RECORD ABSTRACT POSTER

Brain activity during externally and internally guided movements in patients with Parkinsons disease

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Abstract

An imbalance in the activity of the basal ganglia in Parkinsons disease is known to result in disturbance of the planning and initiation of mainly self-initiated voluntary movements. The effectiveness of self-initiated movements can be improved by adding an external stimulus. Despite a large number of studies in this area, the neural mechanisms of motor control of these movements and the role of the basal ganglia in their implementation remain unknown.

The aim of the study was to compare brain activity during the execution of externally triggered (ET) and internally guided (IG) movements in normal state and Parkinson's disease. We used functional MRI with block designed paradigm to analyze brain activity caused by voluntary movements. Twenty healthy participants and twenty Parkinson's disease patients (OFF-state) were asked to perform hand movements in response to sound stimuli (ET) and in advance of the stimuli (IG).

We showed that brain activity during externally induced movements is lateralized mainly in the contralateral hemisphere, both in normal and in Parkinson's disease. During the IG movement, brain activity was observed also in the ipsilateral hemisphere, to a greater extent in patients, which indicates difficulty in performing this test. At the same time, in patients, activation was observed not only in the posterior parts of the putamen but also in the anterior ones during IG movements. These results showed that IG movements in patients with PD were made with the participation of both sensorimotor and associative basal ganglia-thalamocortical loops.

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Brain activity during externally and internally guided movements in patients with Parkinson's disease

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INTRODUCTION

An imbalance in the activity of the basal ganglia in Parkinson's disease is known to result in disturbance of the planning and initiation of mainly self-initiated voluntary movements. The effectiveness of self-initiated movements can be improved by adding an external stimulus. Despite a large number of studies in this area the contribution of basal ganglia in various aspects of human movement remains unclear. We hypothesized that basal ganglia activity pattern should be modified or displaced into associative areas during IG but not ET movement. The aim of the present study was to compare activation areas in the basal ganglia and thalamus during ET and IG motor tasks in normal and PD subjects.

MATERIALS AND METHODS

We used functional MRI with block designed paradigm to analyze brain activity caused by voluntary movements (Fig.1). Twenty healthy participants and twenty Parkinson's disease patients (OFF-state) were asked to perform hand movements in response to sound stimuli (ET) and in advance of the stimuli (IG). Imaging was performed on a 3-Tesla MR-scanner. fMRI and anatomical data analysis was performed with SPM software (http://www.fil.ion.ucl.ac.uk/spm/software/spm12/). The basal ganglia and thalamus areas were analyzed with the mask using WFU PickAtlasSPM package (https://www.nitrc.org/projects/wfu_pickatlas/).

