Regional Myocardial Perfusion Reserve Determined by Patlak Analysis of Myocardial Perfusion MRI Showed a Good Correlation with Coronary Flow Velocity Reserve Measured by Doppler Flow Wire.

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Introduction:

Previous studies using intra-coronary Doppler wire demonstrated that assessment of coronary flow reserve is highly useful in determining functional significance of stenosis in the epicardial coronary arteries and in evaluating microvascular disease [1-3]. However, intra-coronary Doppler wire is invasive and can only be available during cardiac catheterization. Patlak plot analysis of arterial input and myocardial output functions on stress-rest myocardial perfusion MRI can provide quantitative assessment of regional myocardial perfusion in patients with coronary artery disease [4]. The purpose of this study was to evaluate the accuracy of myocardial perfusion reserve quantified by Patlak plot analysis of myocardial perfusion MRI, by comparing with coronary flow velocity reserve measured by intra-coronary Doppler wire.

Methods:

Twenty patients (mean age 68+/-9 years) with coronary artery disease were studied. Flow velocity in the coronary artery was measured by intra-coronary Doppler flow wire in the resting state and during ATP stress in a total of 37 coronary arteries (LAD 15, LCX 12, RCA 10). First-pass myocardial perfusion MRI was performed within 6 days of Doppler flow measurement with a 1.5 T MR system (Signa CV/i, GE Medical Systems) by using a saturation recovery steady-state perfusion MR sequence (TR 3.0ms; TE 1.2ms; TI 180ms; flip-angle 45 degrees) and an intravenous bolus injection of Gd-DTPA (0.05mmol/kg, 4ml/sec). To obtain blood time-intensity curve without signal saturation, we initially acquired first-pass contrast enhanced MR images by injecting low-concentration (0.005mmol/kg) Gd-DTPA. Then first-pass contrast enhanced myocardial perfusion MR images were obtained during ATP stress and in the resting state. After correcting saturation of the blood signal and coil sensitivity profile, arterial input and myocardial output time-intensity curves were analyzed with a Patlak plot method to quantify tissue K1, which represents product of tissue plasma flow and extraction fraction of Gd-DTPA. Quantitative MR measurements of regional myocardial perfusion reserve were compared with the results by Doppler flow wire in the corresponding vessels.

Results:

Figure 1 demonstrates the relation between regional myocardial perfusion reserve determined by quantitative analysis of stress-rest myocardial perfusion MRI and coronary flow velocity reserve measured by intra-coronary Doppler flow wire in the corresponding vessel. A good linear correlation with statistical significance was observed between MR assessments of myocardial perfusion reserve and intra-coronary Doppler measurements of coronary flow velocity reserve ($R=0.73$, $p<0.001$). The averaged myocardial perfusion reserve in 37 coronary arteries in patients with coronary artery disease determined by quantitative assessment of stress-rest perfusion MRI was 1.74+/-0.46. The averaged coronary flow velocity reserve measured in the corresponding coronary arteries by Doppler flow wire was 1.95+/-0.70 (p=N.S.).

Conclusion:

In the current study, an excellent linear correlation was found between MR perfusion reserve and intra-coronary Doppler flow velocity reserve in 20 patients. Quantitative analysis of stress-rest myocardial perfusion MRI can provide accurate and noninvasive assessment of regional myocardial perfusion reserve in patients with coronary artery disease.

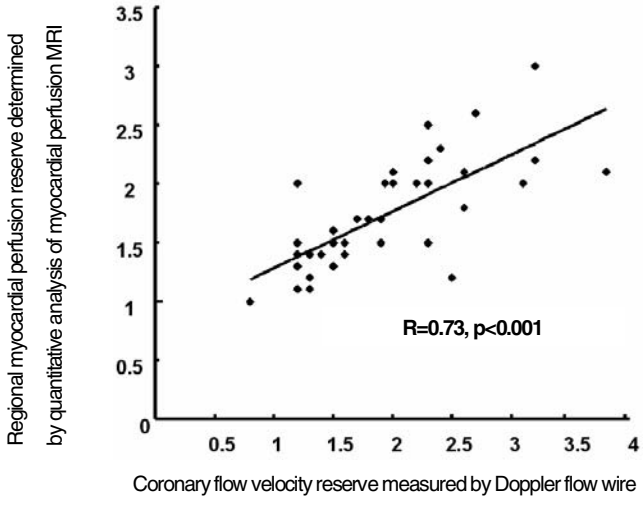

Figure:
Graph shows relationship between coronary flow velocity reserve measured by Doppler flow wire and regional myocardial perfusion reserve determined by quantitative analysis of myocardial perfusion MRI. A good linear correlation ($R=0.73$, $p<0.001$) was observed.

References:

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