Abstracts

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Session 1
**ABSTRACT**

**Introduction:**
Arterial $^{18}$fluorodeoxyglucose (FDG) positron emission tomography (PET) is considered a measure of atherosclerotic plaque macrophages and is used for quantification of disease activity in clinical trials, but the distribution of FDG accumulation in macrophages versus other arterial cells has not been fully clarified. We aimed to analyze FDG uptake in different arterial tissues and their contribution to PET signal in normal and atherosclerotic arteries.

**Methods.**
Wildtype (n=10) and D374Y-PCSK9 transgenic (n=9) minipigs were fed a high-fat, high-cholesterol diet to induce atherosclerosis and subjected to a clinical FDG-PET/CT scanning protocol. Volumes of arterial media, intima/lesion, macrophage-rich and hypoxic tissues were measured in serial histological sections. A general model of PET signal was developed allowing estimation of the activity fraction of sub-resolution tissues in the arterial wall. In separate transgenic minipigs (n=4), the intra-arterial localization of FDG was determined directly by autoradiography and by activity concentration maps derived from total intensity projection (TIP) analyses of ex vivo scanned aortas.

**Results.**
Arterial FDG-PET signal appearance and intensity were similar to human reports. The modelling approach showed high accuracy in describing the FDG-PET signal and revealed comparable FDG accumulation in macrophages and other arterial tissues, including medial smooth muscle cells. These findings were verified directly by TIP-derived maps and by autoradiography of sections of normal and atherosclerotic arteries.

**Conclusion.**
FDG is taken up comparably in macrophage-rich and -poor tissues in arteries and atherosclerotic plaques in minipigs. This offers a mechanistic explanation to a growing number of observations in clinical imaging studies that have been difficult to reconcile with macrophage-selective FDG uptake.
Figure.
Accuracy of bulk arterial tissue as determinant of FDG-PET signal in two vascular beds. (A) Ilio-femoral arteries from high-fat high-cholesterol (HFHC) fed transgenic (n=8) and wildtype (n=4) minipigs. (B) Ascending aortas of HFHC-fed transgenic (n=9) and wildtype (n=6) minipigs, and atherosclerosis-free wildtype minipigs (n=4). Marker diameter is a linear transformation of macrophage volume (A) and luminal surface lesion area (B). The analyses in (A,B) are based on signal-modelling of the PET data. Best fit planes are shown. AROI: total activity in region of interest.
$A_{bg}$: Total activity of background
Mitochondrial encephalomyopathy with lactic acidosis and stroke-like episodes (MELAS) in elderly patients – a report of two cases

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Background
Mitochondrial encephalomyopathy with lactic acidosis and stroke-like episodes (MELAS) is a mitochondrial disorder that in the neuroimaging literature is associated with stroke-like episodes (SLE)(1). MELAS affects multiple organs, and neurological symptoms other than SLE include seizures, headache, dementia, psychiatric symptoms and hearing loss. Disease onset after 40 years of age is sporadic(2). Magnetic resonance imaging (MRI) examinations show migratory stroke-like lesions (SLL) that do not follow vascular territories and particularly involve the occipital, parietal and temporal lobes. Magnetic resonance spectroscopy (MRS) performed in SLL demonstrates elevated lactate peak and decrease in the N-acetylaspartate (NAA) / choline (Cho) ratio(3). We report two cases of elderly patients with SLE where neuroimaging findings played a crucial role in the early diagnosis of MELAS.

Patient case
Two female patients, 60- and 54-years old respectively, were admitted to the neurology department during the period of last six months. Both patients presented with similar neurological symptoms including aphasia, cognitive disturbances and movement problems. MRI done at the time of first admittance in both patients demonstrated bilateral mostly cortical diffusion signal abnormalities (DSA) which were initially interpreted as acute ischemic changes (Figure 1a and 1d). Both patients were readmitted, after three weeks and six months respectively, because of cognitive impairment progression in the case of the first patient and new left-sided homonymous hemianopsia in the case of the second patient. Repeated MRI in both patients along with magnetic resonance spectroscopy showed almost complete regression of the previous DSA, new cortical DSA and a pronounced lactate peak (LP) (Figures 1b, 1e, 1c and 1f). A provisional diagnosis of MELAS was postulated for both patients. The diagnosis of MELAS was confirmed by genetic testing where a m.3243A>G mutation was detected in both patients(4). Supportive treatment with L-arginine was initiated. At 4-months follow-up both patients showed improvement of their cognition.

Conclusion
Presence of migratory DSA corresponding to SLL in the temporal, parietal and occipital lobes with varying apparent diffusion coefficient findings as well as a pronounced LP on MRS in patients with SLE should rise the suspicion of MELAS, even in elderly patients(5, 6).
References

Figure 1

MRI examinations for the two patients done at the time of the first admission for patient 1 (a) and patient 2 (d) showing diffusion signal abnormalities (DSA) corresponding to stroke like lesions in MELAS as well as MRI examinations for the two patients done after readmission for patient 1 (b) and patient 2 (e) showing new DSA and disappearing old DSA. MR spectroscopy with SE 135 done after readmission shows a prominent lactate peak at 1.3 ppm for patient 1 (c) and patient 2 (f).
Comparison of three different methods for detection of T2/FLAIR signal changes in multiple sclerosis patients

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Introduction
Magnetic resonance imaging (MRI) is the most important technique in monitoring disease progression and therapy response in multiple sclerosis (MS), but the conventional side-by-side reading (SBSR) (Figure 1a) of follow-up MRI examinations for the detection of new or changing T2/FLAIR-weighted demyelinating MS lesions is a time-consuming process and prone to misdetection. On the other hand, two recently published articles presented methods for detection of MS lesions based on commonly available software packages that facilitate and accelerate the reading process (1, 2). The aim of this study was to compare the efficiency or these two methods against the conventional SBSR regarding the detection of new MS lesions (NMSL), MS lesion size change (MSLSC) and necessary reading time (RT).

Materials and Methods
This retrospective study included 30 consecutive MS patients. All MRI examinations were performed on the same 1.5T scanner and included a 3D-FLAIR sequence. Four radiologists with different levels of experience analyzed two follow-up examinations, current and previous respectively, on the same workstation (syngo.via, Siemens). Automatic coregistration of the follow-up scans was performed for all readings. Color coding of the current examination for the color-coded reading (CCR) was performed as in Galletto Pregliasco et al (Figure 1b)(2). Contrast inversion of the current examination for the inverted contrast reading (ICR) was performed as in Schmidt et al (Figure 1c)(1). We analyzed the specificity, sensitivity, positive predictive value (PPV) and negative predictive value (NPV) for detection of NMSL and MSLSC as well as the RT. A reference standard for NMSL and MSLSC was provided by a senior neuroradiologist.

Results
The CCR showed the highest combined sensitivity[97.5%] and specificity[85%] for NMSL detection with a PPV of 93.1% and NPV of 95.4%. Regarding MSLSC detection both CCR[60.9%] and ICR[80%] showed a higher combined sensitivity compared to SBSR[49%]. The combined mean RT showed a significant decrease when CCR[71s] and ICR[88s] are compared to SBSR[152s] (Figure 1d).

