MR imaging of the coronary vessel wall: comparison of vessel wall characteristics in patients with coronary artery disease and age-matched healthy controls.

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Introduction

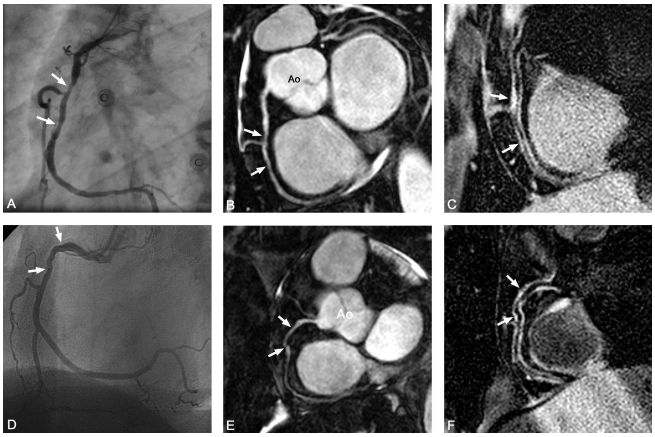
MRI is a promising, non-invasive technique for atherosclerotic plaque imaging and assessment of plaque components in the carotid arteries and the aorta[1,2]. Several researchers have demonstrated the feasibility of vessel wall imaging in human coronary arteries[3-5]. Characterization of atherosclerotic 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]. To solve the problem of limited spatial coverage, the vessel wall can be imaged parallel to the long axis of the vessel. With this technique, vessel wall thickening and positive remodelling can be demonstrated[5]. The purpose of the present study was to investigate the differences in vessel wall characteristics at longitudinal MR coronary vessel wall imaging in patients with angiographically proven coronary artery disease and a control group of age-matched healthy volunteers.

Materials and Methods

22 patients with angiographically proven coronary artery disease (15M, 7F, mean age 60.4 yrs) and 26 healthy volunteers without history of coronary artery disease (11M, 15F, mean age 56.1 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 (RCA) lumen was performed (TR/TE/FA: 6.2/3.1/120°, resolution: 0.98x0.98x3 mm). In the same orientation, a vessel wall scan was 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. We measured minimal, maximal and mean coronary vessel wall thickness, signal intensity (corrected for the distance to the receiver coil) as well as lumen diameter using a custom made software program. Data were compared using a Student T-Test.

Results

In 21/22 patients, stenoses detected on MRA corresponded to stenoses detected with IA-DSA, in one patient DSA-images of the RCA were missing. In 18/26 healthy volunteers, stenoses were also present on MRI and in 4 additional volunteers, vessel wall thickening without stenoses was present. Non-uniform signal intensity was observed of the coronary vessel wall in both patients (figure 1) and some volunteers (Figure 2). Minimal, maximal and mean SI of the vessel wall in patients were significantly higher compared to controls (respectively 0.15 vs 0.11; 0.40 vs 0.34, and 0.28 vs 0.22, all $p<0.03$). Maximum and mean vessel wall thickness in patients were also significantly higher (2.16 mm vs 1.92 mm, and 1.38 mm vs 1.22 mm, both $p<0.05$). There was no significant difference in lumen diameter and minimal vessel wall thickness between both groups.



◄Figure 1. DSA (A,D), bSSFP (B, E) and vessel wall scan (C,F) of the right coronary artery (RCA) in a 40 y/o male (A-C) and a 67 y/o female (D-F), both with stable angina. Note the heterogeneity in vessel wall thickness and signal intensity in both patients.

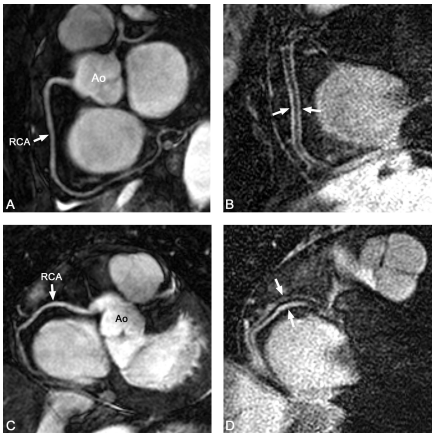


Figure 2 ► bSSFP (A,C) and vessel wall scan (B,D) of the right coronary artery (RCA) in a 62 y/o healthy female (A,B) with a normal vessel wall scan and a 54 y/o healthy female (C,D) with vessel wall thickening and high signal intensity of the posterior wall of the RCA.

Conclusion

MR imaging can be used to non-invasively visualize the coronary vessel wall and to detect the presence of (sub)clinical coronary atherosclerosis. This study showed a significantly higher SI as well as increased maximal and mean wall thickness in patients with proven coronary artery disease compared to age-matched healthy volunteers. The difference in SI and wall thickness could be the result of different vessel wall morphology and atherosclerotic plaque components or it may be related to partial volume effects of flow artifacts at the border between lumen and vessel wall. The true significance remains to be determined in further studies in which MRI is compared to intravascular ultrasound.

References

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