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Meeting abstract

107 Small field of view black-blood imaging of the human heart using local excitation

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Introduction

Black-blood-prepared fast spin-echo (FSE) imaging is a widely used technique for cardiovascular imaging. To avoid fold-over artifacts, a sufficiently large field of view (FOV) in fold-over direction has to be selected. Nevertheless, respiratory artifacts originating from the moving chest wall are commonly observed. While enlarging the FOV leads to an increase in scanning time, motion artifacts have a detrimental impact on image quality. To address these issues, limiting the FOV in fold-over direction using pre-pulses has been proposed [1,2]. While promising results have been obtained, additional pre-pulses are required and the quality of the suppression outside of the desired FOV is T1-dependent.

Purpose

To develop, implement and test an MRI method that integrates local excitation for small-FOV imaging into the imaging part of an FSE sequence.

Methods

Concept

In conventional FSE imaging, a slice-selective 90° pulse is typically followed by a train of slice-selective 180° refocusing pulses. If the initial slice selective 90° pulse is replaced by a 2D-selective cylindrical excitation perpendicular to the imaging plane, the resultant signal will originate from a 'disc' located at the intersection between the 90° cylindrical pulse and the slice selective 180° pulses. Such local excitation enables small-FOV imaging without fold-over artifacts and avoids motion artifacts originating from structures outside of the 2D-selective pulse.

Implementation

A 2D-selective 90° excitation was implemented as part of an FSE imaging sequence (Fig. 1) on a commercial 3 T Philips Achieva MRI system. Localization, angulations, and the diameter of the cylindrical excitation are prescribed on the graphical user interface of the system. Black-blood dual-inversion was combined with the modified FSE sequence. To suppress respiratory motion, a real-time navigator was combined with the local excitation technique.

Phantom experiments

Phantom measurements were obtained using conventional 2D FSE imaging (TR = 2 s, slice thickness = 4 mm, flip-angle = 90°, echo train length (ETL) = 12, TE = 13 ms, interecho spacing = 6.3 ms). This reference image without local excitation had a FOV of 380 mm and a matrix of 544 × 520 (Fig. 2(a)). The same acquisition was then repeated using a reduced FOV (FOV = 120 mm, matrix = 400 × 380) with and without local excitation (local excitation diameter = 60 mm, Fig. 2(b),(c)). On the resultant images, intensity profiles in foldover direction were obtained (Fig. 2(d),(e)).

In vivo experiments

An axial slice in a healthy adult subject was acquired using free-breathing dual-inversion 2D FSE imaging with large and small FOV, and with/without local excitation (slice thickness = 3 mm, FOV = 350 × 350 mm, matrix = 352 × 350, and small FOV = 160 × 160 mm with a matrix of 160 × 150, ETL = 15, TE = 12 ms, interecho spacing = 6 ms, local excitation diameter = 140 mm). Total SNR and total

