pre-processed and a total of 1218 radiomic features per fruit were extracted (pyRadiomics package; 3D Slicer). The robustness of each feature was tested against the different settings by calculation of the concordance-correlation-coefficients (CCCs). A Random Forest classifier was repeatedly trained with different data splitting and feature subsets, to assess a) the impact of the setup parameters and b) the relative importance of the features and its stability.
Results: Test re-test robustness was relatively homogeneous across the settings with 80 % robust features. SF-DE showed a larger variation of the number of robust features compared to DS-DE. Reproducibility of features differed substantially among VMI levels (as low as 32.8 %) and depended on DECT. In regards to the classification task, a subset of 20 features achieved high performance for every parameter combination (accuracy and F-Score higher than 0.99).
Conclusion: Robustness of radiomic features was high within each VMI while comparisons among different VMI levels and DECT scanners decreased robustness. Machine-learning-based classification was, however, unaffected and achieved high performance independent of parameter combination.

A-219

Virtual monoenergetic images from Dual-Energy CT – Systematic assessment of task-based image quality performance for Dual-Source Dual-Energy CT

D. Cester, M. Eberhard, T. Frauenfelder, H. Alkadhi, A. Euler; Zurich/CH

Purpose: To systematically compare task-based image quality among virtual monoenergetic images (VMI) and linear-blended images from dual-source dual-energy CT as a function of contrast task, radiation dose, patient size, and lesion diameter.
Methods and Materials: A multisize image quality phantom (Mercury Phantom 4.0) was repeatedly imaged on a 192-slice dual-source CT in dual-energy mode at 100/Sn150 kV and three radiation doses (5, 10, 15 mGy). The phantom contained a noise and a resolution module with inserts of different materials. Bone and iodine inserts were chosen to emulate a high-contrast task with and without iodine. A polystyrene insert served as low-contrast task. Linear-blended images (LBI) and VMI were reconstructed at 40-190 keV. Noise magnitude and texture were evaluated using the noise power spectrum (NPS). Resolution properties were assessed using the task-transfer function (TTF). Task-based image quality was determined by calculating the detectability index (d') for the three inserts.
Results: Noise magnitude increased with increasing size and decreasing radiation dose or VMI-level. It was higher for VMI at 40-60 keV compared to LBI. Differences in noise texture compared to LBI were found for very low and very high VMI-levels (50 keV, 130-190 keV). Resolution depended on VMI-level for the low-contrast task with a shift to higher TTF frequencies with decreasing VMI-level. No relevant difference in TTF shape was observed for the high contrast tasks. For all reconstructions and inserts, d' increased with increasing radiation dose or lesion diameter and decreasing phantom size. For both high-contrast tasks, d' was higher for 40-80keV and lower at higher keV-levels compared to LBI. For the low-contrast task, d' was higher at 70-90 keV and lower at 40-60 keV.
Conclusion: VMI at 70 to 90 keV yielded comparable or improved task-based image quality compared to linear-blended images for all three contrast tasks. They could offer a balanced alternative to linear-blended images independent of the imaging task.

A-233

QuantImage v2: An open-source and web-based integrated platform for clinical radiomics research

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Purpose: Radiomics models are expected to revolutionize the use of imaging for personalized medicine, but there is currently a lack of integrated solutions allowing radiologists and nuclear medicine physicians to easily create cohorts of patients, extract and manage collections of radiomics features as well as validating them with machine learning models (e.g. classification, survival). We developed a fully open-source web-based platform allowing physicians with no advanced knowledge of programming or machine learning to explore & validate state-of-the-art image biomarkers for specific diagnostic or prognostic clinical tasks.
Methods and Materials: The developed solution combined two main aspects: data management & data processing/analysis. A pre-existing open-source web-based tool (Kheops) was used to provide DICOM image storage, management & sharing functionality. On top of this, we developed a companion web platform (QuantImage v2) to allow radiomics feature extraction & management, predictive model building & validation and data visualization.
Results: The platform allowed preparing a patient cohort using Kheops, then using QuantImage v2 to extract radiomics features. Users could then create, visualize and store curated feature collections, including filtering by imaging modality, region-of-interest & groups of features (e.g. intensity, shape, texture). Finally, it enabled the initialization, training and validation of predictive models for both classification tasks (including various algorithms such as linear regression or random forests) and survival analysis using Cox models.
Conclusion: The developed Quantimage v2 platform allows clinical researchers with no programming background to rapidly investigate the relevance of radiomics models in a novel application context. A first version was deployed on the university's infrastructure, as well as inside a university hospital to allow physicians to test it and provide feedback about the usability and performance of the platform.

A-199

Gadolinium deposition in the brain in a large animal model – Comparison of linear and macrocyclic gadolinium-based contrast agents

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Purpose: This study aimed to compare the amount and the distribution of retained gadolinium of linear and macrocyclic GBCAs in the DCN after a single injection at a dose comparable to a human patient's in a large animal model.
Methods and Materials: In this prospective animal study (licence: ZH235/17), eighteen female sheep (age: 4–10 years, body weight: 80.8±19.6 kg) were randomly assigned in 6 groups of 3 animals, which received a single injection of 0.1 mmol/kg body weight of either the macrocyclic GBCAs gadobutrol, gadoteridol, or gadoterate meglumine; the linear GBCAs gadobenate dimeglumine or gadodiamide; or saline. Animals were euthanized 10 weeks after injection. Local distribution and concentration of gadolinium and colocalization to other metals (iron, zinc, copper) in the DCN was assessed by laser ablation-inductively coupled plasma mass spectrometry.
Results: Average gadolinium concentration for the macrocyclic GBCAs and the saline group was below the limit of quantification (5.7 ng/g tissue). In contrast, 14 (for gadobenate) and 27 (for gadodiamide) times more gadolinium than the limit of quantification was found for the linear GBCAs gadobenate (mean: 83 ng/g) or gadodiamide (mean: 155 ng/g brain tissue). Gadolinium distribution colocalized with other metals for linear GBCAs and a specific accumulation in the DCN was found.
Conclusion: The current study supports the hypothesis that the amount of gadolinium deposited in the brain is primarily determined by its class as either macrocyclic or linear. The accumulation of gadolinium in the DCN for linear GBCAs explains the hyperintensities in the DCN found in previous patient studies with linear GBCAs.

A-259

Gadolinium retention after contrast enhanced MRI: The effect of gadolinium on osteoblast lineage cells.

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Purpose: Gadolinium-based contrast agents (GBCA) are associated with retention of free gadolinium (Gd) in bone and neuronal tissue after dissociation from their chelating agents. Hence, to address potential consequences of Gd on bone metabolism, effects of free and chelated Gd on osteoblast lineage cells (OB) were studied *in vitro*.
Methods and Materials: Murine OB were cultured in Gd-chloride ($CdCl_3$) and various GBCA including non-ionic linear (Gadodiamide), ionic linear (Gadopentetic acid, Gadobenate dimeglumine, Gadoxetic acid) and macrocyclic GBCA (Gadoteric acid, Gadoteridol, Gadobutrol). Cell proliferation (XTT assay) and differentiation (alkaline phosphatase, ALP) were assessed. Gd concentrations in culture media were analyzed by inductively coupled plasma mass spectrometry (ICP-MS).
Results: $GdCl_3$ up to 100 µM and GBCA up to 2000 µM had only minor effects on OB proliferation. OB differentiation was inhibited by 50% at 25 µM for $GdCl_3$, at 250-500 µM for the non-ionic linear GBCA, and at 1000-2000 µM for the ionic linear GBCA. Macrocyclic GBCA did not affect OB differentiation up to 2000 µM. After 5 days of OB culture, Gd concentration in $GdCl_3$-supplemented medium was up to 25% lower as compared to controls without cells.
Conclusion: The presented data show that GBCA affect OB function *in vitro*. $GdCl_3$ up to 100 µM and GBCA up to 2000 µM are not cytotoxic. However, $GdCl_3$, non-ionic linear and ionic linear GBCA inhibited the differentiation of OB dose dependetly, although higher concentrations were required for the GBCA. In contrast, macrocyclic GBCA had none or only minor effects on differentation. This may be directly attributed to the release of Gd from the GBCA, as the more stable forms had less negative effects. The lower concentration of Gd measured in OB cultures after 5 days indicates either cellular uptake of Gd or precipitation of $GdPO_4$ on living cells. Further studies to substantiate those findings and to address the effect of Gd retention on bone tissue are ongoing using different *in vitro* models.

A-339

Estimation of radiation dose in spiral breast CT

S. Shim, J. Unkelbach, A. Boss; Zurich/CH

Purpose: Our study aimed to analyse the average absorbed dose in spiral breast computed-tomography (CT) assessing the influence of volume and density. Unlike in whole-body CT imagers with automatic exposure adjustment, the X-ray fluence in breast CT remains fixed over the entire spiral scan.
Methods and Materials: A Monte Carlo (MC) simulation was applied to datasets of 40 breasts with volume of 300-1600 cm^3 from spiral breast-CT. The material of the breast was assigned as a homogeneous mixture of glandular and adipose tissue with various breast density, 0, 20, 50, 87.5, and 100% glandularity. The MC program was validated by CTDI measurements using an ionisation chamber for absolute dose comparison and MOSFET measurements on 3D printed breast phantoms for relative dose comparison with varying density of the breast phantom. Average absorbed dose over the breast in each MC simulation was calculated by 1e6 trajectories. An exponential regression was applied to the average absorbed dose plots as a function of breast volume and glandularity.
Results: The absorbed dose computed by the MC simulation demonstrated a 2D concave distribution on coronal plane. The error rate of the MC simulation compared to CTDI measurements was 0.3±0.3%. Average absorbed dose over the breast for each glandularity showed good agreement to each corresponding exponential regression equation ($p<0.05$), which is a function of the cube root of breast volume and the two coefficients that have linear correlation of glandularity.
Conclusion: Average absorbed dose in spiral breast CT can be estimated from breast volume and glandularity based on the computed dose calculations.

A-276

Contrast-enhanced Breast CT: Preliminary results

N. Berger, M. Marcon, J. Wieler, T. Frauenfelder, A. Boss; Zurich/CH

Purpose: Contrast-enhanced breast CT (CEBCT) is a new method for detecting breast cancer. The purpose of this study was to quantitatively assess the contrast enhancement in CEBCT.
Methods and Materials: Four patients had at least one suspicious lesion found on breast CT or breast ultrasound and underwent CEBCT. The contrast enhancement of the lesion and the background were measured and the signal difference in percentage (%RS) was calculated (%RS = ((Signal 1-Signal 2)/ Signal 2) x 100%) as well as the signal to noise ratio (STNR = (Signal 1-Signal 2)/ Standard deviation of Signal 2).
Results: The breast lesions in all patients had contrast uptake. Three patients had malignant lesions (one invasive lobular cancer, one invasive ductal cancer, one cribriform carcinoma with DCIS and one patient had fibrosis with signs of acute and chronic inflammation). Mean lesion size was 13 mm (range 5 mm–22 mm). In one patient, two lesions were known and a third in between could be visualized only after contrast media application. The signal difference in percentage was between 137% and 174%. The signal to noise ratio was between 36.2–43.8.
Conclusion: CEBCT might be an alternative to breast MRI for lesion detection according to the preliminary results.

A-343

Fully automated breast segmentation on novel breast computed tomography images

S. Shim, D. Cester, L. Ruby, C. Bluthgen, M. Marcon, N. Berger, J. Unkelbach, A. Boss; Zurich/CH

Purpose: We developed a fully automated segmentation and breast density analysis method for breast CT images that segments breast components such as fibroglandular and adipose tissue, skin, and pectoralis muscle and hard materials such as ribs and breast implants.
Methods and Materials: The automatic segmentation and breast density analysis method was developed on fifty-two volumetric breast images acquired by a novel spiral breast CT imager with a voxel size of 300µm. The segmentation algorithms were specifically developed to segmentation for each breast component: the adipose and glandular tissues, skin, pectoralis major muscle, rib, depicted skin fold from the thoracic or abdominal wall, and silicon implant. The method consists of three parts: segmentation of the components except the adipose and glandular tissues based on adaptive seeded watershed, connected-component, and dynamic programming algorithms; breast density estimation; glandular tissue segmentation based on adaptive region growing algorithm.
The quality of segmentation was evaluated by computing Dice's similarity test (DSC) with the manually segmented contours by two radiologists and by testing based on five-point Likert scale by five radiologists. The inter-reader agreement was assessed based on Cronbach's alpha (p) test.
Results: The computed DSCs for the skin, pectoralis muscle, and skin fold were larger than 0.85, which represents an excellent agreement with the manual segmentation. The paired t-test on the DSC values between the two manual segmentations and the automatic segmentation indicates that our automatic segmentation coincided the manual segmentations as much as the manual segmentations coincides with each other. The Likert scale test resulted in 4.3±0.42 (good-excellent) with $p=0.87$.
Conclusion: The segmented breast CT images using our fully automated segmentation algorithm coincided with the reference standard of human reading.

A-340

Fully Automatic classification of Automated breast ultrasound (ABUS) imaging using deep convolutional neural network

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Purpose: Automated breast ultrasound (ABUS) technique is increasingly supplementing conventional mammography in breast cancer diagnosis. Thanks to reduction of operator dependency, it provides increased standardization. However, reading times are longer than in conventional US and image interpretation requires adequate training. In order to further increase process automation and reliability, automatic lesion detection and BI-RADS categorization AI software has been developed, basing on deep convolutional neural networks.
Methods and Materials: Data annotation consisted in lesion detection and BIRADS classification and was performed by experienced radiologists. An AI model based on artificial deep convolutional neural network was trained with 517 ABUS. Object-detection software has been written to localize lesions in 3-dimensional image space.
The quality of segmentation was evaluated by computing Dice's similarity test (DSC) with the manually segmented contours by two radiologists and by testing based on five-point Likert scale by five radiologists. The inter-reader agreement was assessed based on Cronbach's alpha (p) test.
Results: Results of calculations showed accuracy of 90,91% and Cohen's Kappa score of 0,82 for classification of lesion in ABUS examinations. Furthermore, object localization technique allowed the detection of lesion position slice-wise.
Conclusion: Developed AI software is capable of highly accurate recognition of lesions in examinations what may bring a significant improvement in workflow of a radiology unit.

A-250

Accuracy and Performance of Automated Breast Ultrasound (ABUS) in the coronal plane

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Purpose: The purpose of this study was to evaluate the accuracy and performance of lesion classification in ABUS by reading only the coronal plane.
Methods and Materials: Dense breast tissue (ACR c and d) in Screening needs additional ultrasound assessment to detect probable masked lesions. In Automated Breast Ultrasound (ABUS) a 3D Volume of each breast is acquired and can be read in axial, coronal and sagittal view. Three readers with different levels of experience rated 150 pre-selected cases with a cohort of 100 benign and 50 malignant lesions by using the coronal view only. The readers evaluated the images for artifacts and classified the lesions using the ACR BI-RADS classification. To rule out any measurement related error one reader measured the maximum size of all lesions in the coronal and the axial plane for an evaluation with Bland-Altman plot. Inter-reader agreement and descriptive statistics were calculated.
Results: Bland-Altman plot showed no methodical error when measuring the lesions in the coronal plane vs. axial as the standard measuring method. The kappa coefficient (k value of 0.63, 0.63 and 0.81) implies almost perfect interreader-agreement between the experienced readers and substantial agreement to the less experienced reader. Sensitivity for cancer detection was between 68–74% and specificity between 87–99%.
Conclusion: In conclusion, assessing the coronal plane is a fast and easy tool to classify breast lesions in ABUS. Nevertheless, additional axial view might be needed to achieve a higher sensitivity.

A-344

Automated Diagnostic Quality control in mammography and tomosynthesis with deep convolutional neural networks

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Purpose: Quality control of mammography and tomosynthesis examinations is in Europe generally performed using the Perfect-Good-Moderate-Inadequate criteria. Even though the PGMI criteria are well defined, subjectivity of human judgement may result in incorrect rating. For some screening programs, even 49,7% of mammograms do not satisfy criteria. On top of that, each of those tasks is time consuming and tedious.
Quality assessment automatization with Artificial Intelligence is thus a viable solution to those problems, minimizing errors in quality rating and increasing general productivity in the mammography and tomosynthesis units. With standardized reports it may become a tool for institutions' screening program quality assessment.
Methods and Materials: For each image from mammography and tomosynthesis reconstruction the adequate criteria have been selected and evaluated by experienced radiologists. Using AI methods (dCNN), for each of the features of examinations, models have been trained to evaluate quality of feature presentation and overall quality of mammogram in PGMI scale. Each model has been trained on at least 3000 mammography and 4000 tomosynthesis images acquired from institution's database.
Custom, standalone device with dedicated GUI has been developed for a comparison with human-readers and consensus of assessment of professional radiologists.
Results: Models accuracy varied from 83% for inframammary fold feature presence to 88% for pectoral muscle depiction feature, all tested on separate test datasets. The overall classification of single features resulted into a PGMI score. Initial comparison with human reader assessments showed good agreement on overall quality assessment.
Conclusion: AI models show promising results in automation and standardization of quality assessment in mammography and tomosynthesis. The presented technology may be integrated in the clinical routine and result in lean quality controls.

