Combination of adenosine stress perfusion and MR coronary angiography using an intravascular contrast agent: a feasibility study

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Introduction:

Coronary artery disease (CAD) is still the leading cause of death in the developed nations [1]. For the diagnosis of CAD, invasive coronary artery angiography (CXA) must still be considered as the standard of reference. Recently, noninvasive magnetic reconance coronary angiography (MRCA) has become feasible using breath-hold ECG-triggered 3D-fast gradient echo (FLASH) sequences with suppression of myocardial signal to improve image quality. Furthermore, intravascular contrast agents have been introduced and these agents significantly improve image quality and accuracy of MRCA [2]. However, all luminographic techniques including MRCA, only provide morphologic information and lack of functional data to assess myocardial ischemia. Previous animal studies demonstrated, that first pass stress perfusion imaging using intravascular contrast agents allows for the detection of myocardial ischemia, with prolonged delineation of perfusion defects compared to extracellular agents. The aim of this study was to evaluate an intravascular contrast agent for combined first pass myocardial stress perfusion / MRCA protocol.

Materials and Methods:

5 healthy volunteers (4 male, 1 female, mean age 27±4) and 6 CAD patients (6 male, mean age 61±9 years) were included into the study. All examinations were performed on a 1.5 T MR scanner (Magnetom Sonata, Siemens). Adenosine stress (0.140mg/kg body weight) and rest first pass myocardial perfusion imaging was performed using a saturation-recovery gradient-echo (SR-FLASH) sequence (TR 2.0ms, TE 1.2ms, FA 12°, GRAPPA2) in short axis orientation. For the perfusion scans Gadomer (0.025 mmol/kg bw, Schering AG) was injected at a flow rate of 2 ml/s using a power injector. Thereafter, and additional dose of 0.1 mmol/kg of body weight Gadomer was applied and MRCA of the proximal and middle coronary segments was performed using a breath-hold inversion recovery 3D fast low angle shot sequence (IR-FLASH, TR 3.8ms, TE 1.6ms, FA 25°, bandwidth 490 Hz/pixel, matrix 320, voxel size 1.8-2.3 mm^3). The inversion time (TI) was individually adjusted to minimize the signal of the myocardium und to increase the contrast between blood and myocardium.

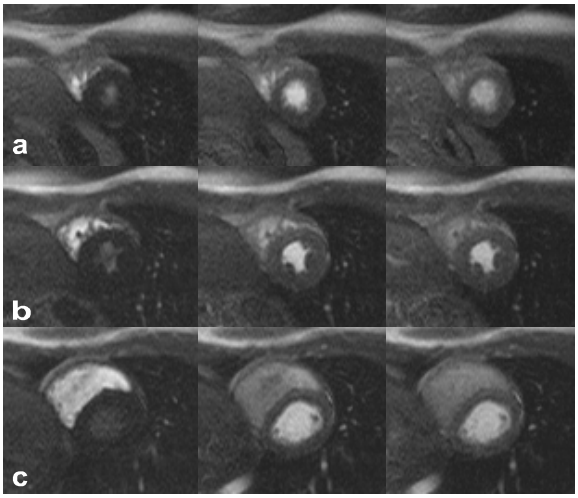

Fig 1: Myocardial stress perfusion images in a healthy volunteer: apical (a), midventricular (b) and basal (c).

Results:

Stress and rest first pass perfusion imaging (Fig. 1) and MRCA imaging (Fig. 2) was successfully completed in all subjects. Neither acute nor late-phase adverse effects were observed in our study cohort. All volunteers showed homogenous enhancement of the myocardium. In one CAD patient we detected a subendocardial perfusion defect in the posterior wall. MRCA allowed the visualization of the proximal and middle coronary artery segments in all subjects. In the CAD patients stenoses of the RCA (n=2), the LAD (n=3) and the RCX (n=2) were detected and confirmed by catheter angiography (Fig. 2).

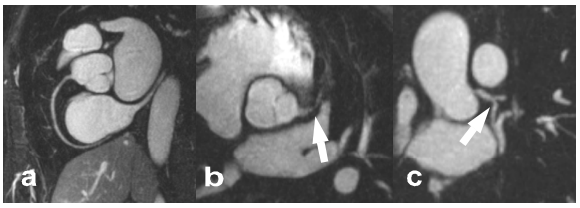

Fig 2: IR FLASH-MRCA of normal RCA (a), and stenosis of the LAD (arrow, b) and the RCX (arrow, c) in CAD patients.

Discussion:

Our study demonstrates the feasibility of a combined first pass stress perfusion / MRCA protocol using an intravascular contrast agent. This examination provides functional and morphologic information for a comprehensive assessment of CAD patients. MRCA accurately detected stenoses in the proximal and middle segments of the coronary arteries, but we only detected one perfusion defect in our study cohort, although Gadomer provided prolonged differentiation of ischemic from remote myocardium in an animal model of myocardial ischemia [3]. However, the applied protocol proved to be feasible and mandates further clinical evaluation in a larger group of CAD patients.

References:

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