Coronary vessel wall thickness: validation of MR coronary vessel wall imaging with intravascular ultrasonography.

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Introduction:

MRI is able to visualize the coronary vessel wall and the presence of early atherosclerosis as manifested by positive remodeling¹. Measurements of wall thickness on MRI have shown values of more than 1 mm, also in healthy volunteers²,³. Most likely, these values are overestimated due to partial volume effects and high signal at the lumen-vessel wall interface due to slow flow. Since it is well known that intra-arterial digital subtraction angiography (IA-DSA) may severely underestimate coronary plaque burden and since no histology of the coronary arteries can be obtained in living patients with coronary artery disease (CAD), the purpose of this study was to compare MR coronary vessel wall (MR-CVW) characteristics with the current in-vivo standard of reference for coronary vessel wall imaging: intravascular ultrasound (IVUS).

Materials and methods:

Fourteen patients with chest pain scheduled for X-ray coronary angiography (CAG) (12M/2F) were included in this study. All subjects underwent MR-CVW on a 1.5T clinical imager (Intera, Philips Medical Systems) using a 5-element cardiac coil. Prior to CVW imaging, bright blood bSSFP imaging of the RCA lumen was performed (TR/TE/FA: 6.2/3.1/120°, resolution: 0.98x0.98x3 mm). In the same orientation, vessel wall scans were acquired (3D FFE, radial sampling, DIR). TR/TE/FA: 8.0/2.0/30°. FOV: 300x300mm, matrix: 384x384, 10 slices of 2 mm. Subsequently, all patients underwent IA-DSA followed by IVUS. Patients were divided in 2 groups based on results of CAG: 1) significant (>50% luminal narrowing; 6 subjects), and 2) no significant stenoses (0-50% luminal narrowing; 8 subjects). During CAG, IVUS of the right coronary artery (RCA) was performed after administration of intracoronary nitroglycerin. A 40 MHz IVUS catheter was used (30 frames/sec), and images were acquired during continuous pull-back of 0.5 mm/s. On both IVUS and MR-CVW, areas of focal wall thickening in the proximal and mid RCA were identified and wall thickness was measured. After this, individual lesions were matched and wall thickness measurements were averaged and compared.

Results:

Based on IVUS, wall irregularities and stenoses could be detected in 13 patients. Only 1 patient was completely free of atherosclerosis in all analyzed segments. There was good visual agreement between MRI and IVUS (figure 1) with regard to location, extent and severity of wall thickening. On both IVUS and MRI, there was no significant difference in mean wall thickness between patients with and without significant stenoses. Overall (in all 14 subjects) mean average wall thickness was 0.46 (±0.22) mm on IVUS and 1.32 (±0.23) mm on MR-CVW (p=0.001).

Discussion and conclusion:

The current study confirmed the ability of MR-CVW to detect areas of coronary artery positive remodeling as seen with IVUS. There is a good agreement between IVUS and MRI with regard to location and extent of wall thickening. However, MR-CVW overestimated wall thickness approximately 3-fold, which is the difference in spatial resolution between techniques.

References:

1. Kim et al, Circ 2002
2. Desai et al. EurHeartJournal 2005
3. Gerretsen et al. ISMRM 2008, # 319