Conclusion
Both CCR and ICR are valid alternatives to the commonly used SBSR that reduce the RT while keeping or improving the detection of NMSL and MSLSC. Therefore, it is recommended to apply such methods in everyday clinical routine.
References

Figure 1

a) Example of side-by-side reading (SBSR). The white arrow points to a new demyelinating lesion on the current scan which is not visible on previous scan. b) Example of color-coded reading (CCR). The white arrow points to a new demyelinating lesion that is displayed in red because of the red color coding applied to the current scan. c) Example of inverted contrast reading (ICR). The white arrow points to a new demyelinating lesion that is displayed in black due to the inverted contrast applied to the current scan. d) Box and whisker plot showing the reading time (RT) in seconds for each of the four readers (numbers from 1 to 4) grouped according to different readings (SBSR, CCR and ICR).
FLT-PET and DW-MRI early after treatment start in patients with small cell lung cancer

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Introduction: Small cell lung cancer (SCLC) is an aggressive cancer, characterized by initially good response to therapy, but often followed by a rapid and fatal relapse. Early evaluation of response to treatment and better prognostication may have impact on the treatment. In this study, we evaluated ¹⁸F-fluorothymidine (FLT)-PET/diffusion-weighted (DW)-MRI early after treatment start in patients with SCLC, to pilot the potential of early response evaluation and prognostication.

Methods: Patients with SCLC referred for standard chemotherapy were eligible. FLT-PET/DW-MRI was acquired within 14 days after treatment start. FLT-PET/DW-MRI was compared with diagnostic FDG-PET/CT. Voxel-by-voxel analyses comparing the modalities were conducted, and spatial distribution of hotspots was compared. FDG-SUV_{peak}, FLT-SUV_{peak} and ADC_{median} were compared with final treatment response, progression free survival (PFS) and overall survival (OS).

Results: A total of 12 patients were included: Eleven patients received 3-6 cycles of cis-/carboplatin and etoposide, and one patient received one cycle of etoposide. Diagnostic FDG-PET/CT was available from nine patients. 17 T-sites and 13 N-sites were identified. In many lesions, FLT-uptake was too low for spatial comparison with FDG-PET and DW-MRI. FDG-PET and FLT-PET had a positive voxel-by-voxel correlation (r=0.10-0.60, n=7). In T-sites, the correlation did not apply for the hottest voxels. In N-sites, hotspots overlapped partially, but were not identical. All lesions had a lower FLT-SUV_{peak} than FDG-SUV_{peak} (1.7 vs 9.4 median). Spatial comparison of FLT-PET and DW-MRI were inconsistent: Voxel-by-voxel correlation varied (r= -0.66 to +0.32), and areas with high FLTuptake corresponded to low ADC in 4/11 lesions. Final response evaluation was available from 11 patients (n=28). All non-responding T-sites (n=3) had a high FLT-SUV_{peak}>2.5, whereas only one T-site with response had FLT-SUV_{peak}>2.5 (2.8). The remaining T-sites (n=12) had a low FLT-uptake (FLT-SUV_{peak} 0.7-2.1). All non-responding N-sites (n=3; one patient) were detectable by FLT-PET (FLT-SUV_{peak} 1.9-2.4), whereas FLT-uptake could not be distinguished from background in the responding N-sites (n=9). FDG-SUV_{peak} and ADC_{median} were not associated with final response. FDG-SUV_{peak}, FLT-SUV_{peak} not ADC_{median} correlated with PFS or OS.

Conclusion: FLT-PET and DW-MRI early after treatment start provides other biological information than pretreatment FDG-PET in patients with SCLC. FLT-PET after one cycle of chemotherapy might identify non-responders.
ACCURACY OF SONOGRAPHIC FEATURES OF THYROID NODULES BASED ON THE THYROID IMAGE REPORTING AND DATA SYSTEM (TI-RADS) USING HISTOPATHOLOGIC REPORT AS THE GOLD STANDARD

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Background:
Thyroid nodule is a common ultrasound finding. At present, there is no guideline in determining the need for a nodule to be biopsied. Thyroid Imaging Reporting and Data system (TI-RADS), although not yet universally applied, has been used in several institutions to describe patterns of thyroid nodules and predict the rate of malignancy. A major benefit of TI-RADS is that it limits the number of thyroid biopsies when the nodule is deemed to have less malignant features. The main objective is to determine the accuracy of TI-RADS in detecting thyroid malignant lesions.

Materials and Methods:
This is a cross-sectional analytical study. A total of 97 patients were included in the study. These patients underwent biopsy and ultrasound. Patients who underwent thyroid nodule biopsy were noted. Their ultrasound imaging findings were reviewed, described and graded according to TI-RADS.

Results:
This study had a total of 97 patients, 88 patients had benign result and 9 patients had malignant result. A higher proportion of patients with malignant thyroid lesion was noted among those with higher TI-RADS classification.

Conclusion:
TI-RADS as seen on ultrasound is an accurate in determining the nodule as benign or malignant.
Figure 1. ACR TI-RADS.

References:
Applying ALARA principle to lower the dosage of iodinated contrast medium in Spectral CT (dual layer)

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Background
The ALARA principle (As Low As Reasonably Archivable) is an important principle in radiation protection. The same principle may also be applied to lower the dosage of iodinated contrast medium and hence reducing the risk of post contrast acute kidney injury (PC-AKI) 1. Faggioni et al described how to optimize a computed tomography angiography (CTA) with “boosted” iodine contrast enhancement by altering the iodine delivery rate (mg iodine per second), which is a product of the iodine concentration (mg iodine per ml) of the contrast medium and the flow rate (ml per second) 2.

In august 2017 a dual-layer CT (128 slice multidetector IQon Spectral CT, Philips Healthcare) was installed in our hospital as the first in Norway. IQon is based on a dual layer technology and has the ability of constructing virtual monoenergetic images (VMI) from 40 keV to 200 keV 3. When lowering the virtual mono-energy (keV), one achieves greater iodine contrast enhancement in the vessels making it possible to reduce the dosage of iodine contrast medium 4.
By combining Faggioni’s approach with this latest Spectral CT technology, one can “boost” the images and reduce the dosage of iodine contrast medium to at least 50% 5.
Our aim is to achieve a vessel enhancement of at least 200 Hounsfield Units (HU) 6. We present this approach in three patients.

Patient cases
We present three patients where standard protocols were altered as part of an ongoing optimization process of our new spectral CT.
Case 1: A 96-year-old woman presented with dyspnoea referred to a CT pulmonary angiography.
Case 2: An 80-year-old man treated with endovascular aortic repair (EVAR) seven years ago, referred to a CT angiography of the abdominal aorta/iliac as part of a follow-up regime.
Case 3: A 57-year-old woman with symptoms of claudication referred to a CT angiography of the total aorta and lower limbs.

