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Poster presentation

Myocardial perfusion with ultra fast spin-echo single-shot echo-planar-imaging

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Introduction

Cardiac motion during each single-shot image is one source of Dark-Rim-Artifacts (DRA) in first-pass myocardial perfusion [Storey, et al., MRM, 48:1028, 2002].

Purpose

This work aimed to minimise motion DRA by developing an ultra-fast but robust sequence, assessing its in-vivo performance for myocardial perfusion. Noting that bright-blood imaging is unnecessary for visual perfusion assessment (but is responsible for many DRAs), the sequence was spin-echo single-shot echo-planar-imaging (EPI) [Edelman and Li, Radiology 1994] modified to improve robustness with respect to cardiac motion and frequency tuning errors by rapidly imaging a narrow strip enclosing the LV ("zonal-EPI") with further acceleration using parallel imaging.

Methods

Six volunteers were scanned during high-dose (0.1 mmol/kg 1 M 3.5 ml/s antecubital Gadobutrol, 15 ml saline flush) first-pass rest perfusion using zonal-EPI (1.5 T, Siemens Avanto), standard 12-element "body array", TE 22 ms; pixel size 3.1 × 3.1 × 10 mm; read/phase FOV 370/156 mm; 2230 Hz/pixel; GRAPPA R = 2; saturation-recovery each slice TI = 115 ms; total time per slice 125 ms. The localised phase-encode FOV coupled with parallel-imaging reduced data acquisition time to 16 ms. In each of 50 cardiac cycles, three slices were acquired starting at each R-wave without particular timing to avoid cardiac motion. 18-segment myocardial Contrast-to-Noise-Ratio (CNR) was measured between pre-contrast and the peak Signal-

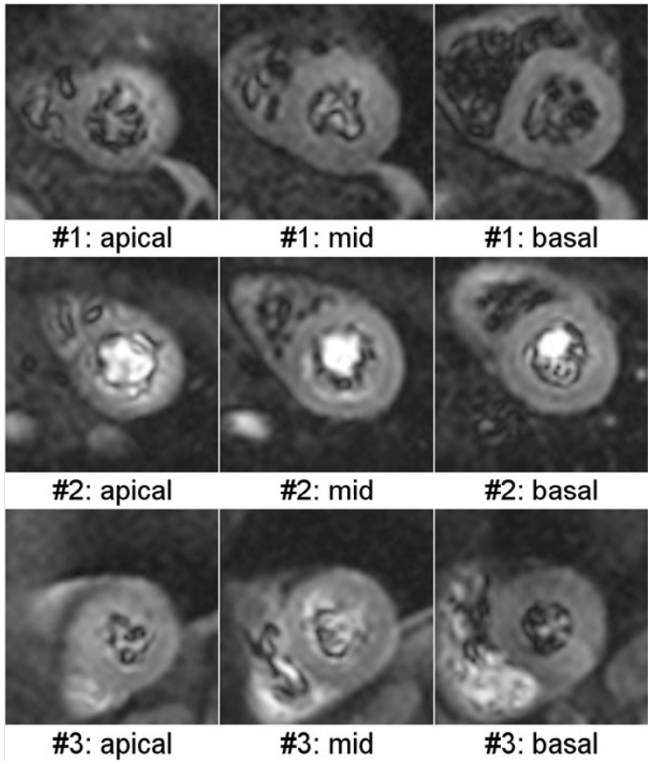

Figure 1
Three in-vivo examples of the zonal sequence. All scans were acquired with an apical -> mid -> basal order. Partial volume effects can be seen in the apical slice only.

