



Cognitive Function Assessment post Subthalamic Nucleus Deep Brain Stimulation in Patients with Parkinson's Disease

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ABSTRACT:

BACKGROUND:

Parkinson disease (PD) is the 2nd most common neurodegenerative disorder affecting more than 6 million people all over the world. Cognitive impairment occurs with variable onsets during the course of disease. Surgical treatment of PD used for patients who, despite optimal medical treatment, experience motor complications. Common surgical treatment is deep brain stimulation (DBS), which may cause complication as general medical complication and neurological complication as cognitive deterioration, primarily affect language domain. Although, other domains also can be affected as executive function, memory, and attention.

OBJECTIVE:

To assess the risk of cognitive decline post subthalamic nucleus-deep brain stimulation in patients with Parkinson disease.

PATIENTS AND METHODS:

A prospective interventional study involved 14 patients with Parkinson's disease, this study was done at Baghdad in medical science of neurology hospital, in a period from June 2022 till December 2022.

RESULTS:

14 patients with PD were included, the age was ranging between (55-75) years, males were (8) patients while females were (6). Montreal cognitive assessment test was done pre and post subthalamic nucleus-deep brain stimulation and we found significant differences between baseline and post-surgical evaluations in terms of language score verbal fluency and there was no significant difference between baseline and post-surgical assessments among other different cognitive domains of Montreal cognitive assessment test scoring. Also, the result of this study shows positive correlation and non-significant differences between Language score verbal fluency with age group, education, duration of disease, and Hohen and Yahr score. While, there's negative correlation and significant association with gender.

CONCLUSION:

Bilateral subthalamic nucleus-deep brain stimulation for patients with Parkinson disease do not lead to a significant fall in cognitive function apart from impairment in verbal fluency.

KEY WORDS: Parkinson disease, cognitive decline, sub-thalamic nucleus deep brain stimulation and verbal fluency.

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INTRODUCTION:

Parkinson disease is one of the most common neurodegenerative disorder ⁽¹⁾, affecting several million people over the world ⁽²⁾. The disease affects the age between 45 and 70 years of age ⁽³⁾. PD is observed in all countries ⁽⁴⁾. It is heterogeneous and includes a broad spectrum of non-motor and motor symptoms ⁽⁵⁾. Cognitive impairment and dementia with Parkinson occur (3-6 times) greater than in the general population with

variable onset in the disease course, development of cognitive impairment has been associated with older age, male, atypical motor syndromes, greater severity of extrapyramidal symptoms and long duration of illness and the early development of hallucinations ⁽⁶⁾.

Deep brain stimulation (DBS), which targets the thalamic subthalamic nucleus or globus pallidus internus, is a frequently used as a surgical treatment ⁽⁷⁾.

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The goal of DBS is to alleviate debilitating motor symptoms that persisted despite optimal medical therapy. Its primary indications include a dyskinesia that persists on optimal medical therapy and a very restrictive off state that occurs more than 20% of the time while awake.⁽⁸⁾

One of complications of DBS is cognitive decline which, primarily affects language domain, particularly verbal fluency;⁽⁹⁾ the striato-thalamo-cortical circuits may have been indirectly damaged by STN, albeit the neurological mechanisms implicated have not yet been thoroughly investigated.⁽¹⁰⁾ Also, it can cause damage of executive function, memory, and attention, all are reversible and disappear by changing the stimulation parameters⁽¹¹⁾.

PATIENTS AND METHODS:

Study design and setting

A prospective interventional study involved 14 patients with PD, this study was done at Baghdad in medical science of neurology hospital, in a period from June 2022 till December 2022.

Ethical Approval

Before the study began, approval was obtained from Al-Rasafa Health Directorate and the committee of the Iraqi Board of Medical Specializations. The study's purpose and scope were explained to the hospital administration, and their verbal consent was acquired. Information will be kept private and not shared outside of the study.

Statistical analysis

Data entry, management, and analysis were conducted using IBM SPSS version 24 and Microsoft Excel 2010. Percentages were used to express the descriptive statistics for the variables.

P value at < 0.05 was considered to be significant.

Inclusion criteria

- 1- Idiopathic PD
- 2- STN-DBS treatment was performed.

Exclusion criteria

- 1- Advanced disease.
- 2- Age more than 75 years.
- 3- Cognitive impairment.

Sample and data collection:

Fourteen patients with Parkinson's disease and developed motor fluctuation were selected after doing levodopa challenge test, by stopping levodopa and other dopaminergic drugs at least for 12 hours and then assess the patients with unified Parkinson's rating scale, motor component, which was performed to the patients before and after giving 150% of morning dose of levodopa and its equivalent dopaminergic drugs; if patients get improvement more than 33% after 2 hours or developed dyskinesia so the patient is candidate for DBS.