A-338

Performance of mammography screening programs in Switzerland, 2010-18

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Purpose: Mammography screening programs have gradually been implemented in Switzerland since 1999. By 2020, 11 organised programs covered 13 cantons and about 60% of the female population aged 50 to 69 years. Monitoring the utilization, quality and effectiveness of public health programmes is paramount to ensure high levels of performance in accordance with European quality standards. This study, conducted by external screening experts, presents the most comprehensive evaluation to date of performance of Swiss mammography screening programs.
Methods and Materials: Anonymous screening records of all regional programs were obtained, processed and pooled. National performance indicators, which largely follow the European Guidelines (EG), were computed by year (2010–2018), type of screening round (prevalent vs incident) and implementation status (programs in steady state situation vs newer programs). Screening performance for women aged 70–74 were analysed separately. Sensitivity analyses were performed.
Results: Over 1,9 million of invitations and 877,440 mammographies were included. Trends in participation and reattendance rates between 2010–12 and 2016–18 are presented and interpreted. Quality and effectiveness indicators in the prevalent (1st) and subsequent rounds are analysed, with a radiological focus on performance over time in the referral and false-positive rates. Inter-program variations was largest for participation and performance in the prevalent round, likely due to regional specificities.
Conclusion: In healthcare systems where screening programs are implemented regionally and at different times, standardized procedures are necessary to improve the quality and comparability of results. Ways to reduce the heterogeneity in quality performance across programs are discussed.

A-150

Reinterpretation of gynecologic radiology findings is purposeful in daily clinical routine: A prospective study of disagreement rates

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Purpose: To investigate disagreement rates in gynecologic radiology reports between subspecialists of different experience levels.
Methods and Materials: Prospective, single-center study of a University Hospital from 30th December 2019 to 24th April 2020. Two specialists in Radiology with 1 and 0.5-year experience in gynecologic radiology decided with low-threshold a need for consultation by the subspecialist colleague (experience 9 years). The reinterpretation reading was performed in the home office (PACS) immediately after the preliminary report, viewed after completed the second reading. Three categories were used to define the discrepancy level detected in the radiology report (RR): 1. RR Confirmed=no discrepancy, 2. RR Complemented=minor discrepancy, 3. RR Significantly changed=major discrepancy. The details and type of the disagreement was documented. For statistical analysis descriptive statistics and T-test (Excel 2016) was used.
Results: 87 examinations, 85 MRI- and 2 CT scans, were analyzed. 49 (56%) consultations concerned the Endometriosis MR-imaging. To mention some of the remaining 39 (44%) consultations; benign uterine, gynecologic oncologic disorders and equivocal adnexal lesions. The RR findings were confirmed in 28%, complemented in 45% and significantly changed in 28% of all cases by the second reader. Of the endometriosis MRI findings 33% were confirmed, 55% complemented and 22% significantly changed. 5/11 (45%) of the significantly changed endometriosis MRI RRs were very small deep infiltrating endometriosis (DIE) lesions detected by the second read. One overcall of DIE occurred. Major discrepancies of all cases diminished 5% in last two months of the observation time compared to the first two months (p=0.32).
Conclusion: Considerable disagreement rates in gynecologic radiology subspecialty reports were observed. Selected double reading may ensure an accurate image interpretation and increasing learning curve, crucial for the appropriate patient management.

A-316

Imaging methods in the diagnosis of uterine congenital defects – A series of cases of patients with residual horns

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Purpose: The aim of this study is to gain knowledge about modern imaging methods in the diagnosis of uterine congenital defects and to highlight their advantages.
Methods and Materials: Three patients with clinical symptoms of painful menstruation (2 patients) and prolonged menstrual bleeding (one patient) underwent ultrasound examination using Voluson E8 (GE Healthcare) endocavity linear probe. Then magnetic resonance imaging was performed using GE Optima 450W 1,5T according to the typical protocol – T1W and T2W axial, T1-weighted fat-suppressed sequences: axial, sagittal and coronal.
Results: Based on the obtained image in ultrasound examination, the presence of residual horn was suspected in each of patients. Magnetic resonance imaging clearly confirmed diagnosis and at the same time excluded other pathologies. The patients were qualified for surgical procedure.
Conclusion: MRI is a method of choice in the diagnostics of congenital uterine defects as it provides the most accurate tissue imaging and differentiation of anomalies.

A-223

Reconstruct gamma-ray interaction position for the development of an on-chip PET system using deep learning

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Purpose: Organoids, stem-cell-derived three-dimensional tissue cultures, find increasing applications ranging from disease modeling to drug discovery and personalized medicine. These growing numbers of uses lead to strong demand for novel measurement capabilities.
In this abstract, we present the first steps of developing an on-chip PET system capable of imaging organoids. Here we aimed to prove the concept of improving the reconstruction of the gamma-ray interaction position using deep learning methods.
Methods and Materials: For this purpose, a tentative detection block was designed using a continuous LYSO crystal and silicon photomultiplier (SiPM), whose geometry fits with the microfluidic chips of 3D cell culture. Monte Carlo simulations of this detection block were established on the Geant 4 platform. A large dataset of simulated light pattern images of a wide range of gamma-ray incidence positions and angles were simulated. A CNN based reconstruction network was trained to learn the nonlinear relation between gamma-ray interaction positions and their resulting surface light patterns.
Results: Various experiments have been run to determine the optimal number of surfaces needed to reconstruct the interaction position from the surface light patterns. Subsequent experiments were then used to find the best CNN backbone architecture for the reconstruction network. The resulting network achieved a mean average error (MAE) of 0.6 mm when trained on a dataset of 100,000 samples and tested on 10,000 samples.
Conclusion: These preliminary results indicate a promising direction for deep neural network-based methods for gamma-ray interaction position reconstruction in continuous crystals. With a larger dataset and an extensive hyperparameter search, the results will be further improved. In successive experiments, the results achieved with simulated data will be compared to experimental data.

A-124

A cross-scanner and cross-tracer deep learning method for the recovery of standard-dose imaging quality from low-dose PET

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Purpose: Despite the fact that radiation dose of modern PET imaging became much less than in early days, it still remains a major bottleneck for extensive application of this modality. Artificial intelligence has been recently developed to recover high-quality imaging from low-dose scans. However, it's not clear if the methods developed on one scanner can be applied to other scanners.
Methods and Materials: Brain PET Fludeoxyglucose (FDG) imaging of 237 patients scanned with scanner 1 (digital, vendor 1) was included for the development of the AI. Then the developed algorithm was tested on FDG PET images of 20 patients with scanner 1, 20 patients scanned with scanner 2 (analogue, vendor 2) and 7 patients scanned with scanner 3 (digital, vendor 2), as well as O-(2-^{18}F-fluoroethyl)-L-tyrosine (^{18}F-FET) PET images of 9 patients with scanner 2 and 4 patients with scanner 3. A 2D generative adversarial network (GAN) was developed with a U-net generator and a convolutional neural network (CNN) based discriminator. The normalized root mean squared error (NRMSE), structural similarity index (SSIM) and peak signal-to-noise ratio (PSNR) were calculated to evaluate the results generated by AI. Two independent nuclear medicine physicians assessed the interpretation ability towards a diagnosis. .
Results: The developed AI method can achieve a good physical performance with an average SSIM of 0.992±0.005, PSNR of 44.5±3.2, and NRMSE of 1.52±0.33% for DRF=2. Clinical reading was performed in a subset of patients and after correction no significant impairment could be observed for DRF up to 20.
Conclusion: Our deep learning method for low-dose PET image enhancement is generalizable for application on different scanners, tracers and diseases, under certain limitations. This encourages the further investigation of this method with emphasis on clinical interpretation.

A-251

PBPK-based in silico tumor microenvironment model for ^{177}Lu-PSMA-617 therapy

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Purpose: The efficacy of the targeted radionuclide-based therapy using ^{177}Lu-PSMA-617 for the treatment of metastatic castration-resistant prostate cancer has been recently demonstrated. However, the treatment effect is still suboptimal for a significant fraction of patients and a substantial individual variance in lesion radiation dose is well known. PBPK models have been established to assist the personalization of RLT. However, an in-depth insight of the interaction with tumor microenvironment is not provided. We propose an in silico approach to investigate the distribution of the radionuclide inside the tumor microenvironment through a PBPK-based convective-diffusion-reaction (CDR) model.
Methods and Materials: Dynamic distribution of ^{177}Lu-PSMA-617 was simulated by establishing an in silico model of the tumor microenvironment. The impact of the interstitial fluid pressure, the presence of hypoxic and necrotic regions, and the spatial variation of physiological parameters have been investigated. A finite-element solution of the CDR equation was implemented to calculate the distribution of ^{177}Lu-PSMA-617 at different time points post-injection. The parameters of the model were extracted from literature and optimized accordingly to the reference PBPK model. Once the activity distribution was recovered, the equivalent absorbed dose was calculated to investigate the dose in tumor microenvironment and normal organs.
Results: Our model can extend the PBPK model to the spatio-temporal distribution of ^{177}Lu-PSMA-617 in the tumor microenvironment at different time points. With a proper arterial input function, the generated time-activity curves are consistent with the clinical observations. The total absorbed dose in different regions of the tumor and in critical organs can be depicted.
Conclusion: The proposed model can recapitulate the time course of ^{177}Lu-PSMA-617 therapy and give deep insight into the microdosimetry. Our in silico model provides a platform to explore different parameters for optimized and personalized RLT

A-305

Study of scattered signal with GATE simulation for Biograph Vision Quadra PET scanner

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Purpose: Biograph Vision Quadra with its 106 cm axial field of view (FoV) is a novel implementation of the cutting edge total-body PET scanner. The long axial FoV with 243200 crystals disposed in 320 crystal rings brings new challenges to the scatter correction in image reconstruction. The increased scatter events in line-of-responses (LORs) with the large ring difference is more heterogeneous than before. This study investigated the scatter events in Biograph Vision Quadra using GATE-based (Geant4 Application for Tomographic Emission) Monte-Carlo simulations and experimental measurements.
Methods and Materials: Firstly, the true coincidence rate, the random event rate and the fraction of scatter produced in a cylindrical plastic phantom of 20 cm diameter and 100 cm length are simulated using GATE. The activity is placed in a plastic tube parallel to the axis of the phantom with an offset of 4.5 cm. The phantom is placed along the axis of the scanner. Two different FoV have been used for the simulations. The narrow FoV with a half opening angle of 18° and the wide FoV with a half opening angle of 52° have been studied. Furthermore, the study is conducted on a standard NEMA-IQ phantom and on a numerical extended cardiac-torso (XCAT) phantom.
Results: The scatter profiles of all phantoms types were calculated. The results of the simulations show that scatter can impact the image quality and the importance of scatter correction in total-body imaging. The scatter contribution is more evident for heterogeneous phantoms. The GATE simulations performed with the cylindrical scatter phantom and the NEMA-IQ phantom are in a very good agreement with the experimental measurements performed with the Vision Quadra PET.
Conclusion: This work provides an in-depth insight on the scatter events that contribute to the image noise in the whole-body Vision Quadra PET scan.

A-253

Quantitative comparison of therapy response assessment of tumour lesions based on PET SUV on different scanners with the harmonization factor EQ.PET

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Purpose: To evaluate EQ.PET, a harmonization factor for adequate comparison of quantitative PET parameters in therapy response assessment of tumour lesions in patients scanned on different PET/CT devices.
Methods and Materials: Correct uptake quantification is essential for tumour therapy response assessment with PET/CT. EQ.PET is a new reference-based quantification technology within *syngo*®.via (Siemens Healthineers) that provides clinicians with harmonized SUVs across patient scans, even if acquired on different scanners or reconstructed with different protocols. For the EQ.PET calibration, a NEMA IQ phantom was scanned on two PET/CT devices (Siemens Biograph Vision and GE Discovery D600). The EQ Parameter was calculated by minimizing the mean absolute percentage difference between recovery coefficient for all lesion sizes obtained for both scanners. The clinical impact of this EQ.PET was evaluated using this factor in different patients that underwent examinations with both devices.
Results: The calculated EQ.Parameter was 6.8, which correlated to a 6.6 % mean absolute percentage difference and maximum percentage difference of 8.8 % between the recovery capabilities of these two devices tested. The patients' evaluation showed that even an initially perceived 150 % increase in the activity uptake represented only the same uptake once EQ.PET was used (SUVmax GE D600 6.63 kBq/ml to Siemens Vision 17.05 kBq/ml and EQ.PET 6.59 kBq/ml). On another lesions the uptake reduction was actually found to be even more significant (SUVmax from GE D600 6.00 kBq/ml to Siemens Vision 3.58 kBq/ml and EQ.PET 1.62 kBq/ml).
Conclusion: The introduction of the EQ.PET allows the adequate comparison of quantitative parameters (e.g. SUV max.) for therapy response assessment in tumour patients scanned on different PET/CT devices.

A-290

Simplified patient specific renal dosimetry in ^{177}Lu therapy: A proof of concept

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Purpose: Patient specific kidney dosimetry provides valuable information to optimize the therapeutic activity administration in ^{177}Lu peptide receptor radionuclide therapy (PRRT) of neuroendocrine tumors and in the treatment of metastatic prostate cancer. Organ dosimetry based on multiple sequential SPECT/CT acquisitions can result in an important clinic resource burden. The goal of this proof of concept study is to provide a simplified and accurate procedure supporting personalized kidney dosimetry in ^{177}Lu therapy.
Methods and Materials: We performed four sequential external dose-rate measurements (Automess 6150 AD 17, Ladenburg, Germany) in an abdominal phantom setup including kidneys, liver and intestines compartments filled with activity concentrations of ^{99m}Tc reproducing patient relevant organ effective half-lives (55, 79 and 85h in kidneys, liver and intestines respectively) occurring in Lu-177 PRRT. We used a 2 cm thick lead collimator to reduce signal pollution. A mono exponential fit of dose-rates measured at the level of the left kidney and in an intermediate position between the two kidneys (for background subtraction purposes) was applied to derive the kidney half-life to compare with the expected value known from the experiment construction. Additionally we performed GAMOS Monte Carlo validation of the experiment using ^{99m}Tc and ^{177}Lu as sources.
Results: The estimated kidney half-life obtained from collimated dose rate measurements with background subtraction was compatible within 5 % with the expected value. Monte Carlo simulation with both ^{99m}Tc and ^{177}Lu confirmed a similar level of accuracy.
Conclusion: The proposed simplified procedure to estimate the patient specific kidney half-life in PRRT from external dose rate measurements provides satisfactory accuracy and reduce to a unique quantitative SPECT/CT the imaging required to derive the kidney absorbed dose with benefits in terms of clinic workflows and patient comfort.

A-237

Influence of volumes, scan times and radiotracer distributions on PET radiomics features: A phantom study

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Purpose: Evaluation of radiomics features (RFs) stability and their ability to distinguish between homogeneous and heterogeneous radiotracer distribution is of paramount importance. In this phantom study, the role of PET RFs to describe the heterogeneity was investigated. Moreover, the RFs variability for different volumes and acquisition scan times were assessed.
Methods and Materials: The phantom has three 250 ml inserts with different distributions: two were filled with homogeneous 18F-FDG solution (0.02 MBq/ml and 0.1 MBq/ml) and one with water equivalent gel balls soaked with three different activities (0, 0.05, and 0.1 MBq/ml) mixed together. Phantom, acquired in list-mode for 60 minutes, was reconstructed at different scan time (from 1 to 60 min) using standard clinical protocol (OSEM3D+TOF3i21s). Five volumes (from 10 to 60 ml) were segmented for each insert. 93 RFs were extracted with Pyradiomics (discretization=64 bin, voxel interpolation=4x4x4 mm^3). Pearson's correlation coefficients and coefficients of variation (COVs) were calculated to quantify RFs dependences and variations over the volumes and acquisition times. Mann–Whitney test was used to evaluate the differences among RFs extracted from heterogeneous and homogeneous uptake.
Results: 81/93 RFs show moderate to high volume dependences without significant differences between distribution. Only 33/93 RFs have COVs exceeding 30 %, with larger COVs for the heterogeneous insert. All features show moderate to high dependences on the scan time, but COVs are always lower than 30 %. Mann-Whitney analysis reveals that 19/93 RFs cannot discriminate between heterogeneous and homogeneous distributions for both 3 and 4 min/bed position; the increase of acquisition time negatively affects the performance.
Conclusion: Most of RFs are capable to distinguish between homogenous and heterogeneous distribution. Even if RFs showed a dependence on volumes and acquisition times, their variability must be compared with the one of the studied population for considering the exclusion.

A-297

Development of a deep learning method for CT-free attenuation correction for an ultra-long axial field of view PET scanner

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Purpose: The possibility of reduced ionization dose of ultra-high-sensitivity total-body PET makes attenuation computed tomography (CT) a critical radiation burden in clinical applications. Artificial intelligence has shown the potential to generate PET images from non-attenuation corrected PET images. Our aim in this work is to develop a CT-free attenuation correction (AC) for an ultra-long field of view (FOV) PET scanner.
Methods and Materials: Whole body PET images of 165 patients scanned with a digital regular FOV PET scanner (Siemens Biograph Vision in Shanghai and Bern) was included for the development and testing of the deep learning methods. Furthermore, the developed algorithm was tested on data of 10 patients scanned with an ultra-long axial FOV scanner (Siemens Biograph Vision Quadra in Bern). A 2D generative adversarial network (GAN) was developed featuring a residual dense block, which enables the model to fully exploit hierarchical features from all network layers. The normalized root mean squared error (NRMSE) and peak signal-to-noise ratio (PSNR), were calculated to evaluate the results generated by deep learning.
Results: The preliminary results showed that, the developed deep learning method achieved an average NRMSE of 0.4±0.3 % and PSNR of 51.4±6.4 for the test on Biograph Vision and an average NRMSE of 1.0±0.3 % and PSNR of 40.3±3.1 for the validation on Biograph Vision Quadra.
Conclusion: The developed deep learning method to shows the potential for CT-free AC for an ultra-long FOV PET scanner. Work in progress includes clinical assessment of PET images by independent nuclear medicine physicians. Training and fine-tuning with more datasets will be performed to further consolidate the development.

