MR Imaging of acute myocardial infarction: extent of late enhancement and no-reflow areas

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Introduction: In patients with acute myocardial infarction (MI) contrast enhanced MR imaging frequently shows a dark zone in the centre of the enhancing necrotic myocardial tissue [1,2]. This 'no-reflow' area indicates microvacular obstruction and the extent of these dark zones is associated with an increased number of cardiac events and poor prognosis [2]. The aim of our study was to investigate the optimum time-point after contrast administration for the assessment of the 'late enhancement' area indicating infarcted tissue and the area of the no-reflow zones using a single shot inversion recovery steady state free precession sequence which allows coverage of the entire heart in single breath-hold.

Materials and Method: 20 patients with first acute myocardial infarction (15 male, 5 female, mean 66 years, range 40 to 76) were included into this study in accordance with the regulations of the local ethics committee. Patients with a history of PCI, CABG (coronary artery bypass grafting) and previous myocardial infarction were not included. All patients were treated by acute PCI (percutaneous coronary intervention) resulting in TIMI grade 3 flow. Within the first 5 days after acute myocardial infarction imaging was performed using a 1.5 T MR-scanner (Siemens, Magnetom Sonata). One, 2, 3, 4, 5, 10, 15 and 20 minutes after i.v. administration of Gadodiamid (0,2 mmol/kg, Omniscan, Amersham) MR-imaging was performed using a single shot inversion recovery steady-state free precession sequence (TR 2.4 ms, TE 1.08 ms, TI 180-280 ms, FA 50°) covering the entire ventricle in a single breath-hold. For the first 4 data sets an inversion time of 200 ms was used, whereas for all other data sets the inversion time (TI) was set to null the signal of normal myocardium. The area of late enhancement and the area of the no-reflow zone were measured by planimetry for the different time points after contrast injection.

Results: The area of 'late enhancement' indicating myocardial infarction increased from 21±15% of the LV myocardium at five minutes to 25±18% at 10 minutes ($p<0,05$) and remained unchanged over the next 10 minutes (25±18% at 20 minutes, $p> 0.05$) Immediately after contrast injection a no-reflow area was detected in 16/20 patients (anterior MI n=10, inferior MI n=6, mean infarct size 29±14% of the LV myocardium). Only 4 patients with small MI (8±2% of the LV myocardium) showed no area of microvascular obstruction. In all patients the extent of the no-reflow area significantly decreased over time from 10±8% immediately after contrast injection, to 8±7%, 5±7% and 3±4% of the LV myocardium at 5, 10 and 20 minutes after contrast injection (Figure 1).

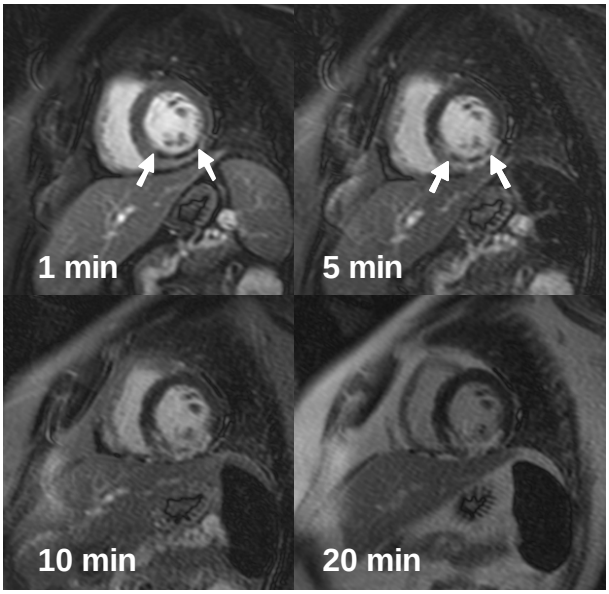

Figure 1: 64 yo female patient with acute inferior myocardial infarction. The extend of the no-reflow area (arrows) decreases over time. 20 minutes after injection the infarcted tissue shows homogenous enhancement.

Conclusion: Several studies have demonstrated the potential of contrast-enhanced MRI to visualize microvascular obstruction in patients with acute myocardial infarction [1]. Compared to other studies [2] our data show a higher incidence of no-reflow zones, because we used fast single shot inversion recovery TrueFISP sequence, covering the entire left ventricle in a single breathhold immediately after contrast injection. Techniques covering only a limited number of slices or techniques covering the entire ventricle within several minutes after contrast injection will underestimate the extent of the no-reflow area because it continuously decreases over time. Therefore, measurements of the no-reflow area to assess patients prognosis should be performed immediately after contrast injection with techniques covering the entire ventricle, whereas scanning to detect 'late enhancement' in patients with acute myocardial infarction requires a delay of at least 10 minutes after contrast injection.

References:

1. Beek AM et al. JAAC (2003) 42, 895-901
2. Wu KC et al. Circ (1998) 97, 765-772