

Quiescent-Interval Single-Shot Magnetic Resonance Angiography: the use of localized thin-slices as an adjunct to the standard technique

Mauricio S Galizia^{1,2}, Christopher Glielmi³, Ioannis Koktzoglou¹, Eugene Dunkle¹, James C Carr², and Robert R Edelman¹

¹Department of Radiology, NorthShore University HealthSystem, Evanston, IL, United States, ²Department of Radiology, Northwestern University-Feinberg School of Medicine, Chicago, IL, United States, ³Cardiovascular MR R&D, Siemens Healthcare, Chicago, IL, United States

Introduction: Quiescent-Interval Single Shot (QISS) is a non-contrast MRA technique which has been shown to be equivalent to contrast-enhanced MRA (CE-MRA) in patients with lower extremity peripheral arterial disease (PAD) who cannot receive contrast material.^{1,2} However, QISS image quality is degraded if the vessel being imaged is parallel to the plane of acquisition. This situation is particularly apparent at the level of the knee, where the anterior tibial artery courses horizontally for a short segment after arising from the popliteal artery. The purpose of this study is to assess the value of acquiring an extra set of thinner slices QISS images at the level of the knees when evaluating lower extremity PAD.

Methods: All measurements were performed on a 1.5T MR system (Avanto, Siemens Healthcare, Erlangen, Germany). Ten patients with lower extremity PAD were examined with an ECG-gated QISS sequence (TE/TR of 1.7/3.7 ms, 7 or 8 groups of 70 axial 3 mm slices, 1x1 mm in-plane resolution, flip angle of 90 deg., 5/8 partial Fourier acquisition, GRAPPA factor of 2, 40 x 32 mm FOV) from the level of the diaphragm to the feet. The same sequence was used to acquire thin-slices (TE/TR of 1.6/3.8 ms, slice thickness = 1.2 mm, 20% overlap) from the distal thighs to the feet. CE-MRA was also acquired using 0.02 mmol/kg of a contrast material at 0.6-2.0 mL/sec (Magnevist). One radiologist blinded to the clinical data scored image quality in the vessels just below the knee level using a 5-point scale (0-nondiagnostic, 1-poor, 2-fair, 3-good, 4-excellent). Image quality was compared using the Wilcoxon test.

Results: Image quality scores between standard and thin-slice QISS were similar for every segment with the exception of the horizontal segments of the anterior tibial, posterior tibial and the peroneal arteries, which had significantly higher image quality scores with thin-slice QISS ($p<0.05$). Of ten horizontal segments of the anterior tibial artery analyzed, 9 (45%) were graded as having poor quality and 5 (50%) as nondiagnostic, as compared to 1 (5%) segment graded as having poor quality and 1 (5%) as being nondiagnostic when imaged by thin-slice QISS.

Discussion: Our study has demonstrated that thin-slice QISS produces images with better quality for depicting the horizontal segments of the anterior tibial (AT), posterior tibial, and the peroneal arteries. This effect is more pronounced at the horizontal segment of the AT artery, where the use of thin slice QISS imaging reduced the proportion of nondiagnostic/poor quality images from approximately 50% to 5%. Acquiring additional thin slices in selected regions when imaging lower extremities with QISS leads to better image quality and might improve diagnosis.

	Popl.	AT-H	AT-V	TPT	PT	Per
Standard QISS	3.8 ± 0.6	1.3 ± 1.2	3.8 ± 0.6	3.7 ± 0.5	3.3 ± 0.9	3.6 ± 0.6
Thin-slice QISS	4.0 ± 0.2	2.9 ± 1.0	3.9 ± 0.4	3.8 ± 0.5	4.0 ± 0.2	4.0 ± 0.2

Table 1. Image quality scores for different arterial segments at the knee level by two different nonenhanced MRA methods: QISS with standard slice thickness (3 mm) and QISS with thin-slices (xx). Popl.= popliteal artery; AT-H=horizontal segment of the anterior tibial artery; AT-V=vertical segment of the anterior tibial artery; TPT=tibio-peroneal trunk; PT=posterior tibial artery; Per.=peroneal artery.



Figure 1. Contrast-enhanced, standard QISS, and thin-slice QISS MRA images of the calf arteries of the same patient. Although most vessels are already well depicted in the standard QISS images, thin-slice QISS images improve the depiction of the horizontal segments of the anterior tibial arteries (white arrows).

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References:

1. Edelman RR et al. MRM 2010; 63:951-8.
2. Hodnett et al. Radiology 2011; 260:282-93.