# Nonenhanced Evaluation of the Peripheral Arteries using Quiescent-Inflow Single-Shot with Arterial Spin Labeling (QISS ASL) MR Angiography

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**Purpose:** Quiescent-Inflow single-shot (QISS) MR angiography has proven to be an accurate nonenhanced technique for evaluation of the peripheral arteries (1). However, the requirement for fat suppression imposes restrictions on pulse sequence design, e.g. necessitating the use of partial Fourier, which may degrade spatial resolution and reduce the SNR. We hypothesized that spin-labeled QISS MRA would eliminate the need for fat suppression and improve venous suppression.

**Methods:** The protocol was approved by the institutional IRB. Imaging was performed at 1.5 Tesla (Magnetom Avanto, Siemens AG, Erlangen, Germany). QISS ASL involves the acquisition of two ECG-gated data sets, which may be acquired in either interleaved or sequential order. One data set is acquired using a modified QISS MRA technique, which involves the application of initial venous and in-plane radiofrequency (RF) saturation pulses, followed by a TI of 365ms, an alpha/2 prep pulse, and finally a balanced SSFP readout. Unlike standard QISS MRA, neither partial Fourier nor fat suppression is applied. The second data set is acquired using an identical QISS technique except that a spatially non-selective RF saturation pulse (SR perf, optimized for reduced B1 sensitivity) is substituted for the in-plane saturation RF pulse. The non-selective saturation data set is subtracted from the slice-selective saturation data set and processed using a maximum intensity projection (MIP) to generate the QISS ASL MRA. Scan time is exactly twice that for standard QISS MRA.

**Results and Discussion:** QISS MRA obtained without fat suppression or partial Fourier showed substantial signal intensity from fat **(Fig. 1A)**, which obscured branch vessels on the MIP (not shown). Background signal was uniformly eliminated with QISS ASL **(Fig. 1B)**, enabling the visualization of very small branch vessels. The background suppression was maintained in the foot **(Fig. 1C)** and pelvic regions, which typically do not show uniform fat suppression with standard QISS MRA. Venous suppression was excellent even when thin (1.2mm) slices were acquired.

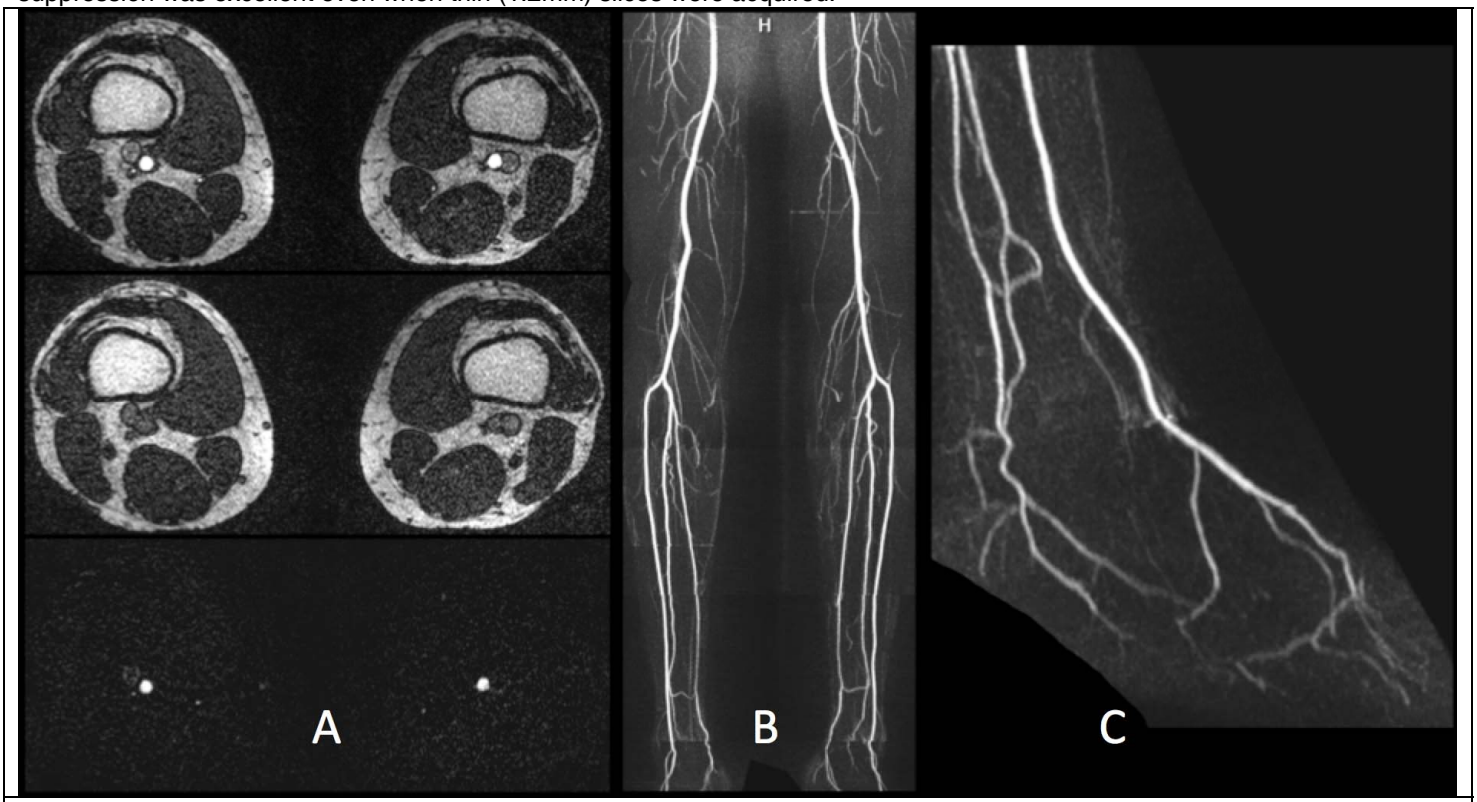


**Fig. 1.** A) Axial images from a healthy volunteer. Top: QISS with slice-selective in-plane saturation shows bright arteries but also bright fat; Middle: QISS with non-selective saturation shows reduced vascular signal intensity; Bottom: Difference image only shows the arteries with complete background suppression. B) Multi-station QISS ASL MRA shows excellent depiction of small arterial branches with uniform background suppression, even though no fat suppression was applied. Venous signal is negligible. C) QISS ASL of the foot using 1.2mm slices depicts small pedal arteries with uniform background suppression.

**Conclusion:** QISS ASL MRA substantially improves the degree and homogeneity of background suppression compared with standard QISS MRA, and consequentially enables the visualization of smaller branch vessels than would otherwise be possible. It eliminates the need for fat suppression, which is anticipated to make the technique more robust than standard QISS MRA for evaluation of the pedal arteries and other regions where the shim is non-uniform.

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**Reference:** 1. Hodnett PA, et al. Radiology 2011;260:282–293.