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RESEARCH

THEORY OF MIND IN AMNESTIC MILD COGNITIVE IMPAIRMENT AND ITS RELATIONSHIP WITH LANGUAGE AND MEMORY FUNCTIONS

ABSTRACT

Introduction: Although it has been proven that theory of mind functions is deteriorated in amnesic type mild cognitive impairment, the relationship between this deterioration and cognitive functions has not been researched. The aim of this study is to compare amnesic type mild cognitive impairment patients with healthy individuals in terms of theory of mind functions and to determine the relationship between theory of mind functions and the functions of language and memory in amnesic type mild cognitive impairment patients.

Materials and Method: Thirty-eight patients with amnesic type mild cognitive impairment were compared with 34 healthy individuals in this study. The Reading the Mind in the Eyes Test, Hinting Test, Boston Naming Test, Wechsler Adult Intelligence Scale-Revised Vocabulary Test Score, Öktem Verbal Memory Process Test, and Clock Drawing Test were used for evaluation.

Results: The scores of the amnesic type mild cognitive impairment group in the tests evaluating theory of mind functions and the functions of language, memory and Clock Drawing Test were lower than those of the control group. The scores of the amnesic type mild cognitive impairment group in the tests evaluating the theory of mind functions were not associate with the tests evaluating the functions of language and memory.

Conclusion: Amnesic type mild cognitive impairment patients perform worse in terms of affective and cognitive theory of mind functions compared with healthy aging individuals. The impairment of theory of mind functions in amnesic type mild cognitive impairment patients is thought to be independent of the deterioration of language and memory functions.

Keywords: Cognitive dysfunction; Theory of mind; Memory; Language

ARAŞTIRMA

AMNESTİK TİP HAFİF KOGNİTİF BOZUKLUKTA ZİHİN KURAMI VE DİL VE BELLEK İŞLEVLERİ İLE İLİŞKİSİ

Öz

Giriş: Amnestik tip hafif kognitif bozuklukta, zihin kuramı işlevlerinin bozulduğu ortaya konmasına karşın bu bozulmanın bilişsel işlevlerle olan ilişkisi araştırılmamıştır. Bu çalışmanın amacı amnestik tip hafif kognitif bozuklukta bulunan hastalar ile sağlıklı kişileri zihin kuramı işlevleri bakımından karşılaştırmak ve amnestik tip hafif kognitif bozuklukta zihin kuramı işlevlerinin dil ve bellek işlevleri ilişkisini belirlemektir.

Gereç ve Yöntem: Bu çalışmada 38 amnestik tip hafif kognitif bozukluk hastası ile 34 sağlıklı katılımcı karşılaştırılmıştır. Değerlendirme amacıyla Gözlerden Zihin Okuma Testi, İmayı Anlama Testi, Boston Adlandırma Testi, Wechsler Yetişkinler İçin Zeka Ölçeği Revize Formu Sözcük Dağarcığı, Alt Testi, Öktem Sözel Bellek Süreçleri Testi, Saat Çizme Testi kullanılmıştır.

Bulgular: Bu çalışmada amnestik tip hafif kognitif bozukluk grubu kontrol grubuna göre zihin kuramı işlevlerini değerlendiren testler ile dil ve bellek işlevlerini değerlendiren testlerden ve Saat Çizme Testi'nden kontrol grubuna göre daha düşük puan almıştır. Amnestik tip hafif kognitif bozukluk grubunun zihin kuramı işlevlerini değerlendiren testlerden aldığı puanların dil ve bellek işlevlerini değerlendiren testler ile ilişkili olmadığı saptanmıştır.

Sonuç: Amnestik tip hafif kognitif bozuklukta hastaları ile sağlıklı yaşlanan kişiler arasında affektif ve kognitif zihin kuramı işlevi açısından daha kötü performans göstermektedir. Amnestik tip hafif kognitif bozuklukta hastalarındaki zihin kuramı işlevlerindeki bozulmanın dil ve bellek işlevlerindeki bozulmadan bağımsız olduğu düşünülmüştür.

Anahtar sözcükler: Kognitif bozukluk; Zihin kuramı; Bellek; Dil



INTRODUCTION

Mild cognitive impairment (MCI) accompanied by complaints about memory is called amnesic type MCI (aMCI). The diagnostic criteria for aMCI are complaints about memory confirmed by a patient's relative, an ordinary course of general cognitive functions and daily life activities, the existence of a memory disorder determined by age and education norms, and the absence of dementia (1).

The concept of theory of mind (ToM) is defined as an individual's ability to realize that others have different mind from his/her own and to understand and represent his/her own and others' mental status as intentions, belief, desires, and level of knowledge. Two types of ToM have been defined as cognitive ToM and affective ToM (2).

The importance of evaluating the functions of ToM to make predictions about the possibility of MCI transforming into Alzheimer's disease (AD) has motivated researchers to conduct studies, which have identified that patients with aMCI perform worse in terms of ToM functions (3). The relationship between cognitive and ToM functions in patients with aMCI has not been studied.

The purpose of this study is to compare aMCI patients with healthy individuals in terms of ToM functions and to determine the relationship between ToM functions and the functions of language and memory in aMCI patients.