Conclusion
This case series demonstrated that iodinated contrast medium dosage can be reduced to as low as one fifth (17-30%) of standard protocols with the latest Spectral CT technology without reducing image quality.
<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th>CT PULMONAL ANGIOGRAPHY</th>
<th>CT ABDOMINAL AORTA/ILIAC</th>
<th>CT AORTA/ILIAC/LOWER LIMBS</th>
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<tr>
<td></td>
<td>ALARA case 1</td>
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<td>13.5 + 31.5 = 45</td>
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<tr>
<td></td>
<td>60 + 0 (0.8mL/kg)</td>
<td>80 + 0 (1mL/kg)</td>
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<td>ALARA vs. standard</td>
<td>4.7 / 21 = 0.22</td>
<td>4.7 / 28 = 0.17</td>
<td>10.5 / 35 = 0.30</td>
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<td>Iodine delivery rate [g/s]</td>
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<td>Tube voltage [kV]</td>
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<tr>
<td>Trigger threshold [HU]</td>
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<tr>
<td></td>
<td>130</td>
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<tr>
<td>Contrast enhancement at 40 sec [HU]</td>
<td>&gt;400</td>
<td>&gt;300</td>
<td>&gt;400</td>
</tr>
</tbody>
</table>

**THORAX**

472 HU CNR:56 SNR:63

538 HU CNR:95 SNR:108

**ABDOMEN**

300 HU CNR:22 SNR:25

611 HU CNR:56 SNR:61

**GROIN**

375 HU CNR:31 SNR:33

700 HU CNR:100 SNR:109

**KNEE**

594 HU CNR:88 SNR:91

**LEGS**

487 HU CNR:53 SNR:59
References
Potential causes of idiopathic non-specific interstitial pneumonia and patterns of changes in diagnostic imaging for ways of farther research to determine causes of this ‘idiopathic’ disorder

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Profession of the presenter: medical doctor, radiology resident (e-mail: emes@e-post.pl)

Introduction
It is proposed that clinical diagnosis of idiopathic non-specific interstitial pneumonia (idiopathic NSIP) should be reserved only for biopsy-proven cases when no causative factor can be identified. Idiopathic NSIP can be opposed to secondary NSIP, which occurs in cases where it is possible to identify a known aetiology (Palmucci et al. 2014). The aim of the study was to collect scattered information about idiopathic NSIP for their critical analysis.

Materials and Methods
Articles from Medline/PubMed database searched by entering the name of ‘idiopathic non-specific interstitial pneumonia’ come from the last 30 years (1990-2019). The information from them was collected and presented in the form of a discussion on the methods of further scientific research.

Results
Literature review showed coexistence of idiopathic non-specific interstitial pneumonia with some disorders including scleroderma, mediastinal lymphadenopathy and condition after lung transplantation (terminological inconsistency, before 2014). Studies on biochemical markers are being deepened (e.g. anti-myxovirus resistance-protein 1 autoantibody). The typology of pulmonary changes observed in computed tomography is discussed by authors of particular articles. In available papers the analyses of changes found in imaging studies (e.g. ground-glass opacification) was compared with the results of microscopic examination.

Conclusion
Idiopathic NSIP is still poorly understood disease entity. Progress determines the search for possible causes of the disease and excluding them in subsequent patients.
References (selected)
Can perfusion and diffusion-weighted imaging predict expression of Ki-67 in locally advanced breast cancer (LABC)?

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Introduction
According to the literature, magnetic resonance imaging (MRI) can predict histopathological features of breast cancer (BC) including expression of Ki-67 [1-4]. Some authors indicated that dynamic MRI or/and diffusion-weighted imaging (DWI) can provide information about proliferation potential or expression of Ki-67 in BC [5-8]. The purpose of our study was to investigate associations between dynamic MRI and apparent diffusion coefficient (ADC) and expression of Ki-67 in LABC patients.

Methods and materials
Thirty-eight women participated in the study (age range 27-79 years) with the clinical and radiological presentation of LABC and core biopsy-proven malignancy. MRI has been performed on Ingenia 1.5 T MRI unit, Philips using 16-channel breast coil in a prone position. Axial T2W TSE bilateral sequence was acquired followed by a DWI with b values of 0, 50 and 800, slice thickness: 3 mm and and axial dynamic contrast enhanced (DCE) MRI (8 phases, slice thickness 2 mm) after injection of 0.1 mmol/L of gadolinium-based contrast agent. Patients were divided into two groups according to Ki-67: group 1 Ki-67<30% (n=15), group 2 Ki-67>30% (n=23). A circular ROI was placed manually onto enhancing area on DCE map in the optimal post contrast phase and on ADC map using Philips IntelliSpace Portal software.

Results:
According to the descriptive and dispersion parameters, the sampling distribution was approximately normal for all observed parameters. We found statistically significant difference between low and high Ki67 groups for ADC (MANOVA, p<0.001). Tumors with low expression of Ki-67 had higher ADC values than tumors with high expression of Ki-67 (0.95 ±0.22 × 10−3 mm2/s; 0.70 ± 0.11 × 10−3 mm2/s, respectively). There were no statistically significant differences in the perfusion parameters among low and high Ki-67 groups (MANOVA, p> 0.05).

Conclusion:
This study shows that ADC values reflect tumor proliferation potential in LABC tumors. Quantitative perfusion parameters show no potential for this differentiation. ADC may be used as a biomarker of tumor proliferation in LABC, if further studies with larger population confirm our results.
References:


Earlier diagnosis of lung cancer with use of low-dose CT. A cohort study of 1241 patients from Diagnostic Centre, Regional Hospital Silkeborg.

Authors: Andrea, Linda Christie; Kromann, Flemming Secher; Fredberg, Ulrich; Nielsen, Sven Cornelius; Vedsted, Peter
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Aim and Introduction
Early diagnosis of lung cancer is associated with improved outcomes and lower mortality. The use of chest x-ray is flawed by false negatives and delayed diagnosis. Studies of screening with low-dose CT (LD-CT) point towards effect on mortality.[1,2]. We hypothesized that LD-CT could identify disease at an earlier stage in patients referred from their general practitioner with vague symptoms, that did not however meet the criteria for the standard cancer patient pathway of lung cancer (“low risk - but not no risk”).

Materials and Methods
We set up a cohort with LD-CT during 2017 and prospectively collected administrative data for follow up and compared these results with local and national outcome of usual cancer patient pathway for lung cancer. All patients were “low risk - but not no risk”-patients with vague symptoms where LD-CT was performed to rule out cancer. Outcome measures were lung cancer stage, rate of follow-up after initial scan and vital state at the end of 2018.

Results
A total of 1241 patients (47.9% male) with a mean age of 63.1 years (sd=12.3) were given a LD-CT. Mean follow-up time were 407 days (sd=109), 32 (2.6%) were diagnosed with lung cancer and 21.9 % of patients with lung cancer died during follow up. 64.0% of patients had no follow-up. Corresponding local results for lung cancer patient pathway were: 241 patients (55.6% male) with a mean age of 68.0 years (sd=11.1), 86 (35.7%) were diagnosed with lung cancer and 40.7% of patients with lung cancer died during follow up. 2.6 % had no follow-up.
Table 1 shows the distribution of patients in the different cancer stages among our cohort, patients in the lung cancer pathway locally and in Denmark in total.

Conclusion
Low-dose CT among selected Danish patients not meeting the criteria for usual lung cancer patient pathway results in more patients with early disease stages and fewer with later disease stages, compared with patients following usual lung cancer patient pathway locally and in Denmark in total. The rate of follow-up was lower than with usual care.
References
1 Reduced Lung-Cancer Mortality with Low-Dose Computed Tomographic Screening N Engl J Med 2011;365:395-409
2 Results of the Randomized Danish Lung Cancer Screening Trial with Focus on High-Risk Profiling Am J Respir Crit Care Med. 2016 Mar 1;193(5):542-51.

