T1rho Magnetic Resonance Imaging in Characterization of Intralesional and Perilesional Area Differences within Active and Non-Active Multiple Sclerosis (MS) White Matter Lesions

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Abstract:

Purpose: Active multiple sclerosis (MS) lesions are characterized by ongoing inflammatory changes and tissue injury, distinguishing them from non-active chronic lesions. They are conventionally defined as enhancing lesions on gadolinium contrast T1-weighted images, or new/enlarging lesions compared with previous imaging. T1rho is an emerging technique which has shown promise in the characterization of pathological changes in MS lesions. This study aimed to quantify T1rho within the intralesional and perilesional regions of MS lesions and evaluate the potential ability of T1rho to discriminate between active and non-active lesions.

Materials And Method: We recruited 10 patients with relapsing-remitting MS (M: 2, F: 8, age: 26-44) and 10 controls without MS or other known brain disease (M:1 F: 9, age: 36-69). T1rho MRI images were acquired with a Philips Ingenia Elition 3.0T X scanner (Philips Medical Systems, Best, The Netherlands). Thirteen active and 17 non-active lesions in patients, and the corresponding normal white matter in controls were delineated as ROIs. Five perilesional layer masks were created beyond the margin of each ROI using MATLAB R2021a (MathWorks, USA). T1rho maps were fitted using the mono-exponential decay model for T1rho quantification. Mann-Whitney U and t tests were used to test differences between active, non-active lesions and normal white matter. Receiver operating characteristic (ROC) analysis and logistic regression were used to assess the performance of T1rho in distinguishing between the lesion types.

Results: T1rho values of active lesions (mean±SD, 100.48 ±15.83 msec) were significantly lower than that of non-active lesions (125.43±38.62 msec) ($p < 0.01$). T1rho values of the perilesional layers 1-5 of active lesions were lower than that of the non-active lesion perilesional layers ($p < 0.01$). Active and non-active lesion T1rho values were both higher than that of the normal white matter of controls ($p < 0.01$). Multifactor logistic regression model using combined lesional and perilesional layers 1-5 T1rho showed the highest AUC of 0.850 in differentiating active from non-active lesions.

Conclusion: This preliminary work suggests that active and non-active MS lesions may demonstrate differences in T1rho in both their lesional and perilesional regions. These T1rho differences may help in the differentiation of active from non-active MS lesions.