MEASUREMENT OF T2* RELAXATION TIME OF CEREBRAL WHITE MATTER STRUCTURES USING LARGE-SCALE FIELD INHOMOGENETIY CORRECTION TECHNIQUE IN HEALTHY VOLUNTEERS AT 3T

A. Sasao[1], M. Kitajima[1], T. Hirai[1], H. Fukuoka[1], T. Okuda[1], T. Okuaki[2], S. Saiki[2], and Y. Yamashita[1]
[1]Diagnostic Radiology, Kumamoto University, Kumamoto, Japan, [2]Philips Medical Systems, Japan

Introduction

3T-MRI can provide high spatial resolution and high tissue contrast images which are particularly dramatic on T2*-weighted imaging. This type of image is sensitive to susceptibility effects caused by a variety of sources, including iron concentration and tissue microstructure. Conversely, T2* relaxometry for quantitative MR imaging is strongly hampered by large-scale field inhomogeneities (B_0 inhomogeneity), which lead to signal losses and an overestimation of the relaxation rate R2*. Recently, a B_0 inhomogeneity correction for accurate measurement of T2* using multislice technique has been proposed (1). The purpose of this study was to evaluate the effect of the main field inhomogeneity correction in measurement of the cerebral white matter T2* relaxation time, and evaluate the differencies of T2* relaxation time in different cerebral white matter structures in healthy volunteers on high-resolution T2*-weighted images at 3T.

Materials and Methods

The institutional review board approved this study. A total of 20 neurologically normal cases (age 12–76 years, mean 43.9-years, female/male=7/13) were prospectively included in this study. Five contiguous T2 * -weighted high-resolution images using a multi-echo fast field echo pulse sequence (FOV=23 cm, slice thickness/gap 5.0/0 mm, matrix size=256×256, TR/first TE/NEX=1469 ms/2.2 ms/1, FA=30, delta TE = 4.6 ms, number of echoes = 32, read-out bandwidth=781.3Hz) were obtained by a 3.0-T MRI system (Acheiva, Philips). For correction of B_0 inhomogeneity in z-direction, multislice technique proposed by Dahnke H. et al. (1) was applied. Use of these multi-echo images with correction of B_0 inhomogeneity, T2*maps (corrected-T2* maps) representing T2* relaxation time in color scale (Fig. 1) were obtained. T2* maps without correction of B_0 inhomogeneity (uncorrected-T2* maps) were also obtained (Fig. 2). We measured T2* values of five white matter regions; the genu and splenium of the corpus callosum (CC), posterior limb of the internal capsule (PLIC), occipital white matter adjacent to the lateral ventricle (OWM) and frontal white matter (FWM) on both corrected- and uncorrected-T2* maps. Statistical significance of difference of mean T2* values between uncorrected- and corrected T2* maps was tested using paired t-test. Statistical significance of difference of mean corrected-T2* values among those five regions was tested using one-way ANOVA and Turkey-Kramer test.

Results

In all white matter regions, we found statistically significant difference between mean corrected- and uncorrected-T2* values ($P<0.05$). In all white matter regions, mean corrected-T2* values were longer than mean uncorrected-T2* values. We found statistically significant difference of the corrected-T2* values within the five white matter regions ($P<0.0001$). In multiple comparison among the five white matter regions, statistical significant differences of mean corrected-T2* values were found between the genu of CC (46.71±5.38 msec; mean ± SD) and PLIC (57.40±6.53 msec) ($P<0.01$), splenium of CC (47.41±4.77 msec) and PLIC ($P<0.01$), FWM (50.39±3.72 msec) and PLIC ($P<0.01$), OWM (44.36±5.93 msec) and PLIC ($P<0.01$), OWM and FWM ($P<0.01$) (Fig.3).

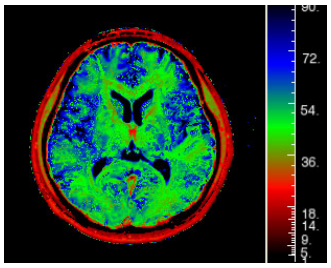

Fig.1 Corrected-T2* map

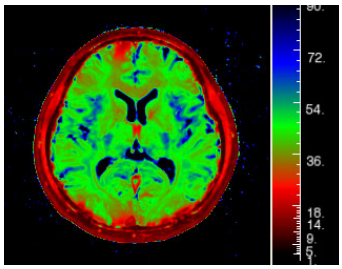

Fig.2. Uncorrected-T2* map

Conclusion

B_0 inhomogeneity affects the T2* relaxation time of the cerebral white matter. T2* relaxation time measured at 3T is different according to the specific white matter region.

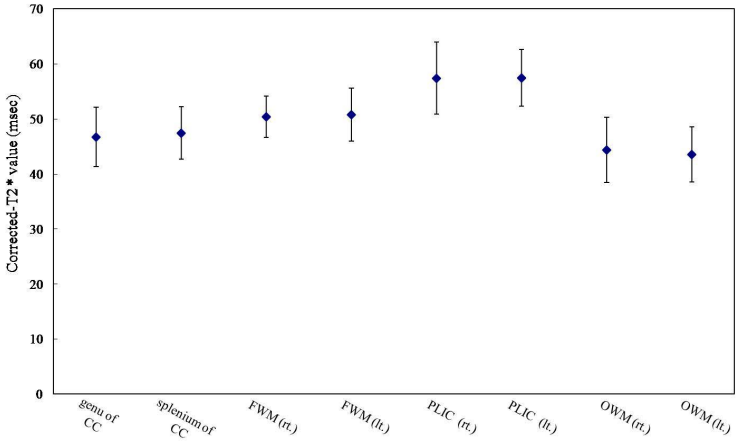

Fig.3 Corrected-T2* value of each region

Reference: (1) Dahnke H., Schaeffer T. Magn Reson Med. 2005;53:1202-1206.