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Cognitive impairments in Parkinson's disease: Evidence from an Iranian population

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Abstract

Background: Patients with Parkinson's disease (PD) have different cognitive impairments. The goal of this study is the analysis of these changes in the mentioned patients.

Methods: A cross-sectional study was performed on 87 patients with PD. Patients were given a questionnaire to gather data about their medical and living statuses. To assess cognitive assessment, SCOPA-COG (Scales for Outcome in Parkinson Cognition) was used by an expert cognitive neuroscientist.

Results: The age inversely correlated to memory and learning ($P < 0.01$). Education level correlated directly to attention, memory, learning, executive function and visuospatial function (for all items $P < 0.001$). Spouse relationship type showed inverse association with memory, learning, executive function and visuospatial function ($P < 0.05$).

Conclusion: Cognitive domains in PD patients may be under the influence of different factors. Due to the lack of control group in this study, cautious interpretation of findings is needed.

Introduction

Different stages of Parkinson's disease (PD) are followed by various neurocognitive impairments.[1] These impairments signify the frontal lobe involvement and are associated with nigrostriatal dopamine defect.[1] Some defects are seen in the temporal lobe in advanced processes of the disease. These defects involve the memory and learning, and result from lack of dopamine. Fundamentally, these patients have movement and biochemical developments with autonomic changes as well as cognitive, mood, and sleep impairments. Clinical spectrum of these patients includes significant disorders in heart, movement, and digestion, urinary, sexual, and respiratory system.[2-8]

Cognition is impaired even in non-demented patients with PD.[9] Cognitive functions that are impaired in PD include memory, learning, visuospatial function, executive function, and attention. Cognitive function deficit is a predictor of dementia in PD.[10] The reported prevalence of dementia in PD varies greatly between studies (19-41%).[11-21] The development of dementia is associated with more rapid progression of disability, increased risk for care and increased mortality.[13] Several studies have relied on Scales for

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Outcomes in Parkinson's Disease-Cognition (SCOPA-COG) as a sensitive instrument for screening of cognitive impairment in PD patients.[10-13,21]

With respect to the lack of cognitive deficits profile for PD in our country, in the present study we tried to assess cognitive impairments that underlie the initiation, development and progression of neurodegenerative process in an Iranian population. Therefore, we evaluated cognitive function in PD patients.

Materials and Methods

Subjects

Eighty-seven patients with PD (73% men) were recruited from the Movement Disorder Center at Shohada Hospital, Tehran, Iran. All patients were examined and diagnosed by a neurologist and a neuropsychologist. All patients were treated with levodopa compounds. Inclusion criteria were as follows: All patients diagnosed as idiopathic Parkinson's disease by movement disorders specialists. Males and females were matched on age, education, and intelligence scales. They were treated with levodopa compounds. Exclusion criteria were as follows: Any health condition that the neurologist considered as it could impede or significantly modify evaluation of the effects caused by PD such as acute illness or active confounding medical conditions such as vestibular disease, alcoholism or other forms of drug addiction and metabolic parkinsonism, other neurologic disease leading to dementia (e.g., Alzheimer's disease, stroke), secondary parkinsonism (e.g., multiple system atrophy, progressive supranuclear palsy, corticobasal degeneration, severe cognitive impairment, brain surgery, history of repeated strokes with stepwise progression of parkinsonian features, history of repeated head injury, history of definite encephalitis, oculogyric crisis, neuroleptic treatment at onset of symptoms, sustained remission of parkinsonian symptoms, unilateral features after 3 years, supranuclear gaze palsy, cerebellar signs, early sever autonomic involvement, early sever dementia with disturbances of memory, language and praxis, Babinski sign, and refusal to participate.[22,23]

PD patients answered demographic questions that covered different aspects of medical history and other background data (age at onset, duration of disease and drug treatment). Cognitive functions were assessed by using SCOPA-COG. The SCOPA-COG is a short, reliable and valid instrument sensitive to measurement of cognition in PD. However, the scale was constructed with items assessing frontal–subcortical functions, but did not include items sensitive to cortical dysfunction.[24] It consists of 10 items with a maximum score of 43 in which higher scores reflect better performance.[22] The SCOPA-COG has the following four domains: Memory, attention, executive functions and visuospatial functions. Memory domain items assess both visual and verbal memory, as well as immediate and delayed recall. In the executive function domain, items address semantic fluency, set shifting and motor planning. Two tasks are included in the Attention domain (counting down by threes and months backward) and one in the area of visuospatial function (figure assembly task).[24]

Cross–cultural adaptation

To use SCOPA-COG, we adapted it into Persian by English language experts. Forward-backward translation from English to Persian and vice versa was used. The final translation was considered linguistically and conceptually equivalent to the original one called the Iranian SCOPA-COG version. Then the internal consistency or reliability of SCOPA-COG test was calculated. Cronbach's alpha value was 0.70. The study was approved by the medical ethics committee in Shahid Beheshti University. All patients were consented.

Statistical analysis

Demographic and clinical characteristics are presented as frequencies and means ± standard deviation (SD). Statistical analysis of this study was performed through SPSS (version 18; SPSS Inc., Chicago, IL., USA) using Kolmogorov-Smirnov and Shapiro-Wilk tests. According to results of normality tests, different correlation coefficients such as Spearman rank correlation and $\eta 2$ coefficient were used.

