PURPOSE

To evaluate the ability to depict anatomy and complications of renal vascular transplant with unenhanced magnetic resonance (MR) angiography with spatial labeling with multiple inversion pulses (SLEEK) and to compare the results with color Doppler (CD) ultrasonography (US), digital subtraction angiography (DSA), and intraoperative findings.

METHOD AND MATERIALS

This study was approved by the institutional review board, and written informed consent was received before examination. Seventy-five patients who underwent renal transplantation were examined with unenhanced MR angiography with SLEEK and CD US. DSA was performed in 15 patients. Surgery was performed in eight patients. The ability of SLEEK to show transplant renal vascular anatomy and complications was evaluated by two experienced radiologists who compared the results with CD US, DSA, and intraoperative findings.

RESULTS

Patients successfully underwent SLEEK MR angiography. Transplant renal vascular anatomy was assessed in 87 arteries and 78 veins. Renal vascular complications from transplantation were diagnosed in 23 patients, which included 14 with arterial stenosis, three with arterial kinking, two with arteriovenous fistulas, two with venous stenosis, one with pseudoaneurysms, and one with fibromuscular dysplasia. Three patients had two renal transplants and nine patients had nine accessory renal arteries. More accessory renal arteries were detected with SLEEK than with CD US. Correlation was excellent between the stenosis degree with SLEEK and DSA (r = 0.96; P < .05). For those with significant artery stenosis (.50% narrowing) proved with DSA (n = 7) or surgery (n = 3), positive predictive value was 91% (10 of 11).

CONCLUSION

Unenhanced MR angiography with SLEEK preliminarily proved to be a reliable diagnostic method for depiction of anatomy and complications of renal vascular transplant. It may be used for evaluation of patients with renal transplant, and in particular for those with renal insufficiency.

CLINICAL RELEVANCE/APPLICATION

Unenhanced MR angiography with SLEEK may be used for evaluation of patients with renal transplant, and in particular for those with renal insufficiency.

Awards

RSNA Country Presents Travel Award
PURPOSE
To assess the clinical value of nonenhanced ECG-gated Quiescent-Interval Single-Shot MR angiography (QISS-MRA) for planning of interventional procedures in patients with peripheral artery disease (PAD).

METHOD AND MATERIALS
43 patients (mean age 68.5 ± 10.8 years) with peripheral artery disease were included in this study. Nonenhanced QISS-MRA of the distal aorta and the lower extremity were acquired at 1.5T with 3mm slice thickness, with 0.6 mm overlap and an inplane resolution of 1.0 x 1.0 mm, resulting in a total scan time of approx. 9 min. ECG-gating was applied for synchronization of the quiescent interval with the period of maximum systolic inflow. The degree of stenosis was assessed by using a 4-point scale (grade 1, normal appearing vessel; grade 2, vessel narrowing < 50%; grade 3, stenosis 50%-99%; grade 4, vessel occlusion) for 15 predefined anatomical segments. QISS-MRA was used to plan interventional procedures. Interventional digital subtraction angiography (DSA) served as the reference standard.

RESULTS
QISS-MRA was performed successfully in all patients. 434 of 645 segments visible on QISS-MRA were evaluated with DSA during interventional procedures and were considered for further analysis. With QISS-MRA the degree of stenosis was assessed correctly in 404 of 434 (93.1%) segments, overestimated in 26 of 434 (5.9%) segments and underestimated in 4 of 434 (0.9%) segments. As compared to DSA, QISS-MRA had a high sensitivity (99.3%), specificity (97.2%) as well as positive and negative predictive value (89.3% and 97.3%) for the detection of significant stenosis (grade 3 and 4). Based on QISS-MRA, an appropriate arterial access was selected in all patients and the estimated length of stenosis or vessel occlusion was assessed correctly. 6 of 6 (100%) stented segments were not assessable.

CONCLUSION
ECG-gated QISS-MRA is a reliable and precise nonenhanced imaging technique for assessment of stenosis of the lower extremities and provides a reliable basis for interventional procedures. A limitation of QISS-MRA is the evaluation of stented segments.

CLINICAL RELEVANCE/APPLICATION
QISS-MRA is a reliable and precise nonenhanced imaging technique for assessment of peripheral arterial disease and can be applied safely in patients with contraindications for contrast material.

RC312-04 Qualitative and Quantitative Image Quality of Lower Extremity Angiography Using Non-Contrast-Enhanced Quiescent Interval Single-Shot (QISS) MRA: Comparison with CTA

Tuesday, Dec. 1 9:15AM - 9:25AM Location: S102AB

Participants
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PURPOSE
To evaluate the qualitative and quantitative image quality of non-contrast quiescent interval single-shot (QISS) MRA in patients with peripheral artery disease (PAD).

