

Diffusion Weighted Imaging of the Breast at 3.0T with BLADE-TSE: Initial Experience

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Introduction

Diffusion-weighted imaging (DWI) of the breast has been found to be useful in differentiating breast lesions and assessing treatment response at an early stage [1-3]. While a higher field strength promises greater intrinsic SNR, it is challenging to obtain better image quality at 3.0T than at 1.5T for body DWI as well as for breast DWI [4]. This is because the commonly used technique for DWI based on single shot echo planar imaging (SS-EPI) is highly susceptible to B_0 inhomogeneities. On the other hand, multi-shot turbo spin echo based techniques with rotating k -space trajectories (BLADE-TSE) benefit from the greater SNR at 3.0T and provide superior diffusion weighted image quality and therefore more accurate results. The purpose of this prospective study is to evaluate a BLADE-TSE based method for breast DWI and to compare the image quality with the SS-EPI method to determine if BLADE-TSE is better suited for clinical breast DWI at 3T. To the best of our knowledge, such work has not been previously reported.

Methods

So far, data were acquired from six patients, age 49 – 75, after obtaining informed consent, who were scheduled to undergo diagnostic breast MRI exams. The breast MRI exams were performed on a 3.0T MRI system (Siemens TIM Trio VB15) with a 7 channel breast coil (InVivo Corp). In addition to the standard scans consisting of a 3D T1w GRE, 3D DCE (VIBE) and a 3D T2w TSE (SPACE) sequences, two sets of diffusion weighted images were also acquired with SS-EPI and BLADE-TSE. Most of the imaging parameters were kept the same between the two DWI series: 4mm slice thickness, 2mm gap, 192x192 matrix size and 34 – 36 cm FOV. The scan time was closely matched to be 4:13 for SS-EPI and 4:59 for BLADE-TSE. For SS-EPI, TR/TE/AVG/pFFT = 4600ms/95ms/6/75%. For BLADE-TSE, TR/TE/ETL/BLADES = 5440ms/64ms/48/6 and the spin echoes and stimulated echoes were acquired separately and their signals combined to improve SNR [5]. For diffusion weighting, the b-values were 50, 500 and 1000 sec/mm² for both methods. Comparisons of image distortion and artifacts were made on diffusion weighted images and ADC maps using the anatomical images as reference. The ADC values in the non-fatty region of the breast (lobules) were obtained from the corresponding ROIs in the ADC map.

Results

Fig. 1 shows the images from one of the cases in the study. Significant distortion was observed with SS-EPI method. It's difficult to match the anatomical landmarks in the diffusion weighted images and ADC maps with the T1w and T2w anatomical images. Chemical shift ghosting from regions of incompletely suppressed fat signal is also observed in the DWI acquired with the SS-EPI method. The distortions and artifacts can become more severe toward the periphery of the breast, making anatomical features unrecognizable. On the other hand, DWI acquired with BLADE-TSE had minimal distortion and chemical shift artifacts. The estimated correlation coefficient of ADC values measured with BLADE-TSE and SS-EPI is 0.96 (Fig. 2)

Discussion and Conclusions

The images produced by the BLADE-TSE method more closely resemble the anatomical images. Regions of interest (ROI) can therefore be matched directly between the anatomical images and the ADC-maps. This could be important for the diagnosis of small lesions. Since both methods provide very similar ADC-values (Fig. 2) the relationship between ADC values and breast lesion type, already demonstrated with SS-EPI, is likely to be valid for BLADE-TSE as well. A drawback of using BLADE-TSE is the increased SAR as compared to SS-EPI, so in some cases a reduction of the number of slices can be required.

References

1. Sinha et al, J Magn Reson Imag 2002, 15, 693-704
2. Guo et al, J Magn Reson Imag 2002, 16, 172-8
3. Pickles MD, *et al.* Magn Reson Imaging 2006; 24:843–7.
4. Matsuoka A, *et al.* Radiat Med. 2008 Jan; 26(1):15-20.
5. Schick F. Magn Reson Med. 1997 Oct; 38(4):638-44.

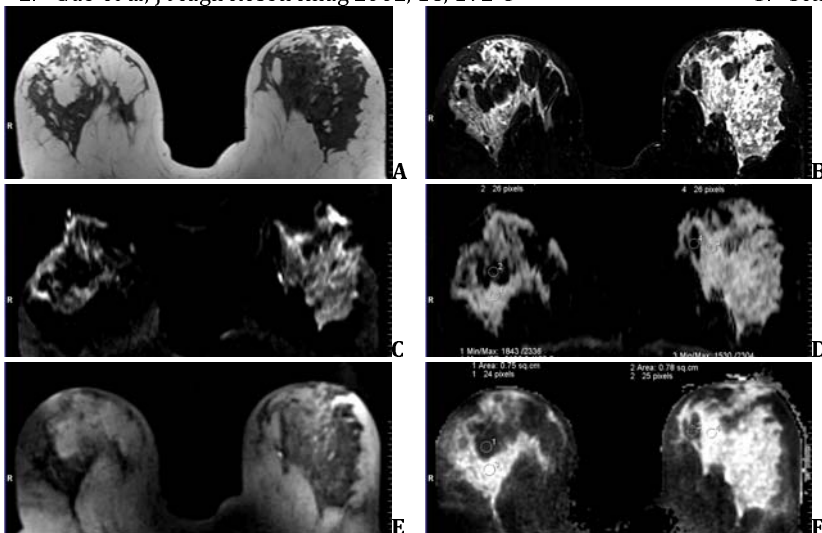


Figure 1. Bilateral breast MR images from one of the subjects acquired at 3.0T: A) T1 GRE; B) T2 SPACE; C) DW SS-EPI @ b=1000 sec/mm²; D) ADC map w. SS-EPI; E) DW BLADE-TSE @ b=1000 sec/mm²; F) ADC map w. BLADE-TSE.

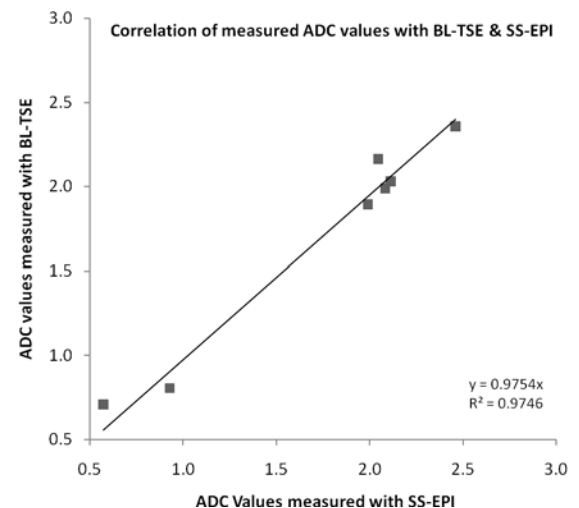


Figure 2. The correlation of ADC values (x10⁻³ mm²/sec) measured with SS-EPI and BLADE-TSE.