

Coronary MRA Angiography at 3T: Fat Suppression Versus Water-Fat Separation

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Introduction: Suppression of lipid signal is a basic requirement in coronary magnetic resonance angiography (CMRA) because coronary arteries are embedded in epicardial fat and signal from fat can decrease coronary vessel conspicuity. Most CMRA scans are currently performed with fat suppression techniques such as Spectral Presaturation with Inversion Recovery (SPIR). However, methods based on spectrally-selective fat saturation are sensitive to B0 and B1 field inhomogeneities. Recent improvements in chemical shift based water fat separation methods such as Dixon [1,2] provide an alternative to conventional spectrally-selective fat suppression techniques. The purpose of this study was to compare the SPIR technique with Dixon water fat separation at 3T for CMRA.

Method: Data were acquired in eight healthy subjects (6 male, 2 female, mean age 36±11) and eight patients (5 male, 3 female, mean age 60±12) with suspected coronary artery disease on a 3T scanner (Achieva, Philips Healthcare, Best, The Netherlands) equipped with a 32-element cardiac coil. Each subject was imaged using a standard clinical Turbo field echo (TFE) imaging sequence with SPIR fat suppression and the 2-point Dixon acquisition. In case of the Dixon protocol, in phase and out of phase images were acquired. Imaging parameters included: FOV= 300 × 300 mm², scan resolution= 248 × 250 mm², slice thickness=1.2mm, TE1/TE2/TR=1.8/3.5/5.8 msec, flip angle=20 ° and average scan time =385sec. All scans were navigator gated (5mm) and corrected and data were acquired in mid-diastole. To compare these two techniques contrast to noise ratio (CNR), signal to noise ratio (SNR) of blood, myocardium and fat as well as sharpness and length of the right coronary artery were measured. In addition, two blinded experts scored the image quality for each dataset.

Results: All scans were successfully performed. Images from healthy young subjects visually had better image quality than images from patients. Figure 1 shows representative CMRA images at 3T from two healthy subjects and two patients for both SPIR and DIXON. The arrows in the images are pointing to locations where the Dixon method has performed favorably in comparison to the SPIR fat suppression technique. Images acquired with the two-point Dixon method were scored higher than the ones acquired with SPIR in healthy subjects (4.4±0.7 vs. 3.6 ± 0.6, p=0.009) and in patients (2.35±0.9 vs. 1.8±1.2, p=0.04). SNR measurements of fat, blood and myocardium demonstrate similar fat signal intensity for the DIXON and SPIR technique (p=NS) but significantly higher blood SNR (p<0.04) and a trend of higher myocardium SNR (p=0.09) with the DIXON technique (Figure 2). There was also a trend of higher CNR between fat and blood and fat and myocardium with the DIXON water-fat separation technique compared to the SPIR fat suppression technique (Figure 2). Vessel sharpness of the right coronary artery with the Dixon water-fat separation technique (57 ± 0.1) was similar to the SPIR fat suppression technique (56 ± 0.1).

Conclusion: These findings demonstrate that Dixon water-fat separation leads to higher SNR of coronary blood and myocardium and improved image quality scores for coronary artery visualization at high field strengths. Furthermore, the additional fat data that is available with Dixon protocols may be an important biomarker and improve the diagnostic value of CMRA.

Reference: [1] Eggers H, Magn Reson Med. 2011 Jan;65(1):96-107 [2] . Börnert P, Magn Reson Med. 2013 Feb 7.

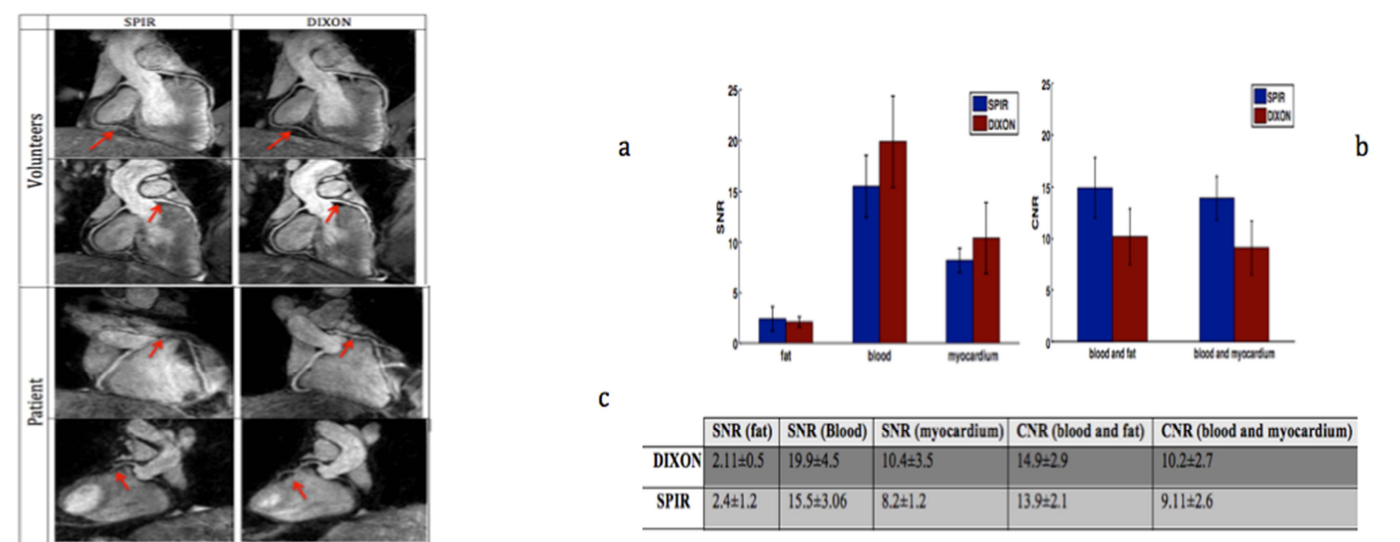


Figure 1: reformatted whole heart CMRA of Dixon (first column) and SPIR (second column) acquisition data of two selected healthy subjects and two patients.

Figure 2: a) SNR of blood and myocardium increase with the DIXON method in healthy subjects leading to better contrast to noise ratio (b) CNR between blood, myocardium and fat c) difference between fat signal is not significant.