Relationship between Perivascular Space Burden, White Matter Hyperintensities, and Cognitive Function

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Introduction. Perivascular space (PVS) is believed to be involved in clearing metabolic waste from the brain. PVS has been found to increase in size in patients with Alzheimer's disease, but the relationship between PVS enlargement and cognitive function still requires further investigation. This study seeks to clarify the relationship between Montreal Cognitive Assessment (MoCA) scores and the percentage of brain volume occupied by perivascular space. We take into account confounding factors such as white matter hyperintensities (WMH), a biomarker associated with cognitive decline. We hypothesize that PVS enlargement leads to decreased brain waste clearing efficiency, which subsequently leads to cognitive impairment.
Methods. The included participants (n = 15, ages 62 to 89, female: n = 9) were recruited for the 3YWU study from the Indiana Alzheimer's Disease Research Center. The sample included the control group (n = 9) and patients with mild cognitive impairment (n = 1) and subjective cognitive decline (n = 5). For imaging processing, the enhanced PVS contrast (EPC) was calculated by dividing T1-weighted images by T2-weighted images, followed by applying the Frangi filter to capture the vessel-like PVS structure. Three trained and blinded reviewers then further manually improved the PVS masks. For the analysis, we calculated the correlation coefficients between the Montreal Cognitive Assessment (MoCA) scores and normalized PVS volume, as well as a partial correlation coefficient while controlling for the normalized WMH volume.
Results. We found a negative association between the PVS volume and MoCA scores of -0.28 (p=0.31), and after controlling for WMH, we still observed a negative correlation of -0.34 (p-value of 0.23).
Conclusion. Our results suggest that PVS enlargement is a possible factor in cognitive impairment. However, further investigation is necessary to characterize these correlations.