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Regional MRI Measures and Disability in Multiple Sclerosis

Objective: To examine the relationship between conventional/non-conventional regional MRI measures and clinical disability in patients with multiple sclerosis (MS).

Background: Many aspects of MS MRI disease burden, conventional and non-conventional, present heterogeneously throughout the brain tissue. This phenomenon may partially explain the common inability of MRI metrics to distinguish between patients with dramatically disparate clinical presentations. Region-by-region investigation of MRI parameters may therefore provide additional insight into the relationship between MRI and clinical disability by increasing both sensitivity and specificity.

Design/Methods: We studied 108 patients with MS (mean age = 46.3±8.9 years, mean disease duration = 14.0±9.6 years). Disease course was relapsing-remitting (RR)=65, secondary-progressive (SP)=43. Mean EDSS was 3.6±1.9. Tissue segmentation (TS) and magnetization transfer ratio (MTR) maps were obtained via fully-automated algorithms. T2 and T1 lesion volume (LV) maps were created using a semi-automated method. A semi-automated brain region extraction (SABRE) technique was then employed to create region-coding maps based on 7 user-identified landmarks. These SABRE maps were then overlaid with each of the calculation maps to create regional TS, T2, T1, and MTR maps. Regional TS maps were further processed to yield regional brain parenchymal fraction (RBPF) and regional grey matter fraction measures (RGMF). Although the SABRE procedure is capable of precisely identifying 26 unique regions, these were combined into larger frontal, parietal, temporal, occipital, and central regions in order to decrease the number of variables involved. Linear regression was used to examine the predictive value of these regional measures with regard to disability.

Results: SP patients demonstrated significantly higher temporal T2-LV than RR subjects. All RBPF and RGMF were significantly different between RR and SP. All regional MTR values except occipital MTR were also significantly different. Temporal, frontal, and central regional measures showed the highest correlations with disability. In particular, temporal RBPF, RGMF and MTR, frontal T2-LV, and central T1-LV showed the highest correlations for regional BPF, GMF, MTR, T2-LV, and T1-LV, respectively. In regression models controlling for age, temporal RBPF accounted for the most variance in clinical disability, explaining 19.8% of the variance in EDSS. In contrast, whole brain BPF explained only 16.7%

Conclusions/Relevance: Regional MRI measures may potentially provide more sensitive and specific information than global measures in predicting clinical disability.