PERIVENTRICULAR VENOUS DENSITY IN MS PATIENTS CORRELATES WITH T2 LESION LOAD - A 7 TESLA MRI STUDY

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Introduction: One century ago, J.W. Dawson histologically described MS plaques to be mostly centred around a small cerebral vein. Today, vascular abnormalities in MS patients - as well as alterations of the cerebral blood perfusion and venous drainage - can be studied *in vivo* using MRI. At ultrahigh field strength, rapid Fast Low Angle Shot (FLASH) MRI techniques depict small cerebral veins with great anatomical detail due to the gain in signal-to-noise ratio. This work studies the correlation of small venous abnormalities, T2 lesion load and lesion distribution in multiple sclerosis (MS) patients in comparison to healthy control subjects using 7 Tesla MRI.

Methods: Seventeen MS patients with relapsing-remitting disease course (RRMS; mean±SD age: 40.3±6.5 years; mean±SD disease duration: 5.2±3.9 years; mean, range EDSS score: 2.2, 1.0-4.5) and nine matched healthy controls were investigated on a 7 Tesla MRI (Siemens Magnetom, Erlangen, Germany), using a 24 channel receive head coil (Nova Medical, Wilmington, MA, USA) together with 2D FLASH sequences (Fig. 1; TE = 25.0ms; TR = 1820ms; acquisition time 12:11 min, spatial resolution (0.5 x 0.5 x 2) mm^3). For 3D T_1-weighted imaging a magnetization-prepared rapid acquisition and multiple gradient echo technique (MPRAGE; TE = 2.98 ms; TR = 2300 ms; TI = 900 ms, acquisition time 9:14 mins, spatial resolution of (1.0 x 1.0 x 1.0) mm^3 was used. For T_2-weighted imaging a fluid attenuated sequences (TIRM; TE = 90 ms; TR = 16000 ms; TI = 2925.5 ms, acquisition time 12:50 mins, spatial resolution of 1.0 x 1.0 x 3.0 mm^3) was applied.

Results: MS patients showed a significantly lower amount of periventricular veins (PV) detectable in 2D FLASH images at 7T (mean+/-SD veins per ROI: 6.6±1.4) compared to age- and gender-matched healthy controls (mean+/-SD veins per ROI: 8.9+/-1.2). Within the MS cohort, the venous density correlated inversely with disease severity as indicated by T2 lesion load (Fig. 1C). In total, we detected 435 cerebral MS lesions (mean, range: 25.6, 8-72). In contrast, healthy control subjects did not present with any detectable brain pathology.

Conclusions: The density of detectable periventricular veins in high spatial resolution anatomical MR images obtained at 7T can be used as a mark to differentiate MS patients from healthy controls. The reduction of veins visualized in MS correlates with the disease severity as demonstrated by the T2 lesion load. Our findings indicate cerebral vascular alterations in MS and hence are of major clinical relevance. It should be also noted, that our preliminary findings are not in alignment with the hypothesis of an increased intracerebral venous pressure resulting from a chronic cerebrovascular insufficiency in MS, a recently suggested cause of MS, and therefore challenge - if not oppose - this interpretation.

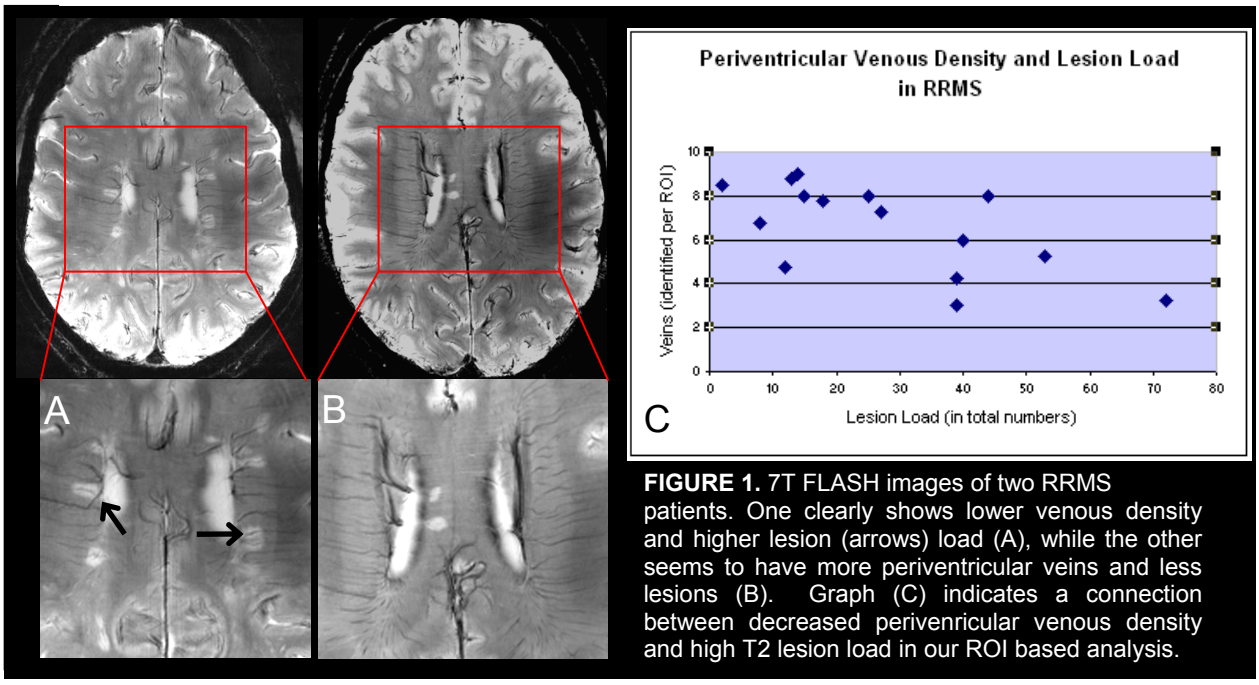

FIGURE 1. 7T FLASH images of two RRMS patients. One clearly shows lower venous density and higher lesion (arrows) load (A), while the other seems to have more periventricular veins and less lesions (B). Graph (C) indicates a connection between decreased perivenricular venous density and high T2 lesion load in our ROI based analysis.