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Meeting abstract

1022 Single-shot SSFP can identify myocardial edema in patients

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Introduction

Cardiovsacular MRI can be used to detect myocardial edema. Current techniques (such as the triple-inversion recovery prepared T_2-weighted turbo spin echo sequence (STIR)) occasionally fail in difficult patients, such as those with poor ejection fraction or cardiac arrhythmia.

SSFP (steady-state free precession) sequences are T_2/T_1-weighted in the steady-state, and therefore should see elevated signal intensity in edematous segments of myocardium because of the long T_2/T_1 ratio of water relative to other myocardial components. SSFP also has a high imaging efficiency. This should allow for imaging in a single cardiac cycle in difficult cases.

Purpose

To demonstrate the feasibility of using single-shot SSFP to image acute infarcts in patients.

Methods

A standard SSFP sequence with a large (31) number of dummy pulses combined with a linear encoding scheme was used to achieve strong T_2/T_1 image contrast during the acquisition of the central lines of k-space. All imaging data was acquired in a single heart beat. In a second heartbeat, coil profile information was acquired which was used during postprocessing to remove signal inhomogeneities caused by the coil sensitivity, as described previously [1]. Imaging parameters were as follows: TR/TE/flip angle = 3.0 ms/1.5 ms/90°; matrix = 78 × 128; Field-of-view = 267 × 380 mm^2; GRAPPA parallel imaging scheme; iPAT factor = 2.

This study was carried out in 6 patients (mean age = 55 years) referred to our centre for myocardial tissue characterization due to ischemic heart disease and was approved by the local institutional review board. These patients were scanned using the above T2-sensitive single-shot SSFP technique. They were also scanned in the same slice position using a conventional T2-sensitive triple-inversion prepared TSE sequence (STIR) for comparison.

Data was analyzed using a validated software package with a modified 17-segment model. In each slice, a region of interest was drawn in myocardial territory which should be unaffected by ischemia (as determined by their clinical referral). All pixels which had a signal intensity two standard deviations greater than the signal intensity of this remote area were considered positive for edema. If a group of 7 or more contiguous pixels were present in a myocardial segment in the STIR image, that segment was considered to be positive edema. Similarly, if 3 contiguous pixels were present in a segment in the SSFP image, that segment was considered positive for edema (different numbers of pixels for SSFP vs. STIR were used to compensate for the different pixel sizes of the two techniques).

Results

Single-shot SSFP was successful in all patients. All data sets were acquired in < 2 seconds. Typical results are shown in Figure 1. A total of 84 segments were evaluated. Of the 32 positive for edema using the STIR sequence, 24 were also positive on the SSFP sequence. Of the 52 negative for edema on the STIR sequence, 45 were also negative on the SSFP sequence.

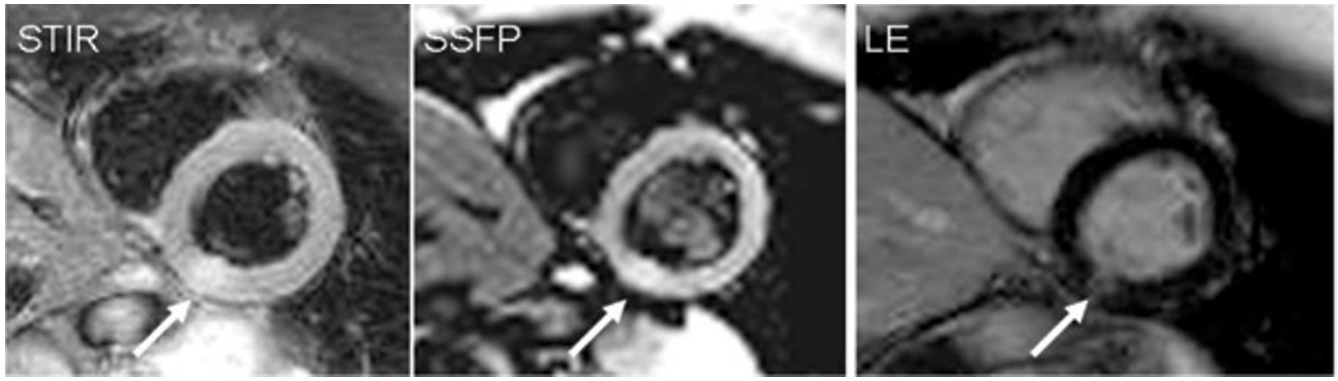

Figure 1
T2-weighted STIR (left) and single-shot SSFP (middle) with a hyperintense area in the inferior wall. In this patient, a late enhancement (LE) protocol was also applied (right), which shows a similar hyperintense region in the same segment.

Conclusion

Single-shot SSFP can be used to detect areas of edema signal in patients. Some discrepancies still exist between the STIR and SSFP sequences, but some of these may be due to the improved coil sensitivity correction strategy used by the SSFP sequence compared to the STIR sequence. Additionally, all patients enrolled in this study had a regular cardiac rhythm and were able to hold their breath for > 10 s. Even with decreased sensitivity, SSFP may ultimately be able to provide previously unavailable information in challenging cases. Further studies are warranted in patients with irregular rhythms and/or difficulty with longer breath holds.

A new single-shot SSFP sequence was developed which detects edematous regions of myocardium. It was compared to conventional T2-weighted STIR in 6 patients. SSFP was able to detect T2 elevations in 24 of 32 myocardial segments that STIR detected elevations

References

1. Kellman PK, *et al.*: *MRM* 2007, **57:**891-897.