METHOD AND MATERIALS
Twenty patients (67±4 years, 11 male) with PAD referred for a clinically indicated lower extremity CTA were consented for a non-contrast enhanced lower extremity MRA on a 1.5 clinical scanner (MAGNETOM Avanto, Siemens AG, Erlangen, Germany) using an investigational prototype QISS sequence (FOV 400x260mm2, TR/TE 3.5/1.4ms, flip angle 90°, acquisition length 144mm). Contrast to noise ratio (CNR) based on the vascular and peri-vascular signal was measured according to an 18-segment model. The segmental vascular enhancement and the image noise were rated on five-point scales (1-poor/non-diagnostic, 5-excellent) by two readers. Additionally, the number of non-diagnostic segments were counted and compared between CTA and QISS-MRA.

RESULTS
A total of 360 segments were evaluated. The average CNR measured in QISS-MRA images was 63.4±17.5. QISS-MRA vascular enhancement ratings by the two readers were 3.7±0.5 and 3.8±0.4, respectively, while the CTA readings were 4.0±0.4 and 4.1±0.5, respectively, resulting in no significant difference between the two modalities. QISS-MRA image noise ratings were 3.4±0.7 and 3.6±0.5, respectively, while those for CTA were 4.0±0.5 and 4.2±0.5, respectively. Excellent inter-reader agreement was found in image quality ratings (κ>0.8). Thirty-one segments (8.6%) were excluded from the CTA analysis due to stent artifacts (11), total occlusion (14), or heavy calcification (6) and 26 segments (7.2%) were non-diagnostic at MRA due to major image artifacts (12) or total occlusion (14). Five out of the six heavily calcified segments were diagnostic at QISS MRA.

CONCLUSION
In this study, image quality of non-contrast QISS-MRA was comparable to that of contrast enhanced CTA. In certain circumstances, such as in heavily calcified segments, QISS-MRA provides superior lumen visibility compared to CTA. Such a non-contrast technique may have potential advantage in patients with severe renal disease or with other risk factors that prohibit the use of iodinated or gadolinium-based contrast material.

CLINICAL RELEVANCE/APPLICATION
QISS-MRA enables non-contrast evaluation of the lower extremity arteries with comparable image quality to CTA, and is potentially
One-stop-shop Gd-EOB-DTPA-enhanced MRI is a more cost-effective and convenient modality with the similar diagnostic accuracy to MDCT-MRCP (25±5 min vs 28±6 min, P<0.05). The effective “in room” time in the Gd-EOB-DTPA-enhanced MRI was 3 minutes longer than MDCT-MRCP (US$519.72 vs US$631.85). The effective findings of hepatic vessels and bile ducts accurately confirmed by intraoperative findings (P>0.05). The repeatability for graft volume measurements on Gd-EOB-DTPA-enhanced MRI was higher than MDCT-MRCP. Gd-EOB-DTPA-enhanced MRI was cheaper than MDCT-MRCP (US$519.72 vs US$631.85). The effective “in room” time in the Gd-EOB-DTPA-enhanced MRI was 3 minutes longer than MDCT-MRCP (25±5 min vs 28±6 min, P<0.05).

**CONCLUSION**

This study aimed at evaluating the accuracy of preoperative DTR MRA for the detection and localization of lower extremity septocutaneous perforators in patients undergoing free fibula flap (FFF) for head and neck reconstruction. DTR MRA accurately predicts the presence and location of cutaneous perforators in patients undergoing FFF reconstruction.

**CLINICAL RELEVANCE/APPLICATION**

To our knowledge, this is one of the largest study validating the role of MRA for this purpose. Preoperative localization of the vessels significantly impacts surgical planning and may prevent unnecessary surgical explorations in a percentage of patients.

**RESULTS**

DTR MRA and surgery identified at least one perforator in 42/43, and 41/43 patients respectively. The technique appropriately detected-the presence of perforators in 40/41 patients and ruled out perforators in 1/2 patients, yielding a sensitivity, specificity and accuracy of 97.5%, 50% and 95.3%. Collectively, DTR-MRA accurately predicted the location of the perforators in 75% of the cases (48/64). On a patient-based analysis, DTR MRA correctly predicted the location of at least one perforator in 37/41 patients yielding an accuracy of 90% for this purpose.

**PURPOSE**

This study aimed at evaluating the accuracy of preoperative DTR MRA for the detection and localization of lower extremity septocutaneous perforators in patients undergoing free fibula flap (FFF) for head and neck reconstruction.

