

Increased Cerebral Grey Matter Volume and Density in Early Parkinson's Disease

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Introduction:

Parkinson's disease (PD) is a neurodegenerative disease that can be difficult to diagnose in the early stage. A vast majority of published structural MRI studies on PD have reported cerebral atrophy with one study showing evidence of increased intracranial volume in early PD (1). The purpose of this study was to investigate possible changes of volume and density in cerebral grey matter using voxel-based morphometry (VBM) in patients with early PD, and demonstrate the potential of these changes for diagnosis of PD in early stage.

Method and materials:

Twenty-one early PD patients (aged 64.9 ± 1.87 years; range 47-81 years), diagnosed based on UPDRS, the Hoehn and Yahr disability scale and MMSE, were compared with an equal number of gender- and age-matched controls (aged 65.73 ± 1.57 years; range 45-80 years). The whole brain volume scan was acquired using a 3D IR-prepared FSPGR sequence on a 1.5T GE Signa Excite MR scanner (General Electric Health Care, Milwaukee, USA) with an 8-channel phased array head coil (TR/TE = 7.0/5.2 ms, flip angle = 20°, matrix size = 256×256 , FOV = 24 cm, slice thickness = 1.6 mm, and number of slices = 80 slices). Data processing was performed using SPM5 software (Institute of Neurology, London, UK) with an optimized VBM protocol (2). The steps included: spatial normalization, segmentation of the normalized images into grey matter, white matter and CSF, analyses of group differences in grey matter density and volume, and smoothing with a full width at half maximum (FWHM) of 8 mm. Two sample t-test was used to compare differences in grey matter between the patient and the control groups. The study was approved by the local ethical committee and written informed consent was obtained from all subjects.

Results:

The patient group showed significantly larger grey matter volume than the controls in right cuneous (BA18) and left middle frontal gyrus (BA6) ($p < 0.001$, uncorrected) (Fig.1). In addition, there was significantly higher grey matter density in the right middle frontal gyrus (BA6) ($p < 0.001$, uncorrected) (Fig.2) in the patient group as compared with the controls. Reduced grey matter volume or decreased grey matter density was not observed in the PD patients when compared to the controls.

Discussion and Conclusions:

Increased grey matter density in the right middle frontal gyrus as well as increased grey matter volume in the left middle frontal gyrus and right cuneous has not been previously reported in early PD patients. Although the present study did not investigate the mechanisms leading to these changes, the new findings suggests that impaired cerebral function in early PD may be compensated for by additional processing (e.g. enhanced attention or increased reliance on visual features), as reported in chronically progressive neurodegenerative disorders (3,4). These mechanisms may contribute to local morphometric changes as observed in this study. In conclusion, the observed changes in grey matter volume and density in early PD may provide new insights into the neurodegenerative process and, more importantly, a new means for diagnosing early PD. This study is also expected to promote future investigations in establishing the relationship between the increased frontal volume and density with behavior deficits.

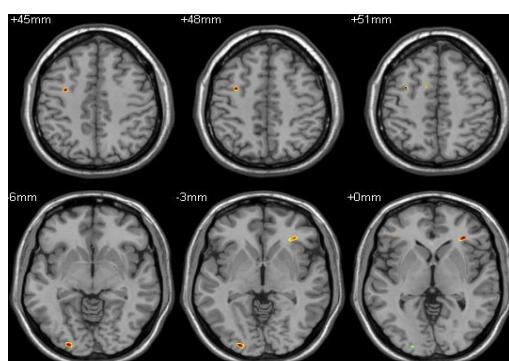


Fig.1 Increased grey matter volume observed in the left middle frontal gyrus and right cuneous. Left of the figure indicates the right side of the brain.

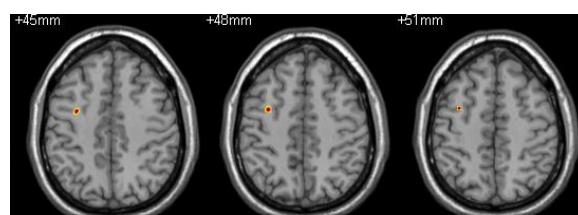


Fig.2 Increased grey matter density in the right middle frontal gyrus. Left of the figure indicates the right side of the brain.

References:

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