Retinal Vascular Fractal Dimension Is Associated with Cognitive Dysfunction

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Fractal analysis is a method used to quantify the geometric branching complexity and density of retinal vessels. This study examined the relationship of retinal vascular fractal dimension and other retinal vascular parameters with cognitive dysfunction in an older Asian population. Subjects aged 60 years and older from the Singapore Malay Eye Study were selected for analysis. Retinal vascular fractal dimension (Df) and other quantitative retinal vascular parameters (branching angle, tortuosity, and caliber) were measured based on a standardized grading protocol from photographs of the retinal fundus using a computer-assisted program. Qualitative retinal signs were also assessed from photographs. Cognitive dysfunction was defined as a locally validated Abbreviated Mental Test (AMT) score ≤6/10 in participants with 0-6 years of formal education and an AMT score ≤8/10 in those with more than 6 years of formal education. Cognitive dysfunction was identified in 262 of the 1202 participants (21.8%). Decreased retinal vascular Df was significantly associated with lower AMT score (P = .019). In multivariate logistic regression analysis, participants with lower retinal vascular Df values were more likely to have cognitive dysfunction (odds ratio, 1.71; 95% confidence interval, 1.03-2.82, comparing the lowest and highest Df quintiles). In subgroup analysis stratified for cardiovascular risk factors, this association was present in participants with hypertension and current smokers. Other retinal vascular signs were not associated with cognitive dysfunction. Decreased retinal vascular Df is associated with cognitive dysfunction in older persons. Rarefaction of the retinal vasculature may reflect similar changes in the cerebral microvasculature that may contribute to cognitive deterioration. **Key Words:** Cognitive dysfunction—fractal—imaging—retinal vasculature.

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Dementia is a significant and growing medical, social, and economic problem worldwide, but its pathogenesis remains poorly understood.1,2 Although cerebrovascular disease, especially cerebral small-vessel disease, is considered to play a role in the pathogenesis of dementia, to date research has been limited by an inability to directly visualize the cerebral microcirculation.3 Retinal and cerebral small vessels share similar embryologic origins, anatomic