Table 1. Lung Cancer stages according to groups

<table>
<thead>
<tr>
<th>N patients</th>
<th>LD-CT</th>
<th>Lung cancer pathway Silkeborg</th>
<th>Lung cancer pathway Denmark*</th>
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<tr>
<td>Early (0-IIIB)</td>
<td>32</td>
<td>51.9</td>
<td>45.9</td>
</tr>
<tr>
<td>IIIA</td>
<td>11.1</td>
<td>8.2</td>
<td>8.9</td>
</tr>
<tr>
<td>Late (IIIB-IV)</td>
<td>37.0</td>
<td>45.9</td>
<td>52.1</td>
</tr>
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</table>

*Danish lung cancer group, annual report 2017, www.lungecancer.dk
Session 2
Sonographers ability to detect and grade pathological findings in shoulder radiograph

Author: Pakanen, Mikko Juhani, sonographer-radiographer, Department of Radiology, Oulu University Hospital (Presenting Author)
Co-authors: Jouni Haverinen, Minna Heiskanen, Esa Liukkonen & Jaakko Niinimäki (all co-authors; Department of Radiology, Oulu University Hospital)

Introduction: The aim of this study was to evaluate and improve the knowledge and ability of sonographers, who perform shoulder ultrasonography examinations, to detect pathological findings in shoulder x-ray images and furthermore, to examine which pathological findings can be reliably detected by sonographers. The focus of this study was to examine the interpretation process primarily in the evaluation of degenerative changes.

Materials and Methods: Study material consisted of 50 anonymized shoulder x-ray examinations of patients who had shoulder ultrasonography within two months of the x-ray study. Three sonographers evaluated research material independently, a semi-structured evaluation, of GH-joint, osteophytes, tendon calcification, acromial shape, subacromial space, AC-osteoarthritis and other observations. Musculoskeletal radiologist evaluated images blinded to the interpretation of sonographers. The results were compared between radiologist and sonographers.

Results: Sonographers' detection rates compared to radiologist were: GH-joint 96,7%, GH-joint space 94%, GH-joint articular surfaces 81,3%, osteophytes 72,7%, tendon calcification 81,4%, acromial shape 69,3%, subacromial space 93,8%, AC-osteoarthritis 39,4% and other observations 76%.

Conclusion: Radiographers’ ability to interpret and report x-rays have been studied widely and good results have been reported in the interpretation of trauma x-ray images. In our study, sonographers (Radiographer University of Applied Sciences) performed well in detecting degenerative radiographic findings of shoulder x-ray images. GH-joint, GH-joint space and articular surfaces, tendon calcification and subacromial space were most accurately evaluated when compared to radiologist’s interpretation. The research material will be further utilised in education to improve the sonographers’ skills to evaluate AC-osteoarthritis, acromial shape and osteophytes.
References:
Do Ahlbäck-scores identify subgroups with different magnitudes of cartilage thickness loss in patients with moderate to severe radiographic osteoarthritis? One-year follow-up data from the Osteoarthritis Initiative

Authors:
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3Institute of Anatomy and Musculoskeletal Research, Paracelsus Medical University, Salzburg, Austria
4Chondrometrics GmbH, Ainring, Germany

Introduction
Moderate and severe radiographic knee osteoarthritis (OA) is usually defined as Kellgren-Lawrence grade (KLG) 3 and 4, with KLG-4 referring to end-stage knee OA, and the KLG scoring system is often used for patient selection and stratification in clinical trials. The Ahlbäck knee OA radiographic grading system (1-5) has been developed for moderate and severe knee OA and subdivide KLG-4 into 4 grades (2-5). The aim of the study was investigate if the Ahlbäck scoring system of radiographic knee osteoarthritis (OA) is able to further subdivide KLG-3 and -4 patients into groups with different sensitivity to change in cartilage thickness over one year in patients with moderate to severe knee OA.

Materials and Methods
One-year femorotibial cartilage thickness change was obtained from 3D cartilage sensitive magnetic resonance imaging (MRI) data in 108 Osteoarthritis Initiative (OAI) participants with moderate to severe radiographic knee OA (KLG-3/4). KLG-scores were available from the publicly available OAI database. Ahlbäck scores were performed using the same baseline x-rays. Sub regional change in cartilage thickness was assessed after manual segmentation of weight-bearing femorotibial cartilage at baseline and 1 year. Cartilage thickness change was analysed in the entire femorotibial joint (FTJ), in the medial compartment (MFTC) and in the lateral compartment (LFTC). One-year change was calculated for FTJ, MFTC, LFTC and the location-independent ordered values 1 and 16 (OV1/OV16) representing the subregions with largest loss (OV1) and gain (OV16) within each knee.

Results
Of the 108 patients, n=30/78 had KLG-3/4. The corresponding Ahlbäck scores (1-5) were: n=30/33/36/9/10. Cartilage thickness changes between Ahlbäck groups showed no statistical significant difference for FTJ, MFTC, LFTC and OV1, but change in OV16 was significantly higher in Ahlbäck-4 knees (p=0.03) compared to Ahlbäck 1-3 knees.

Conclusion
Radiographic knee OA grading with Ahlbäck-scores was not superior to KLG for prediction of cartilage thickness loss over one year, in patients with moderate and severe knee OA supporting the continuous use of the easier and more widely used KLG in clinical trials.
Role of ultrasonography in assessment of normal femoral cartilage: comparison with high-resolution MRI

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Introduction
Femoral cartilage of the knee joint can be assessed on ultrasonography (US), but it remains unknown how much of the cartilage is visualized. The purpose of this study was to establish the acoustic window on US examination of the knee joint by comparing the US and corresponding MRI views of the femoral cartilage.

Materials and Methods
Both knees of ten healthy volunteers without knee symptoms or trauma were examined. Mean subject age was 31 years. Standard knee US was performed with knee flexed 90°: transverse axial US images perpendicular to the cartilage surface were taken from medial and lateral femoral condyles. Subsequently, MRI was performed on a 3T scanner using spine matrix coil integrated into the scanner table and body matrix coil. MRI-compatible 3D-printed brace was used to keep knee flexion angle constant. Subject was scanned lying on the same side of the knee of interest with the knee at 90° flexion. 3D DESS and T1-weighted VIBE sequence were applied. Starting with axial, coronal and sagittal views, the axial view was rotated three-dimensionally to achieve the view corresponding to the respective US imaging plane. After that a direct visual comparison was done to ensure that the MR image corresponded to the imaging plane used in US (Fig. 1).

Results
In the twenty knees analyzed, the mean maximum cartilage coverage of the US examination of medial femoral condyle was 66% (range 54%-80%) and lateral femoral condyle was 37% (range 25%-51%) when compared to the visualization of condylar cartilage on MRI. On MRI, mean width of the medial condyle was 26.2 mm (SD 2.67) and on US the mean width of the visible condyle cartilage was 17.1 mm (SD 2.34). On the lateral condyle they were 32.5 mm (SD 2.74) and 12.1 mm (SD 2.07), respectively.

Conclusion
Acoustic window to the weight-bearing portion of the medial femoral cartilage is achievable on the knee US suggesting that significant amount of cartilage lesions may be evaluated on US.
Geographical variations in the use of diagnostic imaging of musculoskeletal diseases in Norway.

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Profession of the presenter: Radiographer (PhD-scholar).

Introduction:
There is a high prevalence of musculoskeletal disorders in the Norwegian population (1). A significant number of these patients are referred to diagnostic imaging. Geographical variations in the use of imaging for musculoskeletal disorders indicates over- and/or underuse, making knowledge about such variations imperative (2). Accordingly, the purpose of this study was to investigate geographical variations in diagnostic imaging of the musculoskeletal system.

