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Continuous Performance Test for assessing cognition among patients with Parkinson diseases

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ABSTRACT

Background: Many patients with Parkinson diseases are faced with constant attention disorders and evaluation of these disorders in these patients is important.
Methods: A cross-sectional study was conducted on 80 patients with Parkinson disease and 80 healthy Iranian people aged 40 to 70. All participants in the two groups of healthy and patients were examined by neurologists and psychiatrists. After completing the questionnaire, they were evaluated through computerized cognitive Continuous Performance Test.
Results: There was significance difference between the two groups in age, sex and education status and in some variables of the test ($p<0.05$). Patients compared with healthy controls and showed a significant difference in test variables ($p<0.05$).
Conclusion: Patients with Parkinson disease compared to healthy subjects face cognitive changes in sustained attention, and identification and evaluation of cognitive changes before and after treatment will be a considerable help in the rehabilitation of brain and a better quality of life for these patients.

Keywords: CPT; Parkinson Disease; Cognition

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INTRODUCTION

Today the computerized neuro-cognitive tests are widely used in research and rehabilitation. These tests can evaluate cognitive disorders, and in comparison with conventional tests have advantages such as the coordination of implementation and scoring, precise control of the stimulus, enabling the tracking of the various components of their response, saving the cost of test and development of accurate and large databases [1]. The brain has different cognitive domains including attention, executive functioning, memory, language, visuo-spatial functioning.

Attention is determined as a mental strength to focus selectively on a selected stimulus, determination and a desire to maintain the focus and movement by the person willingness. Attention means having intellectual property on one thing clearly out of many possible issues or thoughts that enter the mind at the same time. Attention is leaving something to deal effectively with others and a state that has a real conflict with confusion, staring, distressing thoughts [2]. Attention includes cognitive control of processing of understanding and is important for learning and attention disorders can be one of the causes creating behavioral disorders. This domain is a mechanism to tend the competitive interactions among presentation of bilateral inhibitory sensory in cortex in a way that only the expected stimulus reaches the consciousness. Attention can be goal-oriented or driven to the stimulus or it can be space-based or object-based. Attention is a moderator of neural activity in primary sensory cortex, including primary or even secondary cortexes. Attention is controlled by top-down

cognitive factors such as knowledge, expectations and latest objectives and bottom-up factors that reflect the characteristics of recent sensory stimuli. Other factors such as being new or expected reflect the cognitive or sensory effects[3].

Attention has also been attributed to allocate processing resources and according to Solberg model is divided into five sub-categories: *Focused attention:* the ability to respond distinctively to vision, hearing or touch stimuli. *Selective attention:* The ability to maintain a set of behavioral or cognitive stimulation in the presence of competitive or misleading stimuli. Selective attention is information and data processing capabilities while rejecting false or irrelevant data. *Divided attention*: A high level of attention that includes the ability to answer multiple tasks at the same time, *Sustained attention:* The ability to maintain a stable behavioral response as being consistently and repeatedly. *Alternating attention:* The ability of mental flexibility that allows the person to change his focus of attention among things with different cognitive demands[2-4]. Patients with Parkinson disease (PD) have different cognitive disorders and these disorders affect the quality of their lives, considering these problems is very important in investigating the rehabilitation methods. It seems that the assessment of cognitive domains before the rehabilitation of these disorders have ideal conditions in their quality of lives and life style. Attention is one of the key areas involved in PD. The model of this domain and its prediction is important and all the studies refer to the role of the posterior parietal cortex and areas linked to frontal cortex in attention mechanism[5]. This area consists of large groups of nerve cells, which are in a large network in the frontal cortex, parietal cortex and the limbic cortex[6]. And these areas are involved in these patients.

One type of attention is sustained attention. This sub domain is impaired in PD. In this study, to assess this impairment Continuous Performance Test (CPT) was used. Hence the test is used in order to obtain quantitative information about keeping attention in a specified time. It has been known that the implementation of the CPT is affected by damage or dysfunction of the brain. Different versions of CPT are evaluated in different populations [7]. CPT in this study is assessing the sustained attention of participants by comparing the rate of response (error of presenting the response) commission, (response deleting) omission, reaction time and response interference [2,4]. The purpose of this study was to evaluate sustained attention in patients with PD by CPT test.

