

AN OBJECTIVE MEASUREMENT OF COGNITIVE FUNCTIONS: A COMPARATIVE STUDY BETWEEN PATIENTS WITH PARKINSON'S DISEASE & AGE MATCHED HEALTHY EGYPTIAN POPULATION

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ABSTRACT

Objective: Cognitive impairment is an important feature in patients with parkinson's disease. Cognition is assessed through many validated psychometric batteries as Montreal cognitive assessment (MOCA) and Clinical Dementia Rating Scale (CDRs). Subjective nature of these batteries has an impact on their reliability. An objective measure of cognitive function minimizes this defect. Rehacom cognitive assessment is an objective way of cognitive assessment.

Subjects and Methods: Twenty three male subjects ;twelve patients with parkinson's disease and eleven normal age matched subjects participated in this study.the age ranged from 50 to 70 years old. Subjects were assessed by the MoCA and CDRs and rehacom device for attention and concentration and memory domains (attention level, minimum reaction time, median reaction time and maximum reaction time, while the variables of figural memory modules that were measured were memory level, acquisition time and solution time). This study is a cross section design.

Results: A significant difference was found in CDRs scores, attention level, memory level and solution time between parkinsonian and normal group ($P<0.004$), ($P<0.011$), ($P<0.004$), ($P<0.000$).

Conclusion: MOCA scores can detect objectively any decline in cognitive functions in patients with PD because there was a direct moderate correlation between it and rehacom scores .Also there is a decline in cognitive functions in patients with PD when measured objectively by rehacom and compared with healthy subjects of matched age. Also the mean average of cognitive functions in egyptians healthy subjects by MOCA scores is 25.36 ± 3.776 and rehacom (attention level is 6.55 ± 1.214 , memory level is 5.64 ± 1.286 , solution time is 64.64 ± 8.640 s). the median CDRs score is 0.000, minimum reaction time is 4460.0000 ms, median reaction time is 6190.00 ms, maximum reaction time is 23740.0000 ms and acquisition time is 9.00 s.

Keywords: Rehacom, MoCA, attention, memory, parkinson's disease.

INTRODUCTION

Degeneration of dopaminergic neurons of Substantia Nigra leads to Dopamine deficiency which is a character of Parkinson's disease (PD). Motor disorders like Rigidity, Bradykinesia ,tremors, postural instability and Gait disturbances are the red flags of PD. Degeneration can

progress also to the cerebral cortex leading to cognitive impairment. There are many types of cognitive impairment as Mild Cognitive Impairment(MCI), Dementia and Lewy Body(LB) disorder (Cope et al., 2014).

A frequent complication which is commonly missed in patients with PD is cognitive impairment (Naeem et al., 2016) .It has great implications on the patient function and quality of life. Many cognitive domains are affected in these patients as executive function which is the most affected one. visuospatial function is also impaired early in PD but memory function is affected later (Murray et al., 2012).

Cognitive symptoms between normal age related cognitive decline and dementia is considered as Mild Cognitive Impairment(MCI). People with MCI has a minimal degree of functional impairment or a minimal decline in the functional capacity (Murray et al.,2012). Mild cognitive impairment is considered a risk factor for dementia and Alzheimer disease. Amnesic single domain, amnesic multiple domain, nonamnesic single domain and nonamnesic multiple domain are the subtypes of MCI . The prevalence of MCI in people younger than 75 years is estimated to be 19% and is elevated to be 29% in people over 85 years. Neuropsychiatric symptoms are also common in MCI . Depression occurs in 20%, apathy in 15%, and irritability in 15%. Increased levels of agitation and aggression are also present in MCI(Murray et al.,2012). Mild cognitive impairment should not impair daily functioning (Knopman et al, 2003).

Cognition can be assessed through many validated scales like Mini Mental State Examination (MMSE), Montreal cognitive assessment (MOCA) and Clinical Dementia Rating Scale (CDRs). Early detection of cognitive impairment can be achieved with the Clinical Dementia Rating Scale (CDRs) which it is a valid mental status screening test of cognitive functions in patients with PD. Dementia Rating Scale shows greater specificity in measuring functions in patients with PD(Brown et al., 1999).

Mini Mental State Examination assess orientation ,verbal memory , language, attention/calculation, and visuo-constructive abilities. Mini Mental State Examination lacks specific test for executive function, so MOCA test is used to assess cognitive function in PD as it is more specific in determining mild cognitive impairment rather than MMSE (Naeem et al., 2016). The Montreal Cognitive Assessment has a greater validity than MMSE. This test is superior to the MMSE in detecting cognitive impairment. It has adequate psychometric properties as a screening instrument for the detection of mild cognitive impairment or dementia in Parkinson disease (Hoopset al., 2009).

