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Original Article

Investigating the difference in implicit motor-sequence learning in the elderly with Alzheimer's and Parkinson's disease

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Abstract

Introduction: Acquiring the sequence of information without regard for learning is implicit learning. Many studies have shown implicit motor learning in Alzheimer's patients, but the obtained results are not consistent about Parkinson's patients.

Materials and Methods: In this descriptive-comparative study, through convenient sampling method among elderly patients who referred to the offices of neurologists in city of Zabol (2016), 11 Parkinson's patients, 10 patients with Alzheimer's disease based in NINCDS_ADRDA criteria and 10 cases as control group (4 males and 6 females) were selected. Then MMSE test was used to test the psycho-cognitive status test and the Wechsler Adult IQ test was used to measure the level of intelligence and memory. Parkinson's Disease Staging and Scale (Hoehn & Yahr) was used for Parkinson's patients.

Results: The results for the percentage of errors in Parkinson's patients increased with a change from the fixed blocks to the random block, which indicates tacit learning, but this group of patients responded less tacitly to moving learning compared to other groups at a time.

Conclusion: The errors and the reaction time may indicate separate processes like spatial and motor components of motor-sequence that can be influenced differently in Parkinson and Alzheimer's patients.

Keywords: Alzheimer, Implicit learning, Parkinson

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Introduction

People learn with a particular rule in their environment without being aware of this learning. Acquiring a sequence of information and events regardless of learning or awareness of what has been learned represents implicit learning (1). In this type of learning, people without explicit awareness and precise knowledge of the task in question become proficient in it (2). Explicit and explicit knowledge means providing explanations and instructions in the field of how to perform the movement task, representing another type of learning called explicit learning (3). Learning sequential motor actions such as typing, riding a bicycle, driving, etc., may be impaired in patients

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with brain damage such as Alzheimer's and Parkinson's (4). After Alzheimer's disease, Parkinson's disease is the most commonly known neurodegenerative disease and is a progressive neurodegenerative disorder that is associated with symptoms such as tremors, stiffness, and slowness of movement (5); its primary symptoms include damage to the substantia nigra, especially dopaminergic neurons of the dense part. It is the lesions of the substantia nigra-striatum pathway and leads to the loss and destruction of dopaminergic cells in these areas (6-8). Studies show that striatum activation is associated with success in implicit sequence learning and leads to new motor sequence acquisition (9-11). People with Parkinson's disease not only lose striatal dopaminergic cells in the basal ganglia but also have problems in learning and determining the sequence of movements because they have a disorder in dopamine-producing nerve cells (12). Filoteo and Tedmedox stated that there is an explicit and implicit learning disorder in Parkinson's patients (13-15), which is in line with the results of Maslimovich's study; Mamikanian and McKinally state that Parkinson's patients always experience deficits in attention during their disease (16-20). Seidler, Tuite, and Ashe state that Parkinson's patients are not impaired in implicit learning of regular stimuli (21-23). Wilkinson, Khan, and Jahanshahi stated that both implicit and explicit learning is impaired in Parkinson's patients (24-27).

Machado et al. showed that explicit memory is severely degraded in Alzheimer's disease, but implicit memory of events is preserved (28,29). Gong state that patients with mild cognitive impairment show impaired memory performance (30-32). Also, Van Haltern, Van Tilburg, Scherder, and Holstijn showed that Alzheimer's patients have a better ability to learn new motor skills implicitly rather than explicitly (33-35). Van Tilburg, Roy, Cassel, and Holstijn also stated the absolute performance of Alzheimer's patients in the explicit learning group was lower than the control group (36). The mentioned studies about Parkinson's patients have less consistency in implicit learning (37,38). In such a way, Jackson, Westwater had a severe implicit learning disorder, Ferraro, Pascual-Leone, and Sommer had a partial disorder, and Schmidt, Seigert and McDowell, Seidler, Tweet, and Ashe did not report any disorder (39).

This study can provide much information about the ability of these patients to learn motor skills and will point to the importance and necessity of implicit learning in rehabilitation situations.

Materials and Methods

The participants in this research were 11 people with Parkinson's disease (6 men and five women) and 11 in the control group (7 men and 4 women). Also, there were 10 Alzheimer's group patients (5 men and 5 women) and ten people (4 men and 6 women) in the control group tested in pairs. Patients were selected from one of the general hospitals through convenience sampling. A neurologist in the hospital performed all cases related to the diagnosis of the disease and its severity. The people in the control group were all healthy elderly people who were selected by referring to the nursing home. All patients and control groups expressed their consent and interest by filling out the consent form and participating in the study.

The conditions for exclusion from the study were having severe mental disorders, heart diseases and blood pressure, vision problems, and a history of deep brain stimulation.

Research instruments

A) Criteria for diagnosing Alzheimer's patients: Alzheimer's patients were diagnosed based on the NINCDS-ADRDA criteria, and then the Mini-Mental State Examination (MMSE) test was used to determine the severity of dementia. In this test, patients with MMSE scores>17 were excluded from the study. This test was evaluated for Alzheimer's patients and the control and Parkinson's groups. To evaluate the psycho-cognitive status, all the steps related to the clinical diagnosis of the disease were performed by the neurologist present in the hospital.

