Phase Sensitive Inversion Recovery: An Innovative Technique to Assess Myocardial Infarction by Delayed Enhancement

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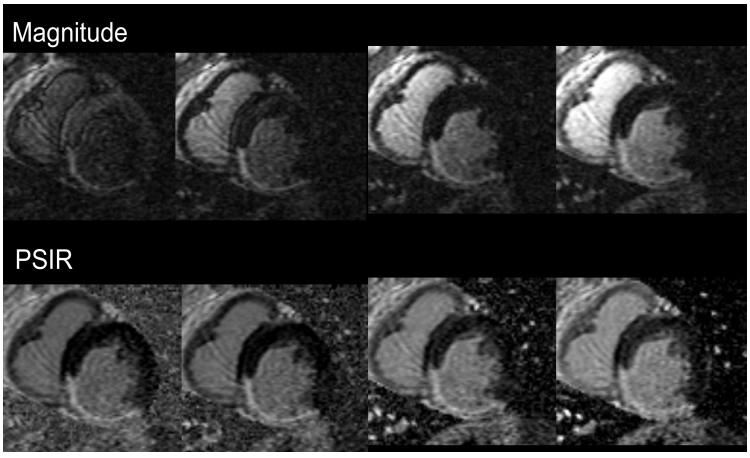
Introduction
Delayed Enhancement imaging (DE) has proven valuable in the assessment of myocardial infarction (MI). Following the administration of gadolinium, an inversion recovery sequence provides T1-weighting. Using conventional magnitude reconstruction, the image is highly dependent on the selection of the proper inversion time (TI). To maximize the contrast between normal and infarcted tissues, the TI must be precise to null normal myocardium. The process of accurately selecting this TI can result in the acquisition of additional scans until the proper time is achieved. Loss of contrast resulting from T1 changes occurs due to time delays and washout. PSIR is a new technique developed to allow use of a wider range of TI.

Purpose
To describe how phase sensitive reconstruction can acquire delayed hyperenhancement images of MI without accurate TI.

Methods
Patients with a history of MI underwent a routine cardiac exam using both research and commercially available versions of Phase Sensitive Inversion Recovery (PSIR) sequences. The image acquisition uses a Fast Recalled Gradient Echo (FGRE) sequence gated during mid diastole. A reference image is obtained during the alternate heartbeat which allows reconstruction of a phase map. Both conventional magnitude images and the PSIR image are reconstructed from the same acquisition.

Results
Figure 1 shows the appearance of delayed enhancement images acquired at correct (last column) and incorrect inversion times (first 3 columns). With magnitude reconstruction of the delayed enhancement images, diagnostic quality is dependent on setting the inversion time correctly to null normal myocardium. If the inversion time is too short, the signal intensity of normal myocardium increases and contrast between infarct and normal myocardium decreases.



With PSIR (bottom row), exactly the same data acquisition can be displayed with simple adjustment of display settings to provide diagnostic image quality at all inversion times – even when the inversion time is 75 ms shorter than optimal (first column).

Conclusion
PSIR is useful in assessing MI. When properly acquired, PSIR and magnitude reconstruction provide equivalent results. However, PSIR provides excellent contrast between normal and infarcted myocardium at inversion times that provide non-diagnostic images with conventional magnitude reconstruction. Thus, the PSIR methodology simplifies acquisition of DE images.

References
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