Cortical thickness and mobility status in healthy aging

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Objective: We set out to investigate the link between cortical thickness and mobility status, white matter lesion load, and cognitive function in healthy elderly subjects.

Background: Previous studies have shown the association between white matter hyperintensity (WMH) load and mobility status in elderly subjects [1]. However, WMH load alone might not be the only or the best predictor of mobility status. Other measures, such as cortical thickness, have been proven as a valuable additional measure of disease progression in multiple sclerosis [2], Alzheimer's disease [3], and HIV/AIDS [4]. In this study, we explored the link between regional cortical thickness and mobility status, lesion load, and cognitive function.

Methods: A cross-sectional MRI study of 99 healthy elderly patients (mean age±SD = 82.3±4.05; range = 75-90; 42 men, 57 women) was performed. Patients were recruited equally from three age groups and there mobility (intact, intermediate, impaired) groups in order to avoid bias. The subjects were screened for a variety of health factors and were given the Short Physical Performance Battery (SPPB) to test mobility status (higher values indicate better mobility) and the Mini Mental Status Exam (MMSE) to assess cognitive function (higher scores indicate better cognition). Three high-resolution structural MR scans, obtained at 3T, were acquired: magnetization-prepared rapid gradient echo (MPRAGE: TR = 2500ms, TE = 2.74ms, FA = 8°, TI = 900ms, 1x1mm resolution, 1mm slice thickness); T2 weighted spin-echo (T2: TR = 2500ms, TE = 355ms, 1x1mm resolution, 1mm slice thickness); fluid-attenuated inversion recovery (FLAIR: TR = 6800ms, TE = 353ms, TI = 2200ms, 1x1mm resolution, 1.3mm slice thickness). Automated tissue classification, followed by manual correction, was performed on the T2 images to get intra-cranial cavity (ICC) volumes. WMH segmentation was performed on the co-registered MPRAGE and FLAIR images, using an expectation-maximization framework [5]. Cortical thickness measurements were also obtained from the MPRAGE images, using Freesurfer, by measuring the distance between reconstructed representations of the inner and the outer surface of the cortical mantle [6]. The associations between white matter hyperintensity fraction (WMHF — WMH normalized by ICC), MMSE, and SPPB on cortical thickness were assessed using the general linear model.

Results: The average cortical volume was 380±35.9 mL with the right hemisphere cortical volume significantly larger (p=0.0386). Significant correlations were found between cortical thickness and SPPB in the somatosensory and motor cortices (Figure 1 - SPPB) and between cortical thickness and WMHF in the motor, premotor, and somatosensory cortical areas (Figure 1 - WMHF). We found no significant correlations between cortical thickness and MMSE.

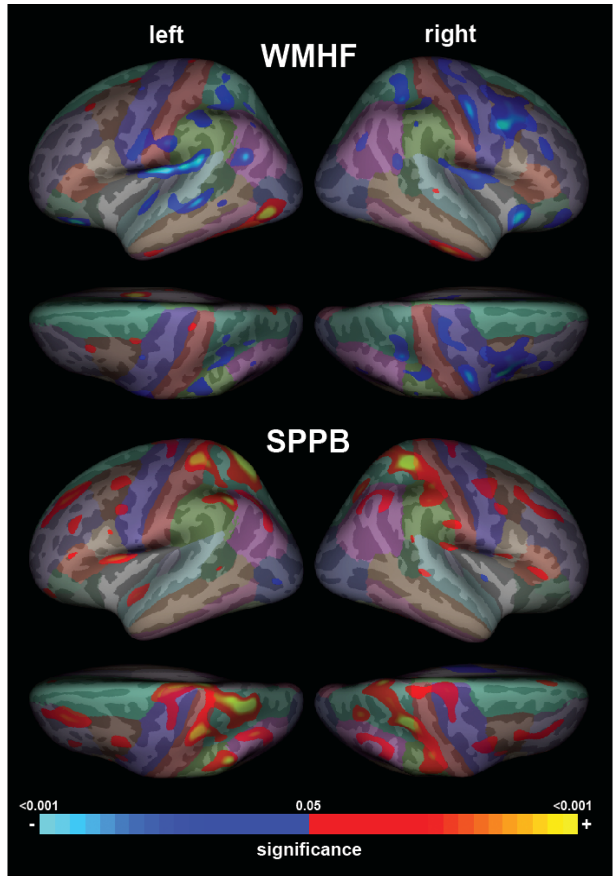

Fig. 1: Visual representation of the correlation between cortical thickness and white matter lesion load (WMHF) and between cortical thickness and mobility status (SPPB). Cortical thickness in parts of the motor and somatosensory cortices is positively correlated with mobility status, while cortical thinning in the motor, premotor, and somatosensory cortical areas is associated with lesion load.

Discussion: The results illustrate that in addition to white matter lesion load, cortical thickness is a potentially important marker of mobility status in the elderly. The mean MMSE score was 28.5±1.33 (range: 24-30). An MMSE score of 24 or higher implies normal cognitive function, thus explaining the lack of significant correlation between cortical thickness and MMSE. Future work will investigate the relationship between the spatial distribution of lesions and cortical atrophy.

References:

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