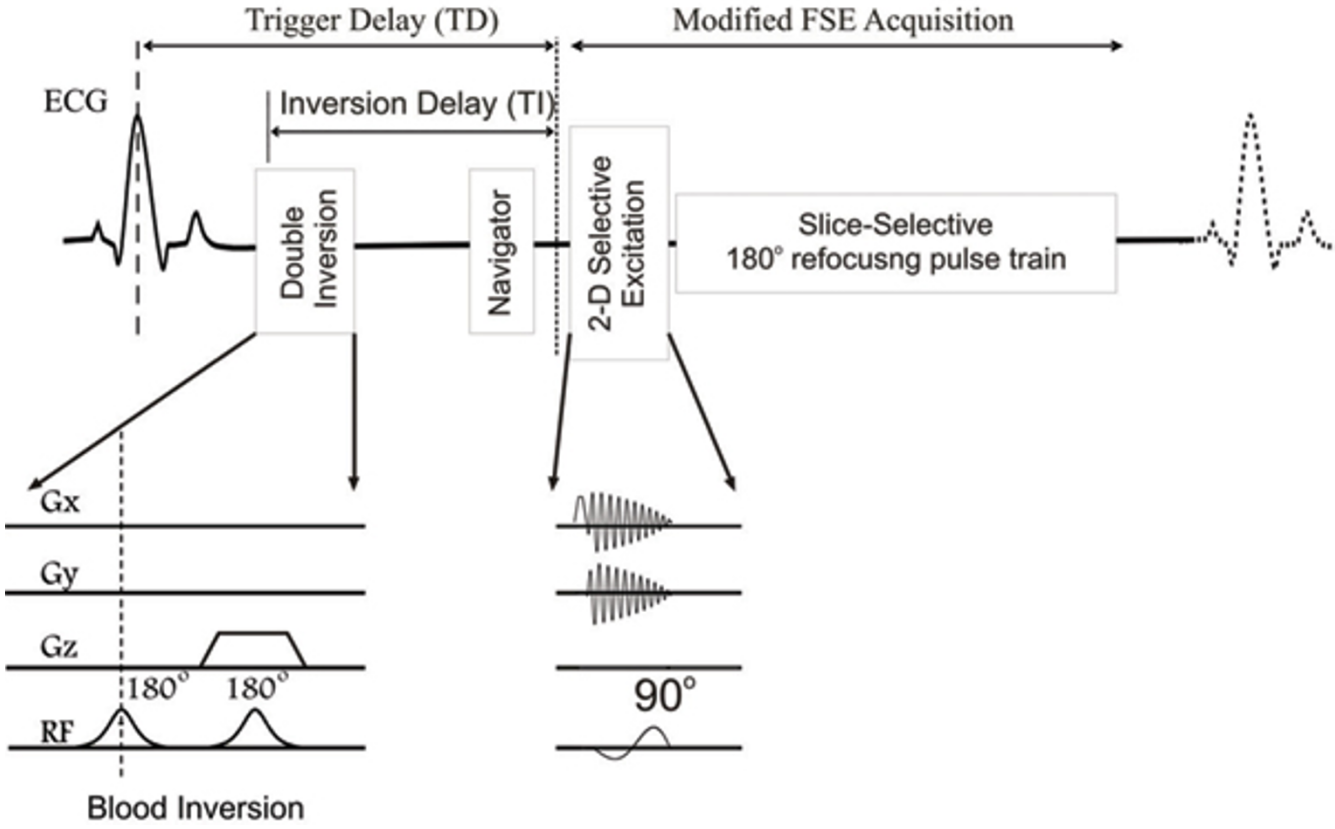

Figure 1
Black-Blood FSE sequence with motion-correction navigator and 2-D local excitation pulse.

scan time were kept constant by doubling the number of signal averages during the small-FOV acquisitions.

Results

Consistent with the visual findings, signal intensity profiles through the small-FOV phantom images (Fig. 2(d),(e)) show excellent suppression of structures outside of the area of the local excitation (Fig. 2(c)). Fig. 3(a) shows the large-FOV baseline acquisition obtained in vivo without local excitation. Consistent with the in vitro results, foldover artifacts were observed in the small-FOV in vivo image that was acquired without local excitation (Fig. 3(b), arrows). Using the same exact acquisition in which the slice-selective 90° pulse was replaced by the local excitation, foldover artifacts were successfully suppressed (Fig. 3(c)).

Discussion

Local excitation is an effective method for small-FOV TSE imaging without the need of extra pre-pulses while the drawback of aliasing artifacts can be avoided. Since the surrounding tissue is suppressed, motion artifacts may be reduced as well. Two-dimensionally-selective excitation pulses are inherently self refocused and therefore no compromises in FSE imaging are necessary and no modifications of TE or interecho spacing are required.

