Contrast-enhanced MR Angiography: A Helpful Methodology to Detect Coronary Atherosclerotic Plaque

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Introduction: Cardiovascular disease is the second leading cause of death in the US. Myocardial ischemia or infarction is caused by coronary luminal stenosis or disruption of atherosclerotic plaque. Thus the detection of coronary atherosclerotic plaques and stenosis can significantly improve outcome by targeting these patients for advanced medical/surgical care. Expansive remodeling was the main mechanism of remodeling in soft lesions, which is responsible for a non-calcified plaque without causing significant luminal stenosis [1]. Coronary MR angiography can detect significant luminal stenosis sensitively [2]. But, coronary MR angiography may omit the atherosclerotic lesions without causing significant stenosis. Plaques with neovasculature and inflammation can be enhanced on carotid post-contrast MRI [3]. Contrast-enhanced MR angiography may help to detect the atherosclerotic plaque.

Aim: 1) To determine if contrast--enhanced coronary MRA can improve the SNR and CNR of the images and 2) To test the hypothesis that Contrast-enhanced MR angiography can increase the detection rate of coronary atherosclerotic non-calcified plaque.

Materials and Methods：

Subjects: Twenty consecutive patients (mean age 57.3, 14 males) with coronary non-calcified plaques demonstrated by CTA were enrolled in this study. **Imaging:** Patients were positioned in a GE 1.5T Signa scanner using 8-elements cardiac coils. Pre- and post-contrast coronary MRA using navigator-gated 3D SSFP sequence with the following imaging parameters: TR(msec)/TE(msec)/Flip angle /FOV(cmxcm)/Matrix/Slice-thickness(mm)/spacial resolution(mmxmmxmm) of 4.7/2.3/65/28x28/256x256/2/1.1x1.1x1.0. T2-preparation was applied to suppress the myocardium. Gadolinium-DTPA (Magnevist, Schering AG, China/Germany) was injected intravenously at a dose of 0.1 mmol/kg. The heart rate of the patients were controlled to be <70bpm. **Image analysis:** SNR and CNR (blood versus thoracic muscle) of pre- and post-contrast MRA images were measured and compared. Thirty one coronary non-calcified plaques on segments >1.5mm in diameter of twenty patients detected by CTA were enrolled in this study. To compare the detection rates of atherosclerotic plaques on cross-section view of MR images between pre- and post-contrast MRA，and the CNRs between the plaque and the surrounding connective tissue and the coronary lumen were also compared. If the plaques were invisible on MRA images but there was or no luminal stenosis on the corresponding coronary segments, the signal intensity of plaques were defined equal to the surrounding connective tissue or the coronary lumen respectively. SPSS11.5 soft ware was used to statistic analyze. A p-value of less than 0.05 was considered significant.

Results: The mean SNR and CNR of post-contrast MRA images were significantly higher than that of pre-contrast MRA (32.01±6.78 vs. 27.84±6.01, 13.67±4.41 vs. 10.76±3.16, $p < 0.05$). Comparison with pre-contrast CMRA, post-contrast CMRA improved the CNRs between the plaque and the surrounding connective tissue and the coronary lumen (table 1). The detection rate for coronary atherosclerotic non-calcified plaques of post-contrast MRA was significant higher than that of pre-contrast MRA (96.8% vs. 32.3%, $p < 0.05$, Fig. 1).

Table 1 CNRs between the plaque and surrounding connective tissue and coronary lumen

	Pre-contrast CNR	Post-contrast CNR	t	p
Between A and B	5.62±6.61	9.81±4.69	2.887	0.0054
Between A and C	8.79±6.63	12.54±5.5	2.407	0.0192

A: plaque; B: surrounding connective tissue; C: coronary lumen.

Conclusions: Contrast-enhanced MRA improving the SNR and CNR of coronary artery images, and improving the CNRs between the plaque and the surrounding connective tissue and the coronary lumen. Contrast-enhanced MRA increased the detection rate of coronary atherosclerotic non-calcified plaques. These results suggest that Contrast-enhanced MRA is helpful to detect coronary atherosclerotic non-calcified plaques.

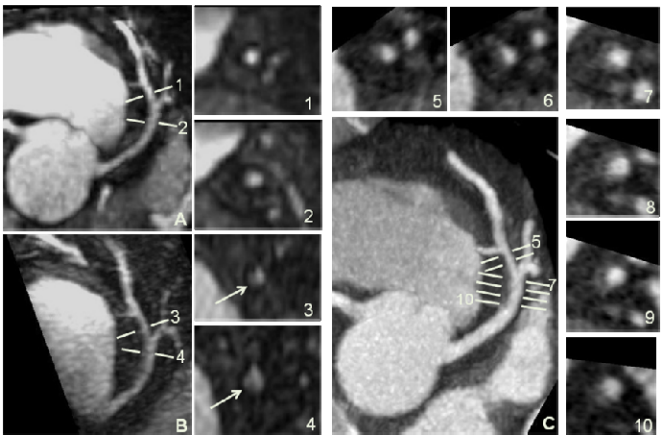

Fig.1 A 49 years old male patient. (A) Pre-contrast MRA showed LAD normal (no luminal stenosis and visible plaque). (B) Post-contrast MRA detected atherosclerotic plaques on cross-section views (small fig. 3-4, white arrow) with slight luminal stenosis. (C) CTA demonstrated coronary atherosclerotic non-calcified plaques on LAD.

References:

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