Supplementary

Appendix 1

Some signal-to-noise ratio (SNR) measurements were carried out on a human head phantom, which is filled with 1.24 g/L $NiSO_4 \cdot 6H_2O$ and 2.62 g/L NaCl. The signal images were acquired using a two-dimensional gradient echo (GRE) sequence (time of relaxation (TR) =3,000 ms; time of echo (TE) =6.5 ms; flip angle =30°; field of view (FOV) =250 mm × 250 mm; slice thickness =5 mm; matrix size =128×128; bandwidth =590 Hz/pixel). The noise images in each channel were obtained by setting the flip angle to zero. SNR was obtained using the following equation.

$$SNR^{\mathrm{cov}-rSoS} = \sqrt{S^{H}\Psi^{-1}S} \quad [1]$$

where S is the signal image, H indicates transposed complex conjugate, and Ψ denotes the noise matrix.

The B_1^+ maps in the phantom were also evaluated using a dual refocusing echo acquisition mode (DREAM) sequence with the following parameters: TR =3,000 ms, TE =1.49 ms, flip angle =54.7°, slice thickness =10 mm, FOV= 250×250 mm^2, and matrix size =80×80.

The normalized SNR was calculated by using the formula: SNR/ sin (B_1^+), as shown in Figure S1. As shown by the mean values in the regions of interest, the average SNR values in the transversal, sagittal, and coronal planes at 5T were 1.90 times, 1.83 times, and 1.79 times of those at 3T, respectively. The average SNR values in the transversal, sagittal, and coronal planes of the human brain at 5T were 1.63 times, 1.85 times, and 1.79 times of those at 3T, respectively. These values corresponded with those of the phantom. The difference in the SNR results in the transversal plane might be caused by different slice positions. Nevertheless, the SNR results of the human brain corresponded with those of the phantom.

A diffusion scan was implemented with following parameters: TR =3,000 ms; TE =57.1 ms; flip angle =90°; slice thickness =5 mm; FOV = 220×230 mm^2; and matrix size =153×160; echo train length =51; bandwidth =1,750 Hz; b values: 0 sec/mm^2 and 3,000 sec/mm^2. In the diffusion scan, the shorter the TE, the stronger the gradient strength. We set the TE to the shortest value, corresponding to a 120 mT/m gradient. Additionally, we implemented two other diffusion scans with TE =61.9 ms and TE =79.9 ms, corresponding to a 40 mT/m and 80 mT/m gradient, respectively. The diffusion images and ADC images are shown in Figure S2. By dividing the signal by the quadrangle noise, the SNR in a region of interest of the diffusion image (b=3000) was obtained, as shown in Figure S2B. Compared to the SNR of the diffusion image (b=3000) using 40 mT/m, the SNR of the diffusion image (b=3000) using 120 mT/m increased by 42%. Compared to the SNR of the diffusion image (b=3000) using 80 mT/m, the SNR of the diffusion image (b=3000) using 120 mT/m increased by 10%. These results demonstrate that the stronger the gradient strength, the shorter the TE and the higher the SNR.