Approximately 27% of patients with Parkinson's Disease (PD) experience mild cognitive impairment (MCI-PD). Parkinson's disease dementia develops within two to five years in the majority of cases(Besser et al., 2014). Many methods of cognitive rehabilitation are present which are based on Restitution or restoration. It means stimulation and repeated practice of exercises and tasks, to restore the mechanisms affected by the lesion and optimize performance. Cognitive rehabilitation is based also on Compensation which it means; the use or support of other pre-served cognitive functions to complete the task done by the altered cognitive domain. Cognitive rehabilitation is based also on Substitution which means using supporting devices or external mechanisms in order to effectively perform the task(Wilson, 2008).

Rehacom is a computer-aided therapy system that enables assessment, training and stimulation of cognitive functions. It consists of a core program and training modules. These modules are designed to allow modifications to session duration, number of stimuli, number of repetitions, response time, type of reinforcement, and the way that the instructions are

presented. It allows also the patient interaction through key-boards, special keyboards with larger push-buttons than those on a conventional keyboard, mouse devices, touch screens, and peripheral devices for patients with sensorimotor impairment (Kulisevsky et al., 2013).

Rehacom allows also storage of each user's data and provides a graphic representation of results overtime. It assesses and trains four domains of cognitive function which are attention and concentration, figural memory, reaction behavior and logical reasoning. Every domain consist of many levels of difficulty which starts with the easiest and ends with the hardest level. It provides continuous feedback and error detector to enhance performance of the patient (Guerrero and García., 2015).

For all the above reasons the Purpose of the study was set to obtain an objective tool that assesses the difference in cognitive functions between patients with parkinson's disease and their age matched normal subjects using Rehacom cognitive assessment and to obtain the normal average mean of cognition by rehacome in egyptian people. Also a correlation test was done between MOCA scores and rehacome measurements.

MATERIALS AND METHODS

Twenty three male subjects; twelve patients with PD and eleven normal subjects, were assessed and referred from the neurologist and recruited from the Outpatient Clinic for neurology, Faculty of medicine and Faculty of Physical Therapy Outpatient Clinic, Cairo University. The study were conductrd from April 2017 to april 2018. Selection of the subjects was based on careful history taking and neurological examination conducted by a neurologist. A written informed consent was signed by the patient before starting the study. The assessment procedures was done at Rehacom lab, Faculty of Physical Therapy, Cairo University.

All the included patients with Idiopathic parkinson's disease and healthy subjects aged from 50-70 years. Any patients with the following criteria were excluded as uncontrolled diabetes mellitus, Psychiatric patients, Drug abuse or problems of hearing or vision.

All the subjects were assessed by the following scales; Clinical Dementia Rating Scale (CDR) (Morris, 1993), Montreal Cognitive Assessment scale and Rehacome software for attention and concentration and figural memory modules using software version is (patient enpult (1990-1997)EN/ISO-13485-certified). The Arabic version of MOCA test was used in this study (Rahman and El Gaafary., 2009). The variables of attention and concentration that were measured were attention level, minimum reaction time, median reaction time and maximum reaction time, while the variables of figural memory modules that were measured were memory level, acquisition time and solution time(measured as average of times of tasks).

Rehacom assessment of twenty minutes for each domain starting from the level one were conducted for each subject included in this study. Illustration of Rehacom tasks were given to the subjects before the assessment with no help introduced during the assessment. Visual feedback feature was allowed during the assessment. Selection of the appropriate response using Rehacom control pannel was instructed for both groups(Flavia et al., 2010). In the parkinsonian group, when motor symptoms affected the patient selection, the researcher pressed on the button after the patient select the appropriate response.

Statistical Analysis:

Data were statistically analyzed by The statistical package for social sciences (SPSS) software(version 20.0; Chicago, IL, USA). The demographic data were analyzed with descriptive statistics. The arithmetic mean and the standard deviation were calculated and

used for analysis. Unpaired t-test will be used to determine the significant difference between both groups in all variables except the acquisition time, the CDRs scores, minimum reaction time, median reaction time, and maximum reaction time, which were analyzed by Mann-Whitney U test because by normality test they were not normally distributed. The p-value < 0.05 was used as acute-off level of significance (Isotalo, 2001).

RESULTS

The mean age of patients with PD was 60.75± 4.615 years while the mean age of healthy subjects was 57.64 ±4.342 years. Comparison of the mean values of age between both groups showed no significant difference (P<0.111). As shown from (table 1); Comparison of the mean values of attention level, memory level and solution time showed a significant difference between both groups (p <0.011), (p <0.004) and (p <0.000) respectively. From these results it was approved that attention level, memory level and solution time are higher in normal matched age subjects than patients with PD. Comparison of the mean values of the MoCA score between both groups showed no significant difference (P<0.077) between both groups.