MATERIALS AND METHODS

This research is a cross-sectional study on 80 patients with patients with PD and 80 healthy Iranians aged 40 to 70 years old. All participants in two groups of healthy and patients were examined by expert neurologists and psychiatrists. Then the final recognition, and consent of the patient, the test of the research such as demographic questionnaire and our designed neuro-cognive computerized battery (NCCB) is applied. All participants were trained after accepting doing CPT of NCCB. After completing the questionnaire, they were evaluated through computerized cognitive CPT test. This study was conducted within 6 months from May 2014 to October 2014 in the Department of Neuroscience Research Center of Functional neurosurgery research center (FNRC), Shohada Hospital, Tehran, Iran. Random sampling was used for this purpose.

Inclusion criteria were patients with PD without a previous or current history of psychiatric neurological disorders and, no history of head injury without learning disabilities, living in Tehran, Persian speakers and in the age range of 40-70 years old. Exclusion criteria were having previous or current history of psychiatric and neurological disorders, a history of head injury, learning disabilities, living in other cities Tehran or not in the age range mentioned. This study was approved by ethics committee of Shahid Beheshti University of Medical Sciences, Tehran, Iran and it was also confirmed and implemented by FNRC.

CPT of NCCB

CPT is used in many studies to evaluate the sustained attention [8,9] and it is popular because of relation with the cognitive and psychological tests [2,10,11].This test is also conducted to evaluate the effects of treatment and rehabilitation in diseases [12,13]. In all types of CPT test, the participant should pay attention to a relatively simple audio or visual stimulus, in this case only visual stimulus, for a while. In this study, the test was designed previously by computer [2,3]. During the rise of the stimulus target, the participant should press a button to submit his/her reply. This test must be carried out in a suitable place and time and the status of implementation of psychometric tests be met. The aim is that the subject use most of his ability and have the best performance at the most speed. A total of 150 stimuli represented 20% of the target stimuli (the stimuli that participants must answer as star shapes, in red and white circles that appear on the screen). The time of presenting each stimulus is 200 ms and 1 second is left between each stimuli. Before the main test, a pilot

test should be implemented.

At the beginning of the test subjects are given the necessary explanations. As pilot test was done and participants were ready, the test was implemented. The total time of the test including the pilot test is 200 seconds. At the implementation stage, first, in the image part of this test the picture that the subject should pay attention to and press the enter bottom is shown. In the numeral part the number that he should pay attention to is presented. Variety of tests and analysis could be obtained based on CPT test. The variables in this study include: Time of the test, error of representing the response of the first 50 stimuli, the first 50 stimuli without response, correct response of the first 50 stimuli, reaction time of the first 50 stimuli, error of representing the response of the second 50 stimuli, the second 50 stimuli without response, correct response of the second 50 stimuli, reaction time of the second 50 stimuli, error of representing the response of the third 50 stimuli, the third 50 stimuli without response, correct response of the third 50 stimuli, reaction time of the third 50 stimuli [14,15].

The hypothesis of this study was assessing of cognition with sustain attention sub-domain in patients with PD by CPT of NCCB. Statistical analysis was done through software SPSS18.

RESULTS

Data is shortly presented in 3 age groups 40-50, 51-60, 61-70 years old in patients with patients with PD and healthy subjects. Their demographic and statistical information is presented in Tables 1 and 2.

Table 1 show 50% of patients were female. They were aged 40-70 years. Regarding educational level, 50% of patients were illiterate or primary school graduates, 22.5% high school graduates, 12.5% had diploma and 12.5% had bachelor. Finally, most patients (72.5%) were in the age group 60 to 70 years and healthy adult were 72.5% in these ages.

Table 2 showed the correlation and p-values between age, education and sex of them and variables of CPT with the suitable difference p-value because more variables showed significant differences (p-value<0.05) between patients and healthy adults.

DISCUSSION

Sustained attention is involved in many of the routine tasks, the evaluation of sustained attention in patients with patients with PD and designing a computer model for this domain are presented by some scholars [2,3]. This evaluation is a non-invasive and inexpensive method that can be done in a private, comfortable outpatient office. When sustained attention disorder is mild, CPT test may be a tool for diagnosis. This test can be used to identify problems related to medical conditions that could affect the field of sustained attention, such as patients with PD, diabetes, high blood pressure, stroke, Huntington's, fibromyalgia, stroke, kidney disease, cognitive decline after surgery, and alcohol addiction. The analysis of cognitive domain of sustained attention, can be measured in good condition by computerized CPT test. And these tests can be used well in situations that reduction of errors, speed and efficiency is considered [16].

