T2-prepared SSFP improves diagnostic confidence in edema imaging in acute MI compared with turbo-SpinEcho

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INTRODUCTION

T2-weighted MR imaging of edema in acute MI provides a means for differentiating acute and chronic MI and for assessing the area-at-risk of infarction [1,2]. Conventional T2-weighted imaging of edema uses turbo-SpinEcho (TSE) readout with a dark-blood preparation [3]. Clinical applications of dark-blood TSE methods can be limited by artifacts such as posterior wall signal loss (Fig. 1) due to through-plane motion (Fig. 2) and bright sub-endocardial artifacts due to stagnant blood (Fig. 3) [4]. We hypothesized that single-shot T2-prepared SSFP would be a more reliable method than dark-blood TSE for imaging of edema in patients with MI.

METHODS

Study Protocol

T2-weighted imaging using both dark-blood TSE and T2-prepared single-shot SSFP was performed on patients within 8 days of acute MI (N=22), and more than 1 year after chronic MI (N=9). The signal uniformity for T2-weighted imaging using both methods was measured for normal volunteers (N=8).

Cardiac Imaging

Experiments were conducted using a 1.5T Siemens Espree widebore imaging system using a custom pulse sequence and image reconstruction software. A T2-prepared single-shot SSFP sequence was used to repetitively acquire an interleaved T2-weighted image and a reference image every 2 R-R intervals (Fig. 1). Single-shot SSFP may be acquired with free-breathing and multiple images may be motion corrected and averaged to enhance SNR [5]. In this study, eight T2-weighted images were acquired over 16 heartbeats.

RESULTS

Normal Volunteers

In normal volunteers (N=8) where uniform T2-weighted signal intensity was expected, the loss in signal intensity of the posterior wall of the LV (mid-ventricular SAX slice) compared to the septal wall was 22.6±13.7% (meansSD) using TSE, and 0.6±4.2% using T2-prepared SSFP. A signal loss of 23% represents a large fraction of the expected difference in signal intensity between acute MI and normal myocardium. Bright blood artifactual artifacts are not an issue with T2p-SSFP approach (Fig. 5).

Acute MI Patients

In patients with acute MI (N=22), T2-weighted imaging with both methods was performed prior to contrast administration and delayed enhancement imaging of viable myocardium. In all 22 cases, the T2-prepared SSFP was rated to be of diagnostic quality and yielded the correct diagnosis (i.e., 100% agreement with coronary territory involvement as determined from delayed enhancement images). The T2-weighted images using TSE were non-diagnostic in 3-422 cases, while a single additional case was rated to be of diagnostic quality when having incorrect diagnosis (incorrect coronary territory). Examples images are shown in Figures 6-8.

SUMMARY & CONCLUSIONS

The proposed T2-prepared SSFP bright blood approach overcomes artifacts such as posterior wall signal loss due to cardiac motion and bright sub-endocardial rims due to stagnant blood that occur with widely used dark-blood TSE methods, thereby improving the diagnostic quality (Fig. 11). The TSE method was sensitive to RRI variation and image quality suffered at higher heart rates, whereas the single shot T2-prepared SSFP approach was robust to such variation and enabled non-breathhold imaging. T2-prepared SSFP may be used clinically for reliable T2-weighted imaging in acute MI.

REFERENCES