Materials and methods:
Population rates from Statistics Norway and outpatient musculoskeletal procedures registered at the Norwegian Health Economics Administration (HELFO) the first half of 2016 were accessed. These data were age-adjusted, and high/low ratios were calculated (3).

Results:
Geographical variations were demonstrated at all levels, with an overall high/low ratio of 1.3. For specific modalities the highest variation was for ultrasound (3.2) and CT (2.2). For individual examinations, the highest high/low ratios were observed for MRI of the shoulder (2.4) and radiography of the lower back (1.9) and shoulder (1.8).

Conclusion:
We demonstrate a moderate to high geographical variation in the use of musculoskeletal radiology. This variation can indicate over- or underuse, which may violate basic principles of equity, priority, setting and quality of care, and needs further attention.

References
Discriminative validity of Strain Elastography in the Supraspinatus Tendon

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Profession: Radiographer

Introduction
The aim was to investigate discriminative validity of strain elastography (SEL) between patients with painful supraspinatus tendinopathy and participants with asymptomatic shoulders.

Materials and Methods
Thirty patients with shoulder pain and MRI-verified supraspinatus tendinopathy and 30 participants with asymptomatic shoulder were evaluated by SEL. Discriminative validity was investigated for the continuous raw (RAW) variables and ratios between a soft area of the deltoid muscle as reference (DELT). Further, a clinically used qualitative color scale (dichotomised from 4-level scale) and counts of red lesions (dichotomised from continuous variables) were investigated.

Logistic regression analyses, adjusted for sex and BMI, was used to test whether SEL is a predictor for having tendinopathy (clinical signs and MRI-tendinosis).

Results
For the continuous variables, patients had decreased OR’s for having hard tissue, corresponding to OR’s 0.25 [95%CL: 0.09-0.71] and 0.84 [95%CL: 0.71-1.00] for RAW and DELT, respectively. This indicates that people with supraspinatus tendinopathy are less likely to have hard tissue compared to participants with asymptomatic shoulders.

For the qualitative variables, there was no difference between patients and participants with asymptomatic shoulders, neither in color rating nor in number of red lesions (OR 0.60 [95%CL: 0.17-2.06]) and 0.91 [95%CL: 0.28-3.01], respectively.

Conclusion
Discriminant validity of SEL was confirmed for RAW and DELT, as SEL of the supraspinatus tendon showed significantly differentiation between patients and participants with asymptomatic shoulders. Patients with supraspinatus tendinopathy showed lower Odds of having hard tissue for continuous variables (RAW and ratios with DELT), but not for qualitative variables (color scale, counts of red lesions). Further clarification of relevant variables for diagnosing supraspinatus tendinopathy is required.
Aggressive Fibromatosis in MRI: pre- and post-therapeutic changes in MRI in two sarcoma centers

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²Department of Diagnostic and Interventional Radiology, BG University Hospital Bergmannsheil, Bochum

Author and Co-Authors are Radiologists

Purpose:
To assess the clinical significance of initial MRI findings and post therapeutic changes in MRI follow up scans after resection of aggressive fibromatosis and to provide an overview of the tumor appearance in MRI.

Methods:
135 patients underwent 1.5 T MRI from 2006 and 2018. The primary tumor was examined for contrast agent behavior, appearance and extent in MRI. Three groups were determined: under 30, 30 to 50, over 50 years of age. MRI findings were categorized as 'safe' (Group A), intermediate (Group B) and malignant (Group C).

Results:
The thigh was the most common localization for AF (p<0.05). The main appearance of the primary tumor was significant more often fascicular than oval or polycyclic (p=0.001 and p=0.01, respectively). In patients under 30 years the main appearance was ovoid with homogenous and fascicular with heterogenous/homogenous contrast enhancement. In patients between 30 and 50 and over 50 years the main appearance of the tumor was fascicular with heterogenous/homogenous and mainly marked contrast enhancement. We incidentally found one inflammatory mamma carcinoma and a malignant esophagus tumor. The most often loco regional post therapeutic changes were subcutaneous edema (74%) and muscle edema (60%).

Conclusions:
The main shape of the primary tumor is fascicular with homogenous/heterogenous and marked contrast agent enhancement but may differ from case to case. Group-C-findings are rare but high malignant and should prompt further diagnostic work-up. Further studies are needed to investigate findings and post therapeutic changes and appearance in CT, MRI and hybrid Systems.
Shear-wave velocity in the long head of the biceps brachii muscle with increasing weight bearing.

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Place of employment: Department of Radiology, Rigshospitalet Blegdamsvej, Copenhagen

Profession of the presenter: Physician training for radiology.

Introduction (including aim):
A previous study has suggested a linear correlation between muscle load and shear elastic modules in minor muscles of the hand. The aim of our study was to examine the change of muscle shear-wave velocity in the long head of the biceps brachii muscle with increasing weight bearing in isometric elbow flexion. Furthermore, we aimed to explore any difference in shear-wave velocity between the dominant and non-dominant arm.

Materials and Methods:
In a pilot study, we examined 10 healthy volunteers (5 male and 5 female), median age 31 years [Interquartile range (IQR) 31-39], median Body Mass Index 22.7 kg/m² [IQR 20.4-24.5], two left handed dominant participants and eight right handed. The participants were examined without weight bearing and with increasing weight bearing in 1 kg increments at the level of the hand until exhaustion or loss of signal. Measurements alternated between the right and left arm respectively ensuring at least one minute recovery time between each increment of weight bearing. A GE Logic E9 system with a 9 MHz linear array transducer and MSK preset (GE, Chalfont St. Giles) was used for all measurements.

Results:
Figure 1 A-D show increasing shear-wave velocities in the muscles with increasing weight bearing in a non-linear configuration with a ceiling effect. Furthermore, we saw higher velocities in the non-dominant arm compared to the dominant arm with a mean difference of 0.55 m/s (95% confidence interval 0.20-0.90, P=0.002).

Conclusion:
Shear-wave velocities seem to increase with increasing muscle load in the long head of biceps brachii muscle until a certain level, which may be caused by synergistic muscle activation. The non-dominant arm seems to react stronger to load compared to the dominant arm suggesting different properties of the muscle fibres.
Figure 1 A-D:

A) Dominant arm - individual measurements

B) Dominant arm - combined

C) Non-dominant arm - individual measurements

D) Non-dominant arm - combined
Introduction
Osteoarthritis (OA) of the knee is a common disease with increasing prevalence worldwide. Previous studies have indicated a potential of using acoustic emissions (AE), thermal imaging (TI) and knee kinematics for cost-efficient diagnosis. The purpose of this study was to evaluate AE, TI and kinetic instability of the osteoarthritic knees and compare those to radiographic findings.

Materials and Methods
Sixty-six female patients (age 44 to 67 years) were recruited. On radiography, joint-space narrowing, osteophytes and Kellgren-Lawrence grade were evaluated. Based on radiography, 33 patients (50%) were diagnosed with radiographic OA (Kellgren-Lawrence grade≥2). Subsequently, patients performed simple tasks while wearing a device able to record AE and kinematics of the knee. Prototype included two non-contact air microphones, located just below the patella, and kinetic sensors fixed on femur and tibia. Patients performed ten flexion-extension and ten sit-to-stand tests to assess knee friction and two one-leg-stands to evaluate knee instability. TI was conducted before and after the tests, and images were manually segmented to assess average temperatures. Area-under-curve (AUC) and chi-square statistics were used in the analyses.

