Pattern of Hemodynamic Impairment in Multiple Sclerosis: Dynamic Susceptibility Contrast Perfusion MRI at 3 T

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Background: Although it has long been known that inflammation associated with vascular occlusion and fibrin deposition occurs prior to demyelination, it has only recently been suggested to contribute to MS disease progression directly. The aims of this study were: a) to investigate the differences in the NAWM perfusion between patients with PP-MS and RR-MS by utilizing DSC perfusion MR Imaging at 3 Tesla; b) to investigate the relationship between perfusion abnormalities and EDSS scores, disease duration, lesion volumes.

Methods: 22 patients with clinically definite MS patients, 11 with PP-MS and 11 with RR-MS were studied. Eleven age- and gender-matched healthy volunteers served as controls. The MRI protocol, acquired on a 3 T unit included axial dual-echo, dynamic susceptibility contrast enhanced T2*-weighted and post-contrast T1-weighted images. For each subject, absolute cerebral blood flow CBF, CBV and mean transit time (MTT) were measured in the periventricular, frontal and occipital NAWM, and in the splenium of the corpus callosum (Fig. 1). Mixed model analysis of variance was used to evaluate differences among subject groups in terms of each perfusion measure, adjusting for age and gender.

Results: Compared to controls, CBF and CBV were significantly lower in all NAWM regions in both RRMS (p values from <0.0001 to 0.020) and PPMS patients (p values from <0.0001 to 0.001). Compared to RRMS, PPMS patients showed significantly lower CBF in the periventricular NAWM (p= 0.002) [Fig. 2] lower CBV in the periventricular and frontal NAWM (p values: 0.0029 and 0.022). EDSS was significantly correlated with the periventricular CBF (r=-0.48, p=0.0016) and with the periventricular and frontal CBV (r=-0.42, p=0.015; r=-0.35, p=0.038, respectively). CBF and CBV did not correlate with disease duration and lesion volume.

Conclusion: Low NAWM perfusion in MS might reflect microvascular impairment which contributes to neurological deficits. DSC perfusion MRI is able to characterize hemodynamic abnormalities in MS.

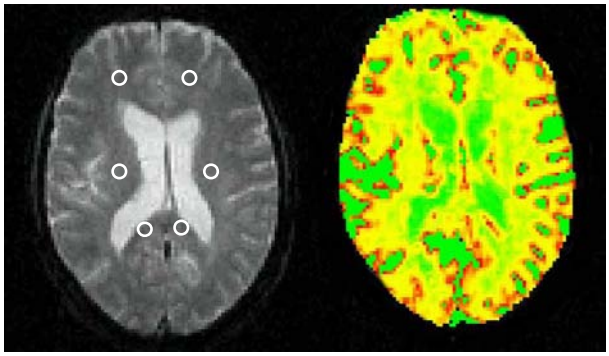

Fig. 1. Left: Axial gradient-echo echo-planar MR image from a patient with PP-MS. Circular regions of interests are placed in the frontal, periventricular NAWM and in the splenium of corpus callosum bilaterally. Each ROI has an in-plane resolution of 2 pixels and was placed after visual co-registration with the transverse T2-weighted image to ensure that lesions were not included in the ROI. **Right:** Axial color-coded CBF map from the same patient.

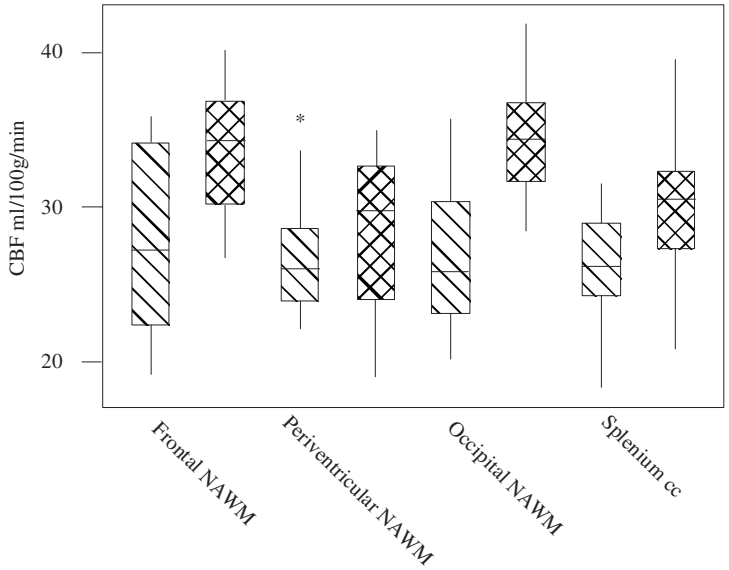

Fig. 2. Box-plots displaying 25%, median, 75% (box) and 95% (whiskers) range of the variation within frontal, periventricular, occipital NAWM and splenium of the corpus callosum. Patients with PP-MS (hatched boxes) show lower CBF values compared with patients with RR-MS (cross-hatched boxes) although the difference reachs statistical significance only in the periventricular NAWM.