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Meeting abstract

130 Contrast-enhanced whole-heart coronary MR angiography at 3.0 T: comparison to steady-state free precession technique at 1.5 T

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Introduction

Contrast-enhanced whole-heart MRA using slow infusion of a high-relaxivity extravascular contrast agent has been shown to be a promising technique for imaging coronary arteries at 3.0 T (Bi X, Carr J, Li D. MRM 2007, 58: 1–7). Steady-state free precession (SSFP) is the most commonly used method for coronary MRA at 1.5 T. A direct comparison of the two techniques will be useful to demonstrate the advantages of coronary MRA at 3.0 T.

Purpose

To compare contrast-enhanced whole-heart MRA at 3.0 T and non-contrast SSFP coronary MRA at 1.5 T in the same volunteers.

Methods

Ten healthy volunteers (mean age 51 years) were recruited for this study and each subject underwent both 3.0 T and 1.5 T coronary MRA in random order. The interval of the two examinations was within two weeks. No beta-blocker or nitroglycerine was administrated to any subject.

All studies were performed on two Siemens whole-body scanners (1.5 T: Avanto; 3.0 T: Tim Trio; Siemens Medical Solutions). Segmented 3D SSFP and 3D contrast-enhanced FLASH techniques were employed at 1.5 T and 3.0 T, respectively. All data were collected with real-time motion adaptive navigator respiratory gating, ECG triggering, and fat saturation. T_2 preparation (40 msec) was applied at 1.5 T to improve the blood-myocardial contrast. At 3.0 T, signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) were optimized by applying a non-selective inversion pulse (TI = 200 msec), accompanied by slowly injecting (0.3 ml/sec) of 0.2 mmol/kg body weight of MultiHance (Bracco Imaging SpA, Milan, Italy). The same number of partitions (120–144), spatial resolution ($1.4 \times 1.4 \times 0.9$ mm^3), GRAPPA (factor of 2), and 12 channel matrix coil were used in 3.0 T and 1.5 T coronary MRA.

SNR and CNR of coronary arteries were measured from original images by a radiologist blinded to all study and volunteer information. The image quality and coverage of coronary anatomy were evaluated independently by two observers using original images of the coronary MRA. The image quality was graded as 1, poor; 2, fair; 3, good; and 4, excellent. The coverage of coronary arteries was assessed based on the number of coronary segments according to the classification of the American Heart Association.

Results

Ten volunteers were successfully performed coronary MRA at both 3.0 T and 1.5 T. Two volunteers were excluded for comparison because their heart rate was significantly different during the two studies (>10 beats per minute, bpm). The mean heart rate for 3.0 T and 1.5 T coronary MRA was 69 ± 10 bpm and 64.5 ± 5 bpm, respectively. The average acquisition time of 3.0 T coronary MRA was significantly shorter than that of 1.5 T coronary MRA (10.8 ± 2.3 versus 14.8 ± 3.5, p = 0.013). The overall SNR was lower at 3.0 T than at 1.5 T (47.6 ± 10.2 versus 69.7 ±

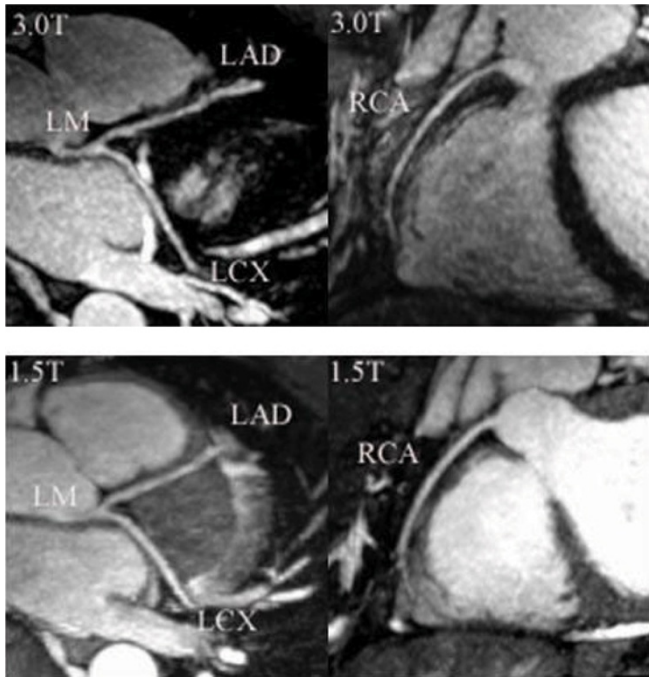

Figure 1
Maximum intensity projection images of a 47-year-old healthy volunteer demonstrate that contrast-enhanced coronary MRA at 3.0 T (top row) has better CNR that non-contrast SSFP technique at 1.5 T (bottom row). A comparison of state-of-the-art 1.5 T and 3 T whole heart coronary MRA techniques in 10 volunteers demonstrated higher CNR, shorter acquisition-time, and better depiction of coronary segments for Contrast-enhanced slow-infusion 3D-FLASH at 3.0 T compared to non-contrast SSFP at 1.5 T. LM, LAD, LCX, and RCA indicate left main, left anterior descending, left circumflex, and right coronary artery, respectively.

8.0, $p < 0.01$), whereas the overall CNR was higher at 3.0 T than at 1.5 T (41.5 ± 8.7 versus 29.5 ± 5.8, $p < 0.01$). The average number of coronary segments visualized on 3.0 T imaging was greater than that on 1.5 T imaging (10.4 ± 3.5 versus 8.5 ± 2.5, $p = 0.049$). Mean score of image quality at 3.0 T was similar to that at 1.5 T (2.8 ± 0.96 versus 3.0 ± 1.03, $p = 0.35$). Figure 1

Conclusion

Contrast-enhanced whole-heart coronary MRA at 3.0 T demonstrated higher CNR, less acquisition time, and better depiction of coronary segments, especially for small branches such as diagonal branch, marginal branch, and posterior descending branch compared to SSFP coronary MRA at 1.5 T. Patient studies are required to evaluate the clinical value of contrast-enhanced whole-heart coronary MRA at 3.0 T.