Montreal cognitive assessment test for multiple cognitive domain assessment was performed before and then three months after DBS.

RESULTS:

A total of 14 patients were included, the age was ranging between (55-75) years, males were (8) (57%) patients while females were (6) (43%), most of the patients were highly educated (graduated) (71.4%), the severity of disease according to HY scale of most of the patients was bilateral involvement with mild instability (grade 3) (42.8%) as shown in table (1)

Table 1: Sociodemographic characteristics of participants.

		Frequency	Percent
Age	55-65	6	43
	65-75	8	57
Gender	female	6	43
	male	8	57
Duration	<10	8	57
	>10	6	43
Education	primary	2	14.3
	Secondary	2	14.3
	graduated	10	71.4
HY scale	2	4	28.6
	3	6	42.8
	4	4	28.6

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Concerning MoCA test, we found significant differences between pre and post-surgical evaluations in terms of language score-verbal fluency (P value= 0.001).

There is no significant difference between pre and post-surgical evaluations among other cognitive domains as visuospatial and executive function, orientation, attention and memory as shown in table (2).

Table 2: The results of MoCA test score with pre and 3 months post DBS-STN.

Cognitive domains		PRE DBS		3 months POST DBS		P- vale
		no.	%	no.	%	
Visuospatial and Executive start-end score	abnormal	2	14.3%	2	14.3%	0.702
	normal	12	85.7%	12	85.7%	
Visuospatial and Executive copying score	abnormal	2	14.3%	2	14.3%	0.702
	normal	12	85.7%	12	85.7%	
Visuospatial and Executive drawing score	abnormal	4	28.6%	4	28.6%	0.661
	normal	10	71.4%	10	71.4%	
Naming score		14	100%	14	100%	
Attention score reading	abnormal	6	42.9%	6	42.9%	0.648
	normal	8	57.1%	8	57.1%	
Attention score disinhibition	normal	12	85.7%	12	85.7%	0.702
	abnormal	2	14.3%	2	14.3%	
Attention score subtraction	normal	12	85.7%	12	85.7%	0.702
	abnormal	2	14.3%	2	14.3%	
Language score reparation		14	100%	14	100%	
Language score verbal fluency	normal	14	100%	6	42.9%	0.001
	abnormal	0	0%	8	57.1%	
Abstract score	normal	12	85.7%	12	85.7%	0.702
	abnormal	2	14.3%	2	14.3%	
Delayed recall score	Recall 2 wards	0	0%	2	14.3%	0.135
	Recall 3 wards	2	14.3%	0	0%	
	Recall 5 wards	12	85.7%	12	85.7%	
Orientation		14	100%	14	100%	

* P value equal or less than 0.05 is significant

The result of this study shows positive correlation and non-significant differences between language score and verbal fluency with age group, education, duration of disease, and HY score.

While, there's a negative correlation and significant association with gender as shown in table (3).

Table 3: Correlation and association between language score verbal fluency and sociodemographic characteristics among participants.

Language score verbal fluency		Age	Gender	Duration	Education	HY score
	r	0.1667	-0.75	0.4167	1	1
	P value	0.627	0.0097	0.2774	0.9999	0.9999
	Significance	No	Yes	No	No	No

* P value equal or less than 0.05 is significant

DISCUSSION:

Parkinson's disease is a 2nd most prevalent neurodegenerative condition, and is brought on by the loss of dopamine neurons in the substantia nigra pars compacta.

DBS is a viable option for patients with movement disorder that improves quality of life with minimal side effects.

In the present study, three months following STN-DBS, a marked reduction in verbal fluency was noted, which is consistent with previous studies (12,13,14,15). This decline is believed to be substantially correlated with hypoperfusion that was centred in the anterior cingulate cortex, the ventral region of the caudate nucleus on the left hemisphere, and the dorsolateral prefrontal cortex (middle frontal gyrus) by using SPECT (16).

Regarding visuospatial, there is no change as goes with other studies, (14,15) but inconsistent with some previous studies (17,18). Regarding the executive function, there is no postsurgical cognitive decline as with this study (19) but it is inconsistent with the study (20).

Regarding memory, there is no significant differences pre and post-surgery as with the study (15) but it is inconsistent with the study (21).

Concerning attention and orientation there is no post-surgical changes as with studies (22,23). All these differences with the studies might be due to differences in sample size or duration of follow up. The study shows that there is a negative correlation and significant association between gender and verbal fluency, this may be due to randomly collection of the data as the numbers of male are higher than female and according to a recent study for patients receiving deep brain stimulation, fewer women underwent DBS indication assessments than would be predicted based on the gender ratio of the overall PD population. This is one of the many indications of a gender gap in DBS for PD. (24)

CONCLUSION:

With the exception of verbal fluency deficits, bilateral STN-DBS does not cause a substantial decline in cognitive performance in PD patients.

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