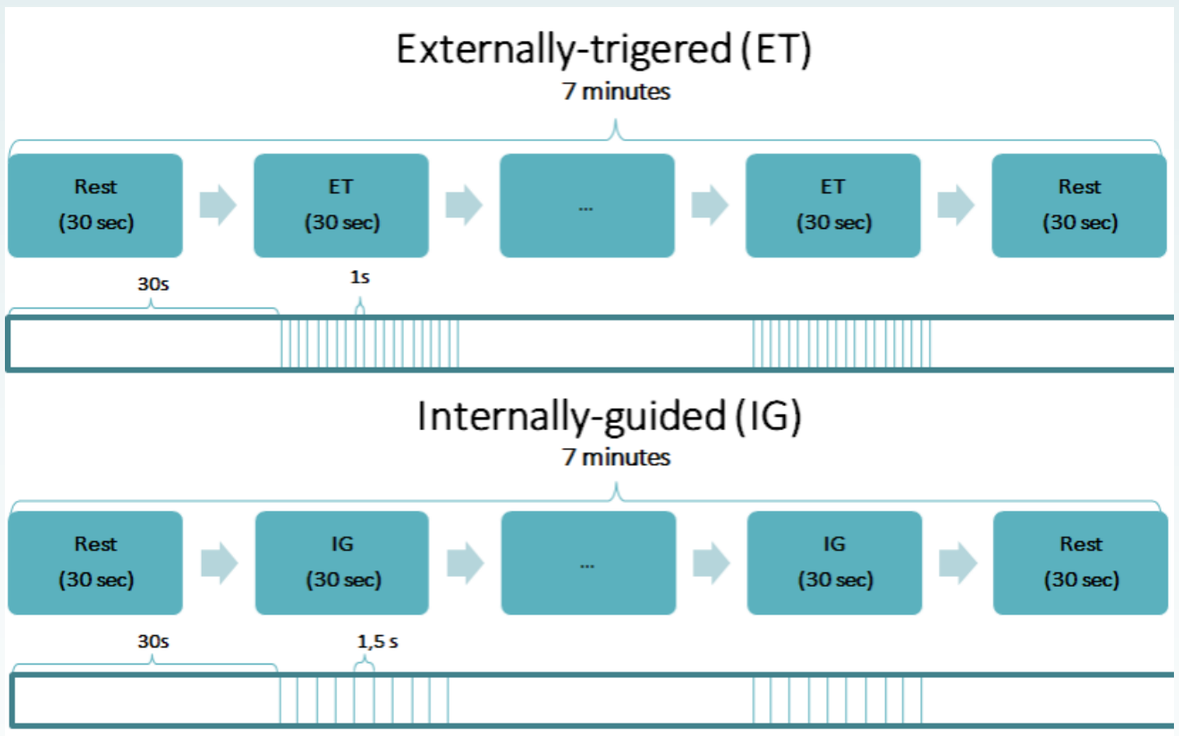


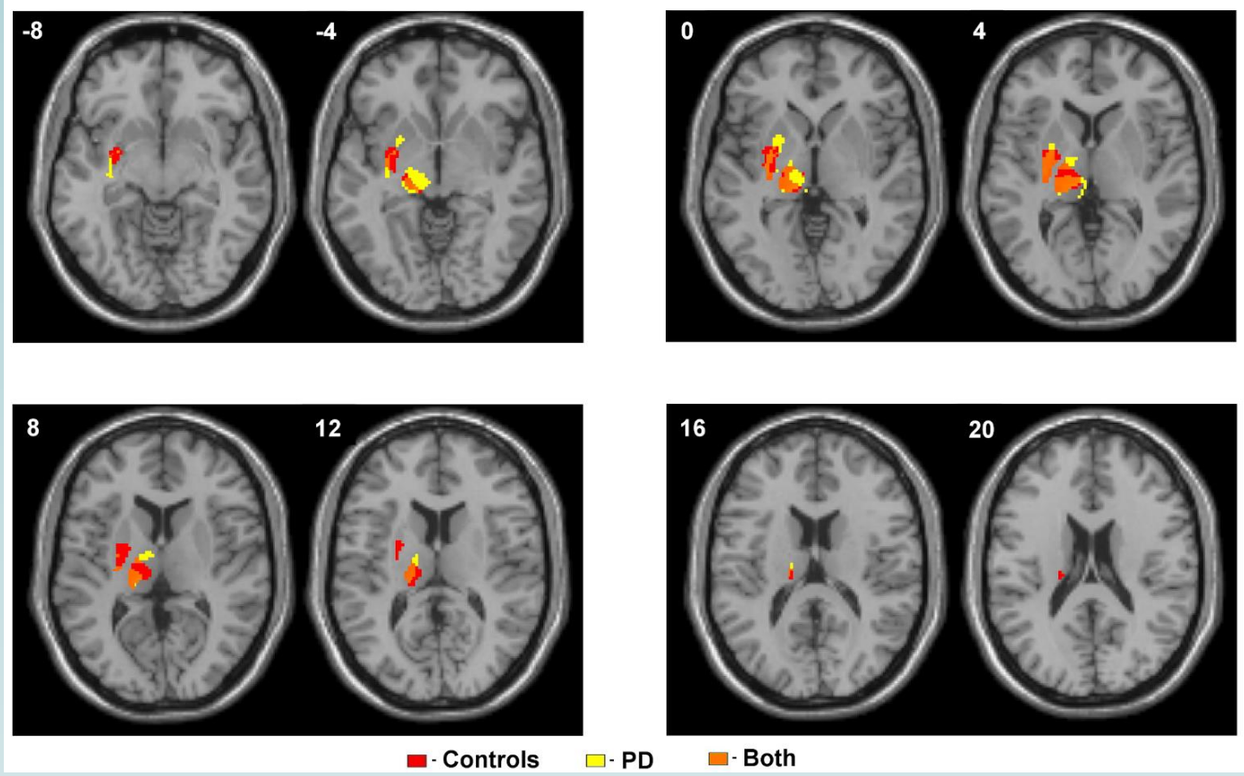
Figure 1. Experimental paradigm

RESULTS

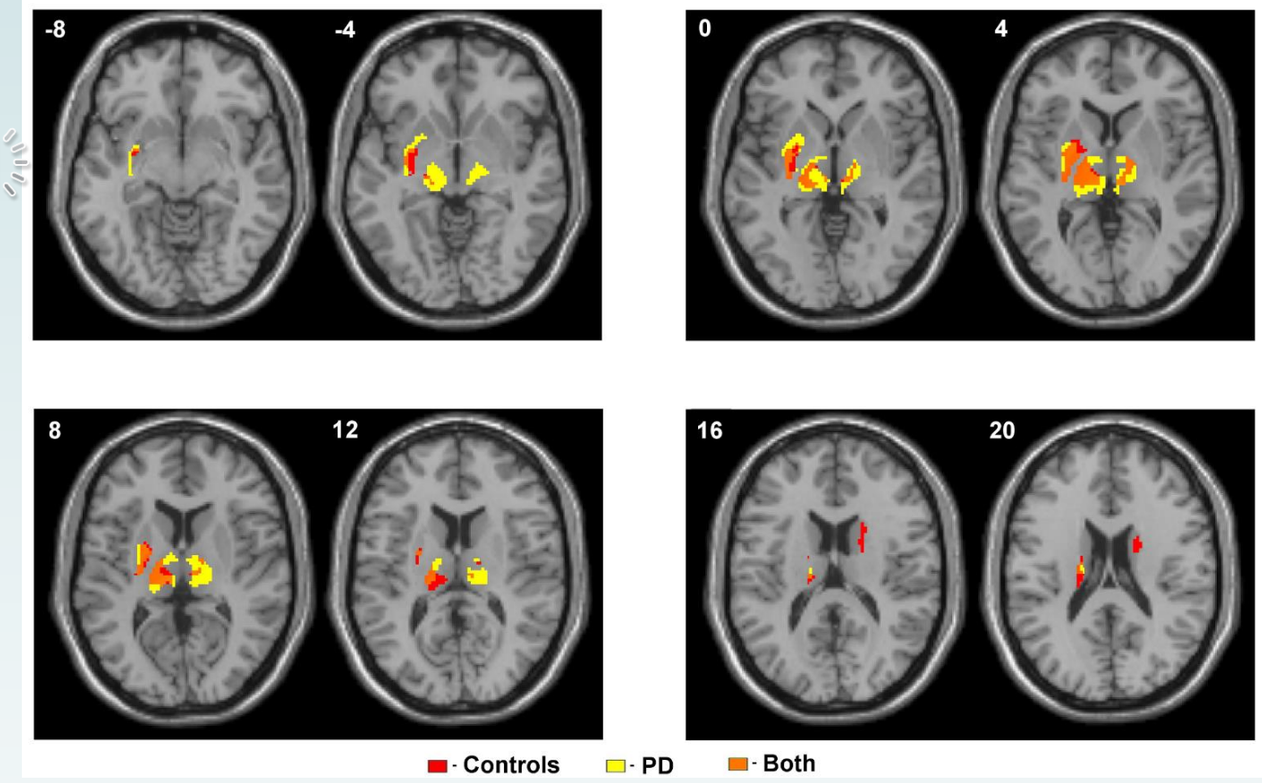
Normal state			Parkinson's disease		
		Externally triggered			
L	Thalamus	158	L	Thalamus	79
L	Putamen	105	L	Putamen	40
L	Pallidum	1	L	Pallidum	1
		Internally guided			
R	Putamen	5	R	Thalamus	31
L	Thalamus	110	L	Thalamus	145
L	Putamen	36	L	Putamen	94
L	Caudate	5	L	Pallidum	4

RESULTS

Externally-trigered movements



Internally-guided movements



Activated areas during ET and IG movements superimposed on anatomic slice of averaged brain in control group and PD patients.

CONCLUSION

We found activation in the main sensorimotor regions of the basal ganglia, namely the posterior putamen, pallidum, and ventrolateral thalamus, both during ET and IG movements in PD patients. At the same time, we found displacement of activation from the dorsolateral putamen in controls into the ventromedial direction in PD patients during ET movements. The most robust differences in basal ganglia were found during IG movements. We demonstrated hyperactivity in the putamen, including its anterior areas, and bilateral thalamus in PD patients.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this study can be found online at:
https://drive.google.com/drive/folders/1aS6BWJkbP69oP7wpQN1xk-qxYxe1gTN-?usp=sharing

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