B) National Institute of Neurological and Communicative Diseases and Stroke/Alzheimer's Disease and Related Disorders Association (NINCDS-ADRDA) criterion: This scale is one of the guidelines used to diagnose dementia among Alzheimer's patients (40). In this scale, eight areas of cognitive function that must be evaluated in patients with cognitive impairment have been identified: memory, language, perceptual skills, attention, constructive abilities and capabilities, orientation, and problem-solving capabilities. In this context, a neurologist in the hospital performed the necessary clinical diagnoses. Several studies have used this criterion to diagnose dementia in Alzheimer's patients (41,42).

C) MMSE test: A brief test of psycho-cognitive status was designed by Folstein (43). This test is used for the initial evaluation of cognitive status and has 11 items divided into two parts. The first part includes verbal answers to orientation, memory, and attention questions. The second section requires reading and writing and includes the ability to name, follow spoken or written commands, write a sentence, and copy a shape. Regarding the convergent validity of the brief mental status examination scale, Tierney et al. (1997) estimated the correlation coefficient between the scores of the brief mental status examination subscales and the corresponding neuropsychological scales between 0.5 and 0.6 (46-44). This scale was also standardized, and Cronbach's alpha coefficient was calculated in the sample group as 0.781 by Foroughan and colleagues in the elderly residents of Tehran city (47). Also, Sidian et al. reported the reliability of this test in Iran as 0.81 (48).

D) Wechsler Intelligence Scale (WMS-O) adult version: this scale is a set of memory tests for adults, designed and standardized by Wechsler in 1945. This scale was standardized by Sarami (1993) in Iran, and Cronbach's alpha coefficient was equal to 0.85 (49). In this research, the reliability of the test was obtained with Cronbach's alpha of 0.76, and no significant difference was obtained between patients and control groups. Several studies have used this scale to measure intelligence (50,51).Criteria for diagnosing Parkinson's patients

A- Scale (Hoehn and Yahr): The severity of symptoms in Parkinson's patients are rated based on the disability scale of Yahr and Hoehn (1967) (52). This scale consists of 1 (no signs of illness) to 5 (complete disability and use of a wheelchair) stages, and its modified version also includes stages 1.5 and 2.5; This scale is one of the most reliable assessments to determine the severity of Parkinson's patients, which has been used in several studies (50-56).

B- Unified Parkinson's Disease Staging Scale (UPDRS_III): This scale was introduced in 1987 by a team of researchers in Parkinson's. This scale has four components adapted from the scales that existed before. In this test, the total score is 16 for four items related to behavior and mood, 52 for 13 items related to daily functioning, 108 for 14 items related to the movement status of the patient, and 23 for 11 items related to treatment complications. A total score of 199 indicates the highest degree of disability, and zero indicates the absence of disability (57). The internal stability of this test has been reported in different studies, and this reliability has remained constant in different stages of disease severity (54). In addition, this test has high face validity and has been used in various studies (1860, 43, 58-60).

Results

Demographic and clinical information related to the patient and control groups is mentioned in Tables 1 and 2.

Table 1. Demographic characteristics of control groups and patients

Group	Age (Year)	Duration of disease (Year)
Alzheimer's patients	75.3 ± 7.6	8.29 ± 2.98
Parkinson's patients	64.2 ± 10.3	8.65 ± 3.34
Alzheimer's controls	76.9 ± 3.8	7.00 ± 3.93
Parkinson's controls	63.5 ± 9.2	7.21 ± 2.68

Table 2. Clinical information related to control groups and patients

Group	WMS-O	MMSE	(UPDRS_III)
Alzheimer's patients	67.75 ± 6.64	22.50 ± 2.00	28.00 ± 12.24
Parkinson's patients	71.34 ± 5.23	28.30 ± 2.30	29.98 ± 10.24
Alzheimer's controls	76.00 ± 4.37	26.80 ± 1.60	33.41 ± 15.59
Parkinson's controls	78.12 ± 3.87	27.50 ± 1.80	32.26 ± 13.76

According to the results of the table and the findings obtained from the research after examining the two components of reaction time and the errors recorded during the test, it was found that the group of Alzheimer's and Parkinson's patients and their control group succeeded in achieving a level of learning that was reduced.The significance of the reaction time was evident in the first random blocks (R1) to the fourth fixed block (L4).

Parkinson's and Alzheimer's groups had longer reaction times than their control groups.

The increase in reaction time from the fixed block (L4) to the random block (R2) (the main phase of learning) was significant in the Parkinson's/Alzheimer's control/control groups: the Parkinson's/control group (F30.91): this increase in the Parkinson's group was less than the control group(which indicated less implicit learning), and in the examination of error percentages for the first random block to the fourth fixed block, there was no significant difference between the groups (Parkinson's: 3.1%, Alzheimer's: 4.2%, Parkinson's control group: 3.5% and Alzheimer's control: 2.9%). However, the error rate in the last random block showed a significant increase compared to the fourth fixed block in the Parkinson's group and control.

