Myocardial Perfusion Quantification Using Dynamic MRI and Gd-DTPA in Patients after PTCA and Brachytherapy

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Introduction
The identification of viable myocardium in patients with infarct who are likely to benefit from revascularization is mainly based on PET and other radionuclide imaging modalities. A recent study suggested the value of delayed MRI contrast enhancement for the exclusion of viability (1). However, early imaging after contrast injection with MR using first pass technique contains also important information regarding viability since K1, the MRI derived perfusion is linearly related to blood flow in permanent coronary occlusion(2). The objective of this preliminary study is to measure K1 in persistent Thallium defect area in patients with stable coronary artery disease as the first step of the evaluation of dynamic MRI for the diagnostic of myocardium viability.

Methods
Patients
16 ambulatory patients with stable CAD were studied 6 months after coronary angioplasty followed by intracoronary brachytherapy (9 to 18 Gray). The protocols consisted on a coronary angiogram, a rest and stress SPECT 201TI imaging and cine MRI coupled with a perfusion study. All the studies were completed within 28 hours.

MRI perfusion study
Two short axis view of the heart under resting conditions were obtained using a Picker Edge 1.5 T MR system with the symmetric prepared FAST sequence (body coil, FA 90°, TR 6.8 ms, TE 2.3 ms, FOV 46 x 23 cm, matrix size 192 x 256, prep time: 150 ms, 1 NEX, ECG triggered with 1 image / 2 heart beat) after injection of a bolus of Gd-DTPA (Magnevist, Schering AG, Deutschland) in a brachial vein (0.035 mmol/kg). After signal intensity calibration based on external references, blood and myocardium concentration time-curves were fitted with a one compartment model for the myocardial perfusion indices: the blood to myocardium transfer constant (K1) and the Gd-DTPA distribution volume (Vd) (3).

Data analysis
From the 3D data set of 201TI images, 2 short axis slices were reconstructed at the level of the MRI slices based on the slice position determined on the long axis MR scout image. MR and 201TI slices were divided in 4 sectors (anterior, septal, inferior and lateral). For each sector defined as normal myocardium or infarct (persistent defect on 201TI imaging), K1 and Vd were measured from the MRI transit curves.

Results
All the 16 patients were asymptomatic with no angiographical sign of restenosis or other coronary obstruction at the time of the study. 7 patients (11 over 128 sectors) had a persistent defect on 201TI imaging reflecting a previous myocardium infarct. K1 in infarct sectors (0.33 ± 0.11 ml/min) was statistically decreased by comparison with normal sectors (0.50 ± 0.09 ml/min, p < 0.0001). No difference in Vd was observed between normal myocardium and infarct (16.8 ± 3 % and 17.3 ± 4.8%, p = 0.44).

Conclusion
Quantification of myocardial perfusion using MRI in patients with stable coronary artery disease can differentiate between normal myocardium and infarct. This represents the rational for further studies on the use of MRI derived perfusion index K1 for the assessment of myocardium viability.

References

Acknowledgments
Picker International, Inc. for technical support.