Feasibility of Detecting Myocardial Ischemia Using First-Pass Contrast MRI and Regadenoson

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Objective: Determine the feasibility of using a single injection coronary vasodilatory agent, regadenoson, in cardiac MR perfusion imaging.

Background: Cardiac stress MR perfusion imaging requires an MRI compatible infusion pump for the administration of adenosine or a non-MRI compatible pump housed in the control room or beyond the 10-Gauss line. This later method requires high-pressure extension tubing running for some distance across the control room and/or scan room floor. This has the potential to compromise both the quality of the examination and patient safety. Regadenoson is a recently FDA-approved A2A receptor agonist which can be given intravenously in a single 400 microgram bolus [1,2]. We hypothesize that a single injection of regadenoson could be used instead of an adenosine infusion to produce coronary vasodilatation and demonstrate myocardial ischemia during first-pass perfusion cardiac MRI.

Method: 44 patients (35 M, 54 yrs, range 41-73 yrs) with a reversible myocardial perfusion defect on SPECT-MPI underwent a cardiac perfusion MRI within 7 days of the SPECT-MPI. The first-pass stress cardiac MR perfusion examination was acquired on a 1.5T MAGNETOM Avanto (Siemens Healthcare USA, Malvern, PA) with Total Imaging Matrix six element body phased-array coil and a six to nine element spine matrix coil. MR exams consisted of short and long axis cine steady state free precession (SSFP) imaging, SR prepared TurboFLASH cardiac first pass perfusion (TI=100ms, TE=1.05ms, TR = 2.2ms, 650 Hz/px, TPAT 2, 160 base resolution) with matched slice positions and delayed contrast-enhanced (DCE) T1 GRE imaging. The last 21 subjects included non-rigid motion correction [3] First-pass perfusion images were obtained 30 seconds after regadenoson 400 micrograms administered in a single IV bolus and during power injection of 0.075 mmol/Kg of gadobenate dimeglumine at 5 mL/sec IV followed by normal saline flush. DCE imaging was obtained 10 minutes after injection of an additional 0.025 mmol/Kg of contrast agent.

Results: All but one patient tolerated the regadenoson MR examination. One patient had chest pain shortly after imaging, and received aminophylline, with resolution of symptoms. MR showed ischemia in 35/44 subjects. In 8 subjects the MR perfusion exam was normal. Five of these 8 patients underwent clinically-ordered invasive cardiac catheterization (ICA) within 3-18 days of the MRI examination. ICA showed no stenoses, suggesting SPECT attenuation artifact. The other 3/8 patients had no MACE within 30-180 days. In one patient, SPECT demonstrated ischemia only, while MRI showed infarct only in the same segment.

Discussion: Regadenoson is a recently FDA-approved A2A receptor agonist which can be given intravenously in a single 400 microgram bolus [1,2]. In human beings it has been shown to increase myocardial blood flow (MBF) by more than 2.5-fold above baseline for at least 2 minutes [2] and has been shown to provide diagnostic information regarding myocardial ischemia on single photon emission computed tomography myocardial perfusion imaging (SPECT-MPI) [4]. In this study, we demonstrate that regadenoson can be safely used in an MRI setting. MRI perfusion findings with regadenoson were overall similar to findings with regadenoson in SPECT. Of note 8 patients with vascular distribution perfusion defects on SPECT were noted to be normal on MRI imaging. However, 5 of these 8 patients subsequently underwent ICA examinations which showed no flow-limiting stenoses, suggesting that the SPECT findings may have been attenuation artifact.

Conclusion: Regadenoson can be used safely in cardiac MR perfusion imaging to demonstrate ischemia.

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