A-302

Fifty shades of Scandium: Phantom-based quantification of Sc-43 in a commercially-available PET/CT device

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Purpose: Evaluate the quantification capabilities of Sc-43 in a commercial PET/CT device with respect to previously-obtained Sc-44 results and the F-18 gold standard.
Methods and Materials: The introduction of new radionuclides for nuclear medicine diagnostic imaging also depends on quantification capabilities of PET/CT devices. In this study, we characterised and compared performances of a commercial PET/CT to quantify a Sc-43/44 mixture (~68% Sc-43) with respect to results previously obtained with F-18 and Sc-44, respectively. Initially, a calibration factor for the Veenstra dose calibrator used in this study was determined, using two different approaches (linearity and detector response). Subsequently, a NEMA image-quality phantom and an anthropomorphic liver phantom was filled with Sc-43 solution, with a 5:1 and 8:1 lesion-to-background activity concentration ratio, respectively, and acquired utilizing a Siemens Biograph Vision PET/CT. Phantom analyses included background calibration, noise level (coefficient of variance – COV) and lesion size-dependent recovery coefficients (RC).
Results: The dose calibrator Sc-43 factor was 835 with an error < 1% with respect to the reference activity. Sc-43 PET quantitative accuracy in both phantoms background activity was within 9%, which is in agreement with F-18 PET standards, and superior to the 30% level of accuracy previously obtained with Sc-44 using a similar device. COV was 6.32% and 14.5% for the NEMA and liver phantoms, respectively. Signal recovery in NEMA phantom lesions provided RCmax values of 0.66, 0.90, 1.03, 1.04, 1.12 and 1.11 for lesions of 10-, 13-, 17-, 22-, 28- and 37-mm diameter, respectively. Comparable RC was observed for the liver phantom. These results agree with EARL reference values for F-18 PET.
Conclusion: The results in this work showed that accurate quantitative Sc-43 PET/CT is achievable in commercial devices. This may promote the future introduction of Sc-43/44-labelled radiopharmaceuticals into clinical use as an alternative to Sc-44.

A-291

Impact of liver movement on predictive SIRT dosimetry: A phantom study

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Purpose: Personalized predictive dosimetry based on ^{99m}Tc-macroaggregate albumin (MAA) SPECT/CT is a valuable information to tailor therapeutic administration in ^{90}Y-radioembolization of primary liver carcinoma or hepatic metastases. We presented a phantom-based experiment in a clinically relevant setup to assess the impact of respiratory-induced organ movement on dosimetry estimations.
Methods and Materials: We performed quantitative ^{99m}Tc-SPECT/CT acquisitions (Siemens Symbia Intevo, Erlangen, Germany) of a liver phantom including tree spherical inserts (dimeter of 40, 30 and 10 mm respectively) simulating tumor uptake. Activity concentration (Ac) in spheres was 6 times higher than liver background (728 vs. 118 kBq/mL). Sinusoidal phantom movement (amplitude: 0, 10, 20, 30 and 50 mm), mimicking respiratory conditions, was obtained with a programmable dynamic platform (CIRS, Norfolk, USA). We obtained Ac and dose maps from quantitative ^{99m}Tc-SPECT/CT reconstructions. We measured tumor volumes, mean Ac, absorbed dose and tumor/non-tumor ratios (T/N) using three different lesion segmentation methods (M). M1 considered CT tumor segmentation according to actual sphere size. M2 and M3 used threshold-based segmentations: 40% of maximum (M2) and average liver Ac plus 3 standard deviations (M3), respectively.
Results: Tumor Ac, absorbed dose and T/N underestimation increased with increasing movement amplitude and was more severe as the lesion size decreased. Ac, lesion absorbed dose and T/N recovery were down to 40% of the actual values using M1 and M2, and 25% using M3. Using M2 and M3, movement-induced spatial signal blurring resulted in tumor volume overestimates up to 300% of the actual size from the smallest sphere.
Conclusion: Our ^{99m}Tc-MAA SPECT/CT phantom study showed that respiratory movement significantly reduced the measured activity concentration and absorbed dose in lesion. In perspective, this bias must be considered to establish accurate dose/response relations for ^{90}Y radioembolization.

A-155

Implementing Dynamic Contrast Enhanced Magnetic Resonance Lymphangiography in a paediatric tertiary hospital in Switzerland

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Purpose: Dynamic Contrast Enhanced Magnetic Resonance Lymphangiography (DCMRL) in paediatric patient as a routine diagnostic procedure is not well established in Switzerland. We present our experience over the past three years of this technically challenging imaging modality.
Methods and Materials: All DCMRL at our institution were performed on a 1.5T GE scanner and retrospectively analyzed. Patient demographics (sex, age, and weight of the patient), referring hospital/department, clinical indication, duration of ultrasound guided needle placement and scan time, and adverse events were noted. Technical success was defined as visible ascending contrast media within the lymphatic system on both iliacal axis and above the cysterna chyli.
Results: The first DCMRL at our institution was performed in May 2017. Since then out of 18 DCMRL, 14 were technically successful (78%). Out of the most recent 10 scans (since March 2020), 90% were technically successful. 10 girls and 8 boys were scanned with a mean age of (46 months; range 1 mo–207 mo; +/-58 months) and a mean body weight of 26 kg (range 2.5 kg–45kg; +/-19 kg). 14/18 were inpatients, 6/14 were referred from dermatology, 7/14 cardiac, and 1/14 from neonatology. Out of the 18 patients 5 had a high-output chylothorax, 4 a congenital chylothorax, 5 a primary or secondary lymphedema and 1 patient a Central Lymphatic Anomaly and 1 patients a Gorham Stout Disease and 2 patient without any lymphatic disorder. Mean total DCMRL time of all scans was 78 min (range 46 min–151 min), needle placement took a mean 39 min (range 19 min–78 min). Total needle placement and scan time of the most recent 10 scans (mean 96 min, range 69 min–112 min) was significantly shorter compared to the initial 5 scans (mean 130 min; range 88 min–171 min) ($p<0.05$). No adverse events were noted.
Conclusion: After an initial learning curve DCMRL is a well-established imaging modality at our institution with a high technical success rate.

A-246

Feasibility of non-gated dynamic fetal cardiac MRI for identification of fetal cardiovascular anatomy

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Purpose: To evaluate the feasibility of identifying the fetal cardiac and thoracic vascular structures with non-gated dynamic balanced steady-state free precession (SSFP) MRI sequences.
Methods and Materials: We retrospectively assessed the visibility of cardiovascular anatomy in 66 fetuses without suspicion of congenital heart defect in a consensus reading by an experienced paediatric cardiologist and radiologist (mean gestational age (GA) 27+/-4, 21–38 weeks). Non-gated dynamic SSFP sequences were acquired in three planes. An imaging score was defined by giving one point to each visualized structure. Basic diagnostics included the atria, ventricles, systemic veins, ventricular outflow tracts (RVOT/LVOT), aortic arch, descending aorta (DAO), ductus arteriosus and thymus (12 pts); advanced diagnostics the atrioventricular (AV) valves, pulmonary arteries/veins, supraaortic arteries and trachea (21 pts). Image quality was rated from 0 to 2. The influence of GA, field strength, placenta position, and maternal panniculus on image quality and score were tested.
Results: 34/32 scans were performed at 1.5/3T. Heart position, atria and ventricles were seen in 66 fetuses. Basic diagnosis was achieved in 60 (90%) cases, with visualization of the IVC/SVC in 65 (98%) / 63 (95%), RVOT in 62 (94%), LVOT in 61 (92%), aortic arch in 60 (91%), DAO in 64 (97%), ductus arteriosus in 59 (89%) and thymus in 50 (76%) fetuses. The AV valves were recognised in 55 (83%), pulmonary arteries in 35 (53%), at least one pulmonary vein in 46 (70%), supraaortic arteries in 42 (64%), and the trachea in 59 (89%) fetuses. The mean imaging score was 16.8+/-3.7. Maternal panniculus (r -0.3; p 0.01) and GA (r 0.6; $p<0.001$) correlated with imaging score. Image quality was better on 1.5T than 3T (p 0.04) while the total score showed no significant difference.
Conclusion: Fetal heart MRI with non-gated SSFP enables recognition of basic cardiovascular anatomy. Advanced diagnostics may be limited by thick maternal panniculus, lower GA and higher field strength.

A-188

Ultrasound in Appendicitis: Complexities beyond the textbook.

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Purpose: Challenges in pediatric ultrasound for appendicitis include children's BMI, operator experience and appendiceal diameter cut-offs for treatment.
Methods and Materials: Children with ultrasound for suspected appendicitis in 2018 were included. Correlation between appendiceal visualisation, BMI/operator's experience (junior vs senior) were tested. Diagnostic accuracy of appendiceal diameter was calculated.
Results: Of 128 children (11 years ± 3.9; 39% female) with clinical suspected appendicitis, 29% had surgery with positive histology in 91.89%. No significant difference in appendix visualization with BMI <25 vs BMI >25, p=0.35 or operator experience, p=0.30, was observed. The area under the curve for appendiceal diameter was 81%. There was no significant difference in treatment between patients with a 6mm vs 8mm cut-off.
Conclusion: No significant correlation was observed between children's BMI or operators' experience for appendiceal isualization. Appendiceal diameter was an important factor for diagnosis of appendicitis, however, cut-offs of 6 mm vs 8 mm, did not affect treatment.

A-317

Imaging Findings in COVID-19 symptomatic pediatric patients

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Purpose: The novel coronavirus (COVID-19) has touched all population worldwide. Though children are less affected, significant clinical and radiologic findings can be found in the pediatric population. We report imaging findings of COVID-19 for symptomatic children in our center.
Methods and Materials: We performed a retrospective review of medical records of children with COVID-19 infection that had imaging from March to September 2020. We analysed clinical symptoms, medical background, chest radiographs, abdominal US, thoraco-abdominal CT, cardiac and brain MRI findings.
Results: 17 patients were involved (age:1 month-14 y; 10 M,7 F).Symptoms included fever 65%, cough 58%, vomiting/diarrhea 41%; 17% had a high BMI.
All patients had chest xray, 8 had US,5 had CT and 2 MRI. Normal imaging was seen in 35% of cases.
Xray lung findings were seen in 8/17 including peribronchial cuffing 5/17, pleural effusion 5/17 and consolidations 4/17.
US had positive findings such as mesenteric lymphadenitis 3/8, colitis 2/8, splenomegaly 2/8.
CT showed positive findings in 5 patients including alveolar lung consolidations 4/5, pleural effusions 4/5, colitis 4/5 and mesenteric lymphadenitis 3/5.
These 5 patients were diagnosed with multisystemic inflammatory syndrome in children. Three out of these 5 patients subsequently developed multifocal pneumonia, hematological impairment, hepatic and renal failure. Two of them developed a coronarian dilatation on cardiac US and 1 in cardiac MRI too.
Brain MRI was positive in 1 patient for contrast enhancement of the vertebral arteries wall.
To date, 14 out of the 17 of the patients were hospitalized, 5 needed intensive care and 3 were discharged. 94% had a favorable disease outcome with no sequella.
Conclusion: Although children seem to be less affected than adults by COVID-19, we have observed some severe cases with diverse pulmonary and abdominal imaging findings. Though 23% needed ICU admission, 94% had a favorable disease outcome. We have noted a high percentage of symptomatic children with no radiological lung abnormalities.

A-220

Impact of Whole Body MRI in the management of pediatric non-oncological pathologies

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Purpose: To present our experience of Whole-body MRI (WBMRI) in various pediatric non-oncologic pathologies involving multiple locations.
Methods and Materials: This retrospective study concerns 149 children who had WBMRI for various non-oncological clinical indications between 2007 to 2019. The MR examination was performed on a 1,5 T (Avanto Siemens) with 3 sequences: coronal T1-weighted, 3D SPACE IR, DWI sequences. No gadolinium injections were administered and the children were sedated according to their age. Clinical charts were reviewed to identify the impact of WBMRI on patient care.
Results: Among the 149 children, some had several follow-up MRI scans according to their pathology In total, we reviewed 199 studies (median age: 6 years, range: 2 weeks-18 years). The indications for performing WBMRI included: chronic recurrent multifocal osteomyelitis (n=76), acute osteomyelitis (n=23), juvenile idiopathic arthritis (n=4), fever of unknown origin (n=17), various systemic and inflammatory diseases (n=16), enchondromatosis (n=1), Langerhans cell histiocytosis (n=14), Loeys Dietz syndrome (n=1), psychogenic arthralgia and myalgia (n=2), non-accidental trauma (n= 45). For each clinical indication, we present the usefulness of this examination through concrete examples, technical difficulties related to the long MR time and sequence analysis.
Conclusion: In the majority of non-oncological pediatric diseases involving multiple locations, WBMRI has proven useful for diagnosis, treatment planning and disease monitoring. As abnormal findings may be non-specific, it should be remembered that they must be interpreted in the context of the clinical setting and other imaging findings.

A-349

MRI 3D UTE Cones and ZTE 4D for detection of lung density in pediatric patients

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Purpose: The aim was to assess the ultrashort echo-time (UTE) and zero echo-time (ZTE) magnetic resonance imaging (MRI) sequences in detecting lung signal in pediatric patients with normal lung (controls) and with cystic fibrosis (CF). Lung to background signal ratio (LBR) was compared for both sequences and correlated to lung density. LBR higher than 1 indicates higher lung singal intensity that may be correlated to lung density.
Methods and Materials: Retrospective study with 17 controls and 9 CF patients. 3D UTE Cones (Cones) and 4D ZTE (ZTE) sequences used to capture the fast decaying T2* lung signal. Both lungs were manually segmented and signal intensities were extracted. The background signal intensity was assessed through four region-of-interest average. LBR analysis for both cohorts. Wilcoxon rank sum statistical test for differences between controls and CF patients and between Cones and ZTE.
Results: The range of Cones LBR for controls from 15 days old up to 17 years old varied from 2.60 to 1.41 and Spearman rank test showed strong negative correlation of LBR to age (Rs=-0.69). Similarly, the range of ZTE LBR was 2.43 to 1.38 with Rs=-0.74. The median LBR for controls was 1.52 and 1.41 for Cones and ZTE respectively. For CF patients between 1.5 and 23 years old the LBR varied from 2.03 to 1.25 for Cones and from 2.17 to 1.2 for ZTE while there was a moderate correlation between LBR and age (Rs=-0.5/-0.55 for Cones/ZTE).
Cones and ZTE LBR did not show a significant difference between controls and CF patients.
Conclusion: Cones and ZTE are able to measure lung density in children as the LBR analysis shows where LBR decreases with increasing age, which is similar to CT findings and might open new open possibilities to evaluate, grade and measure lung pathology which is not possible with conventional MRI.

A-257

Paediatric low dose lung CT – What is the lowest radiation dose for providing diagnostic images?

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Purpose: To investigate a quantitative method for assessing image quality of low dose lung CT and find the lowest exposure dose providing diagnostic images in children.
Methods and Materials: Axial volumetric CT (256 slice scanner) was performed on anthropomorphic phantoms (paediatric chest and adult-sized phantom) at different dose levels and with deep learning image reconstruction (DLIR, TrueFidelity, GE Healthcare). The steepness (maximum slope) of sigmoid curves fitted to line density profiles was measured at lung-to-pleura interfaces. Image sharpness was calculated as the median steepness from 18 different locations. Diagnostic image quality was rated by three radiologists as 1(unacceptable), 2 (limited), 3 (adequate) and 4 (higher than needed). The image sharpness cut-off for obtaining adequate image quality was determined by comparing steepness with qualitative ratings. Lung CT from 18 children (age range 3 weeks to 17.6 years) were reviewed for image quality and radiation dose.
Results: Image sharpness increased with higher CTDIvol (figure 1). Adequate diagnostic quality was reached at median steepness of 862 HU/mm in the paediatric and 515 HU/mm in the adult phantom (figure 2), with corresponding CTDIvol ≥0.1 mGy in the paediatric and ≥0.15 mGy in the adult phantom. Patient studies obtained with low dose (median CTDIvol 0.13 mGy, median effective dose 0.12 mSv) were subjectively rated as adequate for diagnosis while image sharpness was below the adult cut-off in 1/12 cases and below the paediatric cut-off in 12/18 cases.
Conclusion: Determination of image sharpness on line density profiles can be used as measure for image quality of lung CT using DLIR. Adequate diagnostic image quality requires a CTDIvol ≥0.1 mGy in a child and ≥0.15 mGy in adult-sized patients. Our current protocol needs to be refined to ensure diagnostic image quality in children of all sizes with estimated effective dose ranging from 0.1 mSv in a neonate to 0.3 mSv in a teenager.

