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Meeting abstract

2004 3D first-pass myocardial perfusion imaging with complete left ventricular coverage at 3 Tesla

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Introduction

MR first-pass myocardial perfusion imaging (MPI), with its high spatial and temporal resolution and lack of exposure to ionizing radiation, is an ideal technique to diagnose and prognosticate in patients with possible coronary artery disease (CAD) [1]. In conventional 2D multi-slice MPI, incomplete coverage of the left ventricle (LV) can lead to less accurate evaluation of myocardial perfusion. Accelerated 2D multi-slice imaging can achieve more complete coverage [2], but suffers from suboptimal slice profiles and possible inter-slice signal contamination. Three-dimensional (3D) MPI is an attractive alternative, due to its true volumetric coverage and inherently greater signal-to-noise ratio (SNR), and has been reported at 1.5 T [3]. The purpose of this study was to demonstrate 3D first-pass MPI with complete LV coverage at 3 T, by combining 3DFT encoding and 2D parallel imaging. High quality perfusion images were obtained from healthy volunteers and semi-quantitative analysis was performed.

Purpose

To determine the feasibility of 3D first-pass MPI with 2D parallel imaging at 3 Tesla.

Materials and methods

Experiments were performed using a GE Signa Excite HD 3 Tesla scanner with 40 mT/m gradient amplitude, a slew rate of 150 T/m/s, and an eight-channel cardiac phased array coil. ECG and plethysmographic gating were used to synchronize data acquisition at diastole to minimize the effects of cardiac motion. The pulse sequence consisted of a BIR4 saturation RF and a 3DFT gradient echo acquisition. The imaging excitation was slab-selective with a time-bandwidth product of 4. Imaging parameters were: TR/TE = 2.3/0.9 ms, flip angle = 10°, FOV = 30 × 30 × 12 cm^3, spatial resolution = 3.0 × 4.5 × 10.0 mm^3. 2D TSENSE [4,5] was used with an acceleration factor of 3 and 2 along the phase and partition encoding directions, respectively. Imaging time was 303.6 ms per heart beat. Contrast agent (Gd-DTPA, Magnevist, 0.1 mmol/kg) and subsequent saline flush (20 ml), were administered at a rate of 5 ml/s. Prior to contrast injection, proton-weighted images were obtained with a 4° flip angle and without BIR4 saturation. Subjects were asked to perform a breath-hold for as long as possible. Three healthy volunteers were studied (3 males, age 28–34) after providing informed consent.

Data were analyzed using MATLAB. All raw images were normalized by the proton-weighted images for surface coil intensity correction. Epicardial and endocardial borders were outlined for each slice. Within these borders, time intensity curves (TIC) were generated on a pixel-by-pixel basis, and the corresponding upslope values were computed by linear regression analysis between the time of contrast arrival and the time of peak enhancement. The upslope values were subsequently scaled such that 100% represented the average upslope value of the whole myocardium.

Results

Representative perfusion images are shown in Fig. 1. Signal enhancement due to the arrival and passage of contrast agent was clearly visualized in all myocardial segments. The TSENSE accelerated perfusion images exhibited adequate SNR for qualitative diagnostic interpretation. A small degree of signal fluctuation was observed in the reconstructed images, largely due to TSENSE artifacts from the rapid change in blood pool signal. However, this did not appear to affect image quality. Superimposed upslope color maps are shown in Fig. 2 for 8 slices.

Conclusion

3D MPI at 3 Tesla is feasible and can provide complete left ventricular coverage with diagnostic quality. Validation of this technique in patients with CAD including comparison with SPECT MPI, has been initiated.

References

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Figure 1
Representative perfusion images at pre-contrast, RV enhancement, LV enhancement, and myocardial enhancement.

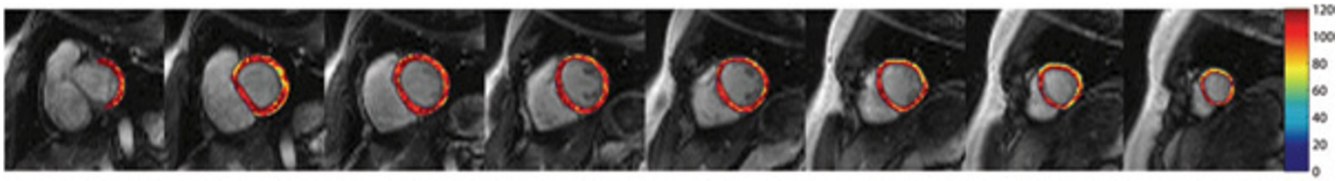

Figure 2
Color upslope map of 8 slices.