Multislice Spiral Superficial Femoral Artery Wall Imaging

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Introduction: Black blood imaging, typically using double inversion pulses, is frequently used to image the walls of blood vessels. By nulling the signal from blood, these techniques allow for better visualization of the vessel wall. Various schemes have been implemented up until now, relying on FSE (1,2) to obtain 2 slices per inversion block, or RARE (3) to obtain 3– 5 slices per inversion block. The goal of this study was to develop a multislice, spiral, double-inversion, black-blood pulse sequence for rapidly imaging a substantial extent of the superficial femoral artery (SFA).

Method: Our sequence uses two 180 degree hyperbolic secant pulses, followed by spiral readouts with spectral-spatial excitation pulses. The first 180 degree pulse is a 5.12 ms non-selective pulse, and the second is a 5.12 ms selective pulse, centered around the imaging slice group. A crusher is used to spoil any remnant transverse magnetization. A delay equal to the TI point for blood is applied next, followed by the readout block. The readout block can include multiple spiral readouts, for acquiring data from multiple slices. A readout block for a single slice consists of a 12 ms spectral-spatial pulse to suppress fat followed by an 18 ms spiral readout. The resolution for the spiral readouts used is 0.39 mm. After the readout block, an additional time delay is inserted to allow the blood magnetization to re-grow to its steady state value. 50 spiral interleaves were acquired per slice, leading to 50 sequence repetitions per scan.

Results: Results for a five slice wall imaging scan are shown in Figure 1a-e. The slices are 3 mm thick, with a separation of 3 mm between slices. The reinversion block thickness was set to 40 mm. The TI is 428 ms, with a TR of 1100 ms. Figure 1f is a one slice scan, with a TI of 630 ms and a TR of 2000 ms. The SNR and flow suppression of all images are good at a resolution of 0.39 mm.

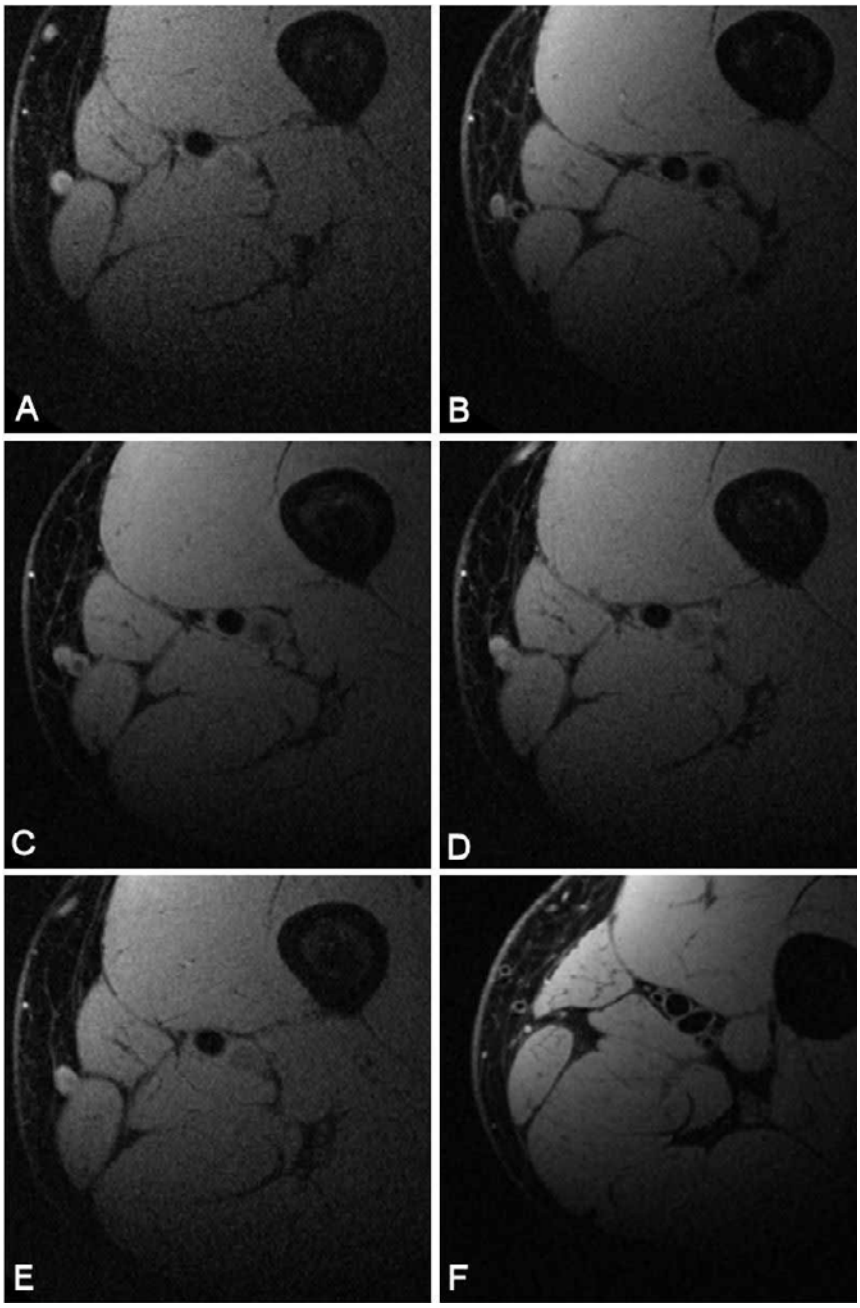

Figure 1: a–e) 5 slice data set of the SFA
f) 1 slice data set of the SFA

Discussion: We have implemented a black blood wall vessel spiral imaging sequence. Results for 1 and 5 slices per inversion block are presented. The advantages of this technique are the efficiency of spirals allows for shorter readouts, which allows more slices to be nulled following a given inversion block. Also, the short TE of the spiral scan leads to high signal from the vessel wall.

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