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Regional gray matter volumes changes in relapsing-remitting and secondary progressive multiple sclerosis – a longitudinal comparative voxel-based morphometry study

Aim

Associations between regional gray matter (GM) atrophy and white matter lesions have been described in relapsing-remitting multiple sclerosis (RRMS) (Sepulcre et al., 2009; Battaglini et al., 2009; Bendfeldt et al., 2009). However, post mortem studies indicate that in advanced disease the cortex is more globally affected and GM demyelination may be extensive with a lack of correlation with WM pathology (Bo et al., Arch neurol 2007). We used optimized voxel-based morphometry (VBM) to study similarities and differences of regional GM volume development in RRMS and secondary progressive (SP) MS, and to investigate whether longitudinal regional GM measures do have added value in the progressive phase.

Methods

T1-weighted three-dimensional magnetic resonance imaging (MRI) data (imaging parameters: echo time, 3 msec; time-to-repetition, 20.8 msec; flip angle, 12; matrix size, 240x256; field of view, 24.0 x 25.6 cm matrix; voxel dimensions, 1x1x1 mm) of data of 248 RRMS and 66 SPMS patients from two different sites followed up for 24 months were analyzed using VBM and Statistical Parametric Mapping software (SPM5). An analysis of covariance model assessed with cluster size inference (all corrected for multiple comparisons, $p<0.05$) was used to compare GM volumes between baseline and follow-up while controlling for site, age, gender, disease duration, global GM volume, T1 hypointense- and T2 hyperintense lesion volumes.

Results

Significant longitudinal cortical GM volume reductions between baseline and follow-up scans were found in the group of RRMS patients bilaterally in the insula (left: BA13; right: BA13) and medial frontal gyrus (left: BA10; right: BA9), in the left orbital gyrus (BA47), medial frontal gyrus (BA10), fusiform gyrus (BA20), and precuneus (BA7), as well as in the right superior frontal gyrus (BA11) and cerebellum. The comparison of RRMS and SPMS patients longitudinally, revealed cortical GM volume differences only in one cortical region i.e. in the left inferior parietal lobule (BA40).

Conclusion

Although regional GM volume measures reveal areas of significant GM volume loss in RRMS, the results from this study suggest, that there is no marked acceleration in the progressive phase of the disease. This implies that the more pronounced impact of GM pathology in the secondary progressive phase is a results of longer linear accrual of such damage, rather than a phase-specific acceleration.

References

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