Abnormal spontaneous neural activity in early Parkinson's disease revealed by resting-state fMRI

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Introduction:

Resting state brain activity in Parkinson's disease (PD) can help us to understand the pathophysiology of the disorder (1, 2), yet it has seldom been investigated in the early stage of the disease. To characterize brain dysfunction in early PD, using regional homogeneity (ReHo) method, the current study explore the abnormal spontaneous neural activity of resting state in early PD patients and demonstrate the potential of these changes for monitor the progression of PD in early stage.

Material and Method:

The study was approved by the local ethical committee and written informed consent was obtained from all subjects. Ten early PD patients (aged 64.1±1.7 years; range 47-80 years), diagnosed based on UPDRS, the Hoehn and Yahr disability scale and MMSE, were compared with eleven gender- and age-matched controls (aged 63.3±1.67 years; range 45-79 years). All subjects are right handed. Twenty-two axial slices covering whole brain were acquired using a 1.5T GE Signa Excite MR scanner (General Electric Health Care, Milwaukee, USA) with an 8 channel phase array head coil (TR/TE 2000/45 ms, flip angle 90°, matrix 64 × 64, FOV 24 cm, thickness/gap 5/1mm, total 200 volumes). Data preprocessing was performed in SPM5, ReHo analysis was performed using the in-house software REST (http://resting-fmri.sourceforge.net). The linear trend of the time series was removed and band-pass filtering (0.01 Hz < f < 0.08 Hz) was performed. Individual ReHo maps were generated (3,4). Then a mask was used to remove nonbrain tissues and noise on the ReHo maps, and standardization by dividing global mean ReHo.

Results:

The singnificent increased ReHo ($p<0.05$, corrected) was showed in left frontal lobe, left parietal lobe, left cerebellum, right frontal lobe (including superior frontal gyrus, middle frontal gyrus, inferior frontal gyrus), right parietal lobe and precuneus; Meanwhile,the singnificent decreased ReHo ($p<0.05$, corrected) was showed in left frontal Lob, Left occipital lobe and calcarine.

Conclusion:

In this study, abnormal ReHo demonstrate that spontaneous neural activity in the resting state is changed in patients with early PD. The increased ReHo in Left cerebellum correlated with abnormal motor function in the early PD (1). The increased ReHo in frontal lobe maybe a compensatory responses to the early damage of the central nervous system (5). These findings shed light on the pathophysiological mechanisms underlying early PD and demonstrate the feasibility of using ReHo as a research and clinical tool to monitor cerebral dysfunction in PD, although further work is necessary to compare different measures of brain function to elucidate the neural substrates of these ReHo abnormalities.

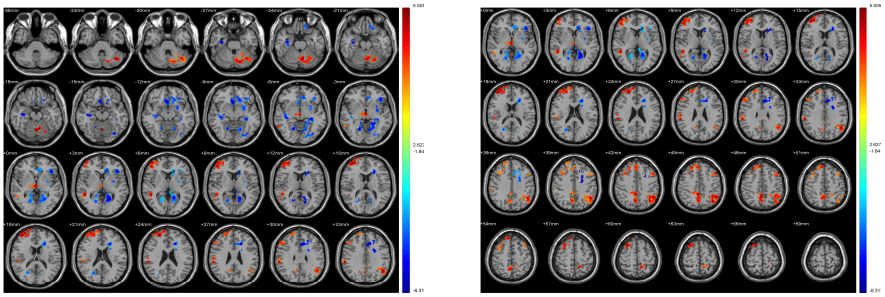

Fig.1 Reho differences between PD and control groups. Blue indicates that PD subjects had decreased Reho compared with the controls and the yellow indicates the opposite. T score bars are shown on the right. Left in the figure indicates the right side of the brain.

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