Baseline Blood-Brain Barrier Leakage and Longitudinal Microstructural Tissue Damage in the Periphery of White Matter Hyperintensities

Danielle Kerkhofs, MD, Sau May Wong, PhD, Eleana Zhang, PhD, MD, et al.

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Study Question
What is the relation between baseline blood-brain barrier (BBB) permeability and the longitudinal change in parenchymal diffusivity over 2 years in the perilesional zone around white matter hyperintensities (WMH) in patients with cerebral small vessel disease (cSVD)?

What Is Known and What This Paper Adds
BBB disruption may be associated with microstructural alterations that ultimately lead to WMH. This investigation’s results suggest that BBB leakage at baseline is related to the 2-year change in parenchymal diffusivity in the perilesional zone of WMH. These results support the hypothesis that BBB impairment might play an early role in subsequent microstructural white matter degeneration as part of the pathophysiology of cSVD.

Methods
For this prospective longitudinal study, the investigators recruited 43 patients (58% male; mean baseline age, 68 ± 12 years) with sporadic cSVD (i.e., lacunar stroke or mild vascular cognitive impairment) through 2 Dutch medical centers between April 2013 and February 2015. At baseline, the participants underwent 3T MRI evaluations that included dynamic contrast-enhanced MRI scans that were used to quantify the extent of BBB permeability (i.e., leakage volumes and rates), and intravoxel incoherent motion imaging (IVIM), which permitted quantification of parenchymal diffusivity. At 2-year follow-up assessments, the participants underwent another round of IVIM. Two-year changes in parenchymal diffusivity (ΔD) in the perilesional zones were calculated and divided into 2-mm contours. The primary outcomes were relationships between baseline BBB permeability levels and ΔD values in the perilesional zones.

Results and Study Limitations
Within the perilesional zones, ΔD values increased by 0.10% (95% confidence interval [CI], 0.07%-0.13%; p < 0.01) per 2-mm contour closer to the lesions. Furthermore, ΔD values positively correlated with baseline BBB leakage volumes (r = 0.29; 95% CI, 0.06–0.52) and baseline BBB leakage rates (r = 0.24; 95% CI, 0.02–0.47). The present study’s limitations include a relatively short follow-up period, the lack of follow-up BBB permeability data, and an inability to establish causal relationships. The reliance on data from 2 Dutch centers may limit international generalizability.

Study Funding and Competing Interests
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