Results
The AE signals during knee flexion-extension medially (p=0.010) and laterally (p=0.014) were statistically different between controls and OA knees. Furthermore, AE signals medially during sit-to-stand test and kinetic instability during one-leg-stand yielded statistically significant difference (p=0.003 and p<0.001, respectively). The combination of tests (AE flexion-extension medially, AE sit-to-stand laterally, kinetic instability) yielded AUC of 86.8% (CI: 77.6%-94.3%). When adding BMI to the model, AUC of 90.5% (CI: 82.9%-96.1%) was obtained. Table 1 shows statistically significant correlations between acquired signals and specific radiographic findings.
## Radiographic finding

<table>
<thead>
<tr>
<th>Acquired signal</th>
<th>Medial joint-space narrowing</th>
<th>Lateral joint-space narrowing</th>
<th>Medial femoral osteophyte</th>
<th>Medial tibial osteophyte</th>
<th>Lateral femoral osteophyte</th>
<th>Lateral tibial osteophyte</th>
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</thead>
<tbody>
<tr>
<td>AE flexion-extension medially</td>
<td></td>
<td>p=0.013</td>
<td></td>
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<td></td>
<td>p=0.003</td>
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<tr>
<td>AE flexion-extension laterally</td>
<td></td>
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<td></td>
<td>p=0.040</td>
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<tr>
<td>AE sit-to-stand medially</td>
<td></td>
<td>p=0.004</td>
<td></td>
<td></td>
<td></td>
<td>p=0.023</td>
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<tr>
<td>AE sit-to-stand laterally</td>
<td></td>
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<tr>
<td>TI before tests</td>
<td></td>
<td>p=0.012</td>
<td>p=0.011</td>
<td></td>
<td>p=0.026</td>
<td></td>
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<tr>
<td>TI after tests</td>
<td></td>
<td>p=0.008</td>
<td>p=0.041</td>
<td></td>
<td>p=0.046</td>
<td></td>
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<tr>
<td>Kinetic instability on one-leg-stand</td>
<td>p=0.035</td>
<td>p=0.002</td>
<td>p=0.001</td>
<td>p=0.021</td>
<td>p&lt;0.001</td>
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</tbody>
</table>

## Conclusion

AE, TI and kinetic instability can be used as a complementary modality to detect radiographic knee OA.
CT and MRI as potential sources for transmission of hospital-acquired infections

Authors:
Charlotte Palmqvist, Anders Samuelsson, Inga Fröding, and Christian G. Giske

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Christian G. Giske: Department of Clinical microbiology, Karolinska University Hospital, Stockholm.

Introduction
Hospital-acquired infections (HAIs) are a major problem for healthcare worldwide and the increase of antimicrobial resistance complicates treatment of bacterial infections (1). HAIs cause additional suffering for the patient and extra societal costs. In Europe, HAIs generate 16 million extra care days at a cost of EUR 7 billion per year (2). There has been extensive research on infection transmission in healthcare, but to a lesser extent within radiology.

The purpose of this study was to identify hand-touched surfaces inside and outside the CT and MRI examination rooms, which are prone to contamination, and which could represent a risk for transmission of multidrug-resistant (MDR) bacteria. We also aimed to examine differences in bacterial contamination between public and private radiology departments.

Materials and Methods
Six public and four private radiology departments participated in the study. Bacterial samples were taken from ten predetermined surfaces inside and outside CT and MRI examination rooms. Sampling was carried out between patients after standard cleaning procedure, using flocked nylon swabs (3, 4). The swab was applied over a 100 cm$^2$ surface and after cultivation, bacterial colony forming units (CFU) /cm$^2$ were calculated.

Results
Bacterial CFUs were found on almost all selected surfaces. Altogether, 23 measured surfaces of 40 had an average of CFU/cm$^2$ which exceeded the limit of 2.5 CFU/cm$^2$. The highest numbers of CFU/cm$^2$ were found on keyboards (10), chairs of the patient changing rooms (10), headphones (169), and the alarm control/buzzer (13). The least contaminated surface was found on the medicine trolley (0) and in the MRI tunnel (0). There was no significant difference between public and private radiology departments. No MDR microorganisms were found in any of the radiology departments.

Conclusion
No MDR bacteria were detected, however, the limit of CFU/cm$^2$ was exceeded on 23/40 surfaces. Among the most contaminated surfaces were keyboards, chairs of the patient changing rooms, headphones and alarm control/buzzer. Generally, the equipment needs improved cleaning and disinfection between patients, to reduce the potential risk of infection transmission. There was no difference between public and private radiology departments.
References
Session 3
Assessment of the Correlation between Dynamic Contrast Enhanced Computed Tomography and Histological and Vascular Biomarkers in Patients resected for Colorectal Liver Metastases.

Authors:
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7Department of Technology, Faculty of Health and Technology Metropolitan University College, Copenhagen.

Profession of the presenter: Post.doc. ph.d. lecturer, radiographer.

Introduction:
Dynamic contrast-enhanced computed tomography (DCE-CT) is a promising non-invasive method that provides the functional evaluation of the vascularity in normal and malignant tissue. The objectives of this consecutive study were to investigate the possible correlation between the perfusion characteristics of colorectal cancer liver metastases as examined by (DCE-CT) and the microvessel density of resected metastases. An additional aim was to investigate the correlation between the urokinase plasminogen activation receptor (uPAR) and perfusion values.

Materials and methods
Eleven patients fulfilled the criteria for comparative analyses. The microvessel density values, uPAR level and the DCE-CT values were analysed. A perfusion index (PI) based on the measurement of arterial and portal flow (AF, PF) was defined as follows: PI=AF/(AF+PF)%. The DCE-CT measurements were compared between metastatic and normal liver tissues. A Spearman correlation test was used for statistical analysis.

Results
The perfusion index and microvessel density values were significantly correlated (r=0.75; p=0.01). Furthermore, a higher volume of metastases significantly correlated with higher plasma levels of the uPAR forms (0.72 ≤ r ≥ 0.89; p < 0.05).

Conclusion
DCE-CT may have the potential to measure the vascularity of colorectal liver metastases; however, the correlation between microvessel density and the perfusion values appears vague.
Low-Dose CT for Diagnosis of Intestinal Obstruction and Pneumoperitoneum

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Presenter: Eva Mikkelsen, MD, radiologist (registrar).

Introduction:
The main concern using low-dose CT scans for evaluation of intestinal obstruction and perforation is the potential requirement of an additional normal-dose CT scan (retake) due to a low diagnostic accuracy resulting from inferior image quality of low-dose CT scans. The objectives of this study were to determine the frequency of retakes and to evaluate the diagnostic accuracy of low-dose CT scans assessing intestinal obstruction and pneumoperitoneum.

Materials and Methods:
In this retrospective study, we registered all low-dose CT scans of the abdomen from 1st of April 2015 to 31st of March 2016 referred from the Department of Emergency and the Department of Surgery at Aarhus University Hospital, Denmark. The indication for the low-dose CT scans was suspicion of intestinal obstruction or pneumoperitoneum. We defined retakes as normal-dose CT scans of the abdomen with or without intravenous contrast conducted within 72 hours after the initial low-dose CT scan and referred with the same indication as the low-dose CT scans or due to unclarified secondary findings. The retakes were identified, and the frequency calculated. In order to evaluate the diagnostic accuracy, we compared the low-dose CT scan diagnoses of intestinal obstruction and pneumoperitoneum to the discharge diagnoses of the scanned patients by determining the sensitivity and the specificity.

