Diffusion changes in thalamus and subthalamus for Parkinson's disease with depression

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Introduction

Depression occurs in up to 40% of individuals with Parkinson's disease (PD) [1,2]. The high prevalence of depression in PD has suggested that depression may not just be a reaction to PD disability, but rather results from neurodegenerative changes occurring in PD [2]. The neural basis of depression in PD remains unclear [2,3]. Previous studies show depression in PD may be related to thalamus and subthalamus nucleus (STN) [3-6]. However it is unclear what kind of changes occurs in these two nuclei for PD patients with and without depression. To investigate the possible changes occurring in the thalamus and STN which are related to depression in PD patients, a DTI study was conducted in PD patients with or without depression with comparisons to healthy controls (HC).

Material and Method

32 PD patients and 12 HC were enrolled in this study. All PD patients fulfilled the UK Parkinson's Disease Society Brain Bank criteria for idiopathic PD. The included 32 PD patients were divided into 14 depressed PD (DPD) patients and 18 non-depressed PD (NDPD) patients by the Diagnostic and Statistical Manual of Mental Disorders-IV (DSM-IV) criteria [7]. DPD patients, NDPD patients and HC were matched for age, gender, and Mini-mental state examination. DT-MRI was carried out with a 3.0 Tesla MR scanner (Trio system; Siemens Magnetom scanner, Erlangen, Germany). The images were obtained using an echo planar imaging sequences with 20 different motion probing gradient directions (TR/TE: 6000/93ms, matrix: 128x128, FOV: 256x256 mm, slice thickness 4mm, b value: 1000s/mm2). Fractional anisotropy (FA) maps were obtained for all subjects. ROI-guided voxel-based analysis among DPD, NDPD and HC groups was conducted on FA maps in thalamus and STN. Moreover, for the detected differed regions, mean FA values were compared among these three groups to get the possible diffusion changes in DPD patients compared to NDPD and NC. Unpaired two-tailed t-test and ANOVA method were used for statistical analysis.

Results

As shown in Fig. 1, decreased FA ($p<0.01$) was found in mediodorsal thalamus (MDThal) as well in the STN in DPD patients compared to HC; while in NDPD patients, the decrease was found only in STN. Fig.2 showed the scatter graphs with mean FA value in the detected bilateral mediodorsal thalamic and left STN regions for NC, NDPD and DPD subjects. DPD patients show significantly decreased mean FA value in the bilateral MDThal compared to NDPD patients (right MDThal, $p = 0.001$; left MDThal, $p = 0.003$) or HC (right MDThal, $p = 0.000$; left MDThal, $p = 0.002$), and in the STN when compared to HC (left STN, $p = 0.000$). Decreased FA value was only found in left STN in NDPD patients compared to HC ($p = 0.016$).

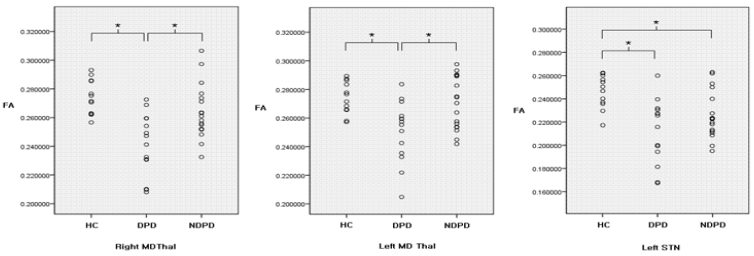

Fig. 1 (right). Illustration of decreased FA ($p<0.01$) in thalamus and STN among groups of DPD, NDPD and HC. A. DPD vs. HC; B. NDPD vs. HC; C. DPD vs. NDPD.

Fig. 2 (above) Scatter graphs of the mean FA value in the detected significant regions for every subject in HC, DPD, and NDPD groups. * indicates significant differences between groups with $p < 0.01$.

Discussion and Conclusion

Distinctive DTI changes were found in the thalamus and STN for Parkinson's disease with or without depression as compared to healthy controls. In DPD patients, decreased FA was found in both the MDThal and STN; while in NDPD patients, decreased FA was only found in the STN but not MDThal. Our findings highlight the difference and relationship between MDThal and STN for PD patients with or without depression, and give more specific explanation of the high percentage of depression in PD patients. This finding may be helpful for understanding the potential neural mechanisms underlying depression in PD.

References

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