A-320

Breast imaging in children and adolescents: Our experience in the 5 past years

C. Sadjo Zoua, D. Botsikas, S. Hanquinet; Geneva/CH

Purpose: To review principal radiological findings for breast imaging in children.
Methods and Materials: This retrospective study includes 152 pediatric patients with breast pain or lump palpation in breast from 2014 to 2019. Patients (36 boys and 116 girls) were aged between 24 days and 18 years: 0–2 years (n=10); 3–8 years (n=24); 9–15 years (n=55); 16–18 years (n=61). Imaging consisted of US and/or MRI (151 US, 3 US and MRI, and 1 MRI alone). A biopsy was performed if considered necessary.
Results: Among our population, 20% of the cases had normal imaging, 33% presented with developmental anomalies and 49% of the population presented a mass. Only 3% of them had malignant/pre-malignant masses: 4 phyllodes tumors and 1 metastatic lesion in breast. The benign breast masses are: 24 fibroadenoma, 9 cysts, 13 inflammatory lesions (abcess and mastitis), 1 hemangioma, 1 cystic lymphangioma, 7 lipomastias, 1 venous malformation, 5 ductal ectasias, 5 fibrosis bands. Normal variation in breast development: 4 neonatal hypertrophy, 12 early breast development (premature thelarche), 4 asymmetrical breast development, 2 juvenile hypertrophy. Other benign abnormalities include 24 gynecomastia, 2 polymastia and 2 hypotrophy of the breast tissue (Poland syndrome, amastia).
Most breast imaging consisted of ultrasound alone, in few cases these were completed by an MRI for instance to characterize a suspected phyllodes tumor, to follow complex recurrent abscesses and in one case of Poland syndrom or breast aplasia. Twenty percutaneous core biopsies and 6 vacuum assisted biopsies were performed in 27 children aged between 9–18 years to characterize the solid masses.
Conclusion: Unlike adults, the majority of breast pathologies are benign in children. Ultrasound is the basic and often sufficient modality to diagnose a breast pathology. The spectrum of abnormalities must be known as it can cause emotional distress to both patients and parents.

A-348

Role of spinal imaging in non-accidental trauma in children

E. Barras, M. Laurent, D. Ribeiro, E. Katirtzidou, S. Hanquinet; Geneva/CH

Purpose: A conclusive diagnosis of non-accidental trauma (NAT) is sometimes difficult, however, MRI findings of spinal capsular-ligamental damage or sub-dural hematomas can increase suspicion. International recommendations suggest mandatory skeletal survey and cerebral imaging without contrast (CT, MRI). Spinal MRI is recommended in the literature, but not mandatory. This study aims to analyze the incidence of spinal injury in our series in the light of recent literature.

Methods and Materials: In this retrospective study, we reviewed the imaging of 58 children (<2 years old) suspected of NAT over the last 11 years. The radiological workup included various modalities: abdominal ultrasound, skeletal survey, brain CT, brain/spine/whole body MRI. Spine MRI included either sagittal T1 SE/T2 SE or STIR whole body (WB) MRI. We selected only cases with spinal imaging.

Results: Of the 58 cases, 38 children had spinal MR imaging: 4 sagittal spine T1/T2 MRI, 24 3D-STIR WB MRI and 9 all sequences.

Among these 38 cases, 14 children had brain injuries. Three cases also had spinal injuries: spinal subdural hematoma (n=2), cervical capsular-ligamental damage (n=1). Two other cases were considered suspicious for cervical capsular-ligamental damage.

The spinal imaging results will be correlated to brain lesions, compared to the literature and the diagnosis of cervical lesions will be discussed in relation to the MRI technique used and variants of the standard.

Conclusion: Non-accidental trauma requires a systematic radiologic assessment within a complex medico-legal context. Although skeletal survey and brain imaging are performed routinely, spinal imaging is sometimes forgotten and, if done, often of poor quality and not sufficiently standardized. Better attention to spinal imaging could help diagnosis in unclear cases.

A-324

Accuracy of an AI-based algorithm in intracranial hemorrhage detection on CT scans

M. Seyam, M.-N. Psychogios, K. A. Blackham; Basel/CH

Purpose: We assessed the diagnostic accuracy of an artificial intelligence-based (AI-based) screening solution for intracranial hemorrhage (ICH) detection on emergent non-contrast head CT scans.
Methods and Materials: The algorithm prospectively evaluated 2,222 non-contrast head CT scans performed at our university hospital from the emergency department between January 2020 and October 2020. The automated results (positive for ICH n = 313, negative for ICH n = 1706) were retrospectively compared to the corresponding finalized reports, as well as categorized by their clinical course (acute/subacute/chronic) if applicable. Examinations with clinical questions other than ICH were excluded.
Results: The AI solution achieved an accuracy of 91.8% with 88.2% sensitivity and 92.5% specificity in detecting intracranial hemorrhage on CT scans, including those of poor imaging quality. More specifically we observed a 100% detection rate for acute intraventricular hemorrhage and acute subdural hematoma, while reliability in less acute bleedings was unsurprisingly lower.
Conclusion: Implementation of similar AI solutions can potentially aid as a valuable tool for worklist prioritization, thus facilitating faster diagnosis and timely management.

A-123

MRI signs of a variant Creutzfeldt Jakob disease (vCJD)

P. Faerber, P. Kelemen; Neuchâtel/CH

Learning objectives:
- Recognize the characteristic signs of Creutzfeldt Jakob disease in MRI.
- Know about the different various form of Creutzfeldt Jakob (sporadic form and variant form)
- May suggest the differential diagnosis.
- Be aware about specific MRI signs for each different various form.
- Know the different MRI sequence to diagnose Creutzfeldt Jakob disease.
- Present a rare disease less know and meet in our daily practice.

Background:
- Reviews of the literature.
- Scientific papers.
- Illustration with a case of a young women take in charge in Neuchâtel hospital with typical symptoms of a variant Creutzfeldt Jakob disease.

Imaging findings or procedure details:
- The diffusion hypersignals and T2 Flair located in the pulvinar (pulvinar sign) and in the dorso-median nuclei of the thalamus (hockey stick sign) are the typical localization of the variant Creutzfeldt Jakob disease (vCJD).
- A lesion of the pulvinar reports a sensitivity of 78 % and a specificity close to 100 % in the vCJD.
- The hypersignal T2 and T2 Flair for the cortex and striatum is typical in sporadic forms of Creutzfeldt Jakob (sCJD).
- The involvement of basal ganglia in the restricted diffusion sequences of ADC can be seen in the sporadic or variant form of Creutzfeld Jakob disease but also in differential diagnoses (encephalopathy on intoxication, Wilson‘s disease ...).

Conclusion:
- MRI remains the gold standard in terms of radiological examination in the search for Creutzfeld Jakob disease but does not remain specific to this pathology, it should be related to the clinical history and the neuro-degenerative markers CSF.
- For searching a Creutzfeld Jakob disease, need to integrate the diffusion, T2 Flair and T2 sequences into the MRI protocol.
- The lesion of the pulvinar and the dorsomedian nuclei of the thalamus on the diffusion and T2 Flair sequences remains a specific localization of the vCJD instead of a cortical lesion which would rather cause suspicion of the sCJD.

A-202

MR Imaging of Cranial nerves pathology: From anatomy to abnormalities. What radiology resident/ fellow should know.

A. Sobieh; Worcester/US

Learning objectives:
1. Review radiological anatomy of cranial nerves.
2. Discuss MRI protocols for cranial nerve imaging.
3. Present a series of cases of cranial nerve pathologies with imaging CT and MRI features. Discuss imaging pitfalls and how to report findings.

Background: Cranial nerves anatomy is complex. Knowledge of anatomy is essential for identifying pathological alterations in case of nervous pathology. Magnetic resonance imaging is the gold standard technique in the study of the cranial nerves. Steady-state free procession (SSFP) images are considered the best sequences for the visualization of the cisternal segments. MRI can evaluate denervation changes of end organs. Computed tomography is useful in evaluation of intraosseous segments of cranial nerves, skull base foramina, and bony traumatic lesions.
Imaging findings or procedure details: In this exhibit, we will review CT and MR findings of common cranial nerve pathologies including infectious, inflammatory, trauma and neoplastic conditions.
For example:
MRI is more sensitive than CECT for perinerual spread. CT might show smoothly widened foramina or canals, muscular denervation atrophy. MR shows nerve enlarged & enhancing, loss of normal fat signal along course of nerves T1WI without fat saturation is mainstay of diagnosis, with contrast necessary for intracranial PNT.
Conclusion: Radiologist plays an essential role in diagnosis of various cranial nerve pathologies. Radiology trainee should know anatomy of each cranila nerve for proper diagnosis and subsequent managment offering better treatment outcome.

A-266

MR Imaging of orbital lesions: From orbital anatomy to abnormalities. What radiology trainee should know

A. Sobieh; Worcester/US

Learning objectives:
1. Review radiological anatomy of orbit.
2. Discuss MRI protocols for orbit imaging.
3. Present a series of cases of orbital pathologies with imaing CT and MRI features. Discuss imaging pitfalls, differential diagnosis algorithm and how to report findings.

Background: Knowledge of orbital anatomy and its compartments is essential for identifying pathological alterations in case of pathology. Differential diagnosis of orbital patholgies is wide. Magnetic resonance imaging and CT play an important role in identification and characterize different lesions.
Imaging findings or procedure details: In this exhibit, we will review anatomy of orbit compartments, CT and MR fiindings of common oribital pathologies including infectious, inflammatory, trauma and neoplastic conditions.
Conclusion: Radiologist plays an essential role in diagnosis of various orbital pathologies. Radiology trainee should know anatomy of orbit for proper diagnosis and subsequent managment offering better treatment outcome.

A-268

Neck MRI after alleged nonfatal strangulation: What the radiologist should know

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Learning objectives:
- To show the typical findings in case of nonfatal strangulation that clinical and forensic radiologists should know about and report accordingly
- To show the technical error that can impair a correct interpretation of the images

Background: In forensic medicine, nonfatal strangulation is a frequent form of violence. Allegations of such an attack are examined if charges are filed. In Switzerland, externally visible injuries are routinely documented by forensic pathologists. In addition, radiological identification of presence, location and extent of any deeper neck lesions may be seen as additionally relevant for clinical diagnosis and/or medicolegal decision-making.
In cases of alleged nonfatal strangulation, radiological findings tend to be absent or very discreet. Findings typically involve anatomical structures that usually are not examined closely in clinical radiology. Because of this, clinical radiologists that are asked to review a forensic neck-MRI for findings in context of alleged strangulation, may overlook such subtle signs that may be interpreted in context of the allegations.

Imaging findings or procedure details:
The poster presentation will demonstrate:
- The indications for such an MR.
- The anatomical structures which are mostly involved in cases of nonfatal strangulation, and typical radiologic findings
- The recommended MR-sequences.
- Common technical and diagnostic pitfalls
- Typical differential diagnoses for neck-MRI findings in cases of alleged strangulation.

Conclusion: Cervical MR may be able to help forensic doctors to identify neck injury in cases of nonfatal strangulation also in cases of absent external findings. In cases of visible skin injuries, the location, extent and type of MRI finding may solidify and extend the medicolegal diagnosis.

A-321

Mitral annular disjunction: Extent and reproducibility of measurements with computed tomography

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Purpose: To determine the prevalence of mitral annular disjunction (MAD), the association of MAD with mitral valve disease, and to evaluate the extent of MAD including the reproducibility of measurements with computed tomography (CT).
Methods and Materials: We retrospectively evaluated 408 patients (median age, 82 years; 186 females) with severe aortic stenosis undergoing ECG-gated cardiac CT with end-systolic data acquisition. Two blinded, independent observers evaluated the presence of MAD on multi-planar reformations. Maximum MAD distance (left atrial wall-mitral leaflet junction to left ventricular myocardium) and circumferential extent of MAD were assessed on CT using dedicated post-processing software. Mitral annular calcification was assessed semi-quantitatively. Associated mitral valve disease was determined with echocardiography.
Results: 7.8% (32/408) of patients with severe aortic stenosis had MAD. Mitral regurgitation (p=1.00) and severe mitral annular calcification (p=0.29) were similarly prevalent in patients with and without MAD. Significantly more patients with MAD (6/32; 19%) had mitral valve prolapse compared to those without (6/376; 2%; p<0.001). The maximum MAD was 3.5 mm (interquartile range: 3.0-4.0 mm). The circumferential extent of MAD comprised 34±15% of the posterior and 26±12% of the entire mitral annulus. Intra- and interobserver agreement for the detection of MAD on CT were excellent (kappa: 0.90±0.02 and 0.92±0.02). Bland-Altman analysis revealed an average variability of 0.1±1.1 mm within and 0.0±0.8 mm between observers for maximum MAD.
Conclusion: MAD was found in 7.8% of patients with severe aortic stenosis, with a higher prevalence in patients with mitral valve prolapse. CT is a highly reliable technique for detecting and measuring the extent of MAD.

A-275

Value of cardiac magnetic resonance imaging derived temporal myocardial strain pattern for non-invasive diagnosis of myocarditis

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Purpose: To evaluate the added diagnostic value of temporal strain curve quantification for non-invasive diagnosis of myocarditis using cardiac MRI.
Methods and Materials: In the single-center prospective MyoRacer-Trial 65 patients (26% female, median age 40 [IQR 29 to 55) years) with suspected myocarditis and symptom onset within 14 days underwent comprehensive cardiac MRI followed by biventricular endomyocardial biopsy (EMB) between 2012 and 2014. Discrete cosine transformation (DCT) was applied to myocardial strain curves extracted from cine-Images. A random forest reference model using global native T1 time, T2 time and extracellular volume was trained to predict EMB results and compared to two models which additionally include three orders of DCT coefficients and three-plane peak longitudinal/circumferential strain, respectively. Predictive performance was evaluated in a leave-one-out cross-validation approach.
Results: A total of 44 (67%) patients had biopsy-proven myocarditis. The DCT model showed lowest mean-square-error (MSE 19% [95% CI 14 to 24]) and best discrimination (Area under the receiver-operating-curve [AUC] 0.75 [95% CI 61 to 86]). Addition of peak strain values (MSE 21% [95% CI 16 to 25]; AUC 0.70 [95% CI: 0.59 to 0.82]) increased MSE and decreased AUC slightly compared to the reference (BS 20% [95% CI 16 to 24]; AUC 0.72 [95% CI: 0.59 to 0.83]).
Conclusion: The preliminary results provide no evidence for added value of myocardial strain measurements for non-invasive diagnosis of myocarditis. Future research should address the value of the proposed DCT approach for quantification of myocardial motion in larger samples and different disease entities.

A-363

Reduced-iodine-dose dual-energy coronary CT angiography compared with conventional CT: A non-inferiority study

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Purpose: To quantitatively evaluate the impact of virtual monochromatic images (VMI) on reduced-iodine-dose dual-energy CCTA regarding the accuracy and precision of coronary lumen area measurements in vitro, and secondly to assess the image quality in vivo, compared with conventional CT obtained with regular iodine dose.
Methods and Materials: A phantom simulating regular and reduced iodine injection protocols was used to determine the accuracy and precision of lumen area measurements for various VMI energy levels. We retrospectively included 203 patients from December 2017 to August 2018 (mean age, 51.7±16.8 years) who underwent CCTA using either standard (group A, n=103) or reduced (group B, n=100) iodine doses. Conventional images (group A) were qualitatively and quantitatively compared with 55-keV VMI (group B). The location of the venous catheter placement was recorded.
Results: In vitro, decreasing the VMI energy level significantly improved lumen area quantification accuracy and precision. In vivo, the rate of diagnostic CCTA in groups A and B was 88.4% (n=91/103) and 89% (n=89/100), respectively, and non-inferiority of protocol B was inferred. Contrast-to-noise ratios (CNR) of lumen versus fat and muscle were higher in group B (p<0.001), and comparable for lumen versus calcium (p=0.423). Finally, the venous catheters were more often placed on the forearm or hand in group B (p<0.001).
Conclusion: In vitro, low-keV VMI improve vessel area quantification. In vivo, low-keV VMI allows for a 40% iodine dose and injection rate reduction while maintaining diagnostic image quality and improve the CNR between lumen versus fat and muscle.

A-157

How to report a cardiac CT: A systematic approach with structured reporting

S. Tomala, L. Widmer, C. Tappero, H. C. Thoeny; Fribourg/CH

Learning objectives: To review radiological anatomy of the heart and the coronary arteries, as well as their clinically significant variants.
To familiarize the radiologist to the coronary arteries and left atrial appendage analysis with practical structured reporting forms based on guidelines and recommendations of various international medical societies.
Background: Cardiac CT is set to become a preferred examination tool in the management of patients in emergency departments round the clock. The proven high sensitivity and high negative predictive value of diagnostic accuracy of coronary CTA indicates the ability to exclude relevant morphological coronary artery disease. Furthermore, cardiac CT gives the referring physicians important anatomical information in patients who may benefit from a left atrial appendage closure, in order to avoid a stroke due to atrial fibrillation. The cardiologists expect a report from which they can extrapolate the relevant information needed for patient care. Common criteria and language are therefore important.
Imaging findings or procedure details: ICardiac CT needs post processing with some technics more suitable for diagnosis while others are more suitable for documentation. Agatston score is used to calculate a score based on the extent of coronary artery calcification. CAD-RADS categorizes the information derived from coronary CT angiography about plaque characteristics, degree of stenosis, as well as previous endovascular or surgical intervention. Left chambers anatomical evaluation focuses on identifying contraindications for left atrial appendage closure. We present in an illustrated manner the tri-planar and curvilinear reconstructions necessary for the correct and systematic evaluation of these items, as well as a standardized report capable of answering the questions of referring physicians.
Conclusion: This educational poster provides a framework of cardiac CT standardized reporting that may improve communication between radiologists and referring physicians, and ultimately improve patient care.

A-230

Image-based classifications of acute aortic syndrome: What the radiologists have to know?

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Learning objectives:
- To explain the principles of the different classifications of the acute aortic syndrome (AAS)
- To learn how to appropriately report AAS type.

Background: AAS is one of the most life-threatening vascular emergencies. CT angiography has a critical role in establishing the diagnosis and identifying associated complications. This educational poster provides an illustrative comprehensive review of existing classifications with specific regard to the most recent one applied for aortic dissections (AD).

