Abstract

Purpose. To analyze brain changes using quantitative multiparametric MRI in a longitudinal study of patients with multiple sclerosis (MS) and to correlate MRI quantitative parameters with clinical status and biochemical markers of oxidative stress.

Methods. Advanced MRI techniques were used, including quantitative susceptibility mapping (QSM) for measuring iron deposition and volumetric processing of MRI images. A cohort of newly diagnosed MS patients (n=103) was included. MRI, clinical evaluations, and biochemical markers of oxidative stress in cerebrospinal fluid and serum were assessed at disease onset and after 2 years. A cohort of healthy controls was also examined similarly.

Results. In newly diagnosed MS patients compared to healthy subjects, thalamus and putamen atrophy, increased iron content in the caudate nucleus and globus pallidus, elevated concentrations of lipid peroxidation markers, and reduced peroxides in cerebrospinal fluid were observed. After 2 years, MS patients exhibited excessive thalamus and white matter atrophy and iron accumulation in the striatum and globus pallidus compared to healthy subjects. No significant development of clinical markers was observed in the first 2 years of MS progression. Biochemical predictors of brain iron accumulation were not found, and oxidative stress markers were not convincingly associated with longitudinal MRI findings. However, serum and cerebrospinal fluid neurofilament levels at diagnosis predicted thalamus atrophy and white matter loss in MS patients.

Conclusions. Our findings suggest that newly diagnosed MS patients already exhibit greater iron accumulation and brain atrophy compared to healthy subjects, which further intensifies after 2 years of follow-up. This indicates that the brains of MS patients, even those well-treated, age faster, and that MRI could serve as a sensitive marker for monitoring and detecting early disease progression. We demonstrated the predictive value of neurofilament light chain levels in cerebrospinal fluid and serum for forecasting future brain tissue loss, whereas the hypothesis that oxidative stress plays a significant role in early disease progression in treated MS patients was not confirmed

Keywords: *magnetic resonance imaging, multiple sclerosis, oxidative stress, disability*