DISRUPTED WHITE MATTER INTEGRITY IN DEPRESSED PATIENTS WITH PARKINSON'S DISEASE: A TRACT-BASED SPATIAL STATISTICS STUDY

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Purpose

Parkinson's disease (PD) is frequently accompanied by depression, with a prevalence much higher than that in other chronic diseases[1]. As yet, the neural basis for depression in PD still remains unclear. Considering that major depressive disorder (MDD) is a disconnection syndrome[2], depressed PD (DPD) patients may also possess disrupted fiber connections. Although previous studies on DPD patients have revealed white matter deficits in a number of brain regions, some findings are contradictory[3, 4], probably due to the use of different regions of interest. In the present study, we aim to perform an un-biased whole brain analysis of white matter integrity in DPD patients.

Methods

We included 15 DPD patients and 15 age-sex-matched non-depressed PD (NDPD) patients in the present study. The disease diagnosis was based on the medical history, the neurologic examinations, response to the dopaminergic drugs and scale evaluation. All the patients were assessed with the Unified Parkinson Disease Rating Scale (UPDRS), the Hamilton Rating Scale for Depression (HRSD), and the Mini-Mental State Examination (MMSE). Diffusion images were acquired from all subjects using a 3.0T GE Signa MR scanner (voxel size=2*2*3mm^3, 31 gradient directions, b=1000). Image analysis was performed using the brain fMRI software library (FSL, version 4.1.0; http://www.fmrib.ox.ac.uk/fsl). We used Tract-Based Spatial Statistics (TBSS) to evaluate the difference of Fractional Anisotropy (FA) maps between the two groups. The threshold was set at P<0.01 (uncorrected) with cluster size>100. Average FA values were then extracted from significant clusters to perform correlation analysis with scale scores.

Results

Comparison between the two groups revealed severe white matter damage in the DPD group (Fig. 1). Damaged fibers were located in left uncinate fasciculus, left superior longitudinal fasciculus, left anterior thalamic radiation, left forceps minor and left inferior longitudinal fasciculus (Tab. 1). Correlation analysis showed that deep temporal white matter FA was negatively correlated with the HDRS scores (r=-.543, p=.037).

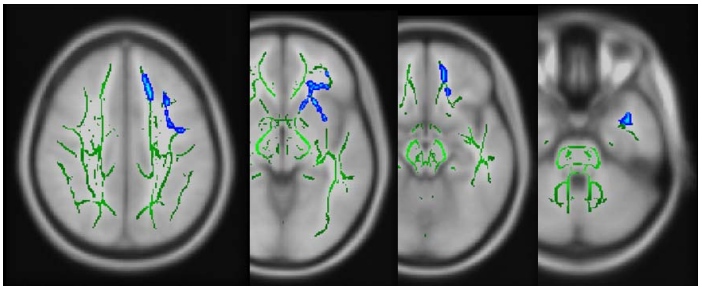

Fig. 1. White matter structures with significantly lower FA in depressed Parkinson's disease patients.

Discussion

Compared to previous studies using region of interest strategy, our results demonstrated more widespread brain fiber degenerations in the DPD patients. Besides, these deficits have been frequently reported in MDD researches[5]. Damages in the local frontal areas and the uncinate fasciculus implicate abnormal top-down control over limbic regions in DPD patients, which is in accordance with the popular fronto-limbic decoupling theory of MDD[6]. Deficits in the superior and inferior longitudinal fasciculus, however, may reflect disrupted large scale networks.

Conclusion

As depression in general population, depression in PD patients may also be caused by disrupted fibers in the brain. These damages might share some common mechanism with the overall fiber deficits in PD patients and explain the tight connection between PD and depression.

References

1 Reijnders, J. S. A. M., U. Ehrt, et al. *Movement Disord.* 23(2), 183-189 (2007).
2 Liao, Y. et al. *J Psychiatr Neurosci.* 37(4), 110180 (2012).
3 Kostić, V. S. & Filippi, M. *J Neurol Sci.* 310(1), 61-63 (2011).
4 Surdhar, I. et al. *Parkinsonism Relat D.* 18(7), 809-13(2012).
5 Sexton, C. E., Mackay, C. E., et al. *Biol Psychiat.* 66(9), 814-23. (2009).
6 Mayberg, H. S. *J Neuropsychiatry Clin Neurosci*. 9(3), 471-481. (1997).

Tab. 1. Regions showing significantly lower FA in depressed Parkinson's disease patients.

Voxels	Peak p	MNI X	MNI Y	MNI Z	Fibers	Closest Gray Matter
899	0.001	114	147	85	UF, ILF	-
293	0.002	118	156	64	UF	Orbitofrontal Gyrus
786	0.000	122	148	95	ATR, SLF	Middle Frontal Gyrus
511	0.002	107	158	105	SLF	Superior Frontal Gyrus
249	0.001	126	126	114	SLF	Precentral Gyrus
252	0.001	117	160	93	ATR, UF	Middle Frontal Gyrus
103	0.001	102	175	58	FM, UF, ATR	Orbitofrontal Gyrus
134	0.001	127	131	40	ILF	Inferior Temporal Gyrus

(UF: uncinate fasciculus, ILF: inferior longitudinal fasciculus, ATR: anterior thalamic radiation, SLF: superior longitudinal fasciculus, FM: forceps minor)