Result:
We registered 643 low-dose CT scans in the period. The frequency of retakes was 3 % (22/643). Of the 643 low-dose CT scans, 143 (22 %) demonstrated intestinal obstruction, 101 (16 %) possible intestinal obstruction, and 45 (7 %) pneumoperitoneum. Compared to the discharge diagnoses, the sensitivity and specificity of the low-dose CT scans was 83 % and 99 %, respectively, for diagnosing intestinal obstruction and pneumoperitoneum combined.

Conclusion:
Low-dose CT scans have a low frequency of retake and a high diagnostic accuracy of intestinal obstruction and pneumoperitoneum. Thus, in order to reduce radiation dose, low-dose CT scans can be recommended as the examination of choice for patients with clinical suspicion of intestinal obstruction or perforation.
The Role of Interventional Radiology and Minimally Invasive Techniques in Abdominal Trauma

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3 Royal National Orthopaedic Hospital, Stanmore, UK
4 Royal Papworth Hospital, Cambridge, UK
Presenting author: MSc Student, Surgeon and Radiology trainee

Introduction
In light of the world wise increasing in the trauma burden on healthcare systems, application of new technologies have resulted in the increasing use of interventional radiology and minimally invasive procedures. Continued innovation in the fields of robotics, optics, miniaturisation, computing and developments in artificial intelligence hold promise that minimally invasive techniques will result in a paradigm shift in the future of surgery. This article assesses the role of interventional radiology and minimally invasive procedures.

Materials and Methods
A literature search of the PubMed/MEDLINE, Cochrane Library, Web of Science and National Institute for Health and Care Excellence Evidence databases using entry sets of Medical Subject Headings (MeSH) for Abdomen (or Abdominal), Trauma, Minimally Invasive, Interventional, Laparoscopy (or Laparoscopic) and Embolisation (or Embolization) as well as a comparative search of the grey literature was also carried out, as well as specific searches of Google Scholar for articles not available via the main databases.

Results
Following screening and abstract review, 48 articles were selected for further analysis. Full text analysis of the 48 eligible articles resulted in selection of 7 systematic reviews for inclusion in the analysis. Results show laparoscopy, embolisation and endoscopic techniques in abdominal trauma is associated with fewer complications, reduced hospital length of stay, less morbidity and a reduction in negative laparotomy rates in haemodynamically stable patients. Current systematic reviews are based on low quality studies with a great degree of heterogeneity.

Conclusion
A concerted effort must be made to focus research efforts on multi-centre, prospective studies on interventional and minimally invasive techniques to increase preparedness for the inevitable rise in the worldwide trauma burden. Hybrid non-operative and minimally invasive techniques will have a greater role to play in future trauma management. Application of current and future technological innovations and dedicated training in these techniques combined with increased research efforts are still needed if we are to effectively combat the individual, societal and global burden of trauma.
Outcomes of portal vein embolization using different concentrations of N-butyl cyanoacrylate glue-ethiodized oil mixture

Authors:
Yu Wen Ming, Yu San Ming

The authors’ place of employment:
Department of Radiology, United Christian Hospital, Hong Kong

Profession of the presenter:
Radiologist

Introduction:
Portal vein embolization is a useful procedure to induce selective liver hypertrophy for patients with inadequate future liver remnant indicated for hepatectomy to prevent post-operative complications and shorten hospital stay. This study aims to evaluate the outcomes of patients who underwent right portal vein (PV) embolization with N-butyl cyanoacrylate (NBCA) glue. We hypothesized that a higher dilution of glue with ethiodized oil would allow more distal embolization of portal vein branches due to increase in polymerization time. In this study, we try to determine whether a higher dilution of NBCA-ethiodized oil (1:7-8) would achieve a higher degree of future liver remnant hypertrophy compared with a lower dilution (1:3).

Materials and Methods:
Between August 2015 and July 2018, a total of 12 patients who had PV embolization before right hepatectomy were retrospectively reviewed. 4 patients were embolized using a 1:3 NBCA-ethiodized oil mixture and 8 patients were embolized using a 1:7-8 NBCA-ethiodized oil mixture. CT volumetry was performed before and 4-8 weeks after PV embolization to measure left lobe volume and calculate functional liver ratio which were analysed using Wilcoxon signed-rank test. The values between the two groups of different glue-ethiodized oil concentrations were compared using Mann-Whitney U test.

Results:
PV embolization was technically successful in 11 cases (91.7%). One patient developed liver abscess and one patient had abdominal pain as complications. The overall degree hypertrophy was 8.3% +/-4.9%, percentage increase in functional liver ratio was 41.4% +/-30.7% and future liver remnant volume increase was 117.1ml +/-69.6ml (P=0.002). No statistical significance in degree hypertrophy (P=0.926), percentage increase in functional liver ratio (P=0.166) or future liver remnant volume increase (P=0.782) was seen between the two different NBCA-ethiodized oil dilutions.

Conclusion:
PV embolization is a safe and effective procedure in achieving future liver remnant hypertrophy. There is no significant difference in degree of remnant liver lobe hypertrophy between using 1:3 and 1:7-8 NBCA-ethiodized oil mixtures.
Super-resolution ultrasound – visualising the microvasculature

Authors:
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Introduction
Super-Resolution Ultrasound Imaging (SRI) is a new ultrasound technique that allows imaging of the microvasculature by tracking the course of individual micro-bubbles (MBs) inside vessels (1,2). The microvasculature of the kidneys is unique in structure and diseases in the small vessels have a big impact on kidney function. This is why we chose the kidneys as our first object for SRI. Our aim was to demonstrate the ability of SRI to visualize the microvasculature of a healthy rat kidney and detect microvascular changes after ischemia-reperfusion events.

Materials and methods
We scanned the left kidney of 10 Sprague-Dawley rats during open laparotomy using a modified bk5000 scanner with a fixated X18L5s Hockey-Stick transducer. A 1:10 dilution of SonoVue (Bracco) was injected through a jugular vein catheter at 100 µl/min and images were acquired over 10 minutes. After a baseline scan, the kidneys were exposed to an ischemia-reperfusion injury induced by clamping either the renal artery or vein. The kidneys were scanned immediately after clamp release and after 60 minutes of reperfusion.

Results
We were able to depict the microvasculature in rat kidneys with a clear distinction between the dense, complex cortical vascular network and the vasa recta of the outer and inner medulla. Vessels as small as 40 µm could be identified. As expected, SRI detected MBs to flow faster in the largest vessels and slower in the smallest vessels and there was a diametrically opposite flow in the parallel artery and vein pairs. Compared to baseline, SRI also allowed observation of changes in the renal microvasculature after ischemia-reperfusion events. We saw a more severe effect on the microvasculature immediately after the release of a vein clamp compared to an artery clamp, which is in accordance with the literature (3).

Conclusion
SRI has potential to improve in vivo tissue characterisation and enhance our understanding of a variety of diseases that cause disruption of the microvasculature, such as diabetes or cancer. The method is still technically challenged by e.g. small physiological motions and needs to be further improved before it can be applied to humans.
References


CT-guided percutaneous cryoablation of renal cancer

Authors:
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¹Department of Radiology, Odense University Hospital (OUH),
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⁴Comparative Medicine Lab, Department of Clinical Medicine, Aarhus University (AU)
Profession of the presenter: MD, PhD student.

