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Meeting abstract

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1078 T1-weighted, navigator-gated HASTE for the monitoring of the early enhancement of myocardium

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Introduction

Monitoring the uptake of contrast agent early (1–4 minutes) after injection has been previously demonstrated to have diagnostic and prognostic value in certain pathologies, most notably myocarditis. However, monitoring of the passage of contrast through the myocardium can be challenging. Due to the long time span which is of interest, breath hold techniques are inappropriate. Previous work has used averaging to overcome respiratory motion artifacts, but image quality is often poor, and only two data sets (pre-contrast and early enhancement) are acquired.

Magnetization-prepared HASTE (Half Fourier Acquisition Single-shot Turbo Spin Echo) can rapidly acquire T_1-weighted images. Additionally, a previously described respiratory compensation scheme (Prospective Acquisition Correction, PACE) technique can be used to compensate for respiratory motion. This potentially allows for time-resolved monitoring of contrast agent in the myocardium over several minutes post-injection.

Purpose

To demonstrate the feasibility of a free-breathing, T_1-weighted HASTE sequence to monitor the passage of contrast through the myocardium over a four minute period.

Methods

Contrast imaging was performed using a HASTE sequence. A low resolution gradient-echo image of the diaphragm was used to monitor breathing patterns and reject images not acquired during end expiration (2D PACE). Before acquisition, a modified saturation recovery (SR) scheme described previously was applied to achieve T_1-weighting. This SR scheme consisted of a series of saturation pulses designed to give strong T_1-weighting while minimizing the effects of eddy currents and off-resonance effects.

This study was performed in six healthy volunteers (3 male; mean age 33) and was approved by our Institutional Review Board. All volunteers were scanned using a 1.5 T MAGNETOM Avanto (Siemens Medical Solutions, Erlangen, Germany) with a dedicated cardiac coil. After basic localization to determine the short axis of the heart, the volunteers were scanned with the modified HASTE sequence described above. Measurements were acquired over a four minute period post-contrast injection of a single dose of Gd-DTPA (Magnevist; Berlex Canada, Pointe-Claire, Québec). A single slice was acquired per heartbeat, and one data set consisted of three short axis slices of the heart. Typical imaging parameters were: TR/TE/flip angle = 133 ms/24 ms/90°; FOV = 234 × 340 mm^2; matrix = 176 × 256; slice thickness = 10 mm; Saturation Time = 80 ms.

Data was analyzed using a validated software package. Subepicardial and subendocardial contours were used to segment the myocardium in each image. Using these Regions-of-interest (ROIs), the signal intensity vs. time for each slice was recorded in the myocardium. ROIs were

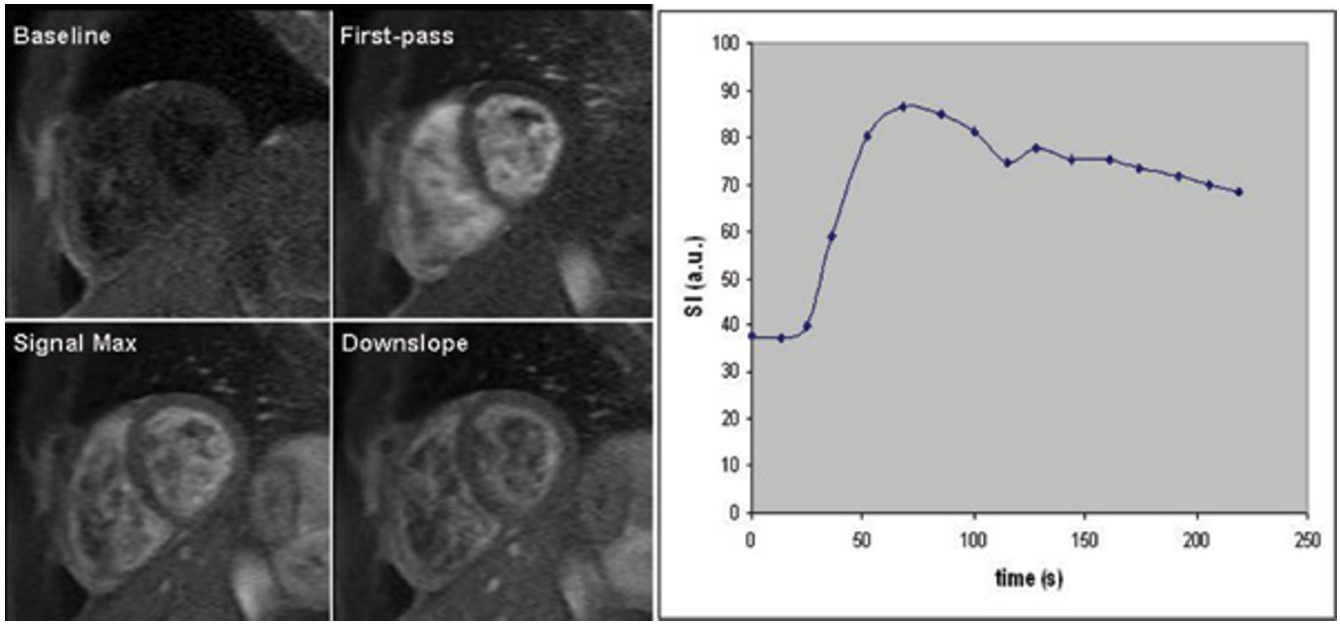

Figure 1
Left: Select images from a typical volunteer at baselinse (t = 0 s after injection), during first-pass perfusion (52 s) at the maximum myocardial signal intensity (68 s) and during contrast washout/downslope (161 s). **Right**: Signal intensity (SI) vs. time (in seconds) for the same data set.

also drawn in skeletal muscle in the first (baseline) image. Signal vs. time graphs were generated for the myocardium (normalized to baseline skeletal muscle signal intensity), and the slope of all points past the signal maximum were calculated using a linear fit in Microsoft Excel.

Results

Multiple 3-slice data sets were acquired over the 4 minute period in all volunteers (Mean number of data sets = 14; range = 5–21). Select images and a plot for a typical study are shown in Figure 1. The mean slope for the time curves, after normalization using the signal intensity for skeletal muscle, was -0.0020 +/- 0.0006.

Conclusion

Continuous monitoring of the passage of contrast through the myocardium over the early enhancement period (0–4 minutes) with free-breathing HASTE is feasible. The results were highly reproducible with a low standard deviation. Earlier techniques which do not compensate for respiratory motion have been shown to have value in identifying patients with myocarditis; further studies are needed to show whether this technique has similar or improved clinical value.