In vivo imaging of myocardial infarction at 3 Tesla in humans – Preliminary experience

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Introduction: Contrast-enhanced (ce) magnetic resonance imaging (MRI) using a segmented inversion-recovery turbo FLASH technique for visualization of myocardial infarction has been presented recently (1). In animal studies, close correlation for presence, location and extent of ceMRI and histopathology (2), and in patients studies, close correlation to the standard technique for visualization of myocardial scar, positron emission tomography (3), has been shown. 3.0T systems which have recently been approved for clinical use are expected to supply improved signal-to-noise ratio (SNR). But next to the limited availability of high-field systems equipped for cardiac applications, other potential impediments include increased suceptibility artifacts, radiofrequency field distortions and more problematic reliable ECG triggering due to the amplified magneto-hydrodynamic effects (4). We, therefore, evaluated the feasability of myocardial infarction data acquisition at 3 Tesla in humans.

Methods: 14 consecutive patients who had suffered clinically proven (elevation of myocardium-specific creatine iseoenzyme more than twice the upper limit) myocardial infarction were examined on a 3.0T scanner (TRIO, Siemens, Erlangen, Germany). Ce images in long- and short-axis orientation of the heart were acquired 10 min after intravenous injection of 0.2 mmol/kg Gd-DTPA (MAGNEVIST, Schering, Berlin, Germany) using an inversion recovery Turbo FLASH sequence (TE 4.3 ms, TR 370 ms, flip angle 30°, inversion time 220-300ms). From each of the patient studies, a single short-axis image showing both the largest high-signal lintensity region and normal regions of myocardium was selected. The mean signal intensity of the myocardial regions with elevated signal intensity and that of a remote normal myocardium, as well as the SD of noise in a rectangular region outside the patient body, was measured. The percent signal intensity elevation in the infarcted myocardium was calculated by the following equation: percent elevation = 100 x (mean signal intensity of high-signal-intensity region – mean signal intensity of normal region) / (mean signal intensity of normal region) (1). Image contrast-to-noise ratios (CNR) were calculated by the following equation: (mean signal intensity of high-signal-intensity region – mean signal intensity of normal region) / (1.5 x SD of noise) (1).

Results: Data in all of the 14 patients were acquired without any subjective problems reported by patients. ECG artifacts did occur related to scanning in 2 patients, but did not intefere with data acquisiton. Ce images showed evidence of myocardial infarction in all of the 14 patients by exhibiting areas of elevated signal intensity (figure 1). The mean percent signal intensity elevation in the infarcted myocardium was 1107±87%, the mean CNR 36.0±7.3.

Conclusions: Ce imaging of myocardial infarction using a segmented inversion-recovery turbo FLASH technique on a 3.0T system was shown to be feasible in this study and produced stable results for image quality and visualization of myocardial infarction. Quantitative image parameter as the percent signal intensity elevation in the infarcted myocardium and the CNR showed even better values as reported by using the same sequence on a dedicated clinical 1.5T scanner (1). The value of high-field scanners fo cardiac imaging, however, awaits further clinical trials and applications as stress first-pass perfusion, coronary and plaque imaging, for which improved signal characteristics supplied by the higher magnetic field strength are mandatory.

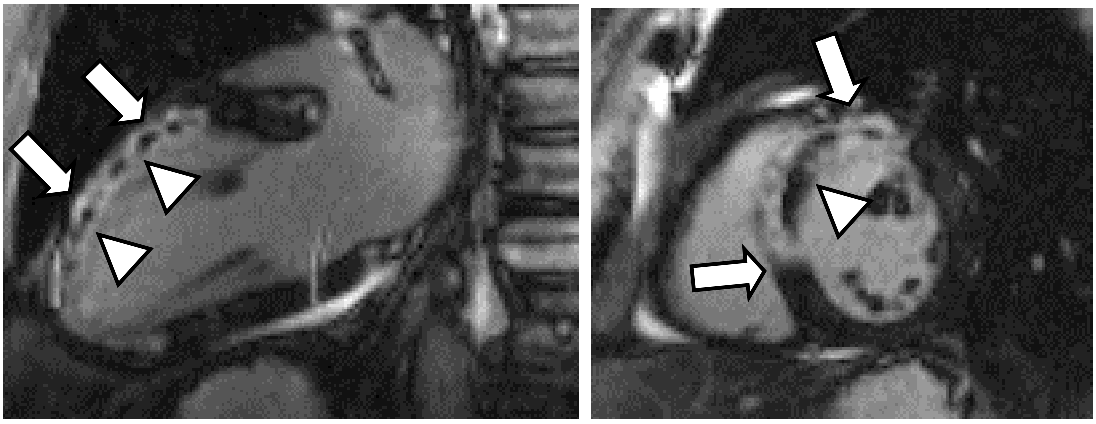

Figure 1: Contrast-enhanced MRI of a patient with an anteroseptal myocardial infarction. MRI shows hyperenhancement of the anteroseptal region (arrows). The black areas surrounded by hyperenhancement (arrowhead) are no-reflow zones.

References
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