Also as shown from (table 2); Comparison of the mean values of the median reaction time, the minimum reaction time, maximum reaction time and Acquisition time showed non-significant difference between both groups (p <0.314), (p <0.695), p <0.347) and (p <0.091) respectively. While the mean values of The CDRs scores showed a significant difference between both groups (p <0.004) where the scores of healthy subjects are lower than of patients with PD, so this means higher cognitive function for healthy subjects than patients with PD.

Table 1. The mean values of the normally distributed variables of the study

Variables	Parkinson's group Mean ±SD	Normal group (n=11) Mean ±SD	T values	P values
Age	60.75± 4.615	57.64± 4.342	1.662	0.111
The MoCA score	22.17± 4.407	25.36±3.776	-1.860	0.077
Attention level	4.42±2.234	6.55 ± 1.214	-2.800	0.011*
Memory level	3.5 ± 1.784	5.64± 1.286	-3.267	0.004*
Solution time	46.08± 11.196	64.64± 8.640	-4.718	0.000*

SD: standard deviation, *significant

Table 2: The mean values of the non-normally distributed variables of the study

Variables	Parkinson's group median ± IQR	Normal group median ± IQR	P value
Minimum reaction time	4050.0000	4460.0000	0.695
Median reaction time	8040.00	6190.00	0.314
Maximum reaction time	25000.0000	23740.0000	0.347
Acquisition time	6.00	9.00	0.091

DISCUSSION

The results of this study showed a significant difference in CDRs scores, attention level, memory level and solution time between the parkinsonian and normal group, **where** the scores of RehaCom were lowered in patients with PD when compared to healthy matched age. This might be attributed to amyloid deposition in cerebro spinal fluid (CSF) and α synclin and Lewy bodies deposition in substantia nigra and other brain areas. The lower levels of β amyloid deposition in CSF is a strong predictor of cognitive decline in patients with PD. This agrees with **Siderowf et al, 2010, Jellinger, 2017, Pfeiffer et al, 2014 and Pedersen et al, 2017 studies** .

Solution time was different between both groups with normal group had more solution times. This might be explained by that They achieved higher memory levels with high difficulty and more number of figures so, it had taken more time for solution. Acquisition time was indifferent between both groups. This finding agrees with **Vlagsma et al., 2016** study of immediate recall.

The age of our study is characterized by normal cognitive decline. This might explain that the MoCA scores were not significantly different between both groups. This is consistent with the finding of **Weintraub et al., 2015** study.

The results of this study is contradicted with the results of **Winder-Rhodes et al., 2015 and Vlagsma et al., 2016** studies of memory function and reaction time of PD and healthy aging respectively. This contradiction might due to normal cognitive decline associated with aging, different nationality as they recruited British population and the use of MMSE not the MoCA. Our study was dedicated to Egyptian population, the normal group in our study had achieved higher attention levels with more difficulty than the Parkinson group and so longer reaction time and our sample size was small, this might explain that contradiction.

Our study results, significant difference between both groups in RehaCom measures agrees with **Makdissi et al., 2001** study findings. Computerized cognitive tests is more sensitive to the cognitive dysfunction than other subjective neuropsychological batteries. Computer based cognitive assessment has many advantages like accurate measurement of variables, standardized administration and automatic data recording and saving (**Zygouris & Tsolaki, 2015 & Hamo et al, 2018**).

CONCLUSION

MOCA scores can detect objectively any decline in cognitive functions in patients with PD because there was a direct moderate correlation between it and rehaCom scores .Also there is a decline in cognitive functions in patients with PD when measured objectively by rehaCom and compared with healthy subjects of matched age. Also the mean average of cognitive functions in Egyptians healthy subjects by MOCA scores is 25.36 ± 3.776 and rehaCom (attention level is 6.55 ± 1.214 , memory level is 5.64 ± 1.286 , solution time is 64.64 ± 8.640 s). the median CDRs score is 0.000, minimum reaction time is 4460.0000 ms, median reaction time is 6190.00, maximum reaction time is 23740.0000 ms and acquisition time is 9.00 s.

LIMITATIONS

Small sample size due to difficult enrolment of patients with PD in the study and the shortage of L-dopa therapy to be available in Egypt(it caused deterioration of motor symptoms and difficult enrollment of patients with parkinson disease). Fixed place of RehaCom device caused inability to recruit patients with parkinsonian with aggressive motor involvement.

Conflicts of Interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

Ethical Standards

The study was conducted in compliance with the regulations of the Faculty of Physical Therapy, Cairo university ethical committee (NO: P.T.REC/012/001549) and in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

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