Double/ Triple IR Dual Contrast FSE of the Heart with ASSET

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INTRODUCTION

Black-blood imaging using double or triple inversion recovery (Double/ Triple IR) pulses for cardiovascular applications has increased in recent years (1,2,3,4). This method provides blood signal nulling to reduce flow artifacts in tissue boundaries. Its applications include myocardial tissue characterization (2), vessel wall imaging (3) and plaque characterization (4). In these studies, tissue contrast differentiation has been achieved through images acquired at different TE’s (e.g., proton density and T2-weighted images). However, these images have been acquired in separate scans, and thus image location is often registered incorrectly. This problem is reduced through the recently introduced black-blood dual-contrast FSE technique (5,6). This technique provides images with two different contrasts obtained at the same cardiac cycle through a single acquisition. However, the acquisition requires a long breath-hold period and thus limits its clinical application. In this study, the ASSET (or SENSE) technique has been applied to reduce the required breath-hold time to complete the dual-contrast FSE image acquisition.

METHOD

Double/Triple IR preparation was implemented in the dual-contrast FSE sequence on a 1.5T GE Signa Twinspeed Whole-body MR scanner (GE Medical Systems, Milwaukee, WI) with EXCITE (Expanding Applications with MultiCoil Technology) technology. The Double IR preparation was consisted of a non-selective adiabatic inversion pulse followed immediately by a selective inversion pulse. The Triple IR preparation was consisted of the Double IR pulse and an extra RF pulse to suppress the fat signal. The dual contrast was achieved through a split echo train. A total of 32 ETL (Echo Train Length) was used for the sequence. The first group of echoes with 16 ETL formed the image at the first TE (TE1). The second group with 16 ETL formed the image at the second TE (TE2). The following imaging parameters were applied: 42 ms TE1, 102 ms TE2, 575 ms TI, 62.5 kHz BW, ECG triggered with 2 R-R intervals, 40 cm FOV, 256x256 matrix size, 4 mm slice thickness, 1 NEX, 1 phase FOV, 4.2 ms echo spacing, and 0.5 ASSET acceleration factor. The acquisition was acquired at the “Whole Body” gradient mode with the slew rate of 80 mT/m/ms. A four channel torso phased array coil was used. Heart images of a normal volunteer were acquired in the direction of the short axis within a single breath-hold period with and then without the application of ASSET.

RESULTS

Figure 1 shows the comparison of the Double IR dual-contrast images between with and without the application of ASSET. Figure 1A and 1B show the non-ASSET images at 42 ms TE1 and 102 ms TE2. Figures 1C and 1D show the ASSET counterparts. On both the non-ASSET and ASSET images, the blood is completely darkened and no flow artifacts are observed on the myocardial boundaries. Similarly, Figure 2 shows the comparison of the Triple IR dual-contrast images between with and without the application of ASSET. Figure 2A and 2B show the non-ASSET images at 42 ms TE1 and 102 ms TE2. Figures 2C and 2D show the ASSET counterparts. For both Double and Triple IR, the application of ASSET has led to two-fold reduction of the scan time.

DISCUSSION

As shown in this study, the addition of ASSET to the Double/Triple IR dual-contrast FSE sequence has reduced the scan time without the sacrifice of the image quality. In fact, the images might contain less motion artifacts because the images are acquired within a shorter period of the cardiac cycle. In this Double/Triple IR dual-contrast FSE sequence, the Double/Triple IR feature provides the black-blood effect. The dual-contrast FSE feature provides the image contrast at two different TE’s without the risk of image location mis-registration. The application of the ASSET greatly reduces the required breath-hold time and thus the black-blood dual-contrast imaging can be applied much easier to the general patient population.

REFERENCES