 https://dx.doi.org/10.21037/qims-22-945

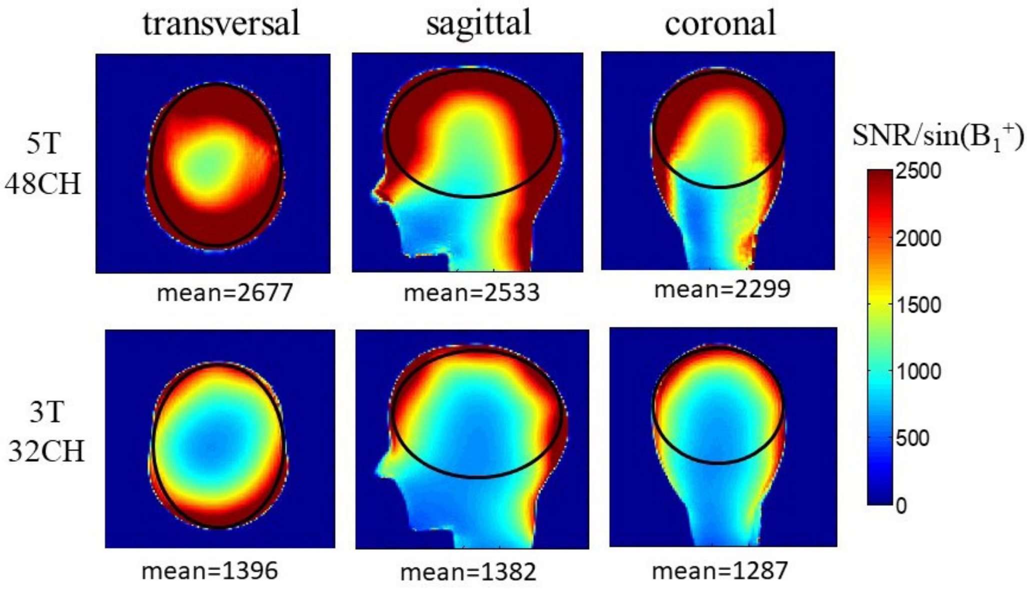

Figure S1 The normalized SNR maps of the phantom in the transversal, sagittal, and coronal planes at 5T and 3T.

 https://dx.doi.org/10.21037/qims-22-945

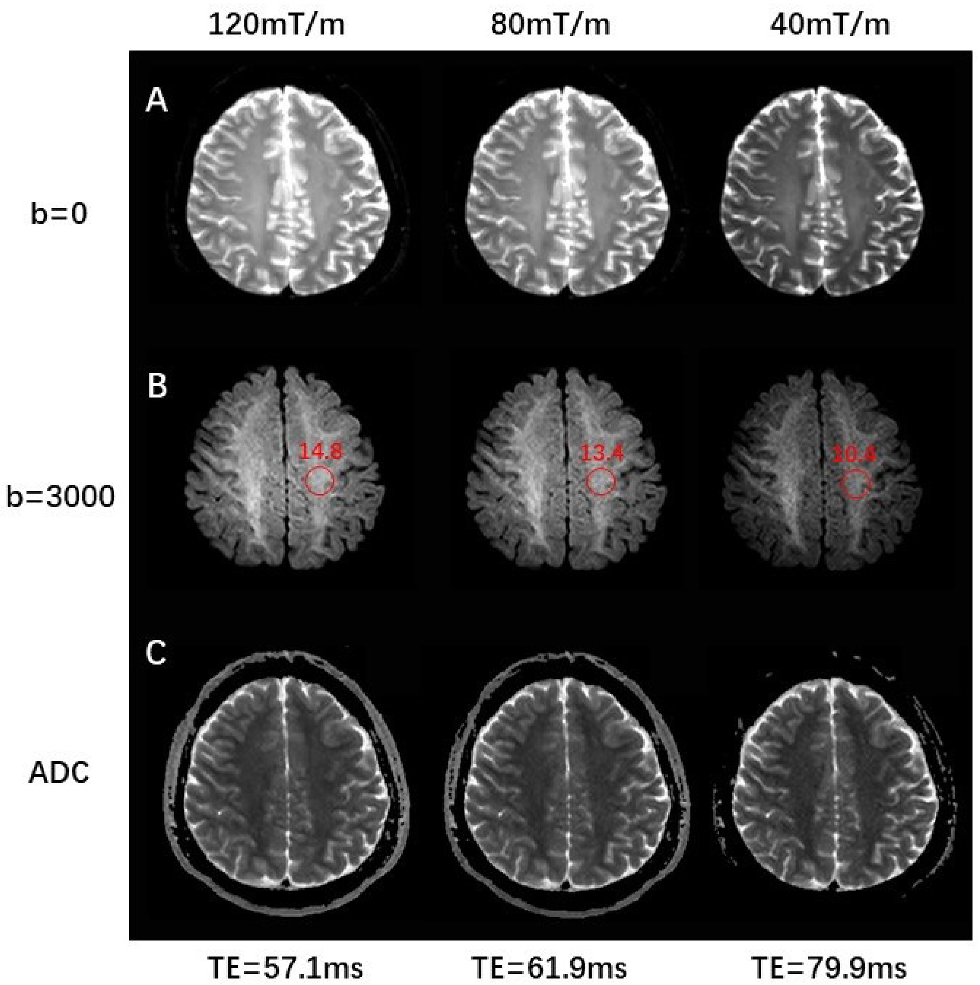

Figure S2 The diffusion images and apparent diffusion coefficient (ADC) images using different gradient strength at 5T MRI. The b3000 images are shown with an appropriate window level, while the other images are displayed with the same window levels.

 https://dx.doi.org/10.21037/qims-22-945