Imaging findings or procedure details: De Bakey initially divided into types 1, 2, and 3, indicating the dissection arising in the ascending aorta (AA) with distal extension, AD limited to the AA, and AD arising in the descending aorta (DA), respectively. Later, the Stanford classification, organized AD into type A and B corresponding to AD involving the AA and DA, respectively. While these classifications were widely applicable in AD clinical management, low accuracy regarding the aortic arch involvement has led to the management discrepancy of this entity. Thereafter, Von Segesser added a "non-A non-B" type to traditional Stanford classification, which further subdivided into descending-entry and arch-entry by Rylski. Despite the major role of these classifications in describing AD, the aortic branches' involvement affecting the clinical outcomes, has yet to be addressed. The Lausanne classification added type C to the Stanford classification, corresponding to aortic arch involvement. They further added four grades in regard to malperfusion syndrome concerning side branch involvement (0, 1, 2, and 3). Recently developed 301 classification has added 3 subtypes to type B highlighting the position of true and false lumens related to AD side branches. It is proposed to predict the risk of AD expansion when considering an endovascular repair.

Conclusion: Familiarity with CT patterns of AAS, especially AD, helps radiologists to better communicate with caregivers and thereby facilitate appropriate management of AD in a timely fashion.

A-221

Predictive value of CT pulmonary angiography to assess the surgical accessibility for pulmonary endarterectomy in patients with chronic thromboembolic pulmonary hypertension

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Purpose: To assess the predictive value of a new radiological classification of the level of disease in chronic thromboembolic pulmonary hypertension (CTEPH) patients on CT pulmonary angiography (CTPA) using the surgical classification as a standard of reference.
Methods and Materials: We retrospectively evaluated 43 patients (mean age, 57 ± 16 years; 14 females) with CTEPH undergoing CTPA prior to surgery between May 2015 and January 2020. The median time between CTPA and surgery was 77 days (range: 1 to 248 days). Three chest radiologists, blinded to surgical results, independently classified the level of disease based on the most proximal thrombus. Radiological and surgical classification was scored as follows: L1 (main pulmonary artery [PA]), L2 (lobar PA), L3 (segmental PA), and L4 (subsegmental PA). L2 was subdivided into L2a (lobar PA) and L2b (lower lobe basal trunk). Fleiss kappa was calculated for interobserver variability. To assess the predictive value, "proximal disease" was defined as L1 & L2a and "distal disease" was defined as L2b, L3, and L4.
Results: Three radiologists classified L1 in 35%, 28%, and 21%, L2a in 51%, 49%, and 61%, L2b in 7%, 14%, and 7%, and L3 in 7%, 9%, and 12%, respectively. None rated L4. Interobserver agreement was moderate (k=0.55). All radiological classifications were within 1 level of the surgical classifications.
Considering surgical classification as the standard of reference, the sensitivity, specificity, and accuracy of CTPA in identifying proximal disease in a cohort of CTEPH patients were 89%, 70%, and 81%, respectively.
Conclusion: Our results show that CTPA is highly sensitive to predict the level of disease in CTEPH patients with a moderate interobserver agreement even for a detailed categorization of the level of disease.

A-271

Predictive capabilities of CT-derived 3D texture features for masaoka and WHO classifications of thymic epithelial neoplasms

C. Blüthgen, M. Patella, A. Euler, I. Schmitt-Opitz, T. Frauenfelder; Zurich/CH

Purpose: To assess the predictive performance of CT-derived 3D texture features for the classification of thymic epithelial neoplasm stage (Masaoka classification) and risk (WHO classification).
Methods and Materials: For this retrospective study, CT scans were reformatted (pixel-spacing 1x1 mm^2, slice thickness 2 mm). Tumors were segmented manually (3D-Slicer). 15 scans were segmented by a second reader, and re-segmented after 2 weeks (original reader). First order statistics, shape-based features, gray level cooccurence matrix, gray level run length matrix, gray level size zone matrix, neigbouring gray tone difference matrix and gray level dependence matrix features were calculated (pyradiomics).
Feature selection was done by excluding features with poor to moderate intra- or interreader agreement (ICC(3,1)<0.61) and by correlation-based subset selection (WEKA).
A machine-learning classifier (Support Vector Machine) was evaluated using 6-fold cross-validation with in-fold synthetic over-sampling technique (SMOTE).
Results: The study included CT scans of 62 Patients (28 female patients, mean age 57±14 years, range 22-82 years) with 34 Low-Risk Thymomas (LRT; WHO A/AB/B1), 22 High-Risk Thymomas (HRT; WHO B2/B3) and 6 Thymic carcinomas (TCA, WHO C) in early stage (49, Masaoka I-II) or advanced stage (13, Masaoka III-IV).
The SVM classifier was trained using the selected 8 (Masaoka) and 7 (WHO) out of initially 1316 features and predicted early vs. advanced stage with an AUC of 0.88±0.06. LRT vs. HRT vs. TCA was predicted with a mean AUC of 0.77±0.07 (One-vs-rest classification, averaged across folds).
Conclusion: CT-derived 3D texture analysis may be a useful imaging biomarker for the prediction of thymic epithelial neoplasm risk and stage.

A-205

Impact of vessel suppressed-CT on diagnostic accuracy in detection of pulmonary metastasis and reading time

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Purpose: To assess if vessel suppression (VS) improves nodule detection rate, interreader agreement, and reduces reading time in oncologic chest computed tomography (CT).
Methods and Materials: One-hundred consecutive oncologic patients (65 male; median age 60y) who underwent contrast-enhanced chest CT were retrospectively included. For all exams, additional VS series (ClearRead CT, Riverrain Technologies, Miamisburg, US) were reconstructed. Two groups of three radiologists each with matched experience were defined. Each group evaluated the SD-CT as well as VS-CT. Each reader marked the presence, size, and position of pulmonary nodules and documented reading time. In addition, for the VS-CT the presence of false positive nodules had to be stated. Cohen's Kappa (k) was used to calculate the interreader-agreement between groups. Reading time was compared using paired t-Test.
Results: Nodule detection rate was significantly higher in VS-CT compared to the SD-CT (+21%; p<0.001). Interreader-agreement was higher in the VS-CT (k=0.431, moderate agreement) compared to SD-CT (k=0.209, fair agreement). Almost all VS-CT series had false positive findings (97-99 out of 100). Average reading time was significantly shorter in the VS-CT compared to the SD-CT (154±134 vs. 194±126; 21%, p<0.001).
Conclusion: Vessel suppression increases nodule detection rate, improves interreader agreement, and reduces reading time in chest CT of oncologic patients. Due to false positive results a consensus reading with the SD-CT is essential.

A-158

Follow-up of severe COVID-19 patients by ultra-low-dose CT: A prospective short and mid-term study

L. Widmer, H. C. Thoeny; Fribourg/CH

Purpose: To prospectively assess short and mid-term follow-up findings on ultra-low-dose chest CT in patients having suffered from severe SARS-CoV-2 infection.
Methods and Materials: Since the outbreak of COVID-19, all patients who suffered from severe SARS-CoV-2 infection and were admitted to our institution are followed by means of an ultra-low-dose chest CT examination at 3 months, 6 months and 12 months, if the previous scan showed lung abnormalities. CT examinations are performed with a standardized ultra-low-dose CT protocol (140 KV, 10 MA) with PDL (dose-length product) around 14 mGycm, corresponding to an effective dose of 0,027 mSv. This is equivalent to approximatively 1/200 of the average annual dose of radiation in Switzerland. CT images are reconstructed with two different lung filters (lung 1,25 mm, std, DLRIM, helical full, and thorax 1,25 mm, std, DLRIH, helical plus). For each exam, chest findings are characterized and compared to the previous CT by means of emerging scores such as the CO-RADS scheme. In addition, COVID-19 findings are stratified into four categories.
Results: In this ongoing study, ultra-low-dose chest CT of 11 consecutive patients who suffered from severe COVID-19 were analyzed. The patients included 8 men (age range 43-67 years) and 3 women (age range 56-70 years). Complete resolution of lung lesions was observed in 6 out of 11 patients. Three patients had partial regression of lung lesions. In two cases, new features were observed, namely pulmonary fibrosis with bronchiectasis, and unilateral diaphragmatic elevation.
Conclusion: Based on our preliminary results, ultra-low-dose chest CT has the ability to demonstrate different radiological features of short and mid-term pulmonary findings after severe SARS-CoV-2 infection.

A-311

Detection of overlooked pulmonary metastases in serial CT scans through deep learning-based tracking of longitudinal changes

H. Kim, J. Kim, K. J. Lee, D. Y. Oh; Seongnam-si/KR

Purpose: Using deep learning-based tracking of longitudinal changes in serial CT images, it is expected that newly developed nodules with a high likelihood of lung metastasis can be detected more easily and sensitively. Our purpose is to evaluate the efficacy of computer-aided detection (CAD) system using deep learning-based longitudinal matching in the detection of pulmonary metastases in serial CT images.
Methods and Materials: Among the patients with colon cancer diagnosed in 2013 and 2014, a total of 20 patients with 39 lung metastases from our institution have been enrolled. The first chest CT scans without metastases and the subsequent CT scans in which metastases existed but missed were defined as phase 1 and phase 2, respectively. The proposed method can be divided into two steps: (1) nodules were extracted using a deep learning-based detection algorithm in both phase 1 and 2 CT scans (2) and through deep learning-based longitudinal matching and identification, phase 1 and 2 CT scans were compared and nodules in phase 2 CT scans were categorized as newly developed and pre-existed. The detection rate for newly developed nodules and false positive results per scan were evaluated.
Results: Of the 39 newly developed nodules with a high likelihood of lung metastasis but overlooked by radiologists, 32 nodules were detected (82%) by CAD. Among them, 28 nodules were classified as new nodules (88%) through deep learning-based longitudinal matching. Among 486 pre-existed nodules or false-lesions, 42% (206/486) were classified as pre-existed nodules which are highly likely to be benign.
Conclusion: Deep learning-based CAD system detected 82% of overlooked lung metastases and 88% were correctly classified as new nodules through deep learning-based longitudinal matching and identification. Of the non-metastatic nodules detected by CAD, 42% were classified as pre-existed nodules which are likely to be benign by deep learning-based longitudinal matching, resulting in reduction of false negatives.

A-201

Comprehensive literature research of COVID-19 Scores in CT chest

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Purpose: TThe main objective was to introduce and compare published COVID-19 CT classifications and scoring systems.
Methods and Materials: Comprehensive literature research.
Results: COVID-19 provided a challenge for most branches of medicine. For radiologists the main challenge was a fast and reliable assessment based on findings in computed tomography (CT). A standardized classification system of findings is key for a quick and accurate diagnosis.
A well-known and widely used Classification for COVID-19 CT findings is CO-RADS introduced by the Dutch Radiological Society. On a scale from 1 (very low) to 5 (very high) it assesses suspicion of COVID-19 pulmonary involvement. Another imaging reporting system is COVID-RADS proposed by the American College of Radiology (ACR), based on 5 grades; 0 for normal chest CT, 1 for low level of suspicion, 2A and 2B for moderate and 3 for high suspicion level of COVID-19 infection. The team of Tongji Medical College of HUST (Wuhan, China) introduced a score, dividing the lung into 5 zones. The chest CT density in each zone was analyzed, graded and summarized giving the final score from 0 to 900. Ran Yang and Xiang Li et al. developed a COVID-19 severity score also based on Chest-CT pathologies. The lungs were divided into 20 regions, each region given 0, 1 or 2 points according to the percentage of parenchymal opacification involved, ranging from 0 to total 40 points.
Conclusion: There are different scoring systems with most dedicated to estimating COVID-19 probability or the severity of lung involvement on chest-CT images. Knowledge of recent scoring systems is crucial for a standardized and fast workup and interpretation of results during the pandemic.

A-299

Short-term effect of e-cigarette and tobacco smoke on ventilation and perfusion in the lung: Assessment with functional MRI

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Purpose: The short-term effects of Electronic nicotine delivery systems (ENDS) and tobacco smoke (TS) on lung physiology are largely unknown. In this study, we examine the acute effect of ENDS exposure and TS on lung ventilation and perfusion by using functional lung magnetic resonance imaging (MRI).
Methods and Materials: In this prospective observational sub-study of the randomized controlled trial (NCT03589989) we enrolled 34 healthy participants (nine former tobacco smokers, thirteen ENDS user and twelve active tobacco smokers) who underwent non-contrast enhanced functional lung MRI before and after tobacco smoke or ENDS use. Baseline measurements were done after two hours of abstinence. Post-exposure measurements were performed immediately after exposure. MRI time-resolved sets of images in coronal sections were acquired using ultra-fast steady state free precession sequence. MRI provided semi-quantitative measures of perfusion (RQ) and ventilation (RFV) impairment as percentages of affected lung volume.
Results: In total, 68 functional MRI measurements were performed in all participants on the same day. MRI showed significantly increase of RQ (p=0.0309) and no systematic change in RFV (p=0.3078) among smokers following exposure. In ENDS users, RQ significantly decreased (p=0.0058); however, ventilation did not systematically change.
Conclusion: Vaping and tobacco smoke variably induces short-term changes in lung perfusion. Facing a widespread transition from smoking to vaping, there is an urgent need to evaluate pulmonary effects of vaping.

A-144

Lung ultrasound for COVID-19: What the radiologist needs to know

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Learning objectives:
At the end of the study of this educational exhibit, the reader will be able to:
- Understand the principles of lung imaging with ultrasound
- Identify the normal appearance of lung on ultrasound
- Correctly recognize the different pathological patterns of COVID-19
- Propose the adequate report describing lesions
- Provide the LUS score of COVID-19 alterations

Background: Lung ultrasound (LUS) in COVID-19 patients correlates to disease severity and has the potential to early discriminate patients requiring hospitalization.
For most of radiologists aware of the physical basis of sonography, imaging the lung with this technique comes close to nonsense, as the relative impedances of lung and thoracic wall will keep any useful image off. Nevertheless, LUS is able to diagnose many pulmonary pathologies and shows a high diagnostic yield, particularly in COVID-19 patients.

Imaging findings or procedure details:
Physical basis of lung ultrasound
Normal images
A lines
< 3 B lines
Lung sliding
Pathological images in general setting
≥ 3 B lines
Coalescent B lines
Consolidations
Lung point
Effusion
Pathological images in COVID-19
≥ 3 B lines
Coalescent B lines
Subpleural consolidations
Consolidations
Effusion
LUS in COVID-19 reporting
LUS score calculation and interpretation

Conclusion: Despite large accessibility and excellent diagnostic yield, LUS remains poorly recognized in the radiological community. It has an exellent predictive value for the short term evolution of COVID-19 disease and can advantageously replace heavier techniques in an emercency setting.

A-167

Differential diagnosis of the most common causes of acute onset ground glass opacity

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Learning objectives:
- To systematically identify the most common differential diagnosis of acute onset Ground Glass Opacification (GGO) in chest CT.
- To identify the differentiating clinical and radiological features that point to the most probable diagnosis.

Background: In the era of COVID-19, GGO pattern is an entity increasingly found in CT of the lungs. The limited specificity of GGO for COVID disease is well known and knowledge of differential diagnosis is crucial for adequate patient triage.

Imaging findings or procedure details:
Four points that guide the differential diagnosis
- We must determine that it is an acute onset of GGO.
- The clinical features and history.
- The distribution of the GGO.
- The additional distinguishing radiological findings.

Most common causes of acute onset GGO
1 Infections
  a COVID-19
  b Pneumocystis Jiroveci
  c Cytomegalovirus
  d Aspiration Pneumonia
2 Pulmonary Edema
3 Diffuse Alveolar Damage / ARDS
4 Pulmonary Haemorrhage
5 Acute hypersensitivity pneumonitis
6 Acute eosinophilic pneumonia
7 Adenocarcinoma in situ
8 Hypostasis of the dependent lung segments

Conclusion:
If the Ground Glass Opacification:
A Multifocal / Patchy bilateral and peripheral
  Consider
  COVID-19 if the distribution is mainly in the lower lobes .
B Diffuse, symmetrical and bilateral
  Consider
  a Pneumocysitis jroveci if the distribution mainly perihilar with associated cysts.
  b Cytomegalovirus if the distribution mainly perihilar with Bronchiectasis.
  c Pulmonary Edema if the distribution mainly perihilar with cardiac history.
  d Diffuse alveolar damage if the distribution is mainly basal with consolidation.
  e Aspiration Pneumonia if the distribution mainly right basal with central airways plugging and tree-in-bud pattern.
  f Acute eosinophilic pneumonia if the distribution mainly patchy and basal.
C Lobular or centrilobular
  Consider
  Pulmonary haemorrhage.
D Multifocal/Patchy, lobular or centrilobular
  Consider
  Acute Hypersenstivity pneumonitis.
E Focal/ localized
  Consider
  Adenocarcinoma in Situ.

A-346

Automated kidney segmentation in magnetic resonance imaging in patients with autosomal-dominant polycystic kidney disease: A multicentre study

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Purpose: Imaging-based total kidney volume (TKV) is a major prognostic factor in autosomal-dominant polycystic kidney disease (ADPKD). However, manual or semi-automated kidney segmentation is extremely time-consuming. Therefore, the purpose of this study was to develop a fully automated method for kidney segmentation in magnetic resonance imaging (MRI) in patients with ADPKD and to evaluate its purpose in a multimodal, multicentric setting.
Methods and Materials: Deep convolutional neural network based on the U-Net architecture was trained on a dataset consisting of 406 abdominal MRI scans of 102 patients, including different MRI sequences (T2 TSE, T2 SPIR, T2 mapping). Manual segmentation of both kidneys delivered the ground-truth labels. The model's performance was evaluated on a test dataset of 25 patients, 17 of whom had longitudinal follow-up data, as well as an external dataset of 335 patients (566 MRI scans, acquired from multiple MRI scanners). Standard similarity metrics were calculated, including Dice score as well as correlation and agreement between TKV derived from automated segmentation and from manual segmentation.
Results: The segmentation model yielded excellent performance on the segmentation task, achieving a mean per-study Dice score of 0.93±0.04 on the test dataset. The automatically computed TKV was highly correlated with manually measured TKV (intraclass correlation coefficient: 0.996) with low bias and high precision (0.7±3.82%). For longitudinal analysis of TKV growth, bias and precision were 0.1±4.9% and there was no significant difference between automated and manual analyses.
Conclusion: Our deep learning model enabled accurate segmentation of the kidneys and objective assessment of TKV in patients with ADPKD. This approach could aid the clinicians in the precise and rapid assessment of disease progression.