**METHOD AND MATERIALS**

Retrospective chart review of 43 patients who underwent pre-operative DTR MRA prior to FFF in a tertiary academic setting from 2009-2015. DTR MRA scans were evaluated for presence of perforators and their location relative to fibular head, and subsequently correlated with intra-operative findings. We considered location of perforator to be in concordance if the vessel was within 3cms based on DTR MRA and surgical findings, and hypothesized that differences within this range could represent distal perforator branches presenting radiologically as separate vessels.

**CONCLUSION**

DTR MRA and surgery identified at least one perforator in 42/43, and 41/43 patients respectively. The technique appropriately detected-the presence of perforators in 40/41 patients and ruled out perforators in 1/2 patients, yielding a sensitivity, specificity and accuracy of 97.5%, 50% and 95.3%. Collectively, DTR-MRA accurately predicted the location of the perforators in 75% of the cases (48/64). On a patient-based analysis, DTR MRA correctly predicted the location of at least one perforator in 37/41 patients yielding an accuracy of 90% for this purpose.

**PURPOSE**

To compare the efficacy, cost-effectiveness and convenience between one-stop-shop gadoxetic-acid-disodium (Gd-EOB-DTPA)-enhanced MR imaging (MRI) and multi-detector CT combined with conventional magnetic resonance cholangiopancreatography (MDCT-MRCP) in preoperative evaluation for living liver donors.

**METHOD AND MATERIALS**

Eighty living liver donors were included in this prospective study. They were randomly grouped in Gd-EOB-DTPA-enhanced MRI group (n=40) and MDCT-MRCP group (n=40). Anatomical variations determined by pre- and intra-operative findings, costs, and time for preoperative images were recorded. Image quality for the depiction of hepatic vessels, bile ducts and graft volume were ranked on a 4-point scale and compared between both groups.

**RESULTS**

Gd-EOB-DTPA-enhanced MRI provided better image quality than MDCT-MRCP for the depiction of hepatic and portal veins, and graft volume by both reviewers (P<0.01), and for the depiction of bile ducts by one reviewer (P<0.01). MDCT provided better image quality than Gd-EOB-DTPA-enhanced MRI for the depiction of hepatic arteries by both reviewers (P<0.01). Fifty nine living donors proceeded to liver donation (n=21 for Gd-EOB-DTPA-enhanced MRI group and n=38 for MDCT-MRCP group) with all anatomical findings of hepatic vessels and bile ducts accurately confirmed by intraoperative findings (P>0.05). The repeatability for graft volume measurements on Gd-EOB-DTPA-enhanced MRI was higher than MDCT-MRCP (US$519.72 vs US$631.85). The effective "in room" time in the Gd-EOB-DTPA-enhanced MRI was 3 minutes longer than MDCT-MRCP (25±5 min vs 28±6 min, P<0.05).

**CONCLUSION**

One-stop-shop Gd-EOB-DTPA-enhanced MRI is a more cost-effective and convenient modality with the similar diagnostic accuracy.
4D Flow can depict and quantify the prominent retrograde flow during early diastole, which is closely related to the presence of peripheral arteries. 

**RESULTS**

Among flow dynamic parameters R/A ratio (p=0.019), and OSI (p=0.0364) were the determinant factors for the presence of atheroma. Prominent back flow collided with antegrade flow was also visually observed at early diastole in atherosclerotic patients. Atherogenic genes in patients with arteriosclerosis, reflected flow appears within the lower abdominal aorta during early diastolic phase. 3D cine PC MRI (4D-Flow) has enabled the coverage of full spatial and cardiac phase resolved data of the velocity vectors of the flowing blood within the whole abdominal aorta, thereby allow OSI mapping and flow volume analysis.

**CONCLUSION**

4D Flow can depict and quantify the prominent retrograde flow in the lower abdominal aorta in patients with arteriosclerosis.
atheroma in the lower abdominal aorta.

**CLINICAL RELEVANCE/APPLICATION**

4DFlow could be an indicator of a loss of arterial volumetric compliance and increased OSI in the lower abdominal aorta, which might be the initiation factors of atherosclerotic degradation that leads to various fatal aortic diseases.

**RC312-10** Assessment of Wall Shear Stress in Patients without Aortic Disease, with Aortic Aneurysms and with Penetrating Aortic Ulcers using Velocity Encoding 4D MRI

Tuesday, Dec. 1 10:55AM - 11:05AM Location: S102AB

**Participants**
Michael Rasper, Munich, Germany (Presenter) Nothing to Disclose
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**PURPOSE**

To determine whether patients with aortic aneurysms and penetrating aortic ulcers have an increased or reduced peak average wall shear stress magnitude compared to patients without aortic disease.