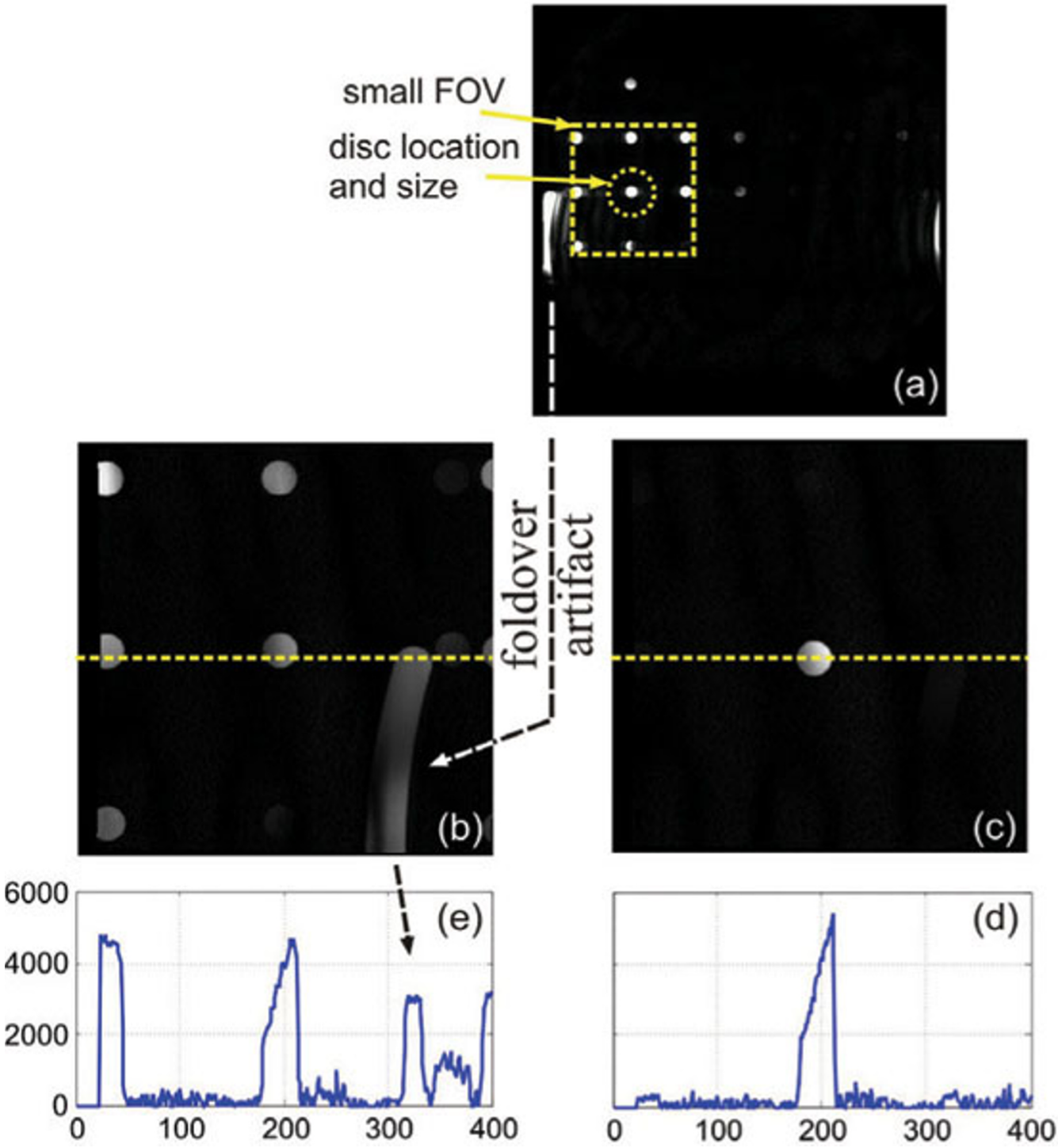

Figure 2
Phantom image with a large FOV (a), a small FOV (b), and a small FOV with local disc excitation (c). The intensity profiles of dotted lines in (b) and (c) are shown in (d) and (e), respectively. Folded artifacts in (b) (dotted arrows) are substantially suppressed with local excitation in (c).