A-163

The role of quantitative measures on Dual-energy CT in the prediction of colorectal adenocarcinoma

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Purpose: To assess the diagnostic value of Dual-energy CT (DECT) to distinguish colorectal wall thickening due to underlying tumoral lesion from pseudo-thickening due to luminal collapse.
Methods and Materials: All patients with a pathologically confirmed colorectal adenocarcinoma, who underwent thoraco-abdominal DECT for initial staging in our department from March 2020 through October 2020, were prospectively included in the present ongoing study. No bowel or rectal preparation was performed prior to CTs. The colorectal tumors, previously detected by colonoscopy, were identified on iodine maps. Three ROIs were delineated on the tumoral lesions. The mean of these measurements was noted as tumoral iodine uptake. The values were normalized by aorta to reach the normalized iodine uptake (NIU). Subsequently, the NIU of colorectal tumors and pseudo-thickening parts of the colorectal wall were compared using a Paired t-test. A receiver operating characteristic (ROC) analysis was applied to determine a cut-off value of probabilities to differentiate colorectal wall tumors from pseudo-thickening of the colorectal wall.
Results: Twenty-four patients (15 men, mean age: 70±13, range: 45-95) were eligible for enrollment. The most frequent tumor size was the sigmoid (50%) followed by the rectum (25%). The size of tumors ranged from 2.5 to 9.0 cm (4.6±2.3). The NIU of tumors was significantly higher than the non-tumoral wall (0.46 vs 0.32, p<0.001). The sensitivity, specificity, PPV and NPV of NIU (cutoff: 0.36) were 91.7%, 79.2%, 81.4%, and 91%, respectively (AUC: 0,878).
Conclusion: This study supports the diagnostic value of DECT to differentiate colorectal tumors from pseudo thickening of the colorectal wall, which is commonly encountered in routine CT. We speculate that the results of this study will serve to substantially reduce false-positive diagnoses of colorectal tumors on CT and further to decrease the remarkable number of unnecessary optical colonoscopies, which are routinely requested in case of diagnostic uncertainty.

A-179

Multidetector-row CT (MDCT) findings in patients with non-occlusive mesenteric ischemia (NOMI): Influence of vasoconstrictive agents

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Purpose: To find out if there is an influence of vasoconstrictive agents (VCA) on MDCT signs of vasoconstriction and bowel ischemia detected in patients with non-occlusive mesenteric ischemia (NOMI).
Methods and Materials: This 8-years single-center retrospective study included all patients with histopathologically proven NOMI and MDCT examination performed ≤48h prior to surgical management.
Two blinded radiologists jointly reviewed the MDCT examinations for presence and distribution of bowel ischemia signs, abdominal organ infarct, mesenteric vessels size and regularity, and ancillary vascular findings.
VCA administration, clinical and biochemical data, risk factors, and outcome were subsequently retrieved.
Subgroups comparisons were performed.
Results: Of the 90 patients (59 males, mean age 65), 44.4% (n=40) had received VCA before MDCT.
Overall mortality was 32% (n=29), with no significant difference between groups (p>0.05).
In the VCA group, superior mesenteric artery (SMA) caliber was significantly smaller (p=0.014) and vasoconstriction of its branches was more commonplace (p=0.048). Although neither the presence nor the extent of bowel ischemia significantly correlated with VCA administration, abdominal organ infarcts were more frequent (p=0.005) and involved more organs (p=0.016).
The VCA group had lower mean arterial pressure (p=0.006) and lower hemoglobin levels (p<0.001). Inflammatory biomarkers, namely leukocytosis (p=0.005) and CRP (p<0.001), were significantly higher. Of the tested organ-failure biomarkers, only serum creatinine (p<0.012) and urea (p<0.036) differed significantly, while there was no difference for serum lactate and other arterial-blood gas test results.
Conclusion: VCA administration in NOMI patients is associated with more severe SMA vasoconstriction and abdominal organ infarct, without decreased survival.

A-129

Low-dose Dual-Energy CT for stone characterization – A systematic comparison of two generations of split-filter single-source and dual-source Dual-Energy CT

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Purpose: To compare noise texture and accuracy to reliably differentiate uric acid from non-uric acid urinary stones among four different single-source and dual-source DECT approaches in an ex vivo phantom study.
Methods and Materials: Thirty-two (32) urinary stones embedded in gelatin were mounted on a Styrofoam disk and placed into a water-filled phantom. The phantom was imaged using a total of four different DECT approaches: A) dual-source DECT (DS-DE); B) 1st generation split-filter single-source DECT (SF1-TB); C) 2nd generation split-filter single-source DECT (SF2-TB) and D) 2nd generation split-filter single-source DECT using serial acquisitions (SF2-TS). Two different radiation doses (3 mGy and 6 mGy) were used. Noise texture was compared by assessing the average spatial frequency (fav) of the normalized noise power spectrum (nNPS). ROC curves for stone classification were then computed and the accuracy for different dual-energy ratio cutoffs was derived.
Results: NNPS demonstrated comparable noise texture among A, C, and D (fav-range, 0.18-0.19) but finer noise texture for B (fav=0.27). Stone classification showed an accuracy of 96.9 %, 96.9 %, 93.8 %, 93.8 % for A, B, C, D for low-dose (3 mGy), respectively, and 100 %, 96.9 %, 96.9 %, 100 % for routine dose (6 mGy). The vendor-specified cutoff for the dual-energy ratio was optimal except for the low-dose scan in D for which the accuracy was improved from 93.8 % to 100 % using an optimized cutoff.
Conclusion: Accuracy to differentiate uric acid from non-uric acid stones was very high among four single-source and dual-source DECT approaches for low- and routine dose DECT scans. Noise texture differed only slightly for the first-generation split-filter approach.

A-156

LI-RADS® 2018: How to apply in daily clinical practice

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Learning objectives:
- To understand the benefit of including the last version of LI-RADS® issued in 2018 in the daily clinical practice.
- To show radiology residents how to apply consistent terminology, reduce imaging interpretation variability and errors, enhance communication with referring clinicians and facilitate quality assurance and research.

Background: Hepatocellular carcinoma (HCC) is the most common primary malignant liver tumor and the fourth leading cause of cancer-related mortality worldwide. Early detection of HCC is important as it has been shown to improve overall survival, particularly when patients are able to receive potentially curative therapy. Standardizing terminology, technique, interpretation and data collection of liver observations in individuals at high risk for hepatocellular carcinoma is the main purpose of LI-RADS® since its first release in 2011. Consequently, LI-RADS® 2018 can help radiology residents in their interpretation and reporting of liver observations, thus offering patients with HCC the chance to be treated in an appropriate and timely manner.
Imaging findings or procedure details: The four LI-RADS® 2018 algorithms based on different imaging modalities and each with specific objectives will be summarized. Illustration of both major and ancillary features emphasize characteristics needed to classify liver observations according to LI-RADS® diagnostic categories. A particular accent will be put on the modifications proposed by the latest revision of the LI-RADS® documentation. Eventually, considerations before issuing a standardized LI-RADS® report will be shared
Conclusion: The purpose of this educational poster is to illustrate and demonstrate how to categorize liver observations in patients at risk of developing HCC, allowing radiology residents to apply consistent terminology, reduce imaging interpretation variability and errors, resulting in more consistent patient care, clearer education, and more rigorous and reproducible research.

A-200

MR Evaluation of acute abdominal pain during pregnancy

B. Mazini, V. Dunet, A. Denys, S. Schmidt Kobbe, Lausanne/CH

Learning objectives:
- To enable radiologists to become familiar with the physiological changes which occur during pregnancy
- To give an overview of the differential diagnoses to keep in mind when interpreting abdominal MR examinations in pregnant women with acute abdominal pain

Background: The diagnosis of etiologies responsible for acute abdominal pain in pregnancy can be challenging. The key diagnostic exam is ultrasound. When abdominal ultrasound is inconclusive, and clinical symptoms remains unclear, abdominal MR can be performed.
Since 2018, our emergency department is equipped with an MR-scanner (MRI 3T Magnetom Vida).
We use a standardized comprehensive multiplanar MR-protocol, including the whole abdominal cavity in the field of view. The protocol includes T2-weighted single-shot turbo-spin echo (SSTSE) MR-sequences with/without fat suppression, diffusion and T1 Spoiled 3D GRE MR-sequences. Our protocol does not include intravenous injection of Gadolinuim based products, as they are not recommended by the scientific community (ACR).
Imaging findings or procedure details: Anatomical changes mainly consist of cranial and lateral shift of ovaries, cranial repositioning of caecum and appendix and physiological hydronephrosis, as a consequence of uterine compression.
According to our database, acute appendicitis was the most commonly suspected disorder. However, we also observed a wide range of other abdominal pathologies such as internal hernia, migration of gallstones, pyelonephritis, ovarian torsion and other gynecological causes. For better illustration, we decided to establish pathologically based categories – i.e. gastrointestinal, hepatobiliary, gynecological and urinary tract disorders- in order to facilitate the differential diagnosis.
Conclusion: MRI during pregnancy is a useful tool for the management of acute abdominal pain in uncertain cases. Radiologists should be familiar with the physiological changes occurring with pregnancy and the most common pathologies in these situations.

A-159

Lymphangiography as a therapeutic tool for lymphatic leakage

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Purpose: Lymphatic leakage is a rare but serious complication of thoracic and abdominal surgery. Surgeons are often reluctant to return in the operating room because of the difficulty to visualize the level of lymphatic leakage in post-operative conditions. Ultrasound-guided intranodal lipiodol lymphography permits detection of the leakage and can act as an embolization tool preventing the patient of undergoing subsequent surgery. We assessed the mid-term technical and clinical success rate of lymphangiography in the treatment of lymphatic leakage at our institute.
Methods and Materials: Ultrasound-guided intranodal lymphangiography for lymphatic leakage followed by CT was performed in 3 patients (1 male and 2 females; age range 61-66 years). Lymphatic leakage appeared after pancreaticoduodenectomy in one case, oesophagectomy in the second case and pulmonary right lower lobectomy in the last one. The amount of drainage before lymphangiography was 750 mL/day, 1230 mL/day and 510 mL/day, respectively. The procedure consisted of ultrasound-guided bilateral puncture of an inguinal lymph node with placement of the needle-tip at the junction between the cortex and the hilum, position control by means of injection of sonographic contrast, slow injection of lipiodol and performing of an unenhanced CT.
Results: Lymphangiography was technically successful in all patients, and could determine precise localization of the lymphatic leakage. In 2 out of 3 patients, lymphangiography was therapeutic with decreasing amount of drainage and drain ablation possible 6 and 12 days after intervention. The last patient could be successfully treated by thoracotomy and thoracic duct ligation. There were neither complications of lymphangiography nor recurrence of lymphatic leakage. These results are discussed alongside the literature.
Conclusion: This small series proves the primary role of interventional radiology in post-operative lymphatic leakage either in solving the leakage or in guiding the surgeon by indicating the level of the leakage.

A-211

Recanalization of extensive chronic non-cirrhotic, non-malignant splanchnic thromboses is feasible: A primarily transsplenic patient tailored approach

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Purpose: Chronic extensive non-cirrhotic, non-malignant splanchnic thromboses are rare but potentially fatal. Current guidelines recommend best supportive care with therapeutic anticoagulation and primarily endoscopic therapy in case of upper GI-bleeding. The purpose of this study was to evaluate the feasibility and safety of percutaneous recanalization of such extensive thromboses with a primarily transsplenic approach.
Methods and Materials: In total, between November 2016 and August 2020, 10 patients (60 % male, mean age 48.2 ± 10 years) were included. Primarily, transsplenic access was routinely performed. If recanalization was not successful an additional transhepatic access was used. Finally, in higher order intrahepatic thrombosis and/or reduced inflow to the recanalized portal trunk due to persisting collaterals a transjugular intrahepatic portosystemic shunt (TIPS) was placed.
Results: All patients (100%) presented with a cavernous transformation of the portal vein. The splenic vein was completely thrombosed in 7 patients (70 %). Primary technical success rate was 90 %. Transsplenic access was used in 100 %, transhepatic in 40 % and transjugular in 70 % of patients. Major in hospital complications were observed in one patient (10 %) with early TIPS and splenic vein re-thrombosis. Mean hospital stay was 9.1 ± 10 days. At a mean follow-up of 18.3 ± 12.3 months primary and secondary patency rate were 70 % and 100 %, respectively. During follow-up one patient died due to recurrent upper-GI bleeding. No other major complications were observed.
Conclusion: Percutaneous transsplenic recanalization of chronic, extensive splanchnic thromboses is feasible and safe. This bail out procedure can be offered in case of recurrent upper GI-bleedings, hepatic hydrothorax and/or ascites refractory to conservative or endoscopic therapies.

A-214

Prediction of treatment response to transarterial radioembolisation of liver metastases: Radiomics analysis of pre-treatment cone-beam CT

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Purpose: The purpose of this study was to investigate the potential of texture analysis and machine learning to predict treatment response to TARE on pre-interventional cone-beam CT (CBCT) images in patients with liver metastases.
Methods and Materials: 36 patients with a total of 104 liver metastases (55.6 % male, mean age 61.1 ± 13 years), who underwent CBCT prior to TARE and follow-up imaging 6 months after therapy, were included. Treatment response was evaluated according to RECIST version 1.1 and dichotomized into TARE responders (PR/SD) and non-responders (PD). After target lesion segmentation 104 radiomics features, corresponding to seven different feature classes, were extracted with the pyRadiomics package. After dimension reduction machine learning classifications were performed on a custom artificial neural network (ANN). Finally, 10-fold cross validation on a previously unseen test data set was performed.
Results: Average administered cumulative dose during TARE was 1.6 Gbq (range 0.8–2.9 Gbq). At a mean follow-up of 5.9 ± 0.8 months treatment response rate was 81.7 %. After dimension reduction 15 out of 103 (14.5 %) texture analysis features remained for further analysis. On a previously unseen set of included liver metastases the Multilayer Perceptron ANN yielded a Sensitivity of 94.2 %, a Specificity of 67.7 % and an AUC in ROC of 0.85.
Conclusion: Our study shows that texture analysis based machine learning is capable to predict treatment response on pre-treatment CBCT images in patients with liver metastases undergoing TARE with high accuracy.

A-351

Impact of acceleration on virtual bone ultrashort echo-time magnetic resonance imaging sequences on bone depiction quality in medication-related osteonecrosis of the jaw

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Purpose: To assess the impact of decreasing number of radial acquisitions of a virtual bone ultrashort echo-time (UTE) magnetic resonance (MR) imaging sequence on bone depiction quality in medication-related osteonecrosis of the jaw (MRONJ).
Methods and Materials: Virtual MR bone imaging sequences with 60'000, 30'000 and 10'000 radial views were prospectively acquired of 16 patients with clinically confirmed MRONJ and of a control group of 16 healthy volunteers. Blinded readout sessions were performed by two radiologists. Qualitative analysis of the different image series was performed by comparing the detection of osteolytic lesions and productive bony changes (e.g., medullary osteosclerosis or periosteal thickening) in the different virtual MR bone imaging sequences of the patients with MRONJ. Quantitative analysis was performed by comparing the different sequences in the healthy study population with regard to differences in image artifacts, contrast-to-noise ratio (CNR), and image noise. Cohen's kappa (κ) was used to assess interreader agreement. Standard statistical tests were used for sequence comparison.
Results: Acquisition times were significantly reduced from 315 to 165 and 65 seconds (60'000, 30'000, 10'000 radial views, respectively; $P < 0.05$). Interreader agreement was substantial ($0.6 < \kappa \leq 0.8$) to almost perfect ($0.8 < \kappa$) depending on the underlying qualitative parameter. A linear decrease in the extent of motion and susceptibility-related artifacts was observed when comparing sequences with 60'000, 30'000 and 10'000 radial views, respectively. No significant trade-off in terms of diagnostic performance had to be accepted.
Conclusion: Virtual bone UTE MR imaging sequences with a lower number of radial views provide a good option for detecting osteolytic lesions and productive bony changes in MRONJ subjects with sufficient image quality and faster acquisition times than standard UTE MR imaging sequences.

A-361

Utilization of free-breathing acquisition in automated body composition segmentation of whole-body MRI data

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Purpose: To investigate the usability of free-breathing sequences in an automated wholebody MRI (wbMRI) segmentation workflow for body composition profiling.
Methods and Materials: Two same-sized cohorts of 16 elderly and young student volunteers each underwent native wbMRI using standard Dixon imaging. Imaging of the trunk was performed twice per patient, once using traditional breath-hold (BH) commands, the second time allowing for free breathing (FB) without commands. Image data was subsequently normalized and subjected to automated segmentation of subcutaneous (SCAT) and visceral adipose tissue (VAT) as well as of muscle mass (MM), using an institute-own deep learning-based algorithm. Furthermore, manual segmentation was performed in BH images of a subgroup as a reference standard. BH- and FB-derived segmentation masks were compared by their respective volume counts and by Sorensen-Dice-coefficient (DSC) per compartment.
Results: Visual assessment showed excellent comparability between BH and FB segmentations. Overall, DSC ranged from 0.96 (SCAT) to 0.83 (VAT) without major differences between the study cohorts. Furthermore, comparison of body compartment volumes (in pixel) showed no significant differences between BH and FB acquisition (p=0.69–1). In general, automated segmentation masks showed good matching with manual ones, with reduced overlap for VAT, mainly caused by coarse border delineation of VAT adjacent to bowel loops in the manual segmentations.
Conclusion: FB sequences can be implemented in wbMRI protocols for BCP purposes, allowing for reduced scan time and potentially higher patient comfort at comparable diagnostic value.

