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Title: Artifact Suppression in Delayed Hyperenhancement Imaging of Myocardial Infarction using B_1-weighted Phased Array Combined Phase Sensitive Inversion Recovery

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Introduction:

Myocardial viability assessment using Gd-DTPA hyperenhancement MRI is gaining clinical acceptance [1-2]. Using recent MRI methods [3] myocardial infarction may be imaged with high spatial resolution and good contrast. Following administration of Gd-DTPA, infarcted myocardium exhibits delayed hyperenhancement and can be imaged using an inversion recovery sequence.

Oscillations in the transient approach to steady state for regions such as CSF with long T_1 may cause artifacts in breath-held, segmented imaging. B_1-weighted phased-array combining [4] provides an inherent suppression ghost artifacts. Image reconstruction uses phase sensitive detection with B_1-weighted phased-array combining to optimize SNR. Phase sensitive inversion recovery (PSIR) techniques have demonstrated a number of benefits [5] including consistent contrast and appearance over a relatively wide range of inversion recovery times (TI), improved contrast-to-noise ratio, and consistent size of the hyperenhanced region.

Purpose:

To demonstrate suppression of CSF artifact using B_1-weighted phased-array combining method for imaging myocardial infarction.

Methods:

A B_1-weighted phased array combined phase sensitive reconstruction method was used [5]. This previously described approach acquires a reference image at the same cardiac phase, during the same breath-hold during alternate heart beats to estimate both the background phase and surface coil field maps.

The sequence was implemented on a GE Signa 1.5T scanner using the following typical parameters: BW ±31.25 kHz, TE/TR 3.4/7.8 ms, 20° readout flip angle (5° reference), FOV 360x270mm^2, 256x96 image matrix. The 96 phase encodes were acquired in 12 heartbeats collecting 16 lines per heartbeat with 2 R-R intervals between inversions. The segment duration was 125 ms per R-R interval, acquired during diastasis. A standard 4-element cardiac phased-array was used. Images are usually acquired between 10 and 30 minutes after administering a double dose (0.2 mmol/kg) of contrast agent (Gd-DTPA, Berlex Magnevist).

Results:

Long axis images of the heart are shown to illustrate the artifact suppression using B_1-weighted phased-array combining. There is a greater prevalence for this artifact with the 4-chamber view. Root-sum-of-squares magnitude combined and B_1-weighted phased-array combined phase sensitive reconstructions are shown in Figures 1 (a) and (b), respectively. Both magnitude and phase sensitive images were acquired using the same breath-hold data. An artifact may be observed in the magnitude image that is not present in the B_1-weighted phased-array combined phase sensitive image which is reconstructed using the same data. The magnitude images for the individual coils are shown in Figure 2. The artifact is clearly caused by ghosting of the CSF in the spinal cord, and is only evident in the back coils, Fig. 2 (c) and (d). The CSF artifact is suppressed by the B_1-weighting. The suppression was calculated to be 4:1.

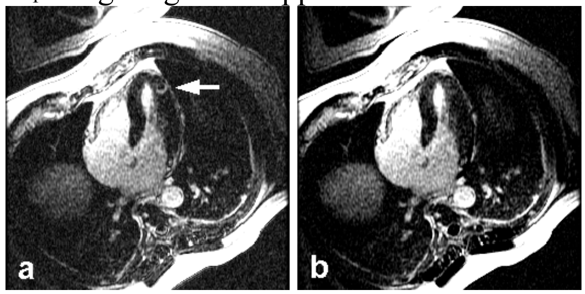

Figure 1. Images illustrating (a) artifact in root-sum-of-squares magnitude combined image, and (b) suppressed artifact in B_1-weighted phased-array combined PSIR image.

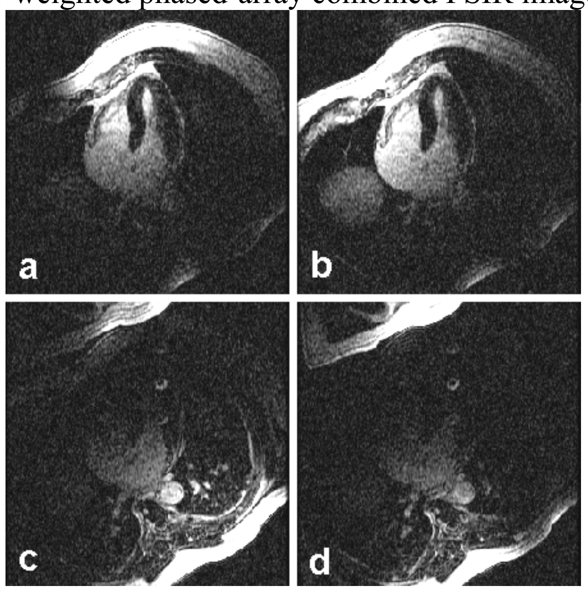

Figure 2. Individual coil images illustrating B_1-weighting of ghost artifacts. The CSF artifact from spinal cord is evident in back coil images (c),(d), and suppressed in chest coil images (a),(b).

Conclusions:

Hyperenhancement imaging of myocardial infarction using inversion recovery sequences with breath-held, segmented acquisition may lead to an artifact in regions with long T_1 such as CSF. The CSF artifact is rather small, unlike larger breathing or motion related artifacts, and is less well recognized as an artifact. B_1-weighted phased-array combined phase sensitive reconstruction provides an inherent degree of artifact suppression that is shown to effectively mitigate this artifact.

References:

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