It should be considered that these tests are applied as a tool with good sensitivity to a wide range of clinical conditions associated with cognitive deficits [1]. In studies on common neurological tests, a moderate correlation has been observed between the variables in computerized CPT tests. The impact of environmental factors on application of these computerized tests is very important that arch refers to the popularity of these tests in researches [17]. In our study, the test also measures the variables of age, sex, and education was assessed. In our study, the scales of

Table 1. Demographics of patients with PD and healthy adult.

Variables	healthy	patients	Percent for each of group
Sex			
Female	40	40	50 %
Male	40	40	50 %
Education			
illiterate or primary school graduates	40	40	50%
Under diploma	18	18	22.5%
Diploma	12	12	15%
Bachelor	10	10	12.5%
Age groups			
40-50	8	8	10 %
51-60	14	14	17.5%
61-70	58	58	72.5 %

Table 2. Comparative assessment of sustain attention among patients with PD and healthy adults with investigating the correlation and p-values between age, education and sex of them and variables of CPT.

	no01	true01	timerec01	error02	no02	true02	timerec02	error03	no03	true03	timerec03
Age											
healthy	r=0.035 p-value=0.056	r=0.036 p-value=0.061	r=0.032 p-value=0.060	r=0.034 p-value=0.061	r=0.042 p-value=0.064	r=0.045 p-value=0.065	r=0.071 p-value=0.009	r=-0.084 p-value=0.021	r=0.064 p-value=0.054	r=0.055 p-value=0.051	r=0.021 p-value=0.071
Patient	r=0.039 p-value=0.026	r=0.032 p-value=0.048	r=0.053 p-value=0.047	r=-0.076 p-value=0.045	r=0.051 p-value=0.027	r=0.042 p-value=0.026	r=0.045 p-value=0.051	r=0.046 p-value=0.006	r=0.027 p-value=0.049	r=0.074 p-value=0.041	r=0.087 p-value=0.023
Difference p-value	0.010	0.056	0.042	0.012	0.010	0.020	0.010	0.002	0.001	0.042	0.000
Education											
healthy	r=0.037 p-value=0.061	r=0.036 p-value=0.071	r=-0.042 p-value=0.042	r=-0.034 p-value=0.061	r=0.042 p-value=0.064	r=0.045 p-value=0.065	r=0.071 p-value=0.009	r=-0.084 p-value=0.021	r=0.064 p-value=0.054	r=0.045 p-value=0.051	r=0.021 p-value=0.071
Patient	r=0.074 p-value=0.012	r=-0.052 p-value=0.048	r=0.053 p-value=0.047	r=-0.046 p-value=0.055	r=0.081 p-value=0.072	r=0.072 p-value=0.062	r=0.055 p-value=0.051	r=-0.046 p-value=0.06	r=0.057 p-value=0.049	r=0.074 p-value=0.041	r=0.077 p-value=0.023
Difference p-value	0.002	0.006	0.04	0.039	0.009	0.008	0.009	0.002	0.010	0.002	0.001
Sex											
healthy	r=0.041 p-value=-0.061	r=0.026 p-value=- 0.071	r=0.042 p-value=0.070	r=-0.034 p-value=-0.061	r=0.042 p-value=0.064	r=0.042 p-value=-0.065	r=0.072 p-value=-0.009	r=-.083 p-value-0.021	r=0.063 p-value=-0.054	r=0.015 p-value=0.051	r=0.021 p-value=0.071
Patient	r=0.039 p-value=0.026	r=0.032 p-value=0.048	r=0.053 p-value=0.047	r=-0.076 p-value=0.045	r=0.051 p-value=0.027	r=0.042 p-value=0.026	r=0.045 p-value=0.051	r=0.046 p-value=0.006	r=0.027 p-value=0.049	r=0.074 p-value=0.041	r=0.087 p-value=0.023
Difference p-value	0.013	0.016	0.034	0.029	0.019	0.018	0.019	0.012	0.020	0.000	0.001

the mentioned test were assessed with age, education and sex status. Many researchers have reported the relation between attention changes in these tests with age-related factors [18]. In some other studies, age has no impact on the scale intervention display these patterns [19,20]. The results emphasize the importance of using this test on patients with PD.

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