T1 and T2 Relaxographies of human brain at the 3.0T MRI system

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Introduction

3.0T MRI system is potentially advantageous due to higher SNR compared with 1.5T MRI. However the t1 relaxation time is also increasing which results in either increasing repetition time, TR or a decreasing SNR at the fixed TR[1]. For T2 relaxation time, the previous studies demonstrated the small amount of field dependency of T2 although the classical theroy[2] predicts that the T2 is not dependent on the field strength contradicly. To maximize a 3.0T MRI as an effective clinical tool, one has to fully understand the contrast mechanism of T1 and T2 parameters. The purpose of this study is to calculate T1 and T2 relaxation time of brain tissues and to reconstruct T1 and T2 relaxography of brain at 3.0T.

Methods

All scans were performed with the home built 3.0T MRI with a 16 legs quadrature head coil. For the measurement, transaxial slices of 5 mm thickness were selected across of basal ganglia so those measurable amounts of gray and white matter were visible in the images. T1 values were measured with a series of spin echo images of which parameters are 15msec of TE and varying TRs of 100, 200, 400, 800, 1600, and 3200msec. For the T2 measurement, SE images were acquired with 4000msec of TR and varying TEs of 15, 30, 45, 60, 75, and 90msec. Different receiver gains were used for the images with different time TE and TR for the optimal signal reception. The single echo approach was used because imperfections in the 180° pulses accentuated inaccuracies in multiple-echo T2 measurement[3]. T1 relaxography were reconstructed with the nonlinear least squares fitting algorithm and the image processing software (IDL: Research Systems Inc., Boulder, CO). T2 relaxography was reconstructed with linear least square fit algorithm. All images were corrected by making the standard deviation of the noise same to eliminate the impact of gain difference between each image.

Results

Table1. T1 and T2 measurements of brain tissues

	T1 (msec)	T2(msec)
White Matter	1373±71	68±6
Gray Matter	913±36	88±7

The relaxation measurements from 5 healthy volunteers are shown in Table 1. ROIs located entirely within either GM or WM were chosen manually. Like the previous study[3], T1 values increased comparing to 1.5 T system. Our result appears that T2 values dose not change significantly on 3.0T. Figure 1 shows the reconstructed T1 and T2 relaxogaphies at 3.0T MRI. T2 values of higher than

300ms were set to be zero for better display. The chi-square map of T2 is shown in Figure 2 with a range of 0.001 ~ 0.018.
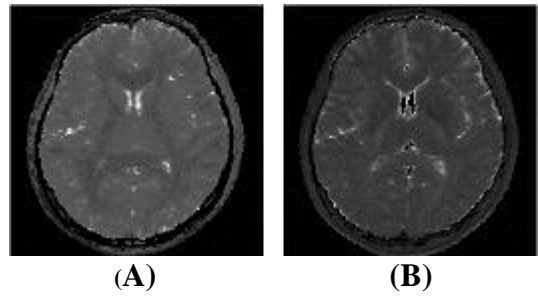

(A)　　　　　　　　(B)

Figure 1. (**A**)Reconstructed T1 (**B**)T2 relaxography at 3.0T. Ventricle area shows dark signal due to 300ms threshold.
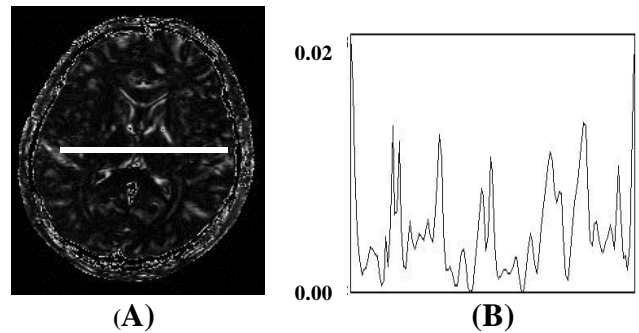

(A)　　　　　　　　(B)

Figure 2. (**A**)Chi-square map of T2 relaxography
(**B**)Profiles across the white line located at (**A**)

Discussion

T1 measurement was agreed with the previous report[4]. For our T2 measurement no significant dependency on field strength was observed. For more accurate T2 measurement, Whittall et al suggested the use of 32 spin echo imaging pulse sequence[5]. The longer T1 values at 3.0T cause magnetization saturation effects with short TRs. To achieve higher SNR and better contrast, scan parameter must be designed carefully to keep amount of all the relaxation time values that may pay off against one another in a given pulse sequence.

References

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