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Title: 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 of differentiating acute and chronic MI [1] and for assessing the area-at-risk of infarction [2]. Standard T2-weighted imaging of edema uses turbo-SpinEcho (TSE) readout with dark-blood preparation. Dark-blood TSE methods are subject to artifacts such as posterior wall signal loss due to cardiac motion [3] and bright sub-encardial rims due to stagnant blood which pose a significant limitation to clinical use. Thus clinical application of T2-weighted CMR is hindered by poor reliability of standard methods [4].

Single-shot imaging with T2-prepared SSFP (true-FISP) readout provides an alternative to dark-blood TSE and may be conducted during free-breathing. This is desirable where patients cannot tolerate breath-holding.

### **Purpose:**

We hypothesized that T2-prepared true-FISP would be a more reliable method than dark-blood TSE for imaging of edema in acute MI.

### **Methods:**

The proposed approach uses a T2-prepared single-shot true-FISP readout with parallel imaging. Repeated images were acquired, corrected for respiratory motion, and averaged to enhance SNR. The T2-prepared FISP sequence was compared with dark-blood prepared TSE in both normal volunteers and patients with acute MI (within 7 days of acute event).

Images were acquired on a Siemens Espree 1.5T widebore scanner. In-plane resolution was typically  $1.9 \times 2.5 \text{ mm}^2$  with 6mm slice-thickness. ECG triggering used 2 R-R intervals between readouts. TSE images used a double inversion-recovery dark-blood prep with 300% slice-thickness for selective component, BW=449Hz/pixel, echo-train-length=25, TE=64 ms. Single-shot T2-prepared FISP images used a BW=977Hz/pixel, TE/TR=1.6/3.2 ms, flip angle=90°, T2-prep TE=60ms, 8 repetitions. Parallel imaging (rate=2) was used to obtain the full resolution in a single heartbeat. Delayed enhancement imaging was performed using a segmented turboFLASH sequence.

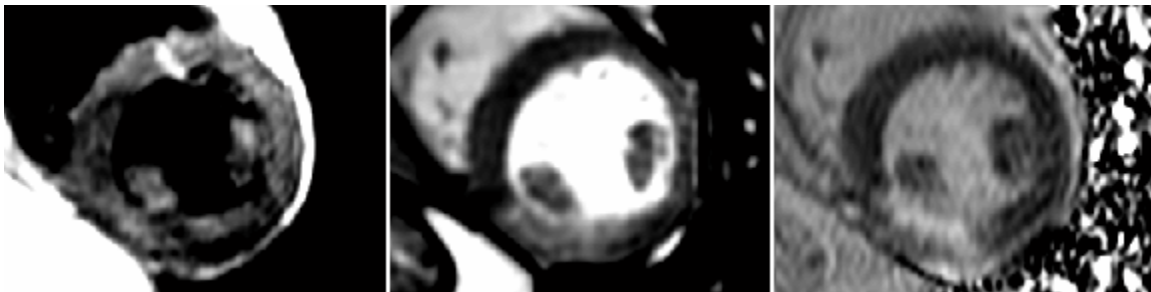
### **Results:**

In normal volunteers (n=8) where uniform T2-weighted signal intensity is expected, the loss in signal intensity of the posterior wall of the LV (mid-ventricular SAX slice) compared to the septal wall was  $22.6 \pm 13.7\%$  (mean $\pm$ SD) using TSE, and  $0.6 \pm 4.2\%$  using T2-prepared FISP. Both methods had surface coil intensity correction, and TSE images used timing optimized for minimal cardiac motion. A signal loss of 23% would represent a large fraction of the expected difference in signal intensity between acute MI and normal myocardium.

In patients with acute MI (n=10), T2-weighted imaging with both methods was performed prior to contrast administration and delayed enhancement imaging of viable myocardium. While the SNR of the edema region for both methods was quite good (Fig 1), the T2-weighted images using TSE were non-diagnostic in 2-of-10 images, while 1 additional case (Fig 2) rated diagnostic quality had incorrect diagnosis (incorrect coronary territory). In all 10 cases the T2-prepared FISP was rated diagnostic quality and yielded correct diagnosis.



**Figure 1.** Acute MI patient exhibiting edema in LAD territory: DIR-TSE (left), T2-prepared true-FISP (center), delayed enhancement (right).



**Figure 2.** Acute MI patient exhibiting edema: DIR-TSE (left) with apparent elevated T2 in LAD (incorrect) coronary territory, T2-prepared true-FISP (center) with elevated-T2 in RCA territory, delayed enhancement (right) with MI in RCA territory. Patient had significant RR-variability.

### Conclusions:

The proposed bright blood approach overcomes artifacts such as posterior wall signal loss due to cardiac motion and bright sub-endocardial rims due to stagnant blood which pose a significant limitation to more widely used dark-blood TSE methods. The TSE method was sensitive to RR variation and image quality suffered at higher heart rates, whereas the single shot T2-prepared FISP approach was robust to such variation and enabled non-breathhold imaging. T2-prepared FISP may be used clinically for reliable T2-weighted imaging in acute MI.

### References:

1. Abdel-Aty H, et al. *Circulation*. 2004;109:2411-2416.
2. Aletras AH, et al. *Circulation*. 2006;113(15):1865-1870.
3. Keegan, J, et al. *JMRI* 2006;24:563-570.
4. Pennell D. *Circulation*. 2006;113(15):1821-1823.