Comparative Performance of High Acceleration Quiescent-Interval Single Shot Magnetic Resonance Angiography at 3T With Contrast-Enhanced MR Angiography in Patients with Peripheral Artery Disease

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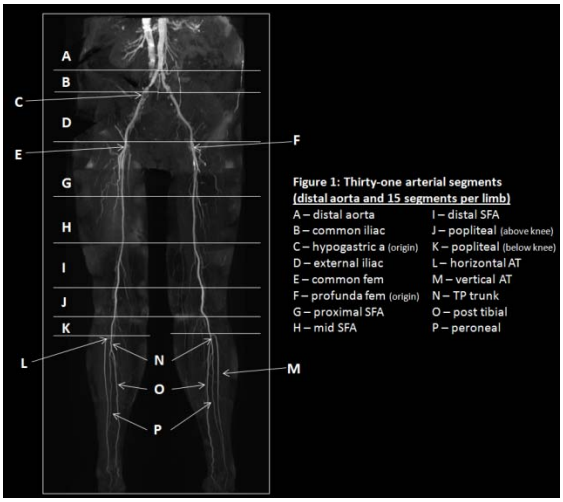
Introduction: Quiescent-Interval Single Shot (QISS) non-contrast MR angiography (QISS-MRA) is an emerging technique with growing evidence for its use in the evaluation of peripheral artery disease (PAD) at 1.5T [1-2]. The use of 3 Tesla MRI scans is becoming more common in clinical practice and offers the advantage of roughly double the signal-to-noise ratio (SNR) than that of 1.5 Tesla MRI. Improvements in B1 field inhomogeneity along with fast (parallel) imaging make QISS-MRA a viable technique on state-of-the-art 3T scanners. A prior study from this group investigated the potential to accelerate imaging at 3T using higher parallel imaging acceleration factors on healthy volunteers [3]. With this optimized technique, we report preliminary results in symptomatic clinical patients. The objective of this study is to evaluate the diagnostic accuracy and image quality of QISS-MRA at 3T in patients with PAD using contrast-enhanced MR angiography (CE-MRA) as the reference standard.

Methods: With IRB approval, eighteen patients (13 males, age 58-84 yrs; 5 females age 37-84 yrs) with symptoms of chronic lower extremity PAD were recruited prospectively and underwent imaging on a 3T scanner (MAGNETOM Skyra; Siemens Healthcare, Germany) using an ECG-gated QISS-MRA sequence (iPAT factor of 3); CE-MRA was acquired at 3T for each patient at the time of visit. The degree of arterial stenosis was evaluated using a 5-point scale for 31 predefined arterial segments (from infra-renal aorta through to bilateral run-off vessels) on both QISS- and CE-MRA (Figure 1). Image quality was scored by one blinded radiologist (P.A.) with greater than 4 years of experience reading MR angiograms. The sensitivity and specificity of QISS-MRA at 3T for the identification of significant (≥50%) stenosis was calculated with first pass perfusion CE-MRA with time-resolved calf imaging as the reference standard.

Results: QISS-MRA acquisitions were diagnostic for all patients, across all but 7 arterial segments (out of 558 total segments). These 7 segments were poorly visualized due to susceptibility artifact from adjacent hip prostheses in 2 patients and were excluded from analysis. Accordingly, vascular segment-based analysis demonstrated a sensitivity of 95.1% (98 of 103 segments) and a specificity of 98.9% (432 of 437 segments) for QISS-MRA using CE-MRA as the reference standard. Regional analysis demonstrated a decrease in sensitivity from 100% in the pelvis to 91.7% at the calf station, without variation in specificity (Table 1). This was primarily due to underestimation of significant stenosis on QISS-MRA in 3 arterial segments at the calf station as compared to CE-MRA. Venous signal did not limit segment-based analysis on any of the QISS-MRA scans but was a confounding factor in the calf regions of 7 CE-MRA scans (Table 2).

Conclusion: Preliminary results from QISS-MRA at 3T demonstrate excellent performance with near complete agreement with CE-MRA in patients with lower extremity PAD. Nevertheless, in 3 of 558 total vascular segments, QISS-MRA underestimated significant stenosis when compared to CE-MRA, with all 3 segments occurring at the calf station. Work is ongoing to improve accuracy in the calves and validate these findings in a larger cohort.



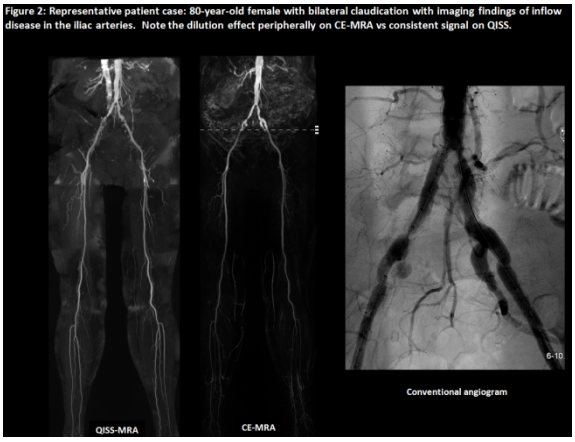


Table 1: Regional-based analysis of performance of QISS vs CE-MRA

	Pelvis (inflow)	Thighs (outflow)	Calves (run-off)
Sensitivity	100% (18/18 segments)	95.9% (47/49 segments)	91.7% (33/36 segments)
Specificity	98.1% (101/103 segments)	99.4% (162/163 segments)	98.8% (169/172 segments)

Table 2: Comparison of Likert Scores for Diagnostic Image Quality by Station

MR Angiography Sequence	Pelvis	Thigh	Calf
Nonenhanced	3.1 ± 0.74	3.5 ± 0.53	3.5 ± 0.71
Contrast enhanced	3.7 ± 0.67	3.5 ± 0.53	2.6 ± 0.97
P value	0.024	1	0.01

Note – Data are mean Likert scores ± standard deviations. *P* values derived by using paired *t* test.

Refs: [1] Edelman RR et al. MRM 2010; 63:951-58 [2] Hodnett PA et al. Radiology 2011 260:282-93 [3] Glielmi C et al. ISMRM abstract #5701 May 2012