A-193

Deep learning for fully-automatic quantification of avascular necrosis of the femoral head on 3D hip MRI in young patients eligible for joint preserving hip surgery: A pilot study

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Purpose: Size of necrosis is an important prognostic factor in management of femoral head necrosis (AVN), usually estimated on radiographs and MRI. Ideally, a fast-volumetric assessment of necrosis size would be desirable. Thus, we evaluated a deep-learning method to automatically quantify the necrotic bone in AVN.
Methods and Materials: IRB-approved retrospective study of 24 patients (mean age 30 years, 9 women) with AVN according to the 2019 ARCO grading: I (negative x-rays): 3 hips; II (no fracture): 4 hips; IIIA (head collapse < 2 mm): 10 hips; IIIB (head collapse > 2 mm): 7 hips. Patients underwent preoperative 3T hip MRI including 0.8 mm3 3D T1VIBE on which manual ground truth segmentation of necrosis was performed by an expert reader and then used to train a convolutional neural network (2D U-Net). A 3-fold cross-validation was performed between manual and automatic volumetric analysis of absolute/relative necrosis volume which was compared between early and advanced AVN (ARCO I/II versus IIIA/B).
Results: Mean absolute and relative AVN volume was comparable between manual ($8.8\pm8\,cm^3$, $19\pm17\%$) and automatic ($7.2\pm6.1\,cm^3$, $16\pm13\%$) segmentation (both $p>0.05$) and showed a strong correlation ($rp=0.76$ and 0.74, both $p<0.001$), respectively. Manual and automated segmentation detected a difference (both $p<0.05$) in relative necrosis volume between early and advanced AVN: $9\pm8\%$ vs $23\pm18\%$ and $9\pm7\%$ vs $18\pm14\%$, respectively.
Conclusion: Applying a deep learning method for volumetric assessment of AVN is feasible and showed good agreement which paves way for evaluation in larger datasets, with the goal to determine its prognostic value.

A-235

Assessment of the osseous craniocervical junction on magnetic resonance imaging compared to computed tomography

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Purpose: Comparison of two MR sequences optimized for bone visualization to CT reference standard in the assessment of the osseous craniocervical junction (CCJ).
Methods and Materials: The responsible ethics committee waived ethical approval. The study is based on a retrospective analysis of prospectively acquired data.
In the time of October 2019 until November 2020, 27 decedents underwent head and neck CT and MR examinations with a maximum of 48 hours between examinations. 4 healthy volunteers underwent the same MR examination as proof of concept. Age range: 30 and 93 years.
Images were aquired on a 128-multi-detector CT and a 3 T MRI scanner using an ultra-short-echo time gradient echo (UTE) and optimized 3D-multiecho in-phase gradient echo sequences (FRACTURE).
3 readers rated the CCJ regarding the degenerative changes joints using a 4-point Likert scale Based on the observations on the CT images, which were considered as gold standard and therefore used as reference. Two additional independent reader obtained quantitative parameters, measuring distance intervals between the skull base and the first vertebras. Interrater and intermodality reliability were calculated using an intraclass correlation coefficient. To compare distance measurements between examination methods, a Friedman-test was performed. A Kruskal-Wallis test was used to compare distance measurements to degenerative ratings.
Results: Overall, degenerative ratings of the craniocervical junction between both MR sequences and CT were observed, showing a good interrater reliability, as well as a good intermodality agreement. Both MR sequences had a tendency to underestimate the degree of degeneration compared to CT and this became more marked with increasing degeneration severity. There were no significant relationships between distance measurements and the degree of degeneration (PCT = 0.62, PUTE = 0.64, PFRACTURE = 0.67)
Conclusion: UTE MRI may be a valid alternative to CT assessing the osseous CCJ in non-traumatic cases.

A-307

DCE-MR perfusion differences between healthy regions and histologically confirmed medication-related osteonecrosis of the jaw

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Purpose: To compare perfusion-MRI parameters between healthy and pathologic regions in patients with histologically confirmed medication-related osteonecrosis of the jaw (MRONJ).
Methods and Materials: A retrospective analysis of standard parameters of dynamic contrast-enhanced (DCE) perfusion MRI of 22 patients was performed. All included patients received DCE-MRI as part of a dedicated MRI protocol for MRONJ assessment. Same sized regions of interest were placed into representative bone of predefined regions. All regions were assessed qualitatively by a blinded MSK expert radiologist as ground truth, using a four-point Likert-scale from 0 to 3 for normal and mild-severe changes. Histology was present for all resected regions.
Results Mean patient age was 75 years (+/- 9.9; 12 female patients). Wash-in (0.15 vs. 0.05) and positive enhancement integral (PEI; 0.17 vs. 0.11) values were significantly higher in MRONJ-affected regions than in healthy jaw areas (p<.05 for both). The qualitative ratings correlated with some DCE-parameters (Wash-in, PEI, initial area under the curve, all p<.05). Quantitative DCE changes were present in all pathologic regions, indepent from presence of osteolysis.
Conclusion: DCE-MRI shows significantly different bone perfusion in MRONJ-affected regions of mandible and maxilla, compared to healthy jaw. Disease extent according to MRI data was larger than visible necrotic areas during clinical examination. This may help improving the understanding of early stage, sub-clinical findings in MRONJ.

A-306

In vitro and ex vivo validation of spectral photon-counting radiography for detection of monosodium urate depositions

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Purpose: To investigate and validate the usability of spectral photon-counting radiography (SPCR) for identification of monosodium urate (MSU) among the most common crystals involved in arthropathies and to compare the findings with dual-energy CT (DECT).
Methods and Materials: Industry-standard custom-designed cylindrical rods of monosodium urate (MSU), calcium pyrophosphate (CPP), or calcium hydroxyapatite (HA) in clinically relevant concentrations (MSU: 200/400/600 mg/ml, CPP/HA: 50/100/200 mg/ml) were first imaged with SPCR, using a vendor X-ray tube and a prototype detector. Four energy thresholds were set at 15, 25, 30 and 35 keV. Subsequent validation scans were performed with a dual-source DECT of the latest generation. Attenuation values (AV), Hounsfield units (HU) and effective atomic numbers (Zeff) of the different rods and their respective different concentrations were compared in both modalities and intermodally. Furthermore, an ex vivo sample of a gout-affected human toe was scanned with SPCR and DECT for detection of tophi.
Results: MSU, CPP and HA were significantly different in AV, HU and Zeff in both imaging modalities (Zeff: MSU 6.52-6.96; CPP 7.47-9.47; HA 7.57-9.56). For each material, AV/HU/Zeff differed significantly among different concentrations except between MSU at low vs. medium concentrations (all p< 0.001). Mean Zeff measured with SPCR and DECT were comparable (p= 0.9). Comparable extent of tophi between modalities was seen in the ex vivo specimen.
Conclusion: Characterization of MSU among the three most common crystals involved in arthropathies is comparable between SPCR and DECT. MSU is clearly distinguishable from calcium-containing crystals. Zeff and AV of CPP and HA show overlap,complicating their clear-cut differentiation. Further investigations have to test the clinical usability of this technique for the future diagnostic workup of crystal arthropathies.

A-308

Diagnostic accuracy of texture analysis vs. qualitative assessment for differentiation of inflammation vs. degeneration in the sacroiliac joints

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Purpose: To investigate the performance of texture analysis (TA) for differentiation of inflammation from degeneration in sacroiliac joints (SIJ).
Methods and Materials: MR examinations of SIJ from 90 patients with clinically established ankylosing spondyloarthritis (SpA), degenerative changes, or healthy joints were analyzed retrospectively in same-sized groups. Two report-blinded radiologists with 4 and 5 years experience rated typical structural and inflammatory changes on a four-point Likert scale and categorized patients into different groups. The dataset included coronal-oblique images of TIRM, T1w and T1w fat-saturated contrast enhanced (T1wCE) sequences. Same-sized regions of interest were placed into pathologic (where applicable) or random healthy spots of SIJ. TA of 304 parameters was performed with open-source software (MaZda). Logistic regression with ten-fold cross validation was applied to find relations with clinical labels. Interreader agreements (IA), distribution of qualitative and TA findings among clinical categories as well as ROC analysis were investigated.
Results: Moderate IA was present for group categorization (k=.40). Qualitative assessment showed fair to moderate IA. Cumulative qualitative scores differed significantly among patient categories (p<.001). TA showed perfect IA (k>.80) for 194-210 features in the different sequences, respectively. Combined TA of all sequences performed substantially better than qualitative ratings for differentiation between SpA vs. remainder (AUC=.89 vs. .75 for TA vs. qualitative), and between SpA vs. degeneration (AUC=.91 vs. .66). TA performance was different among the single sequences (SpA vs. remainder: AUC=0.74 vs. 0.81 for TIRM vs. T1wCE).
Conclusion: TA improves the accuracy in differentiation of SpA from degenerative changes in the SIJ. T1wCE images were the main discriminator for TA performance.

A-134

Normal variants of the glenoid labrum and their pitfalls: What the radiologist should know

Q. D. Vo, P. Oliveira, O. Nadjar, A. Bensaid; Morges/CH

Learning objectives:
- To know the normal labrum anatomy
- To know and recognize the anatomical variants of the labrum
- To know the „radiological keys" to differentiate labrum tears vs anatomical variants

Background: The shoulder is the most mobile joint of the human body but also the most instable one since it is mostly held together by relatively lax tendinous structures. The labrum is a fibrocartilaginous rim structure composed of a more fibrous substance at its periphery. It plays an important role in the stabilization of the gleno-humeral. Anatomic variants of the glenoid labrum are very frequent and may be found in 13,5% of the normal population. Therefore, it is very important to be familiar with these anatomic variants since they can be easily confused with labral tears which often necessitate a surgical procedure
Imaging findings or procedure details:
- The anatomy of the labrum will be explained and illustrated with MR images.
- Normal variants of the labrum such as sublabral sulcus, sublabral foramen, Buford complex, cartilage undercutting and pseudo-SLAP lesions, will be discussed and also illustrated with MR images.
- „Radiological keys" to differentiate labral tears and anatomic variants will be explained and discussed. These „keys" include imaging findings such as lesion margin, orientation, width and agent contrast distribution. Patient's age and clinical history are also included in „radiological keys".

Conclusion: The labrum is an essential structure to stabilize the gleno-humeral joint. Therefore, recognition of its normal variants is essential to exclude labral tears. „Radiological keys" are very helpful and should be known by all radiologists.

A-135

Gleno-humeral instability and surgical procedures: What the radiologist needs to know

Q. D. Vo, P. Oliveira, A. Bensaid, O. Nadjar; Morges/CH

Learning objectives:
- To know the imaging modalities in shoulder instability.
- To recognize bone and soft tissue lesions in shoulder instability.
- To know the surgical procedures and their imaging aspects.

Background: The gleno-humeral joint is the most mobile joint in the human body, but also the most unstable with a natural tendency to antero-inferior dislocation. Passive stabilizers include the glenoid labrum, the joint capsule and the gleno-humeral ligaments. Active stabilizers include rotator cuff muscles and peri-scapular muscles. Anterior gleno-humeral dislocation is a frequent traumatic injury with a prevalence of 2%, resulting in shoulder instability. Thus, chronic instability and recurrent disclocations are indications for surgical treatments which includes many procedures such as Latarjet, Bankart repair,capsular shift and humeral head allograft.

Imaging findings or procedure details:
- Imaging modalities to investigate shoulder instability will be discussed. Such modalities include MRI, plain film and CT scan.
- Most frequent case of shoulder instability will be illustrated, including lesions such as bony lesions (bony Bankart and Hill-Sachs). We will explained and illustrated bankart variants lesions such as HAGL, Perthes and GLAD.
- Frequent instability surgical procedure such as Bankart repair, capsular shift, Latarjet and humeral head allograft will be discussed and illustrated with MR imaging.

Conclusion: Shoulder instability is a frequent shoulder clinical problem and are often encountered in daily practice.
Thus, gleno-humeral instability requires imaging investigations to recognize bony and labral lesions which may condition the surgical procedure choice.

A-136

Condensing osteitis of the clavicle and clavicular bone disease: What the radiologist should know

Q. D. Vo, T. Molteni, P. Oliveira, H. Abbes; Morges/CH

Learning objectives:
- To recognize imaging features of condensing osteitis of the clavicle
- To know differential diagnosis of sclerotic lesions of the clavicle
- To recognize and know malignant features of clavicle tumors.

Background: Condensing osteitis of the clavicle is a very rare entity which was first described in 1974 by Brower and al. Since its first description, only 25 cases have been reported in the literature. Since it can be easily mistaken for sclerotic bone metastasis, the condition must be recognized in order to avoid unnecessary biopsy or a more aggressive diagnostic procedure.

Imaging findings or procedure details: We will described imaging and clinical features of condensing osteitis of the clavicle.
Differential diagnosis will be also discussed, lesions such as Friedrich disease, osteoid osteoma, clavicle metastasis, sterno-clavicular septic arthritis, sterno-clavicular osteoarthritis and clavicle osteosarcoma will be described. We will highlight the imaging differences of these lesions. All described diseases will be illustrated with various imaging modalities.

Conclusion: Condensing osteitis of the clavicle is a rare but benign entity that can mimic more serious conditions such as osteosarcoma and bone metastasis. Since misdiagnosis can often lead to biopsy and other expensive diagnostic interventions, one must be familiar with its clinical and radiological manifestations in order to avoid unnecessary procedures and patient anxiety.

A-147

Ultrasound guided interventions of the painful shoulder: What residents need to know.

D. Radcliffe, Y. Younan, V. Murugan, G. Watts; Worcester/US

Learning objectives: This educational exhibit aims to review common etiologies of shoulder pain and their classically associated sonographic findings. Subsequently, the indications, contraindications, technical, and procedural aspects of ultrasound guided percutaneous interventions will be reviewed.

Background: Shoulder pain is a common clinical presentation with a wide range of possible etiologies most commonly, but not limited to degenerative, infectious or inflammatory processes. Ultrasonography has proven to be a useful diagnostic tool as it is quick, efficient, inexpensive, and lacks ionizing radiation. However, ultrasonography is arguably underappreciated and underutilized when it comes to therapeutic interventions despite being shown to be safe, accurate, and cost effective.

Imaging findings or procedure details: Classic imaging features for degenerative, infectious and inflammatory processes will be demonstrated. A brief description of standard indications and contraindications for percutaneous interventions will be reviewed. Subsequently, important landmarks for shoulder procedures will be shown with normal anatomic imaging. Lastly, the technical approach from table set up through needle exit will be described and shown for glenohumeral injections/aspirations, acromioclavicular injections/aspirations, subacromial-subdeltoid injections, long head biceps tendon injections, and barbotage of rotator cuff calcific tendinosis.

Conclusion: Shoulder pain is a common clinical presentation and one for which ultrasound is well positioned to be of diagnostic and therapeutic benefit. Through learning the classic imaging features of common pathologies, and following the stepwise approach to common ultrasound guided percutaneous interventions, radiologists should be comfortable in providing safe, efficient, accurate and cost effective care in treating patients with a painful shoulder.

A-189

Extramedullary multiple myeloma

A. Leban, K. Daneshvar; Bern/CH

Learning objectives: To recall the definition and classification and show a few examples of the imaging findings in extramedullary multiple myeloma.

Background: Extramedullary multiple myeloma (EMM) is an aggressive subentity of multiple myeloma, characterized by the ability of a subclone to thrive and grow independent of the bone marrow microenvironment. Outcomes of the patients with EMM are poor and there is a reported higher incidence in younger patients and in those with IgD myeloma and nonsecretory myeloma. A three-stage anatomic classification was proposed because of the different outcomes of the patients. In Stage I the myeloma is confined to the skeleton, Stage II it spreads to adjoinig tissues and Stage III is the spread to distant sites. The Stage III EMM plasma cells carry different biological characteristics. The definition excludes solitary extramedullary plasmacytoma[1].

Imaging findings or procedure details: Main imaging methods are CT, MRI and FDG-PET CT[2]. Patients with EMM present with involvement of lymph nodes, skin, soft tissues, central nervous system, thoracoabdominal organs and effusions either at initial diagnosis (primary) or at the time of relapse (secondary)[1]. Rarely testicular involvement is seen as a painless swelling of the testicles. A sudden enlarged testis with hydrocele should make us consider this rare EMM manifestation since hematologic malignant cells may remain in the testes even after systemic chemotherapy because of the testicular blood barrier[3].

Conclusion: Early and correct diagnosis is crucial for prompt and effective treatment of EMM. Therefore, we must be able to recognize different manifestations of MM and pay attention to findings such as pulmonary nodules, liver and renal lesions or testicular enlargement with hydrocele.

