Non-contrast coronary vessel wall and plaque imaging using inversion recovery prepared steady state free precession: comparison with plaque characterization of 64 detector row CT

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Background:
Intraplaque hemorrhage is a feature of vulnerable atheromatous plaques. It has strong associations with cardiovascular ischemic events. Early detection of such a plaque characteristic is critical and potentially benefit for their aggressive management. The purpose of this study was to determine whether coronary vessel wall imaging using inversion recovery prepared steady state free precession sequence (IR-SSFP) correlates with atherosclerosis detected by 64–detector row computed tomography (MDCT).

Methods:
21 patients (age 65 ± 12 years, range 35 to 86 years; 2 women) with coronary artery disease as confirmed MDCT were studied by coronary artery wall imaging on a 1.5-T CMR scanner (Intera, Philips Medical Systems, Best, The Netherlands) with 5-element cardiac synergy coil. The coronary artery wall imaging was a navigator-gated free breathing and ECG-triggered and fat-suppressed 3D IR-SSFP. Acquisition parameters are TE / TR 2.4-2.6/4.8-5.2 msec, TFE factor 17-35, matrix of 304x512, FOV of 300 mm. Inversion time was adjusted to null blood (typical inversion time 450 ms). Scans were performed in the coronal or sagittal oblique plane, and the number of slices was limited to 35 because of time constraints. IR-SSFP data (27 vessels, 77 segments) were assessed detection of coronary wall and signal intensity ratio (SIR) between the coronary vessel wall and blood signal (SIvw/SIblood) was calculated for every coronary artery segment. MDCT data sets were evaluated for the presence of calcified plaque, non-calcified plaque, or both (mixed) plaque.

Results:
Almost all coronary artery walls (66/77 segments) were successfully visualized. High signal intensity areas (HSI; SIR>8, 11 segments) were observed in 5 (17%) of 30 segments with >50% coronary artery stenosis by MDCT but also in 6 (13%) of 47 segments without MDCT angiographically apparent coronary disease. HSI were detected in the sites that had no plaque (5 segments) and mixed plaque (5 segments) on MDCT images.

Conclusion:
IR-SSFP can be used for visualization of the coronary vessel wall and plaque and give us different information and profound message about plaque characterization comparing to MDCT. HSI may be indicative of plaque inflammation and /or hemorrhage. Therefore coronary vulnerable plaque could be detected by this method.

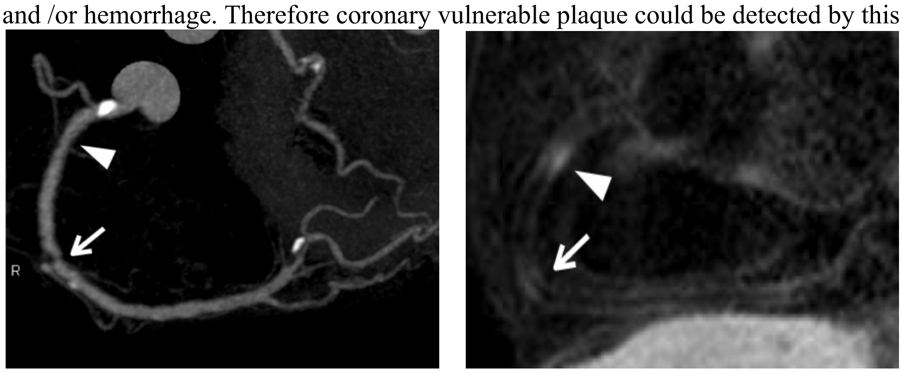

Fig. 1 Moderate stenosis in the mid-right coronary artery (RCA) of a 75-year-old patient is shown. MDCT maximum-intensity reformation image (left) only demonstrates the mixed plaque (arrow) at mid-RCA. On the corresponding IR-SSFP (right), HIS visualized not only this mixed plaque site (arrow) but also the proximal RCA (arrow heads).

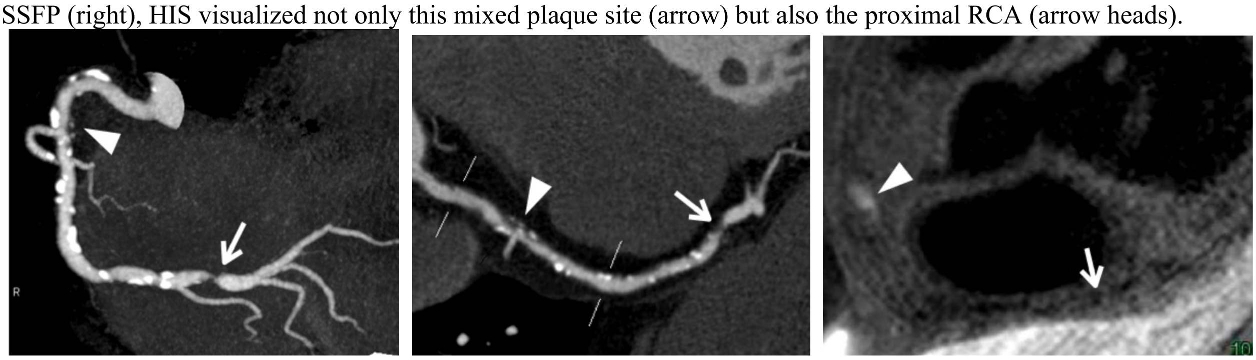

Fig. 2 Severe stenosis in the distal RCA and a mild stenosis in the proximal RCA of a 66-year-old patient are shown. MDCT curved multiplanar reformation image (center) demonstrates the mixed plaque (arrow head) with proximal RCA and the non-calcified plaque with distal RCA. On the corresponding IR-SSFP (right), HIS was visualized at proximal RCA (arrow head) but not at distal RCA (arrow).