

Clinical Validation of Automatic Quantitative Measurements of Perivascular Spaces in Older Age MRI Brain Data

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Introduction: Perivascular Spaces (PVS), also known as Virchow-Robin spaces, are an emerging feature of small vessel disease. Automatic quantification of PVS in brain Magnetic Resonance Imaging (MRI) is important for understanding their relationship with neurological disease. We developed an automatic segmentation method [1] and here we present its clinical validation in a population of older people in their early seventies.

Materials and Methods: We compared PVS visual rating scores vs PVS volume and number, computed with our automatic method. We included 539 individuals of the Lothian Birth Cohort 1936 (LBC1936) study, at mean age 72.7 years. The recruitment and testing of this cohort has been described in detail previously [2]. Visual ratings were assessed by an experienced neuroradiologist using a validated scale [3]. Perivascular spaces were automatically segmented in the centrum semiovale and deep corona radiata supraventricular, and their volume and number calculated [1]. We used linear modelling and multivariate regression for the analyses.

Results: PVS total count and volume correlate with visual rating scores (Spearman's $\rho = 0.55$, $p < 0.001$ and $\rho = 0.60$, $p < 0.001$, respectively). Scatter plots of these associations are shown in Fig. 1a and b. Number and volume of PVS was independently and significantly correlated with visual scores after correction for confounders, including age, gender and vascular risk factors (i.e. hypertension, diabetes, cholesterol, cardiovascular disease history) ($\beta=118.15$, $p < 0.001$ and $\beta=1266.2$, $p < 0.001$). We noted that men has greater PVS burden, as already shown in similar studies [4]. PVS burden is also associated with ageing, even within the narrow age range of these individuals.

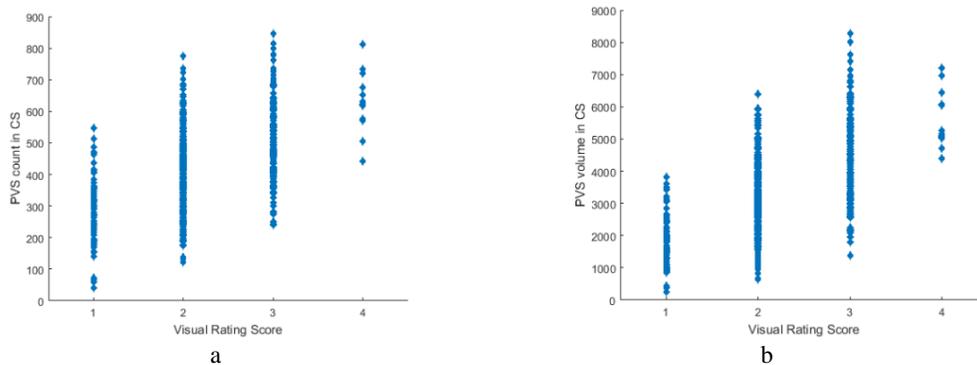


Figure 1. Associations between PVS computational total volume (a) and count (b) vs. PVS visual rating scores in centrum semiovale (CS) region.

Conclusions: PVS count and volume agree with visual ratings. Quantitative measurements will better characterize the severity of PVS in ageing people and their associations with dementia, stroke and vascular diseases.

Acknowledgements: This work was funded by Age UK, the Centre for Cognitive Ageing and Cognitive Epidemiology (G0700704/84698), Row Fogo Charitable Trust (grant no. BRO-D.FID3668413), the Fondation Leducq Transatlantic Networks of Excellence program (16 CVD 05) “Understanding the role of the perivascular space in cerebral small vessel disease, and the EPSRC grant [EP/M005976/1].

References: [1] Ballerini et al. *Sci Rep* 2018; **8**: 2132. [2] Deary et al. *BMC Geriatr* 2007; **7**: 28. [3] Potter et al. *Cerebrovascular Diseases* 2015; **39**: 224. [4] Ramirez et al. *J. of Alzheimer's Disease* 2015 **43**, 415.