1. Bhutani M, et al. Extramedullary multiple myeloma. Leukemia.
2. Rajkumar SV. Updated Diagnostic Criteria and Staging System for Multiple Myeloma. Am Soc Clin Oncol Educ Book.
3. Yamashita K, et al. Multiple myeloma with testicular involvement: A case report. Urol Case Report

A-203

Transient osteoporosis of the hip – What the radiologist needs to know

P. Santos Oliveira, Q. D. Vo, O. Nadjar, T. Molteni, G. Fahrni, A. Bensaïd; Morges/CH

Learning objectives:
- Know clinical findings and risks factors of transient osteoporosis of the hip
- Know imaging findings of transient osteoporosis of the hip
- Know differential diagnosis of transient osteoporosis of the hip

Background: Transient osteoporosis of the hip (TOH) is a rare and self-limiting condition that causes sudden pain related to bone marrow edema of the hip in middle-aged men and in pregnant women in their third trimester. Literature on this topic is poor and the aetiology remains unclear. Radiologists play a fundamental role in the diagnosis of this condition. Differential diagnosis include avascular osteonecrosis and stress fracture. MRI can distinguish between them. TOH has a self-limited course and spontaneous resolution in 6-12 months is the rule. Management is conservative and essentially encompasses symptomatic relief and reduced weight bearing to prevent stress fractures. Recurrence is possible in the same or in a different joint.

Imaging findings or procedure details: During the early course of the disease, plain films are often negative. After 3 to 6 weeks, radiographic findings are more evident and may show osteopenia and subchondral bone loss of the femoral head or neck. Unlike transient hip osteoporosis, AVN usually reveals subchondral sclerosis and curvilinea lucent subchondral line.

MRI is the gold standard to diagnose TOH. Findings include areas of bone edema (intermediate signal on T1-weighted images and high-signal on T2-weighted) and the lack of subchondral and focal abnormalities – specific for AVN.

A bone scan is usually positive, but has low specificity. Computed tomography (CT) is not indicated.

Conclusion: TOH is not an uncommon condition in daily practice. However, diagnosis of this entity is often difficult in the early stages, due to the lack of awareness and suspicion of the referring physicians. An early and accurate diagnosis of TOH can lead to early resolution of symptoms and can avoid unnecessary investigations or treatment for other mimicking conditions (like AVN or femoral stress fracture).

A-209

Anterior knee pain: What the radiologist should know

T. Molteni, Q. D. Vo, O. Patrique, G. Fahrni, A. Bensaïd, O. Nadjar; Morges/CH

Learning objectives:
- To know the anatomy of the anterior knee compartment and structures which are involved in knee pain.
- To recognize the MRI characteristics of anterior knee disease according to age and clinical findings
- To recognize the main differential diagnosis in anterior knee pain

Background: Anterior knee pain is a very common clinical situation encountered in 11-17% of physician visits. The pain origin can be caused by a traumatic or non-traumatic process and covers a wide spectrum of disorders. Differential diagnosis is based on the structural layer involved which can be the superficial tissue, the extensor mechanism, the intracapsular extra synovial tissue or the intraarticular structures. A systematic approach to analyze alle the structure found in the anterior compartment is needed to understand the different pathologic process. Standard X-ray imaging is useful for diagnosing osseous pathology while MRI imaging is the spearhead for diagnosing soft tissues pathologies and surgical planning. Therefore it's important to understand the anterior knee anatomy and the main traumatic and non-traumatic pathologies that could be encountered to improve the diagnosis..

Imaging findings or procedure details: The anatomy of the anterior knee compartment and illustrated with standard X-ray and MRI images.

The main X-ray and MRI findings in anterior knee pain will be shown

Differential diagnosis that could be encountered in a situation of anterior knee pain and abnormal knee MRI will be illustrated

Conclusion: Anterior knee pain is a frequent clinical complain and can be from a traumatic or non traumatic origin. Anterior knee compartment is a complex structure and understanding its anatomy is important to determine the underlying pathology. Standard X-ray are obtained to exclude a osseous pathology, while MRI imaging offers a superior evaluation of soft tissues pathologies and allows surgical planning.

A-226

Breast Implant-associated Anaplastic Large Cell Lymphoma (BIA-ALCL): A rare but important diagnosis

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Learning objectives: BIA-ALCL was first described in 1997. In 2016 the WHO recognized it as an independent disease. It is a subtype of non-Hodgkin lymphoma. The majority of the cases (95%) occur with structured implants. The diagnosis is usually made 8-10 years after the implants have been inserted using sonography. For confirmation/exclusion of the diagnosis image guided puncture of peri-implant fluid or biopsy is necessary.
Background: Worldwide, 10 million women have implants. A total of 573 cases of BIA-ALCL are recorded. The lymphoma develops between the fibrous capsule and the implant, in the peri-implant fluid or along the capsule, either individually or in clusters. The pathophysiology is not yet fully understood. Some theories see a bacterial biofilm as the cause. Another hypothesis is chronic inflammation with the recruitment of CD4 T cells.
Imaging findings or procedure details: The most common symptoms are asymmetrical breast enlargement, breast pain, capsular contracture or rarely a rash. 70% of the lymphomas are associated with a peri-implant fluid effusion. This is by far the most common radiologic sign. A tumor mass adjacent to the capsule or with infiltration of the capsule occurs in 30%. Lymphadenopathy is less specific with 12%. Trauma, infection and implant rupture are important differential diagnoses. For confirmation a fine needle aspiration should be performed, ideally 100 ml. If the cells are CD30 positive and ALK-1 negative the pathologist can confirm the diagnosis. If an implant associated lymphoma is diagnosed, PET CT should be performed for staging.
Conclusion: The most important step in the diagnostic process of BIA-ALCL is to consider it as a differential diagnosis. Imaging and good interdisciplinary communication are further essential steps for diagnostic workup.

A-145

3D scoliosis angle provided by raster-sterography versus 3D reconstruction of low dose radiography (EOS) in adolescent idiopathic scoliosis: A preliminary study

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Purpose: Gold standard practice of care for imaging scoliosis consists of low dose radiography (EOS) with anteroposterior and lateral views to analyze the Cobb angle for treatment planning. As scoliosis is a 3-dimensional (3D) deformity, a 3D imaging tool can improve evaluation of the true scoliosis angle. The 3D reconstruction of EOS images can be used to evaluate the 3D scoliosis angle. Another emerging technique is 3D modeling of the spine with raster-stereography (RASTER) that avoids radiation. It allows for the measurement of spinal deformity using the back's surface topography, the shape of the patient's back being recorded in a standing position by projecting parallel light raster lines onto the skin surface.
This study aimed to compare the value of 3D scoliosis angle (SA) as computed by RASTER with 3D-EOS in adolescent idiopathic scoliosis (AIS) patients.
Methods and Materials: 53 AIS children (female = 32) aged 13.5±1.9 years were recruited. The scoliosis angle of the major curve provided by the RASTER (SAR) and the 3D-EOS was extracted. Mean differences between measurements provided by each system were evaluated. Agreement and correlation were computed with intraclass correlation coefficient (ICC) and Pearson correlation coefficient (Cor), respectively.
Results: Scoliosis angles with those 2 techniques were strongly correlated (Cor > 0.85) with high agreement (ICC > 0.85). But mean difference between SAR and 3D-EOS was 7.5+/-6.4° and 56% patients had a difference superior to 5°, considered as clinically relevant.
Conclusion: This preliminary study showed an excellent correlation in scoliosis angle measurements by RASTER compared to EOS. However, the mean difference value between these systems was clinically relevant with more than 50% patients with a difference > 5°. Further studies are needed to see if a conversion factor could be applied, so that RASTER could be used in clinical practice as a complementary or alternative radiation-free technique to monitor 3D scoliosis angle.

A-133

Congenital portosystemic shunt in children: What should radiologists know?

D. Arada, M. Laurent, E. Barras, S. Hanquinet; Geneva/CH

Learning objectives: Congenital portosystemic shunts (CPSS) are vascular malformations that cause systemic complications. We summarize clinical presentation, imaging and recommendations for management.
Background: Children with CPSS present with unexplained developmental delay, encephalopathy, liver mass, hepatopulmonary syndrome and portopulmonary hypertension. Children with CPSS should be screened for complications and associated malformations. Spontaneous closure may occur but others may require angiography or surgery. Shunt closure is indicated in symptomatic patients and has favorable outcomes.
Imaging findings or procedure details: Abdominal ultrasound / Doppler, CT and/or MRI are used to evaluate shunt anatomy, liver parenchyma and portopulmonary hypertension. Brain MRI show characteristic findings of hepatic encephalopathy. Portal angiography is used to identify hypoplastic and/or ectopic vessels, measurement of portal pressure and analysis of shunt dynamics.
Conclusion: The appropriate radiological detection, characterization, and treatment of CPSS is important in this
rare and poorly understood congenital vascular hepatic malformation. Successful treatment prevents, resolves or stabilizes pre-existing complications.

A-146

Ultrasonography in neonatal cholestasis: When to evoke biliary atresia?

L. Fonseca, M. Anooshiravani-Dumont, S. Hanquinet; Geneva/CH

Learning objectives: Identify key imaging techniques and findings to improve diagnostic accuracy of biliary atresia (BA) in the neonatal period.
Background: BA, a fibro-inflammatory destruction of hepatic bile ducts, is often responsible for liver failure in the first months of life. Clinical findings are non-specific though screening programs include serum conjugated bilirubin and stool color card programs have shown promising results. Early Kasai hepatic portoenterostomy (<60 days of life), is the main stay of treatment to prevent or delay liver transplant.
Imaging findings or procedure details: Key sonographic findings include liver echogenicity, triangular cord sign, hepatomegaly, splenomegaly/polysplenia, gallbladder anomalies, ascites, hepatic artery to portal vein diameter ratio >0.45, intestinal malrotation, inferior vena cava anomalies and elevated elastography values. Liver biopsy may contribute to the diagnosis, however, intra-hepatic cholangiography remains the gold-standard.
Conclusion: Appropriate ultrasound interpretation allows differential diagnosis of neonatal cholestasis and can suggest a BA, resulting in faster surgical treatment and better prognosis.

A-218

Abdominal ultrasound of the vomiting newborn – A brief overview

G. Fahrni[1], Q.-D. Vo[2], M. Thierry[2], P. Santos Oliveira[2], O. Nadjar[2]; [1]Lausanne/CH, [2]Morges/CH

Learning objectives: To review the differential diagnosis of a vomiting newborn and to illustrate the key abdominal ultrasonographic findings to differentiate them.
Background: Vomiting in newborns, especially biliary or in a projectile fashion, should quickly lead to abdominal ultrasound exploration to exclude urgent pathologies such as volvulus, intussuception or pyloric stenosis.
Here we provide the key sonographic appearances of those pathologies and some useful tips on how to perform ultrasound in the best possible conditions.
Imaging findings or procedure details:
- How to perform abdominal ultrasound of newborns in good conditions
- Where to look first ?
- Malrotation and volvulus
- Intestinal invaginations
- Pyloric stenosis
- Conclusions.

Conclusion: Getting called in the middle of the night to assess a vomiting newborn can be quite frightening for young radiologist intern. Having in mind the clinical presentation of the main pathologies and where to find them is helpful to not get lost during the abdominal ultrasound exploration of the child and confidently exclude urgent diagnoses.

A-254

MRI of hydrocephalus in children

J. Gaultier, K. Minkner Klahre, A. Dhouib; Neuchâtel/CH

Learning objectives: To understand the challenging role of MRI in both diagnosis and follow-up of pediatric hydrocephalus, to know the appropriate MRI protocols and to present an overview of some main cases of hydrochephalus in children.

Background: Hydrocephalus is a common pediatric condition resulting from imbalance between the production and absorption of cerebral cerebrospinal fluid (CSF). Most common etiologies in pediatric population are congenital malformations, hemorrhage, tumors and infection. Ultrasound (US) is used as a primary screening modality in the first few months of life, while the anterior fontanel is still open. It is helpful to explore the size and shape of lateral ventricles and peri-cerebral spaces. Exploration of posterior fossa and the fourth ventricles is however limited with this modality. CT scan should be considered and is useful only in emergency conditions because of concerns of ionazing radiation. MRI remains the best current modalitdy to explore hydrocephalus in children.

Imaging findings or procedure details: In addition to MR conventional sequences, like T1-weighted and T2 weighted images, other specific techniques such as sagittal steady-state T2 imaging, 3D sequences and MR cisternography should be included in the MRI protocol to explore pediatric hydrocephalus in children. Besides anatomical details, MRI gives information about CSF flow dynamics, helps to identify possible causes and assesses parenchymal changes.

Conclusion: MRI is not only useful to evaluate and assess ventricular size, but is also helpful to better understand the underlying mecanisms and causes of hydrocephalus in children as well as to assess structural changes in the periventricular white matter.

A-160

How to survive the Swiss Radiology Congress by being colorblind: Accessibility in Radiology

L. Widmer, J. Vidal, A. Kolly, H. C. Thoeny

Learning objectives:

- To become aware of the frequency of color blindness in the radiological community.
- To overcome the difficulties of colorblind people by optimizing your visual communication.

Background: Color blindness, which occurs in about 8%–12% of men and about 0.5% of women, is a condition in which certain colors cannot be distinguished. At an event such as the Swiss Congress of Radiology, with 1300 participants in 2019, several dozens of colorblind people can be expected to be present. Although available on a majority of smartphones and computers, the specific configurations developed to facilitate accessibility for colorblind people are not default settings. Slides or posters that rely too heavily on colors could be leaving some of your audience behind. This problem is common in data visualizations as colors are often used to highlight comparative data points. Specifically in radiology, colors have become crucial in Doppler display, perfusion cartography or mapping in MRI studies.

Imaging findings or procedure details: Being friendly to colorblind people does not mean that you should not use colors. Even for the colorblind, colors are very useful cues to distinguish different objects easily and quickly. We detail the difficulties faced by people with color blindness and present an illustrative checklist of do/don'ts as solutions overcoming these issues. Colorblind-friendly palettes are options for a multitude of programs. Reproducible research tools such as the language R are well adapted to the issue, since libraries offer easy-to-use colorblind-friendly palettes. When not available, emphasis can be placed on the use of different shapes, positions, contrasts, patterns, line types, text, hierarchy, and animation. We also point out the key considerations that should be taken into account during an oral presentation, such as the value of the verbal description of your graphics and the color of the laser pointer.

Conclusion: This poster provides recommendations for speakers on making their presentations accessible to the colorblind population.

A-294

KHEOPS-KARNAK: Open Source platform for storage and sharing of large imaging databanks

J. Spaltenstein, N. Roduit, S. Cicciu, G. Pasquier, N. van Dooren, O. Ratib; Geneva/CH

Purpose: To provide an Open-Source web-based platform for storage, communication, wide distribution, processing and analysis of large data collections of digital images.
Methods and Materials: The goal of our project is to develop an Open-Source framework to power open-access repositories of medical images geared specifically toward multi-centric collaborative initiatives featuring:
- Open databanks of imaging biomarkers (phenotype).
- Based on contributions from research groups sharing curated and consented data
- User-friendly cockpit for the management and distribution of images by users
- Imbedded HTML5 viewer (OHIF) as well as links to popular open-source viewers (OsiriX/Horos, Weasis)
- Open APIs for developers of image analysis and data mining tools.

Its highly secured and flexible cockpit allows user to manage and exchange data through a simple paradigm of "shared albums" that consists of subset of data from multiple sources. The use of unique and revocable tokens allows users to manage and monitor the use of their shared data. A data anonymization gateway (KARNAK) was developed to template-based deidentification of imaging data before exporting them from clinical settings.
Results: This platform provides a flexible means for data sharing that gives access to Big Data repositories for machine learning and Radiomics. Its highly secured and flexible cockpit allows user to manage and exchange data through a simple paradigm of "shared albums". The use of unique and revocable tokens allows users to manage and monitor the use of their shared data. Special attention was given to facilitating the integration with existing institutional PACS as well as existing imaging databanks.
This platform was already downloaded and installed in several centers worldwide including HUG and CHUV and adopted by research groups of the SPHN and PHRT networks.
Conclusion: Web-based platform accessible on any device that provides a cost-effective solution for securely hosting and sharing imaging data for research (www.kheop.online).

A-252

Viewing history in different phases: Grating-based phase-contrast computed tomography in mummy studies

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Purpose: This feasibility study aims to evaluate the potential of grating-based phase-contrast computed tomography in mummy studies by individual consideration of X-ray attenuation, phase shift, and ultra-small angle (dark-field) scattering signals.
Methods and Materials: No institutional approval was required for this prospective feasibility study conducted in February 2020.
To fully exploit the potential of phase-contrast computed tomography by generating discrete signals for X-ray attenuation, phase shift, and ultra-small angle scattering (dark-field), we used a grating-based CT setup at the Paul Scherrer Institute to image an ancient Egyptian mummified human hand. Our setup consisted of a high-power source operating at 70 kVp with a focal spot size of 0.4 mm, three micro-structured X-ray gratings, a 150x12 mm field of view with a geometric magnification of two, and a direct conversion X-ray detector with a pixel size of 100 um. Over the course of 3.5 hours, we recorded 19 tomographic scans to cover the 190 mm height of the specimen. Attenuation, phase shift, and darkfield images, reconstructed by filtered back-projection, were individually evaluated for the visibility of anatomical structures by two readers using a five-point Likert scale. Descriptive statistics are provided.
Results: Differentiation of anatomical structures, especially tissues rich in type I collagen, such as tendons, skin, or bone, was rated best in phase-contrast images, followed by absorption and significantly inferior in dark-field images (average ratings of 4.5 ±0.7, 4.4 ±0.8, and 2.5 ±0.5, respectively).
Conclusion: Grating-based phase-contrast CT allowed a differentiated comparison of the diagnostic information in absorption, phase-contrast, and darkfield images by delivering three discrete signals. The phase-contrast image offered unprecedented contrast of soft tissue structures in a dry ancient mummified human remain at high resolution.