Evaluation of Coronary Atherosclerotic Plaque Using Navigator Coronary MR Angiography with Reference to 64-MDCT Coronary Angiography

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Introduction: Navigator coronary MR angiography (CMRA) with steady-state free precession (SSFP) demonstrated good diagnostic accuracy of assessing coronary significant stenosis [1], but evaluation of the modality in detecting coronary atherosclerotic plaques was not reported. The purpose of this study was to investigate the ability of navigator CMRA wih SSFP in detecting coronary plaque with reference to 64-slice MDCT coronary angiography which has showed very high accuracy for detecting coronary plaque and stenosis [2].

Methods: Fifteen patients with suspected coronary artery disease were performed with a 64-slice MDCT coronary angiography (Siemens, Sensation Cardiac 64). Fifteen non-calcified plaques with significant stenosis (>50%) and 4 severe calcified plaques were detected in the 15 patients on 64-slice MDCT. Non-calcified plaque (<300 Hu) and calcified plaque were defined according to the mean density on CT [3]. All the 15 patients underwent the MR examination within 3 days at 1.5T MR scanner (Excite Twin Speed, GE Healthcare, Milwaukee) equipped with an 8-channel phase-array cardiac coil. The ability of CMRA with SSFP technique in detecting coronary plaque and stenosis was evaluated by two experienced radiologists in consensus without knowledge of the findings on MDCT.

MDCT was performed with 64×0.625 mm detector collimation and 0.33 s rotation time. MR was performed with respiratory navigator 3D SSFP sequence with the following parameters: TR 4.9 ms, TE 2.4 ms, flip angle 65°, slice thickness 2.0 mm, FOV 280 mm, matrix 256×256, voxel size 1.1x1.1x2.0 mm^3. The mean heart rate was 68±7 bpm for both MDCT and MR scan.. Oral β-blocker was used in 9 patients to lower heart rate.

Results: Of the 15 non-calcified plaques, 9 were detected as low signal on SSFP and the stenosis caused by the 9 plaques were correctly evaluated by MR compared to MDCT. Other 6 were not detected from MR imaging. In the 4 calcified plaques, no significant (>50%) stenosis was detected on MR.

Discussion: MR successfully detected the stenosis in 9 of 15 non-calcified plaques. The result suggests that MRCA with SSFP is an effective and accurate technique for detection of significant stenosis caused by non-calcified plaque. In the 6 non-calcified plaques which were not detected by MR, 4 were smaller size plaque (mean thickness was 2.3±0.3 mm) compared with the 9 plaques (mean thickness was 3.1±0.4 mm). The failure detection may be caused by the relative lower spatial resolution of MR comparing with MDCT. This suggests higher resolution than 256x256 is still required in order to detect the small size plaque (<2.3mm) and increase the diagnostic accuracy. Another 2 plaques showed high signal on SSFP and were not detected by MR. The 2 plaques contained rich fibrous component which showed higher density on MDCT (7~142 Hu, mean 58±30 Hu and 21~281 Hu, mean 134±51 Hu, respectively). This suggests that other methods such as black blood MR technique should be developed to identify the components of coronary atherosclerotic plaque .

Conclusion: Navigator CMRA with SSFP (256 x 256 matrix) showed good diagnostic accuracy for evaluation of significant stenosis caused by the non-calcified plaque, but the method could not detect the stenosis caused by small size non-calcified plaque (<2.3 mm).The mainly fibrous plaque could be depicted as high signal on SSFP and lead to false negative diagnosis. MR had significant advantage to visualize coronary lumen with severe calcified plaque.

Reference: 1, Kefer J, et al. J Am Coll Cardio, 2005; 46: 93-100 2, Leschka S, et al. Eur Heart J, 2005;19 3, Fuster V, et al. J Am Coll Cardio, 2005; 46: 1209-1218

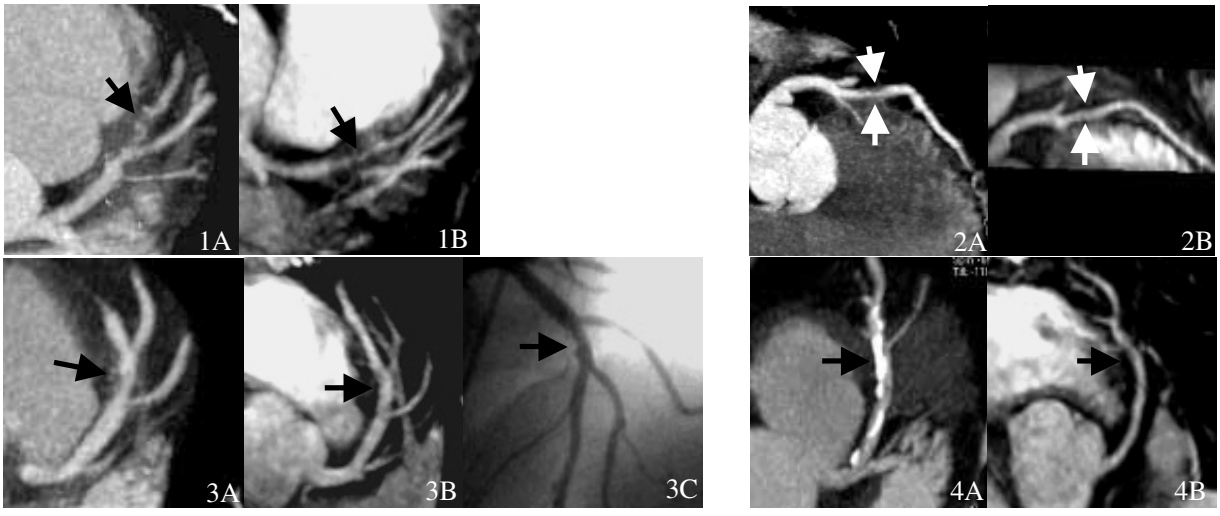

Figure 1: CTA showed an irregular non-calcified plaque in the middle LAD (1A). MRA depicted the stenosis in good correlation to CTA (1B).

Figure 2: CTA showed a centripetal plaque (thickness 2.1 mm) in the middle LAD (2A). MRA failed to visualize the stenosis in the segment (2B).

Figure 3: CTA showed a mainly fibrous plaque(mean density 134±51Hu) in the middle LAD (3A) confirmed by conventional angiography (3C). MR failed to detect the lesion due to the plaque demonstrated high signal on MR with SSFP (3B).

Figure 4: CTA showed extensive calcified plaque in LAD superimposing the lumen (4A). MRA demonstrated no significant stenosis in LAD (4B).