Results

Eighty seven patients with PD (73% men and mean age 59.1 ± 9.1 years) were recruited. Disease duration was from 2 months to 27 years. Patients received treatment with levodopa. Table 1 shows the main descriptive statistics for the demographic variables of the sample. 43% of patients were in the age group of 51-60 years, 38.4% were educated in secondary grade, 93% never smoked cigarettes, 69.8% did not have radiotherapy history, 73.3% had no history of head trauma, 79.1% represented no family history of disease and 60.5% of them were at a moderate economic level.

Table 2 shows that age reversely correlated cognitive function. Memory (verbal recall) and learning inversely correlated with age ($P < 0.01$). Attention, executive function, memory (delayed recall) and visuospatial function did not correlate with age. It was shown that cognitive function was reversely correlated with spouse relationship type ($P < 0.01$). Spouse relationship type inversely correlated with memory (verbal recall), learning visuospatial function ($P < 0.05$), and executive function ($P < 0.01$). Spouse relationship type did not correlate with attention and memory (delayed recall).

Education level was directly correlated with cognitive function ($P < 0.01$). Education level had also

Table 1. The comparison of demographic variable among PD patients

Items	Sub-items	Frequency (%)	Items	Sub-items	Frequency (%)
Age	40-50 years	13(15.1)	Cigarette consumption	Yes	6(7)
	51-60 years	37(43)		No	80(93)
	61-70 years	28(32.6)	Radiotherapy history	Yes	18(20.9)
	71-80 years	6(7)		No	60(69.8)
	81-90 years	1(1.2)		Missing	8(9.3)
Gender	Missing	1(1.2)	Head trauma	Yes	22(25.6)
	Female	23(26.7)		No	63(73.3)
	Male	63(73.3)		Missing	1(1.2)
Education	Illiterate	14(16.3)	Familial disease history	Yes	10(11.6)
	Diploma and under diploma	52(60)		No	68(79.1)
	Graduate and undergraduate	12 (14)		Missing	8(9.3)
	Postgraduate	5(5.9)	Economic situation	More than expenditure	5(5.8)
	Missing	3(3.5)		Equal to expenditure	52(60.5)
				Less than expenditure	29(33.7)

Table 2. Correlation analysis: Age, education, and cognition with memory learning, attention, executive functions, visuospatial functions and memory scores

	education		COG score		Memory learning score		Attention score		Executive functioning score		Visuospatial functions score		Memory score	
	r	P-value	r	P-value	r	P-value	r	P-value	r	P-value	r	P-value	r	P-value
Age	-	-	-0.285	0.13	-0.33	0.002	0-.129	-0.129	-0.16	0.16	-0.182	0.96	-0.129	0.239
Education	1	-	0.575	0.001	0.638	0.001	0.414	0.001	0.372	0.001	-	-	-	-
COG score	0.575	0.001	1	-	1	-	1	-	1	-	-	-	-	-

r: Correlation coefficient; COG: Cognitive

direct correlation with memory (verbal recall) and learning, attention, executive function and visuospatial function ($P < 0.001$). Education level did not correlate with memory (delayed recall).

Discussion

Patients included in this study were selected from different stages of PD (initial, moderate and advanced stages).[26] It means that with increase in age, verbal working memory and learning are declined.[26] Previous findings about the association between SCOPA-COG and age in PD were supported by the present study, using the same scale.[13,14] It was proposed that pattern deterioration caused by aging process and its effect on cognitive function in PD may be different and is controlled by key factors; and this pattern can be changed.[27] It has been found that education level reversely correlated to cognitive function in PD. Previously findings about the association between SCOPA-COG and duration of education in PD were also supported by the present study, using the same scale.[13] It seems that high education level can postpone progression of disease. This finding can be related to several mechanisms. On the other hand, brain of educated people is frequently stimulated. This mental stimulation leads to maintenance of cognitive function and chemical and structural alterations in the brain such as increasing synapse number or visualization and creating cognitive reserves.[22] Understanding the underlying mechanisms can help to decipher neuroprotective mechanism for treatment and to postpone progression of the disease.[16] It has been found that spouse relationship type was reversely correlated to cognitive function.

There are several issues regarding the SCOPA-COG test that needed to be clarified in future research before that any strong conclusions can be driven. One issue that can be addressed is exact mapping activated neural circuits during the SCOPA-COG by using neuroimaging studies. On the other hand, longitudinal research is needed to elucidate whether SCOPA-COG test results are correlated to results of neuroimaging studies. It is suggested that memory (verbal recall) and learning are more predispose to deterioration during aging, while attention, executive function, memory (delayed recall) and visuospatial function did not show any association with age by using this test.[28,29] Aging by different and complex mechanisms can damage to brain parts that involve in verbal working memory and learning.[30] We found that with increasing age, working

verbal memory and learning are decreased in PD. Increasing age can be a risk factor and predictive factor in cognitive impairment in PD. Impairment in PD can be due to striatal deterioration and dopaminergic dysregulation of the frontostriatal circuits.[15-17] Decline in verbal working memory can be due to damage to left supramarginal gyrus (phonological store) and frontal Broca's area (articulatory rehearsal loop).[23] It is proposed that deterioration pattern caused by aging process and its effect on cognitive function in PD may be different and is controlled by key factors and this pattern can be changed according to the type and function of these key factors.

Conclusion

We investigated the cognitive impairment in PD and its potential relevant factors. In current study, we did not have healthy control subjects, hence, it is worth mentioning that interpretation of the results should be considered cautiously. Future study in this area with control group as well as other cognitive assessments tools might help better understanding of the issue.

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