Comparative Study of Coronary MRA, CTA and X-ray Angiography

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Purpose: To evaluate the application of coronary MRA using navigator echo gated 3D-FIESTA sequence in stenosis detection, taking 64-MDCT coronary CTA and conventional x-ray angiography (CAG) as references.

Materials and Methods: 30 patients (21 males and 9 females) were clinically diagnosed as coronary heart disease and prepared for CAG examinations. They had coronary CTA examinations before they were enrolled in coronary MRA study. CAG was performed within 1 week after CTA and MRA. *Coronary MRA* was acquired on GE 1.5T Excite HD MR scanner, using respiratory navigator echo gated, 3D-FIESTA sequence. The major parameters were as following: TR: 4.5~4.9ms, TE: 2.1ms, prep time for myocardium suppression: 85ms, chemical selective fat saturation scheme, peripheral pulse gating, FOV: 26cm, matrix: 256*256, a slab of 16 partitions, 2mm thickness for each partition, diaphragm acceptance window for navigator threshold: 3mm. For each partition the k-space was segmented into 8 R-R interval and the data sampling windows was around 150ms. Oral beta-block agent was administrated when heart rate was over than 75bpm. The whole coronary tree was covered in 3-4 slabs. *Coronary CTA* was acquired on SIEMENS Sensation Cardiac 64 CT scanner. The major parameters were as following: 120kV, 900mAs, collimation: 0.6mm, slice thickness:0.75mm, increment: 0.5mm, pitch: 0.2:1, rotation 0.33s/rotation, 64 slices covering the whole heart. Oral beta-block agent was administrated before scan, making sure that heart rate was less than 70bpm. *CAG* was performed and reviewed by the interventional cardiologist. The data were blindedly reviewed by two radiologists. The severe stenosis was defined as lumen loss larger than 50% in diameter. Retrospective review was conducted by the principal investigator to interpret the image findings on MRA, especially those segments on which the stenosis grading were different on CTA, MRA or CAG.

Results: The table shows the sensitivity, specificity and accuracy of CTA and MRA referred to CAG. The consistency of CTA and MRA is 85.8% (201/236), where the kappa value is 0.643. On CTA, 24 of 28 segments were overestimated because they were obscured by the calcified plaques and the lumen loss could not be accurately graded. But 15 of them could be correctly graded on MRA. On MRA, 11 of 26 overestimated segments were misguided by the flow-induced low signal intensity downstream to the stenosis. 4 of 8 segments were under-estimated because of the non-calcified plaque showing bright signal intensity. The underlying plaque showed variable signal on non-calcified plaques, low signal on mixed plaque and moderate on calcified plaque. Clinically, 3 of the 4 bright plaques had myocardial delay enhancement and 8 of the 11 flow-induced over-estimation had significant angina pectoris.

Discussion: The accuracy of coronary MRA in stenosis grading is controversial when compared to the 64-MDCT coronary CTA. But coronary CTA was frustrated by calcified plaque in practice. In this study, coronary MRA using navigator echo gated 3D-FIESTA sequence is comparable to CTA in stenosis detection, showing advantage over CTA in calcified stenosis grading. Interestingly, the variable plaque intensity and flow-induced signal loss on MRA, although confusing for stenosis grading, had the potentials for plaque characterization and hemodynamic evaluation.

References:

1. Raff Gl. *et al.* J Am Coll Cardiol 2005;46:552
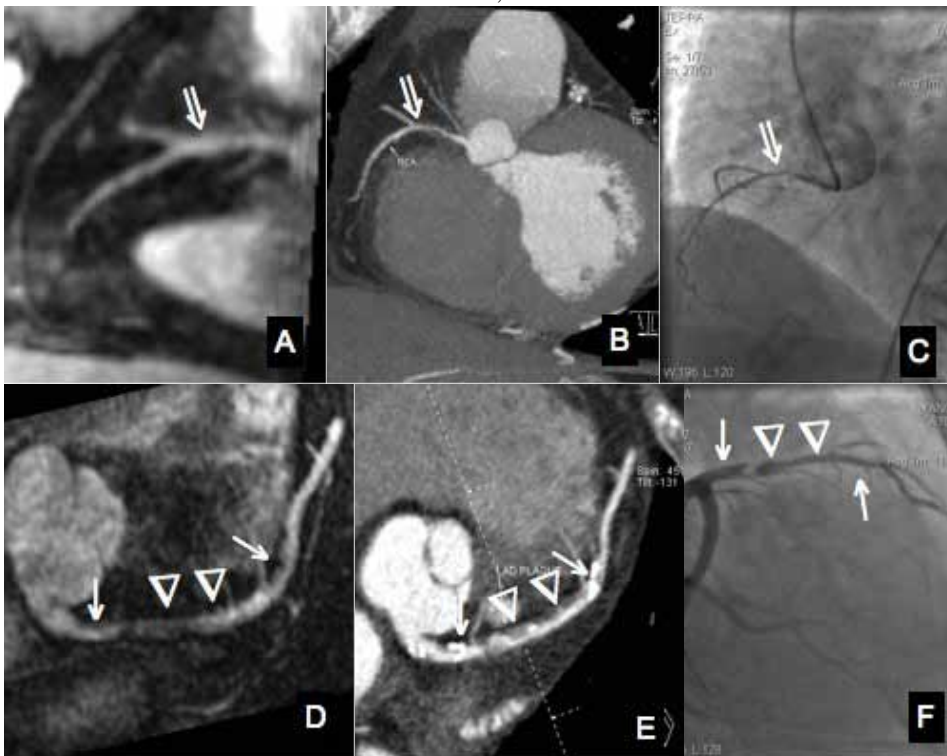2. Leber AW. *et al.* J Am Coll Cardiol 2006;47:672

Table: Comparison between CTA and MRA using CAG as reference

Index	CTA	MRA
Sensitivity	85.1%	83.0%
Specificity	87.2%	86.9%
Accuracy	86.8%	86.1%

Figure A-F: The patient had 2 diseased vessels and septum delay enhancement. The severe stenosis (⇑) on CAG (C) due to the non-calcified plaque on CTA (B) shows high signal intensity on MRA (A) and it was under-estimated on MRA. The moderate stenosis (↑) on CAG (F) due to the calcified plaques were obscured on CTA (E) but could be evaluated on MRA (D). The diffuse mixed plaque (∇∇) on CTA (E) shows variable signal on MRA (D) and it is well consistent between CTA, MRA and CAG.