Noncontrast MRA of Abdominopelvic Arteries Using Quadruple Inversion-Recovery Preconditioning and 3D Balanced Steady-State Free Precession Imaging at 3T

Marc D Lindley[1], Daniel Kim[1], Glen Morrell[1], Marta E Heilbrun[1], Christopher J Hanrahan[1], and Vivian S Lee[1]
[1]*UCAIR, Radiology, University of Utah, Salt Lake City, Utah, United States*

Target Audience: Clinicians and investigators performing abdominal MRA at 3T.

Introduction: Non-invasive assessment of the abdominopelvic arteries is crucial for the management of peripheral arterial disease (PAD). While contrast-enhanced MRA is a proven method for visualization of abdominpelvic arteries, its utility may be limited in patients with poor renal function due to nephrogenic systemic fibrosis associated with gadolinium-based contrast agents. A non-contrast MRA (NC-MRA) technique for imaging aortoiliac arteries using quadruple inversion-recovery (QIR) of magnetization preparation and 3D balanced steady-state of free precession (b-SSFP) readout has been developed and evaluated at 1.5T [1]. NC-MRA at 3T presents an opportunity to increase the signal-to-noise ratio. We sought to perform QIR NC-MRA at 3T.

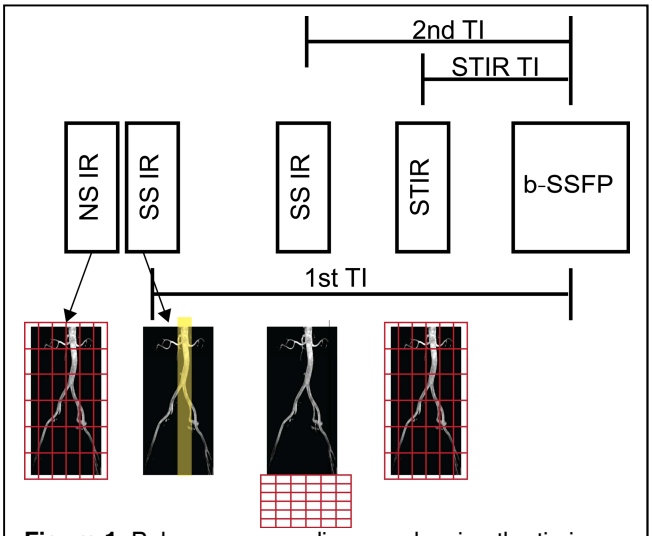

Figure 1: Pulse sequence diagram showing the timing and placement of the IR pulses.

Methods: Figure 1 shows the pulse sequence timing diagram and placement of the IR pulses in QIR NC-MRA. The inversion time (TI) of the first IR pulse was set to 1400 ms to achieve adequate arterial coverage for both 1.5T and 3T. For 1.5T, TI of the second slice-selective IR pulse was set to 500 ms to null the inflowing venous spins, and TI for the STIR pulse to 200 ms to null the fat, as previously described [1]. To account for increased T1 values at 3T, we empirically derived the TI of the second slice-selective IR pulse (TI = 800 ms) to null the inflowing venous spins, and TI for the STIR pulse (TI = 253 ms) to null the fat. One healthy volunteer was scanned at 1.5T (Avanto, Siemens) and 3T (Tim Trio, Siemens) using the QIR NC-MRA pulse sequence with respiratory gating and identical imaging parameters: spatial resolution 1.3 x 1.3 x 1.7 mm, TR = 1 respiratory cycle, flip angle = 120°, and scan time ~ 6 min. Both 1.5T and 3T acquisitions were performed within the SAR limits. One patient with femoral arterial disease was scanned at 3T using QIR NC-MRA and contrast-enhanced MRA.

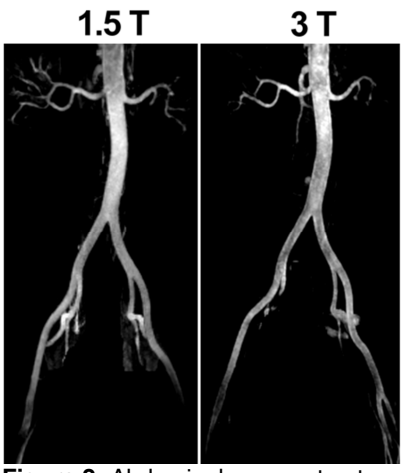

Figure 2: Abdominal non-contrast MRA MIP of a volunteer at 1.5T and 3T.

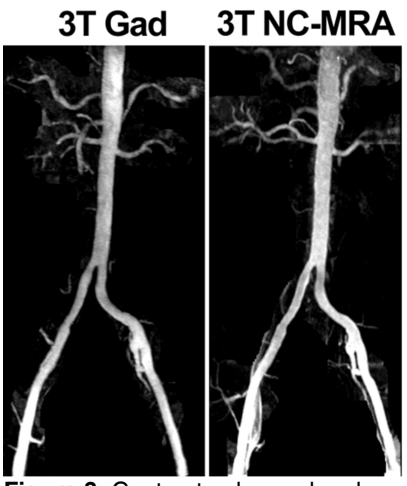

Figure 3: Contrast enhanced and NC MRA MIP of a patient with femoral arterial disease at 3T.

Results: In one volunteer, both 1.5T and 3T NC-MRA results exhibited similarly high quality maximum-intensity-projection (MIP) (Fig. 2). In one patient with femoral arterial disease at 3T, both contrast-enhanced and NC-MRA results exhibited similarly high quality MIPs (Fig. 3).

Conclusion: Our preliminary study shows that it is feasible to perform high-quality QIR NC-MRA at 3T. More tests are needed to compare the contrast-to-noise ratio of QIR NC-MRA between 1.5T and 3T, as well as evaluate the diagnostic image quality of NC-MRA at 3T.

References: [1] Atanosova, I, et al., JMRI 2011; 33:1430-1439.

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