Coronary vessel wall contrast uptake at MR imaging: comparison of patients with stable angina compared to age-matched healthy controls

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Introduction

MRI is a promising, non-invasive technique for atherosclerotic plaque imaging and characterization of plaque components in the carotid arteries and the aorta[1,2]. Several researchers have demonstrated the feasibility of vessel wall imaging in human coronary arteries[3-5]. Characterization of atherosclerotic plaques in coronary arteries remains challenging due to cardiac and respiratory motion. Additionally, cross-sectional multisequence vessel wall imaging of the coronary arteries at 1.5T is very time consuming due to requirements for high SNR and spatial resolution and limited spatial coverage of the coronary artery tree[6]. Recently, contrast agents have been used for in vivo plaque imaging in human coronary arteries[7,8]. The purpose of the present study was to investigate the differences in vessel wall characteristics and contrast-uptake at MR coronary vessel wall imaging in patients with angiographically proven coronary artery disease and a control group of age-matched volunteers.

Materials and Methods

Nine patients with angiographically proven coronary artery disease (5M, 4F, mean age 55.9 yrs) and 24 healthy volunteers without history of coronary artery disease (10M, 14F, mean age 56.6 yrs) were examined on a 1.5 T clinical imager (Intera, Philips Medical Systems). A 5-element phased array cardiac coil was used. Prior to vessel wall imaging, bright blood balanced steady state free precession (bSSFP) imaging of the right coronary artery lumen was performed (TR/TE/FA: 6.2/3.1/120°, resolution: 0.98x0.98x3 mm). In the same orientation, pre- and post-contrast vessel wall scans were acquired (3D FFE, radial k-space sampling, double inversion prepulse). TR/TE/FA: 8.0/2.0/30°. FOV: 300x300mm, matrix: 384x384, 10 slices of 2 mm, resulting in an acquired spatial resolution of 0.78x0.78x2.0 mm. Post-contrast imaging time was 5-25 minutes after administration of 0.1 mmol/kg Gd-DTPA. Inversion times were depending on heart rate, dose and time after contrast administration. We calculated relative signal intensities (RSI) of the coronary vessel wall compared to the surrounding tissue in pre- and post-contrast images and corrected for differences in receiver gain and scaling factors. Data were compared using the Mann-Whitney Test.

Results

All patients underwent MRI without problems. In patients stenoses could be detected on MRA, corresponding to stenoses detected with IA-DSA. In healthy volunteers, minor to moderate luminal narrowing was also present on MRI. Before and after contrast administration there was non-uniform signal intensity of the coronary vessel wall in both patients (figure 1) and some volunteers (figure 2). There was significantly more enhancement of the vessel wall in controls compared to patients (1.7 vs 1.4, p=0.003). There was a significant higher pre-contrast RSI in patients, but there was no significant difference in post-contrast RSI (Table 1).

	Pre-contrast RSI	Post-contrast RSI
Patients (n=9)	4.87 (±1.1)	6.85 (±1.7)
Controls (n=24)	3.64 (±1.8)	6.31 (±1.85)
	p= 0.017	p=0.332

Table 1. Pre- and post-contrast relative signal intensity (RSI) of the coronary vessel wall in patients and healthy controls

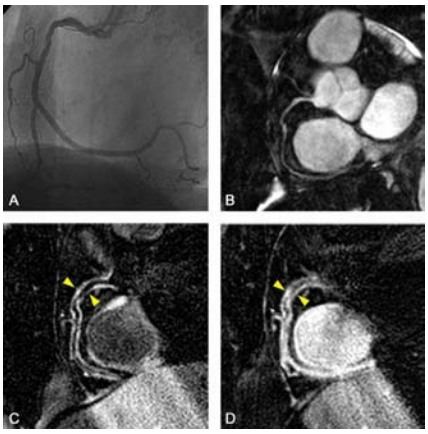

Figure 1. IA-DSA (A), bSSFP (B) and pre- (C) and post-contrast vessel wall scan (D) of the right coronary artery (RCA) in a patient with coronary artery disease. Note the non-uniform signal intensity of the coronary vessel wall in pre- and post-contrast images (arrow heads).

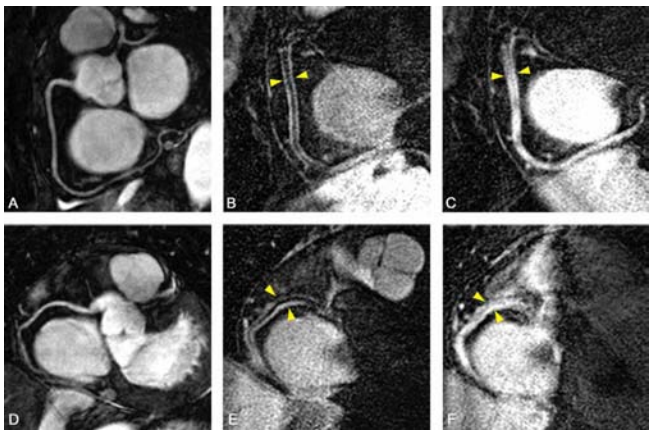

Figure 2. bSSFP (A,D) and pre- (B, E) and post-contrast vessel wall scan (C, F) of the right coronary artery (RCA) in 2 volunteers without history of coronary artery disease. One volunteer (A-C) has a thin vessel wall with uniform signal intensity in contrast to the other (D-F) as indicated by arrow heads.

Conclusion

MR imaging can be used to non-invasively visualize the coronary vessel wall and to detect positive remodeling. This study showed a significantly higher pre-contrast RSI and decreased enhancement of the coronary vessel wall in patients with proven coronary artery disease compared to age-matched healthy volunteers. The significance of this phenomenon remains to be determined in further studies. In post-contrast scans, discrimination of the lumen from the vessel wall is difficult. This is probably a flow related problem. Insufficient outflow of blood in the RCA can be caused by the very short inversion times used in post-contrast scans to null the contrast-enhanced blood. After contrast administration, the use of a single inversion prepulse, which is flow independent, could therefore be more advantageous to detect uptake of contrast agent in the coronary vessel wall compared to the double inversion prepulse used in this study.

References

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