**METHOD AND MATERIALS**

26 patients (10 patients without aortic disease, 8 patients with aortic aneurysms (AA) and 8 patients with penetrating aortic ulcers (PAU)) underwent velocity encoded time resolved 3D MRI (4D PC MRI) of the aorta after contrast material (0.15 mmol/kg gadobenate dimeglumine) application during high resolution contrast-enhanced MR angiography of the aorta. 4D PC MRI was performed using ECG Gating and navigator echo based respiratory gating. Data acquisition was accelerated by SENSE in two directions (AF 1.5 x 2.5). The spatial resolution was 1.5 x 1.5 x 1.5 mm3. The temporal resolution was 40 ms. The peak velocity and the peak average wall shear stress magnitude were determined using the software GT-Flow (Version 2.0.10, Gyrotools, Switzerland).

**RESULTS**

The peak velocity was 71.6 ± 6.8 cm/s in patients without aortic disease, 35.6 cm/s ± 3.2 cm/s in patients with penetrating aortic ulcer and 18.2 ± 2.7 cm/s in patients with aortic aneurysms. The peak average wall shear stress magnitude was 0.35 ± 0.09 N/m2 in patients without aortic disease, 0.13 ± 0.004 N/m2 in patients PAU and 0.07 ± 0.018 N/m2 in AA patients. Both patients with aortic ulcers and patients with aortic aneurysms showed lower mean values for peak velocity (p < 0.001 and p < 0.00001) and peak average wall shear stress magnitude (p < 0.01 and p < 0.004) compared to patients without aortic disease. Patients with AA had significantly lower wall shear stress magnitude values than PAU patients.

**CONCLUSION**

Compared to patients without aortic disease, peak velocity and wall shear stress were significantly reduced in patients with penetrating aortic ulcers and patients with aortic aneurysms.

**CLINICAL RELEVANCE/APPLICATION**

Aortic segmental wall shear stress and flow velocity can reliably be determined with velocity encoded 4D MRI. Reduced wall shear stress is associated with aneurysms growth and might therefore help to identify patients at risk.

**RC312-11** A Speeding Ticket for Perfusion MRI? Acceleration Techniques and Their Effect on Arterial Input Function Sampling: Non-accelerated versus View-sharing and Compressed Sensing Sequences

Tuesday, Dec. 1 11:05AM - 11:15AM Location: S102AB

**Participants**
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**PURPOSE**

Initiatives such as the Quantitative Imaging Biomarkers Alliance and the American College of Radiology Imaging Network seek to identify sources of variation that may contribute to the overall measurement error in dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI). The aim of this study was to determine the ability of various DCE-MRI sequences to image the arterial input function (AIF) of an arterial bolus in comparison to a reference standard in a flow-phantom.

**METHOD AND MATERIALS**

The dynamic flow-phantom consists of three input ports representing the venous backflow and three mixing chambers simulating the cardiopulmonary circulation with 4L/min. A 25 mm diameter cylindrical outflow representing the aorta, a water- and a muscle-phantom were scanned on a 3T MRI (Magnetom Prisma, Siemens Healthcare, Erlangen, Germany) using fast low angle shot 2d (FL2d; temporal resolution [tr] 0.6s; reference standard) and 3d (FL3d; tr 2.4s [P2=parallel imaging factor 2] and 3.9s), time-resolved imaging with stochastic trajectories (TWIST; tr 2.2s), and golden-angle radial sparse parallel imaging (GRASP, tr 1.1s) GRE sequences. Each acquisition with administration of 10 ml contrast agent (Dotarem, Guerbet) via a power injector (2ml/s flow rate).
was repeated three times. Essential sequence parameters were standardized: flip angle 15°; spatial resolution 2.3x2.3x3mm3. Signal over time curves were normalized and analyzed by full width half maximum (FWHM) measurements to assess within sequence (coefficient of variation [COV]) and between sequence variations (percentage difference).

RESULTS
Water and muscle signal COV ranged from 0.1-0.8%. Within sequence FWHM COV was 1.0% for Fl3d, 1.0% for Fl3dP2, 9.1% for TWIST and 0.3% for GRASP. Percentage difference FWHM in comparison to Fl2d as reference standard was 2.2% for Fl3d, 0.3% for Fl3dP2, 45.9% for TWIST, and 7.8% for GRASP.

CONCLUSION
MRI acceleration techniques vary in reproducibility and sampling of arterial input function. Incomplete coverage of the k-space with TWIST as representative of view-sharing techniques demonstrates incoherent data over time and thus limitations in the evaluation of AIF.

