A Novel Set Shifting fMRI Task Identifies Differences in Brain Activation in Parkinson's disease and Healthy Matched Controls

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Objective

To investigate differences in functional brain patterns on a novel event-related attentional set shifting fMRI task in individuals with Parkinson's disease (PD) and age-matched healthy controls (HC).

Introduction

Cognitive impairment, including executive dysfunction, is a common non-motor symptom of PD and can lead to reductions in quality of life for patients and caregivers. Throughout the course of the disease, approximately 50-80% of PD patients demonstrate cognitive declines, with approximately 30% meeting criteria for dementia. Specific deficits are most often found on executive functioning tasks.

Functional magnetic resonance imaging (fMRI) is a method used to probe brain activity during task performance. We tested PD and Healthy controls on a novel set shifting fMRI task.

Methods

Subjects

14 PD patients and 10 healthy controls (HC)

Table 1: Demographics		
	PD N=14	HC N=10
Gender	67/33	50/50
Age	67.5 (4.3)	65.7 (7.2)
Education	12.8 (2.9)	12.7 (2.3)
H&Y off	2.0 to 3.0	NA

fMRI Task

In a visual stimulus, large numbers 1-2 composed of small numbers 3-9 were presented and subjects were asked to switch back and forth between sets by responding to the large number or to the small number. The paradigm contained a total of 256 stimuli with 50 switches occurring randomly. Consecutive axial gradient EPI images (256 phases, 64x64,FOV=220mm, slice thickness 3 mm, duration: 12 min 48 sec) were acquired during task performance. Total number of images for this task was in the order of 12,000.

Large number one composed of small numbers three
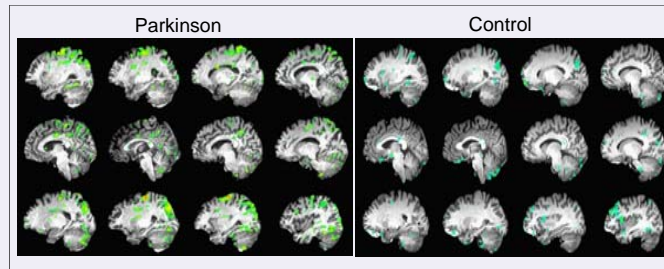
Small numbers one composing large number three
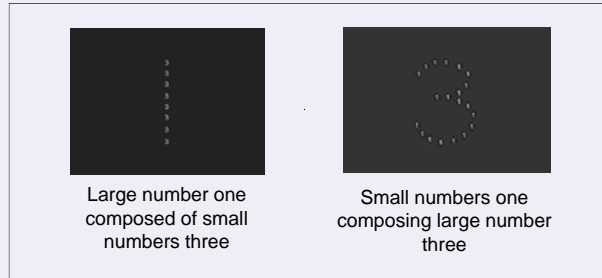
Data Analysis

AFNI software (NIH) was utilized to evaluate the differences in activation patterns for the correct switches between the PD and HC groups.

Student t-test was employed to identify statistically significant differences in activation.

Results

Parkinson   Control

For only the trials with correct switches:
The PD patients demonstrated lower activation than the HC controls in diffuse areas of the brain.

❖Frontal lobe (left/right superior frontal gyrus, right inferior frontal gyrus, left supplemental motor area)
❖Subcortical/medial structures (right caudate, left/right cingulate gyrus)
❖Parietal lobe (right postcentral gyrus, right superior parietal)
❖Temporal lobe (left middle temporal gyrus, right superior temporal gyrus)
❖Cerebellum (left pyramis, left/right lingual, right cuneus).

Results
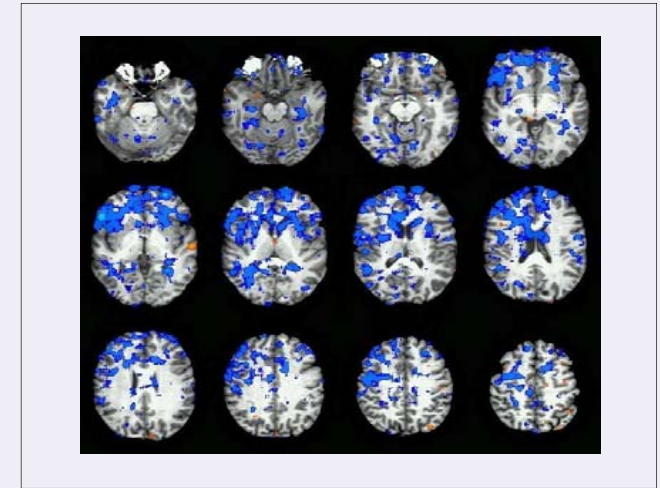
Discussion

❖The PD patients' brain activation patterns differed significantly in diffuse brain regions from the HC on a novel executive functioning set shifting task.

❖The differences in activation patterns were localized to the frontal, subcortical, parietal, temporal and cerebellar regions.

❖These preliminary findings suggest that fMRI is capable of measuring functional differences in PD patients and age-matched controls during the performance of a set-shifting task.