Short term visual memory dysfunction in Parkinsonism

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Introduction: The patients exhibiting parkinsonism present certain non-motor symptoms including dysfunctions in speech/ attention and a loss in memory[1] apart from the six characteristic features: rest tremor, rigidity, gait disturbances, bradykinesia-hypokinesia, flexed posture, loss of postural reflexes and freezing phenomenon[2]. The loss of dopaminergic neurons, in nigrostriatal tracts and in the mesocortical pathway is believed to be responsible for such motor and cognitive decline[3] that occurs due to degeneration in sensory/motor areas of brain[4]. Early Identification of such non-motor features, may help to understand the parkinsonian neurodegeneration[5]. In this study we compare the short term working memory deficit among the three types of Parkinsonism and response to Levodopa.

Materials and methods: The study was approved by the institute's ethical committee and Parkinson's disease (PD), Multiple System Atrophy (MSA) and Progressive Supranuclear Palsy (PSP) patients and controls were recruited for the study (Table 1). The active task consisted two blocks with images of familiar objects (household items and fruits/vegetables) and scenic images respectively and two corresponding baseline (colored circular spots and clouds) presented using a binocular camera (Nordic NeuroLab, Norway) mounted on 12-channel head coil. During the encoding phase, the subjects were instructed to observe the 24 pictures from the two categories and 15-30 minutes later, 96 images were presented randomly. The subjects registered their responses by pressing the assigned key on the Lumina LP400 response pad as to whether they had seen that image earlier or not (Figure 1). Each image was displayed for 2000 ms and a response time of 2000 ms was provided. Whole brain EPI-BOLD sequences were acquired on a 1.5 T Scanner (Avanto, M/s. Siemen) with parameters: slices: 31(4.5mm), TR/TE: 4000/44, EPI factor 128. Also T1-weighted 3 dimensional magnetically prepared rapid gradient-echo (MPRAGE) sequences were acquired to observe any anatomical abnormality, to overlay the BOLD activation pattern. The patients were scanned during the 'off-state' and 2 hours after taking dopamine.

Table 1. Demographic details

Group	N (M /F)	Age (Years)	Duration (Years)	LEDD (mg/ day)	Stage	MMSE	UPDRS III
PD	29(22 / 7)	59.55 ± 12.0	5.34 ± 3.4	348.57 ± 129.86	H & Y 1.8 ± 0.6	27.14 ± 2.4	22.69 ± 11.16
MSA	20(13 / 7)	61.45 ± 6.9	4.65 ± 5.9	279.3 ±115.19	UMSARS 2. 8 ± 1.0	28.1 ± 2.2	23.78 ± 14.7
PSP	19(16 / 3)	63.0 ± 6.9	3.08 ± 2.3	288.89 ± 67.91	PSP rating 1.92 ± 1.7	26.85 ± 2.8	20.78 ± 6.0
Control	40(24 / 16)	51 ± 7.4	-	-	-	29.0 ± 1.0	-

Results: A significantly lowered recall for both the familiar and scenic categories in PD during the 'off-state' was observed in the Lumina response. The MSA and PSP have a better memory recall response as compared to the PD patients (Figure 1). No significant difference was observed in memory recall in patients with respect to controls during the 'on-state'. For familiar objects, BOLD activations (using Anova,$p \leq 0.01$, cluster threshold 10) were observed in the bilateral fusiform gyrus (FG), parahippocampal gyrus (PhCG), post central gyrus (PoCG), thalamus, right cuneus and middle occipital gyrus (MOG) in controls; left cuneus, PoCG, inferior frontal gyrus (IFG), and superior frontal gyrus (SFG), right FG and MOG in PD; bilateral FG, MOG, precuneus, left thalamus and right PhCG in MSA; and bilateral FG, IFG, MOG, and SFG and left medial frontal gyrus (MFG), right MOG, precuneus and precentral gyrus in PSP during the 'off-state'. For the sceneries, activation was observed in the bilateral cuneus, precuneus and PhCG in controls; PoCG, and thalamus, left cuneus, MFG, precuneus, right FG, MFG, PhCG, and SFG in PD; left FG, MOG, SFG, right cuneus and PhCG in MSA; and bilateral cuneus, IFG, MOG, and precuneus, left caudate, FG, MFG, right inferior occipital gyrus in PSP during the 'off-state'.

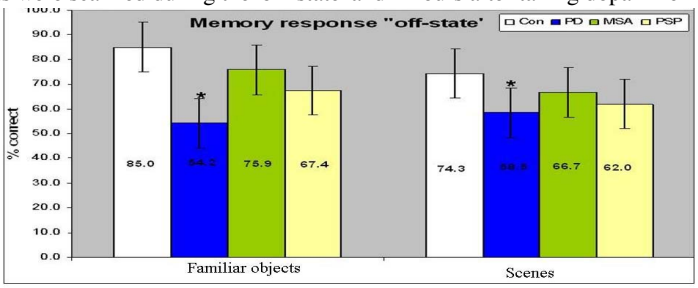

Figure 1. The comparative response of patient's group as obtained from the Lumina responses**.**

Discussion: The lesions in dorsolateral prefrontal cortex (DLPFC) has been attributed to the impairments of working memory in Parkinson's disease[6]. Also, the nigrostriatal dopaminergic deficiency[7, 8] may disrupt dorsolateral prefrontal-dorsal caudate nucleus pathway and a loss in hippocampal volume[9] grey matter volume reduction in the frontal, parietal and temporal lobe[10] may explain such memory decline. The BOLD analysis reflects a greater activation in the fusiform gyrus involved in memory encoding[11] in MSA and PSP in comparison to controls, which was absent in PD. It is quite probable that the encoding process may be more affected in PD as compared to MSA or PSP. Although the cortical grey matter atrophy in PSP has been reported to be limited to the frontal cortex, the dorsolateral prefrontal cortex was preserved in PSP which may account for a better memory recall in PSP as compared to PD[12].

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