Research Week 2021

Resting state functional connectivity shows that motor and non-motor networks predict motor symptoms in Parkinson's Disease

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Keywords

Parkinson's disease, resting state fMRI, somatomotor network, CinguloOpercular network

Abstract

Objective

Investigate the functional connectivity network pairs associated with the motor symptoms in people with Parkinson's disease (pwPD).

Background

PD is a neurodegenerative disorder characterized by motor dysfunction. Functional MRI offers a unique opportunity to non-invasively characterize brain function. In this study, we hypothesized that the motor functions observed in PD may involve connectivity in higher-level attention networks. Understanding the resting state functional networks that correlate with the severity of the motor symptoms would be valuable to understand the disease physiology.

Methods

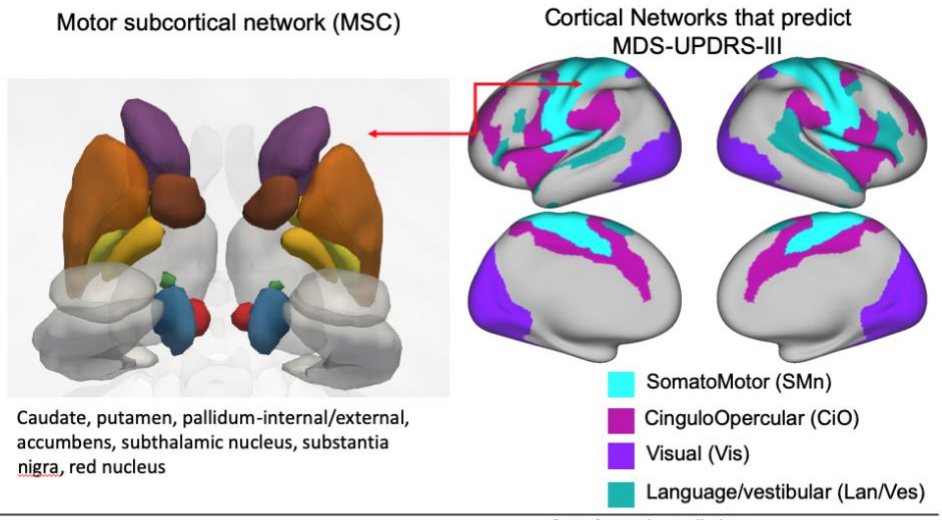
Our sample consisted of 88 subjects (mean age: 68.2(SD:10), 55M/33F). Motor severity of pwPD was assessed in practical OFF medication state, using MDS-UPDRS Part-III scores (mean: 49 (SD:10)). MRI data was processed using an adapted version of HCP pipeline [1]. HCP Cole Anticevic atlas was used for creating cortical functional connectivity networks [2]. For subcortical network, we included the regions that are likely involved in motor symptoms in PD (figure 1). We used training (N=64) and test (N=24) dataset for predictive modelling. PLSR models were used to predict MDS-UPDRS-III scores based on functional connectivity using the training dataset and optimized by leave-3-out cross validation [3,4]. The most predictive modes were then used to predict MDS-UPDRS-III in the test dataset.

Results

The top 5% PLSR models that predicted the MDS-UPDRS-III scores with effect size > 0.5 were the somatomotor (SMn) and MSC (d=0.6), SMn and Visual (d=0.5) and CinguloOpercular and language/vestibular (d=0.5) networks (figure 1).

Conclusion

Our finding suggests that along with motor networks, visual- and attention-related cortical networks are also impacted in the motor symptoms of PD. When pwPD have deficits in motor networks, probably more attention is required to carry out motor functions. Characterization of functional networks could be helpful in understanding the contribution of motor and non-motor cortical regions in parkinsonian movement disorders.



Functional system pair	Optimal # of components	Out-of-sample predictions					
		Within Training		Training to Test			
		MAE	Effect Size	MAE	*p*	R	*p*
MSC and SMn	10	0.73	0.61	0.48	<0.01	0.53	<0.01
Smn and Vis	3	0.71	0.53	0.46	0.02	0.53	<0.01
CiO and Lan/Ves	1	0.71	0.49	0.50	0.02	0.43	0.02

Figure 1. Network pairs that predict MDS-UPDRS-III scores. In subcortical networks, motor related regions (MSC) are in color while non-motor regions are in white. Table shows the out of sample prediction performance. MSC – motor subcortical network, MAE – mean absolute error; R – correlation coefficient between observed and predicted UPDRS-III.

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