Accelerated Phase Sensitive Inversion Recovery for Detecting Myocardial Infarction using Gd-DTPA Delayed Hyperenhancement

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INTRODUCTION
Following administration of gadolinium, infarcted myocardium exhibits delayed hyperenhancement and can be imaged using an inversion recovery (IR) gradient recalled echo sequence. Phase sensitive reconstructed IR has a number of benefits [1] including consistent contrast and appearance over a relatively wide range of inversion recovery times (TI), improved contrast-to-noise ratio, and consistent size of hyperenhanced region. The imaging time may be accelerated by acquiring fewer phase encodes using partial-Fourier and/or sensitivity encoding (SENSE [2]) methods. We present and compare experimental results for both methods. The acceleration may be used to either reduce breath-hold duration or increase spatial resolution for a fixed breath-hold time.

METHODS
Phase sensitive cardiac imaging poses unique challenges due to the combination of field inhomogeneity, motion, and low SNR, which make it difficult to obtain a reliable estimate of the background phase. The approach we have taken is to obtain a background reference image at the same cardiac phase, during the same breath-hold acquisition. Using Gd-DTPA, the inversion recovery acquisition sequence requires 2 heart beats for almost full magnetization recovery. Therefore, it is possible to acquire the reference image during alternate heart beats without increasing the breath-hold duration. This type of acquisition provides a reference image with high spatial resolution and eliminates mis-registration errors due to motion. The reference image is used to estimate both the background phase and surface coil field maps.

The surface coil field maps derived from the reference images were used for optimal B1-weighted combining [3], and for SENSE processing [2] in the case of reduced FOV acquisitions. By applying the same B1-weighted complex combining to both T1-weighted and reference images, any phase error in the B1-maps was cancelled in the phase sensitive (homodyne) image. All images were surface coil intensity normalized based on the reference magnitude image.

RESULTS

DISCUSSION

• SENSE Method
  - g-factor related SNR loss approx. 30% for 4 coils (< 5% for 8 coils)
  - more sensitive to localizing for best in-plane rotation and to avoid wrap (canceling wrap increases g-factor loss)
• Partial k-space Method
  - combined partial-NEX & inversion recovery
  - point spread function (PSF) may cause edge artifacts (dependent on TI)
  - artifacts minimized using smaller acquisition window
  - combined partial-echo & inversion recovery
  - has negligible artifacts

CONCLUSIONS

• R=2 acceleration of phase sensitive IR imaging possible using SENSE or partial k-space
• reduced breath-hold duration or improved spatial resolution
• can be combined with multi-slice phase sensitive IR for single breath-hold 8 slice SAX stack (see poster 1637)

REFERENCES