CLINICAL RELEVANCE/APPLICATION
In order to establish DCE-MRI as a reproducible quantitative imaging biomarker it is necessary to assess how various forms of accelerated sequences handle the dynamic signal over time.

RC312-12 Clinical Impact of MRA in Site Selection in Patients Undergoing Free Fibular Flap Transfer (FFF)

Participants
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METHOD AND MATERIALS
A retrospective review of medical records of 69 patients who underwent pre-operative lower extremity DTR MRA prior to head and neck reconstructive surgery was done. Clinical findings were compared with MRA in determining the appropriate site of graft harvest.

RESULTS
DTR MRA identified vascular abnormalities, which led to change in management plan in 18/67 (27%) patients. Clinical findings were abnormal only in 4/18 (22%) of these patients. The two most common abnormalities included atherosclerotic narrowing (12 patients) and anatomical variations (4 patients). DTR MRA had significantly higher sensitivity to detect vascular abnormalities with implications in management than clinical examination alone (p=0.002). Addition of venous phase of imaging led to clinically occult venous pathologies in 4 patients, including deep venous thrombosis (2), varicose veins (1) and arteriovenous malformation/fistula (1).

CONCLUSION
Preoperative DTR MRA detected significant vascular abnormalities in patients undergoing FFF for head and neck reconstructive surgeries when compared to clinical examination, with a change in management in 28% of patients.

CLINICAL RELEVANCE/APPLICATION
DTR MRA prior to FFF can identify vascular pathology and anatomic variations and can potentially reduce the rate of complications and morbidity post fibular transfer for head and neck reconstructive surgeries.

RC312-13 Contrast-enhanced T1 Free-breathing Gradient Echo Sequences in the Assessment of Aortic Disease: Diagnostic Efficacy in Comparison with Standard T1 Breath-hold Gradient Echo Sequences

Participants
Cammillo R. Talei Franzesi, Milan, Italy (Presenter) Nothing to Disclose
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Giuila Querques, MD, Monza, Italy (Abstract Co-Author) Nothing to Disclose
Sandro Sironi, MD, Monza, Italy (Abstract Co-Author) Nothing to Disclose

METHOD AND MATERIALS
From January 2012 to January 2015, 57 patients (35 men; mean age 62.1 years) with aortic disease were evaluated. All patients were examined with a 1.5T magnet (Achieva, Philips), using a phased array multi-coil, after the intravenous injection of 0.1 mL*Kg of gadobutrol. The standard thoracoabdominal MR angiography (MRA) protocol included 3D-angiographic T1 gradient-echo fat-suppressed (3D-HR) sequences and T1 breath-hold gradient-echo fat-suppressed sequences (THRIVE). Multplanar T1 free-breathing gradient-echo fat-suppressed (THRIVE-FB) sequences were additionally performed in all the examinations. Two
Radiologists independently compared the diagnostic quality of the different angiographic sequences, in terms of visualization of aortic wall and lumen and main arterial branches. The vascular calipers at different aortic levels were calculated, compared and statistically analyzed among the different sequences. The interobserver agreement was then evaluated using the Intraclass Correlation Coefficient (ICC).

RESULTS
THRIVE-FB sequences showed high diagnostic accuracy in the assessment of vascular calipers and walls, with no significant differences in comparison with standard breath-hold sequences. They also demonstrated high sensitivity and specificity in the evaluation of vascular plaques, thrombus and adjacent structures. No significant differences were obtained in terms of overall diagnostic quality between THRIVE-FB sequences and standard angiographic sequences (interobserver agreement ICC of 0.97).

CONCLUSION
Contrast-enhanced T1 free-breathing gradient-echo fat-suppressed sequences have shown higher diagnostic efficacy, with no significant differences, in comparison with standard breath-hold angiographic sequences, permitting to correctly visualize and evaluate the aorta and its major branches.

CLINICAL RELEVANCE/APPLICATION
Free-breathing angiographic protocol represents a useful tool, even in not-compliant patients, offering high diagnostic quality images, able to correctly evaluate thoracic and abdominal arteries.

RC312-14  Role of MR in Cardiovascular Disease Research
Tuesday, Dec. 1 11:35AM - 12:00PM Location: S102AB

Participants
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LEARNING OBJECTIVES
1) To identify how MRI can contribute to understanding the pathophysiology of non-cardiac vascular disease and to describe its merits and shortcomings in relation to other commonly used imaging modalities. 2) To describe different MR methods that can be used to study vascular disease such as vessel wall imaging, atherosclerotic plaque imaging and measurement of pulse wave velocity. 3) To explain which of the above MR methods can be used clinically, and which methods are primarily experimental.