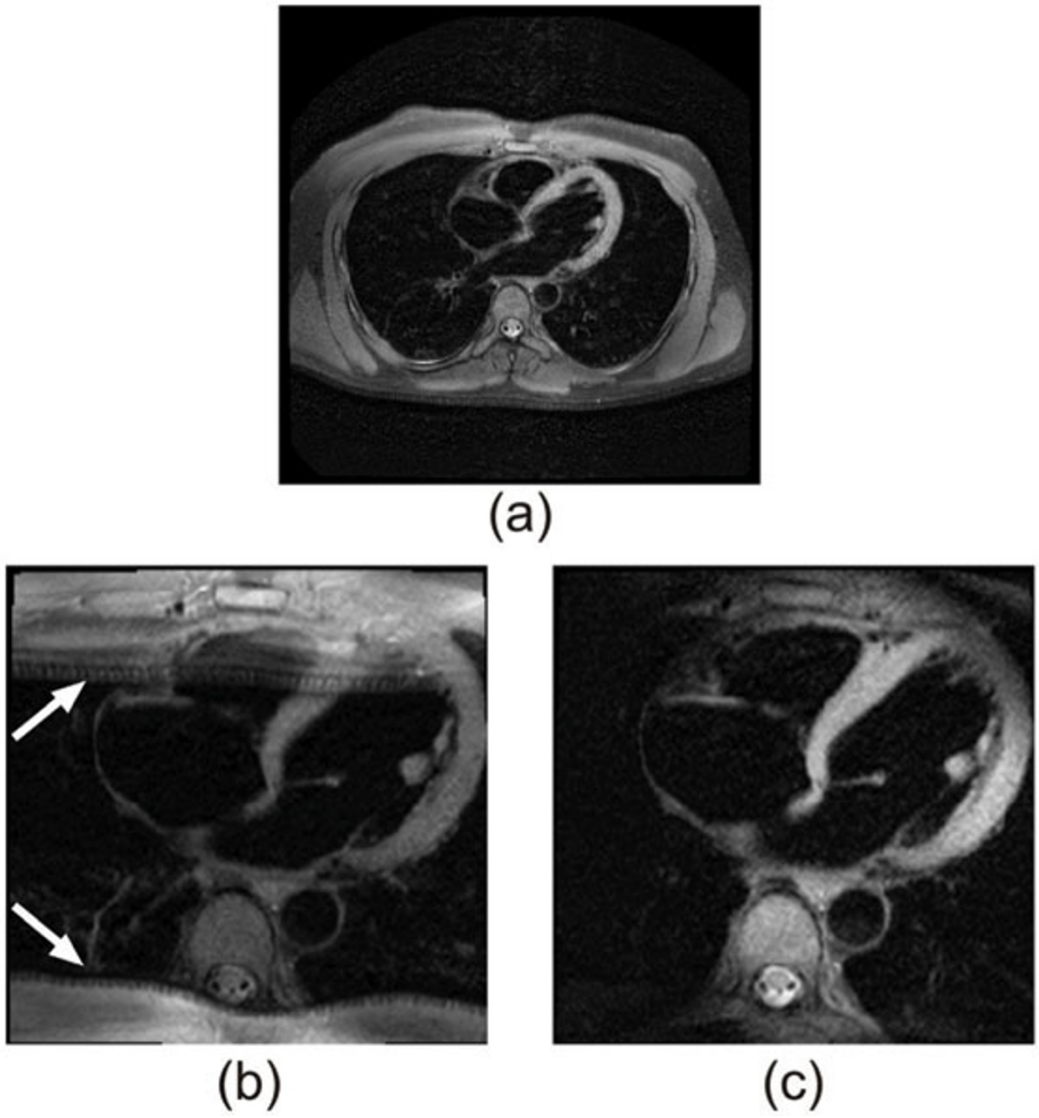

Figure 3
(a) In-vivo axial FOV. (b) Small FOV without the proposed local excitation affected by fold-over artifacts (arrows) and reduced image quality. (c) Small FOV with local excitation.

References

1. Fischer , *et al.*: *MRM* 1994, **31(4):**401-413.
2. Crowe , *et al.*: *JMRI* 2003, **17:**572-580.