(Parkinson's group: L4=3.1%, R2=4.9%; control group: L4=3.9%, R2=4.4% / F=9.77, *P*= 0.001).

This error increase was higher for the Parkinson's group than for the control group (*P*< 0.001, T=6.88). The increase in error percentage in the last random block compared to the fourth fixed block for the Alzheimer's group with an increase (4.9% to 5.8%) and the control group with an increase, respectively (4.5% to 5.1%). However, it was insignificant, and there was no significant difference between the groups. The graph of the average reaction time and error percentage for the test groups is shown in Figures 1 and 2.

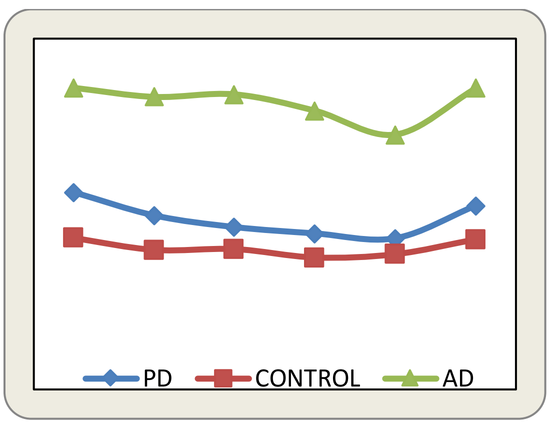

Figure 1. The average reaction time in Successive reaction time assignment test

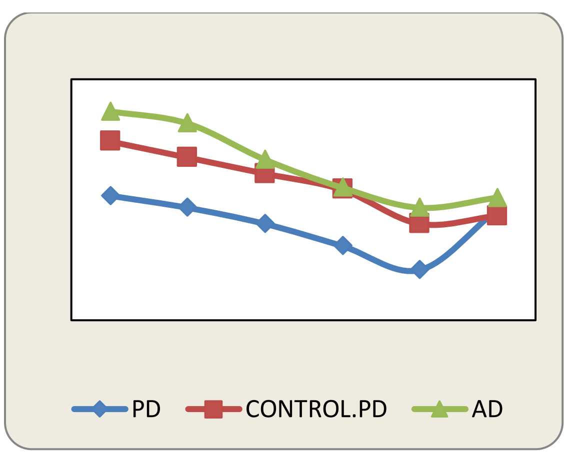

Figure 2. Percentage error graph in Successive reaction time assignment test

Discussion

Implicit sequence learning involves learning a sequence of events without regard to learning or awareness of what has been learned. Studies that used the sequential reaction time task test showed that implicit learning in Parkinson's patients is significantly better than the performance of similar healthy groups (8) will become more prominent. Memory and attention problems will also become more evident, along with movement symptoms. These findings are in line with studies that state that implicit learning is impaired in Parkinson's patients which is consistent with the results of the studies of Hayes, Jellinger, Nieuwboer, Wilkinson, et al., Seigert, Schmidt and McDowell and Westwater et al. (7,19,25,27,32,33,61). In addition, Pascual-Leon et al. stated that the speed of acquisition of the working process in the reaction time task was slower in Parkinson's patients than in the healthy control group (29). Ferraro et al. showed impaired implicit learning in Parkinson's patients without dementia (28). On the other hand, in addition to the reaction time evaluations, in examining the percentage of errors, the increase in errors observed in the last random block in Parkinson's patients and controls indicates implicit learning. The percentage of errors in the last block of fixed order (L4) in the control group was higher than Parkinson's group. These findings were inconsistent with Wilkinson et al.'s study (19), while with Nieuwboer's studies, Van Tilburg and Halstijn; Schendan is the same (39,61,62). The number of errors in practice did not increase in Alzheimer's patients. These results are consistent with the studies of Seidler, Tweet and Ashi, Schak et al., and inconsistent with the results of Kuzis et al. (18,24,36).

In their study, Nakahara, Doya, and Hikosaka showed how different brain areas participate in the learning process. Is. The results obtained from this research can be used to improve the learning process in Parkinson's patients from active mechanisms in their visual-spatial ability. The present study has discussed and tested the two main branches of neurotic diseases, including Alzheimer's and Parkinson's, in a case-by-case manner. In general, the findings of this study, as shown by different time scales, have evidence of implicit learning in the control group, and Alzheimer's patients showed sequential reaction time task test, but the error percentage in practice showed that implicit learning is incomplete in Alzheimer's group. Although the reaction times of Parkinson's patients indicated less implicit learning, error measures showed that Parkinson's patients had acquired knowledge of the repeated sequences implicitly. By looking at the various aspects that underlie our remarkable ability to master sequential motor actions, we can learn more about the defective processes in patients. Implicit learning of movement sequences is related to motor actions. People learn many sequential activities throughout life but cannot explain how they learn these skills. In rehabilitation and rehabilitation activities, especially in the elderly, for example, learning to walk with a new assistive device and other types of rehabilitation, it is possible to benefit from implicit learning processes.

Conclusion

In the current study, the Parkinson's patients were able to learn the sequence of stimuli and experienced implicit learning to a lesser extent than the group of Alzheimer's and healthy elderly.

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