IV. Abstract

Multiple sclerosis (MS) is a chronic inflammatory disorder of the central nervous system (CNS) associated with demyelination, axonal loss and neurodegeneration. Studies have found demyelination and consequent axonal loss in the optic nerve (ON) of early MS. Conventional magnetic resonance imaging (MRI) qualitative tool methods used to diagnose MS provides only macrostructural information. Quantitative MRI (qMRI) methods have been shown to measure macromolecular tissue volume (MTV) in neurological disease associated with demyelination. The hypothesis is that MTV estimation may be a useful tool in quantifying ON lesions in MS. This study aims to explore the feasibility of using qMRI for MTV estimation in the ON of healthy participants determining its validity and reproducibility of the method for its potential clinical use.

A 3T (tesla) MR system and spoiled gradient recalled (SPGR) acquisitions were used to image the ON of ten healthy participants for estimating of the qMRI parameters, T1 and T2* relaxation times, MTV and its complement, proton density (PD). The MR images were segmented to manually draw the ON and then co-registered onto SPGR to obtain T1 and T2* relaxation times, PD and MTV values. Five of the participants were rescanned for a reproducibility assessment of the qMRI parameters using two raters. The mean and standard deviation (σ) of all the qMRI parameters were as follows: MTV (right ON=0.21 a.u. $\pm$0.10, left ON=0.24 a.u. $\pm$0.11), PD (right ON=0.82 a.u. $\pm$0.13, left ON=0.78 a.u. $\pm$0.13), T1 (right ON=1179.98 ms $\pm$306.80, left ON=1144.83 ms $\pm$301.51), T2* (right ON=16.34 ms $\pm$7.88, left ON=17.68 ms $\pm$8.70). Paired t-test found no statistically significant difference in the T1 and T2* values between the left and right ON indicating successful segmentation. A statistically significant difference was found in MTV and PD values between the left and right ON suggesting unsuccessful estimation. Discrepancy in the reproducibility of the qMRI parameters to measure left and right ON was noted as T1 and MTV measurements were not reproducible and T2* and PD were. In conclusion, the feasibility of using qMRI methods to quantify MTV and PD in the optic nerve at 3T in healthy volunteers was unattainable in this study, however it was for the T1 and T2* parameters. Nonetheless, quantifying MTV is an invaluable tool and its valid and reproducible acquisition for clinical application in MS should be the direction of future research.