Contrast-enhanced Coronary MR Angiography with Gd-DTPA Slow Infusion

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Purpose: To evaluate the visualization of the coronary vessels on 3D-FIESTA sequence with Gd-DTPA slow infusion.

Materials and Methods: 10 patients with suspected coronary diseases were invited as volunteers for contrast-enhanced coronary MR angiography. 7 of them had coronary CTA examinations on 64-MDCT scanner and 4 of them had PCI therapy. Beta-block agent was orally administrated to keep the heart rate less than 75bpm during MRA acquisition. Coronary MRA was acquired on GE 1.5T Excite HD MR scanner. It was a respiratory navigator echo gated, 3-dimensional FIESTA sequence with T2 preparation myocardial suppression and chemical selective fat saturation. The spatial resolution was 1.0*1.0*1.0mm (z-interpolated) and the data sampling windows were around 150ms. The navigator window for diaphragm acceptance was 3mm. All the parameters and locations were kept the same before and after the Gd-DTPA administration except that the matrix was increased from 256*256 to 320*256 to focus on a lesion. A 2-phase scheme was designed for the Gd-DTPA delivery: a bolus was injected at a rate of 1ml/sec (a dosage of 0.1ml/kg body weight) and then followed a slow infusion at a rate of 0.02ml/sec (another dosage of 0.1ml/kg body weight). The contrast-enhanced scan was acquired during or even after the infusion of Gd-DTPA depending on how long it took for the scans. SNR(SI/air) of the blood in aorta, myocardium and CNR((blood-myocardium)/air)) were measured and compared.

Results: 34 scans were repeated before and after Gd-DTPA administration. Visually, the contrast-enhanced coronary vessels had better sharpness, contrast and more homogeneous (Figure-1) than the non-contrast scans except for 5 acquisitions because of heart rate fluctuation or inpatient of the volunteers. Statistically, the SNR of blood in aorta significantly increased from 4.35±1.36 to 5.63±2.04 ($t=3.44$, $p<0.05$) and the SNR of myocardium significantly increased from 2.11±0.66 to 3.17±1.17 ($t=3.09$, $p<0.05$). But the CNR of blood to myocardium showed no significant difference where it was 2.24±0.82 before and 2.47±1.16 after Gd-DTPA administration. When referred to CTA, both pre- and post- contrast MRA had a sensitivity of 87.5% (14/16) but 3 over-estimated lesions on pre-contrast MRA and 2 over-estimated calcified stenoses on CTA could be corrected on the high resolution contrast-enhanced MRA and it could show the stenoses with more details and more confidence (Figure-2).

Discussion: FIESTA is a steady state free precession sequence providing T2/T1 contrast and Gd-DTPA could improve its SNR while does not change its contrast. In this study, the slow infusion of the Gd-DTPA was to keep its SNR constant and long enough for the data sampling window of the free-breathing navigator echo gated coronary MR angiography. The image quality was significantly improved and it showed promising in detecting coronary stenosis. The overestimation due to the flow turbulence subsequent to the severe stenosis on pre-contrast MRA and had beam artifacts of the calcification on CTA could be corrected on the high resolution contrast-enhanced MR angiography.

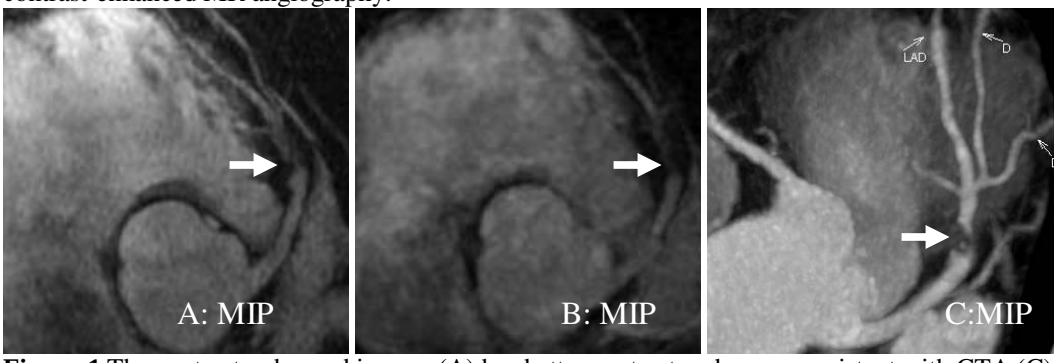

Figure-1 The contrast-enhanced images (A) has better contrast and more consistent with CTA (C) than the non-contrast image (B) which overestimates the length of the stenosis. (arrow)

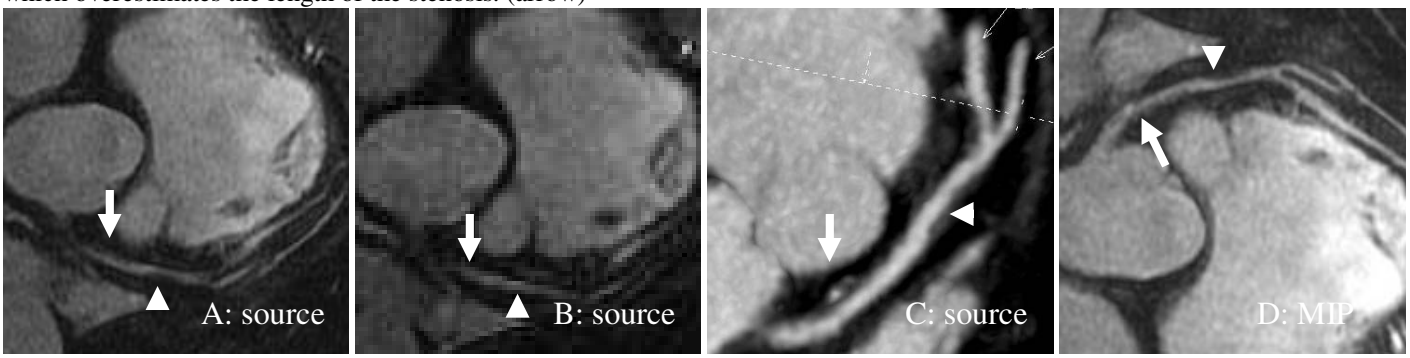

Figure-2 The high resolution (320*256) contrast-enhanced image (A) can show the thin plaques revealed on CTA (C) while the non-contrast (256*256) image (B) can not show them clearly (arrow and arrowhead).