Assessment of myocardial viability using contrast enhanced MRI –Comparison of Gd-DTPA and Gd-BOPTA

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Introduction: Recent studies have demonstrated that contrast-enhanced magnetic resonance imaging (MRI) permits the differentiation between reversible and irreversible ischemic myocardial injury (1,2). Much effort has been spent to find both optimum dose and time point for data acquisition after contrast injection. However, the effect of different contrast agents on contrast to noise ratio and the course of T1 values over time in damaged and normal myocardium has not been assessed yet. The aim of this study was to compare Gadobenate Dimeglumine (Gd-BOPTA) and Gadopentate Dimeglumine (Gd-DTPA) for the assessment of myocardial viability in patients with chronic myocardial infarction (MI).

Methods: 15 patients with a history of MI were examined on two separate occasions with both agents (Gd-BOPTA, Multihance, Bracco S.p.A., Milan, Italy, and Gd-DTPA, Magnevist, Schering AG, Berlin, Germany) in random order. The minimum time between both examinations was 48h. Following the acquisition of cine MRI images to assess myocardial function, MR imaging was performed after the injection of each contrast agent (0.2 mmol/kg). T_1 values of non-infarcted myocardium, infarcted myocardium and left ventricular cavity (LVC) were determined based on steady state free precession images with incrementally increased inversion times acquired during a single breath-hold (3). This sequence was performed 1, 3, 5, 10 and 20 minutes after contrast injection. T1-values were obtained using the following equation: $T1 = TI_{(min)}/\ln 2$, where $TI_{(min)}$ is the inversion time of the image with the minimum signal intensity of the tissue. 15 min after injection of the contrast agent late enhancement MR imaging was performed using a segmented inversion-recovery gradient-echo sequence (TR: 8 msec; TE: 4,3 msec; flip angle: 25°). Signal intensities and contrast-to-noise-ratio were measured in the non-infarcted myocardium, the infarcted myocardium, and the LVC. The intraindividual comparison of CNR values was based on a Wilcoxon-Mann-Whitney U-test for non-parametric data, a *p* value < 0.05 was considered statistically significant.

Results: Analysis of T1 values at all time points after contrast injection showed statistically significantly lower values for Gd-BOPTA data sets in the infarcted and non-infarcted myocardium compared to Gd-DTPA ($p<0.05$). While T1 values in the LVC were not statistically significantly different for both agents 1 min after contrast administration ($p>0.05$), they were statistically significantly lower for Gd-BOPTA ($p<0.05$) at 3, 5, 10, and 20 min after injection. Comparative analysis between measurements in the Gd-BOPTA data sets 15 minutes after injection and those obtained with Gd-DTPA demonstrated significantly higher SI in the infarcted myocardium and the LVC for Gd-BOPTA ($SI_{infarct}$ 58.6 ± 10.9 vs. 45.2 ± 13.3, $p < 0.02$; SI_{LVC} 69.8 ± 18.5 vs. 41.4 ± 9.0, $p < 0.01$) whereas the SI in the non-infarcted myocardium was not significantly different ($SI_{noninfarct}$ 12.7 ± 7.2 for Gd-BOPTA vs. 9.3 ± 6.7 for Gd-DTPA ($p > 0.05$). $CNR_{infarct\text{-}noninfarct}$ was significantly higher in the Gd-BOPTA data sets compared to Gd-DTPA (48.6 ± 14.2 vs. 34.5 ± 15.4, $p < 0.04$), whereas $CNR_{infarct\text{-}LVC}$ was significantly higher in Gd-DTPA enhanced images (5.2 ± 8.5 vs. –10.9 ± 17.9, $p < 0.02$; Figure 1).

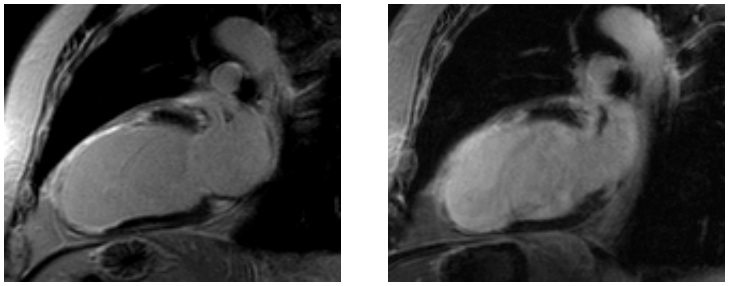

Figure 1: Contrast-enhanced MRI images in a patient with a large myocardial infarction in LAD territory using Gd-DTPA (left) and Gd-BOPTA (right).

Conclusion: 15 minutes after contrast injection CNR between infarcted und normal myocardium was higher in the Gd-BOPTA data sets in comparison to Gd-DTPA. Gd-DTPA permitted better differentiation between the infarcted myocardium and the LV cavity which in turn may help to detect subendocardial infarction, because 15 minutes after injection of Gd-BOPTA the LV cavity was still isointense or slightly hyperintense compared to the infarcted tissue. In order to distinguish between the infarcted tissue and the LVC, late-enhancement studies using Gd-BOPTA might benefit from a longer delay after contrast injection. However, to improve workflow in cardiac MRI a more rapid clearing contrast agent appears advantageous.

References:

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