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

Lucia Ballerini,²,³, Maria del C. Valdés Hernández,²,³ Ruggiero Lovreglio,² Susana Muñoz Maniega,²,³ Mark E. Bastin,²,³, Ian J. Deary,² and Joanna M. Wardlaw²

²Department of Neuroimaging Sciences, University of Edinburgh, Edinburgh, UK ³Centre for Cognitive Ageing and Cognitive Epidemiology, University of Edinburgh, Edinburgh, UK ⁴School of Engineering and Advanced Technology, Massey University, Auckland, New Zealand

*Corresponding author: lucia.ballerini@ed.ac.uk

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 ρ = 0.55, p < 0.001 and ρ = 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) (β=118.15, p < 0.001 and β=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.

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.

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