Introduction (including aim)
CT-guided percutaneous cryoablation (PCA) appears to be an effective treatment of renal cell carcinoma (RCC) (1) and can be used in patients selected for nephron sparing procedures after a multidisciplinary conference. The aim of this study was to evaluate the outcome in patients treated with PCA of RCC at Odense University Hospital (OUH), Denmark.

Materials and methods
In this retrospective study, we included all patients with biopsy proven RCC treated with PCA between 2012-2017. Follow-up imaging was performed after 3 and 6 months and annually up to 5 years. Complications were defined according to the Clavien-Dindo Classification (2). We defined residual tumor as malignant enhancement detected ≤ 3 months after treatment, while recurrent tumor was detected in later follow-ups.

Results
A total of 147 RCC in 140 patients were included. The population included both healthy and comorbid patients with a mean age of 66.2 years (range 27-91). Mean tumor diameter was 27.4 mm (range 10-70). Mean follow-up length was 439 days (range 84-2215) with 141 tumors in follow-up longer than 3 months. PCA was performed during general anesthesia in 120 procedures (82%) or sedation in 27 procedures (18%).
Six patients (4%) had complications that were classified as major (Clavien-Dindo ³ 3). We found treatment success (no residual or recurrent tumor) in 93% (131 tumors). Residual tumor or recurrence was found in 7% (10 patients). Two patients with treatment failure underwent total nephrectomy. The remaining 8 residual/recurrent tumors were treated with re-cryoablation with success of re-treatment in 88% (7 tumors), hereof one patient needed a third cryoablation for success. We found metastases in 2% (3 patients). Hereof, 67% (2 patients) also had residual or recurrent tumor.

Conclusion
Patients treated with PCA had a high rate of successful treatment and few patients experienced significant complications.
References
Simulation-Based Training of Ultrasound-Guided Procedures – A Systematic Review

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Objectives
To perform a systematic review of the effect of simulation-based training (SBT) of percutaneous abdominal and thoracic ultrasound (US)-guided procedures and to assess the transfer of procedural competence to a clinical context.

Methods
This systematic review was conducted in accordance with the PRISMA statement. Pubmed, Embase, Web of Science, and the Cochrane Library were searched for studies assessing procedural competence after SBT. Two authors independently reviewed all studies and extracted data. Risk of bias was assessed using the Cochrane tool for randomized studies (RoB) and non-randomized studies (ROBINS-I). Quality of evidence was assessed using the GRADE approach.

Results
Forty-two studies were included. Six were randomized controlled, three were non-randomized controlled, and 33 were non-randomized non-controlled. Twenty-six studies examined US-guided abdominal procedures, 13 examined thoracic procedures, and three examined both. Results favored SBT compared to other educational interventions and found that training was superior to no training. Only two studies examined transfer of procedural skills to a clinical context. All studies had a high or critical risk of bias. Thus, the quality of evidence for the effect of SBT on procedural competence was low, and evidence for its transfer to a clinical context was very low.

Conclusion
The evidence supporting SBT of percutaneous abdominal and thoracic US-guided procedures remains insufficient, due to methodological problems and a high risk of bias. Future studies should be randomized, single-blinded, use assessment tools supported by validity evidence, compare different educational strategies, and examine the transfer of skills to a clinical setting.
Flow complexity quantification in dysfunctional arteriovenous fistulas using Vector Flow Imaging

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Introduction
Stenotic vascular lesions commonly appear in arteriovenous dialysis fistulas [1] with most stenoses occurring on the venous side or at the arterial anastomosis [2]. Vascular stenoses modify the blood flow and increase flow complexity, and recent studies have reported vector flow imaging (VFI) to be a useful tool for flow evaluation [3]. VFI is an ultrasound technique that uses the transverse oscillation method to obtain simultaneous axial and transverse velocity vectors [4,5], thus enabling calculation of two-dimensional velocity vectors. Vector angle diversity, also known as vector concentration (VC), was then used to assess flow complexity. The aim of our study was to evaluate the use of VFI as a tool in the assessment of dysfunctional arteriovenous dialysis fistulas (AVF).

Materials and methods
Six patients with AVF were scanned with VFI before and after fluoroscopy-guided angioplasty. Ultrasound scans were performed on a bk5000 scanner with a linear transducer, and VFI analyses were performed on an offline computer station. Stenosis diameter was measured in PACS on angiographies acquired during angioplasty. Spearman’s rank correlation coefficient was used to test the monotonic relationship between angiographic measurements and VC. Paired t-tests were calculated to test differences of the means.

Results
VC correlated moderately with stenosis diameter for all stenoses ($r_s = 0.46, p = 0.05$). When only including the first stenosis in every patient’s AVF, VC correlated strongly with stenosis diameter ($r_s = 0.75, p = 0.03$). There was no significant correlation, when comparing measurements for the second and third stenosis ($p = 0.08$). Mean VC was 0.66 (SD: 0.22) before and 0.79 (SD: 0.18) after angioplasty, while mean stenosis diameter was 0.23 cm (SD: 0.13 cm) and 0.49 cm (SD: 0.08 cm), respectively. Paired t-tests confirmed significant differences of the mean values (VC: $p = 0.02$, stenosis diameter: $p = 0.0002$) indicating that flow had become less complex following vascular intervention.

Conclusion
There is a strong monotonic relationship between VC and stenosis diameter for the first stenosis in AVFs, although the sample size in our study is limited. VFI offers real-time two-dimensional flow assessment and may potentially ease non-invasive vascular stenosis evaluation.
References
Can We Trust Radiographic Measurements of the Distal Radius Fracture?

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Introduction (including aim)
A distal radius fracture (DRF) is one of the most common injuries seen in emergency rooms worldwide, accounting for approximately 15% of all fractures in the adult population (1). A DRF could be of significant socioeconomic concern particularly because of the high incidence and the potential long-term disability (2). Treatment choice; operative versus non-operative, of a DRF fracture is mainly decided based on radiographic characterization of the fracture. Hence, radiographic measurement accuracy and reliability is of utmost importance.

The aim of this study was to explore existing evidence on accuracy of the radiographic measurements commonly used to characterize a DRF, i.e. i) Dorsal/volar tilt of the distal radius, ii) Radial shortening, iii) Ulnar variance, iv) Radial inclination and v) Articular step-off of the distal radius.

Materials and Methods
We conducted a systematic critical review of the literature. EMBASE, MEDLINE and the Cochrane Library databases were searched. The Preferred Reporting Items for Systematic Reviews (PRISMA) guidelines was followed. Quality of included studies was assessed using a tailored version of the Quality Assessment of Diagnostic Accuracy Studies (QUADAS-2) tool. Studies comparing radiographic measurements to measurements performed directly on the bone either surgically, arthroscopically or post mortem, were eligible for inclusion.

Results
A total of 5908 titles were screened. Only five studies met the inclusion criteria. Accuracy of articular step-off was assessed in four articles of which two found step-off to be accurate. Two studies found step-off to vary significantly from measurements performed on the bone (3-6). The radiographic measurements of ulnar variance were significantly underestimated when compared to the true variance (7). We did not identify any studies that assessed accuracy of radial shortening, radial inclination or dorsal/volar tilt.

Conclusion
Currently evidence is not available to support accuracy of the five radiographic measurements most commonly used when characterizing a DRF.
Quality of included studies varied. We found that the methodological aspects of the orthopedic procedures were described in more detail than the radiographic/radiological procedures. Perhaps accuracy studies incorporating radiographic and radiological procedures with equal rigor would help expand the knowledge base.

References