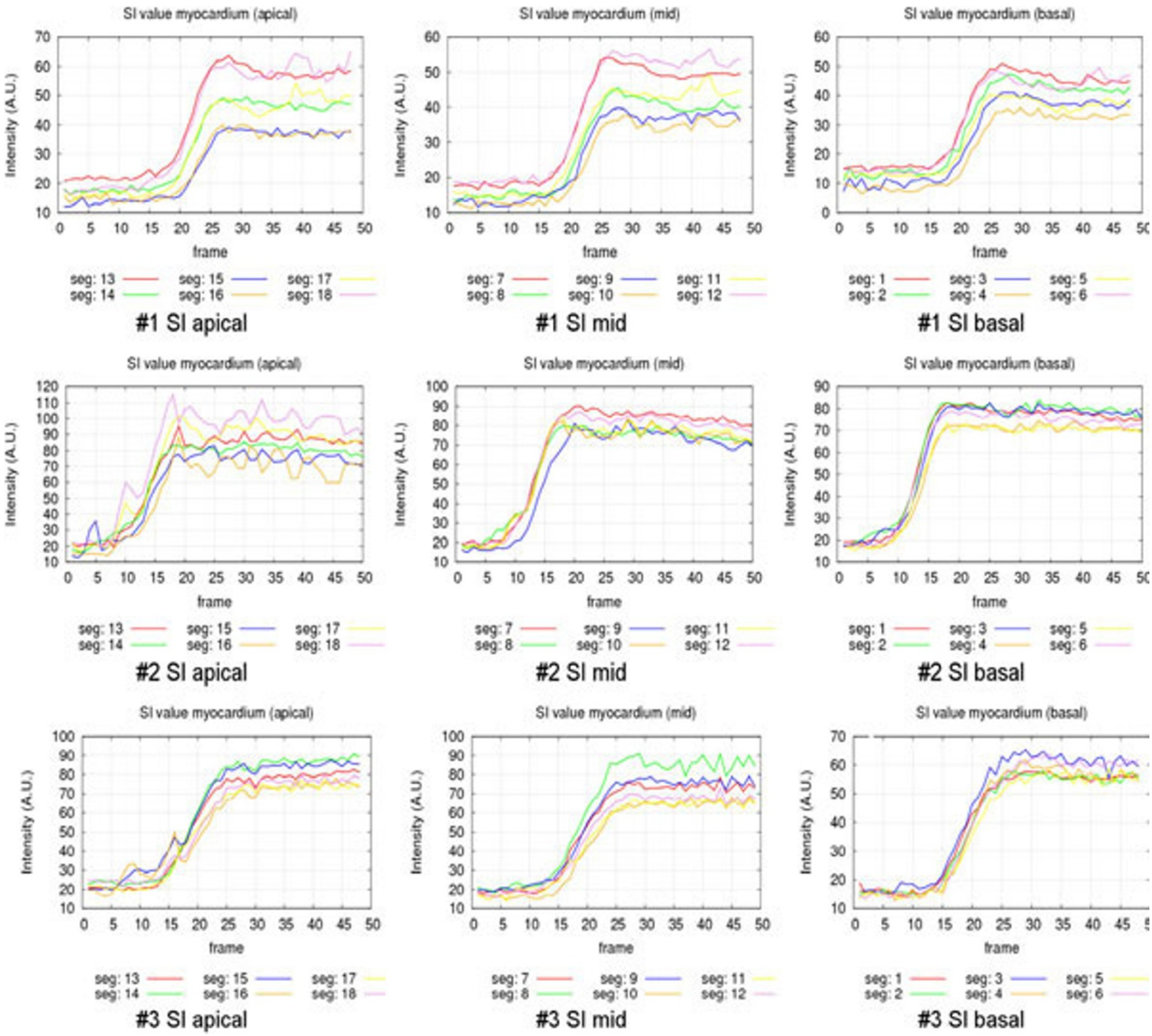

Figure 2
The respective myocardial signal intensity curves for the in vivo examples shown in Figure 1. Each slice divided the myocardium into 6 segments.

Intensity (SI), using the pre-contrast ROI's temporal standard deviation to measure noise. Preliminary work in volunteers (results not shown) demonstrated that extra blood suppression techniques tended to reduce myocardial signal during LV filling, therefore no additional blood suppression was employed.

Results

In all subjects and slices, the myocardium was imaged throughout first-pass without distortion or signal loss due to motion or the CA first-pass bolus (Figure 1). LV blood signal was only partially reduced but there were no rapid flow "accidental phase-encoding" artefacts from the remaining bright blood. Gibbs artifacts, another cause of perfusion DRA, were also reduced with the LV blood brightness. The 18-segment myocardial SI curves (Figure 2) were similar to conventional first-pass imaging, yielding average CNR of 10.9 over all subjects. However it is difficult to compare CNR against other work, e.g. various noise measurement methods, differing voxel volumes, and greater CNR of normal myocardium stress perfusion than at rest.

Conclusion

Reliable single-shot EPI was achieved during first-pass high dose perfusion with the short parallel imaging zonal-EPI acquisition time. The reduction of at least the motion-related subendocardial dark-rim artefacts may be useful in myocardial perfusion.