MATERIALS AND METHOD

Sample

The study sample was composed of patients admitted to the neurology polyclinic between October 2012 and June 2014 with complaints of dysmnnesia. Those who were diagnosed with aMCI, and accepted to participate in the study were assigned to the patient group, while those who were not diagnosed with aMCI but were willing to take part in the study were assigned to the control

group. The inclusion criteria for both groups were age 50 years or older, literate, scoring 24 or over on the Standardized Mini-Mental State Examination, scoring 0.5 or lower on the Clinical Dementia Rating Scale, and scoring 3 or lower on the Hachinski Ischaemic Scale. Meeting the Petersen Criteria was an additional criterion for inclusion in the aMCI group. Taking a type of medication affecting cognitive function, having a history of head trauma, scoring 14 or over on the Geriatric Depression Scale, having focal brain injury, and alcohol and drug abuse were the exclusion criteria. Seven patients were excluded due to the changes observed in brain MR imaging, four patients were excluded due to alcohol use, and three patients were excluded due to nonacquiescence to participate in the study. Therefore, data collection methods were applied to 38 patients diagnosed with aMCI and 34 individuals in the control group.

Data collection methods

Sociodemographic characteristics and clinical features information form: The features of age, gender, marital status, education status, income level, employment and economic status, and information related to the patient's and his/her relatives' accounts about amnesia, dementia family history, head trauma, general anesthesia intake after 50 years of age, smoking, and alcohol and substance use were collected through this form.

Clinical Dementia Rating (CDR) Scale: This scale was developed to evaluate the functional destruction in AD (4); it is used to measure a patient's cognitive and functional performance. The purpose of using this scale in the study is to identify whether the participant meets the necessary criteria for participation in the study.

Standardized Mini-Mental State Examination (SMMSE): This is a commonly used cognitive survey tool (5), and the validity and reliability of its Turkish version have been completed (6).

The Reading the Mind in the Eyes Test (Eyes Test): Eyes Test was developed to evaluate affect

recognition (7). The validity and reliability of the Turkish version have been assessed (KR_{20} was 0.72) (8). During the administration of the test, the participant is instructed to check the choice that best suits his/her thoughts and feelings about the eyes in the image. A high score indicates good affective ToM function.

Hinting Test: One of the stories applied to second-tier ToM functions was used in this study (9). Through this story, the ability to uncover the real intention behind implicitly stated expressions is evaluated. The participant is told a story, wherein Elif, whose birthday is coming, tells her father that she loves animals, especially dogs. Then, the participant is asked what Elif's real intention is and scores two points if he/she gives the correct answer. If the participant cannot give the correct answer, then the story is continued by recounting another of Elif's statements, wherein she asks her father whether pet shops are open on her birthday. Then, the participant is asked what Elif wants her father to do. The correct answer scores one point at this stage. If there is no correct answer, the participant does not score any points. This story has been used in previous studies in Turkey. In this study, a similar methodology has been used in terms of statistics (10).

Boston Naming Test (BNT): This test is used to evaluate naming ability skill (11). The shortened version containing 31 images was used in this study. The Turkish adaptation and norm determination study of the test is completed but not has been published yet.

Wechsler Adult Intelligence Scale-Revised Vocabulary Subtest (WAIS-R): Developed by Wechsler (12), this vocabulary subtest (WAIS-R/VTS) is used to measure the abilities of vocabulary use and self-expression, sensitivity to new information, storage in the long-term memory, and re-grouping when necessary. The Turkish standardization study of the test has been completed (13).

Öktem Verbal Memory Process Test (Öktem-VMPT): This test has been developed to research

verbal learning and memory in terms of multiple factors. The Öktem-VMPT has been standardized, and normal scores have been identified for the variables age, gender, and education (14). The Immediate memory, Learning, Achieving Criteria, Spontaneous Recall, and Recognition subtests were used in this study. This test was also used to identify the criteria for determination of memory impairment (the case in which the score for episodic memory is lower than normal values as 1.5 standard deviation) when adapted to the Petersen Criteria.

Clock Drawing Test (CDT): This test is a part of the Boston Diagnostic Aphasia Examination (15), and the validity and reliability of the Turkish version have been assessed (16). The cognitive features measured by the test are comprehension, planning, visual memory and reconstruction, visual-spatial ability, motor planning and method, digital information, abstract thinking, inhibiting the tendency created by the physical features of the stimulant, concentration, and tolerance against detention.

Geriatric Depression Scale (GDS): Based on self-report assessment, this scale is used to identify depression in the elderly (17). The validity and reliability of the Turkish version have been assessed (18).

Functional Activities Questionnaire (FAQ): Based on self-report assessment, this questionnaire evaluates 10 mixed daily activities (19). A Turkish adaptation study of the FAQ suitable for the 50 years and older age group has been completed (20).

Statistical analysis

The data obtained were analyzed in Statistical Package for Social Sciences 21.0 version. The Kolmogorov-Smirnov test was applied in order to show the normal distribution (95% confidence interval). The groups were compared in terms of normally distributed, continuous numerical variables by t-test, non-normally distributed variables by



Mann–Whitney U test, and categorical variables by Pearson’s Chi-Square test. For the purpose of identifying the variables predicting the scores of the aMCI group on the Eyes Test and Hinting Test, linear regression analysis was applied to the variables that were determined to have statistical significance.

RESULTS

The proportion of participants who graduated from primary school in the aMCI group was significantly higher than that in the control group, whereas the duration of education and monthly income of the aMCI group were found to be significantly lower ($X^2=8.943$ and $p= 0.011$; $z=-2.36$ and $p=0.018$; $z=-2.09$ and $p=0.036$, respectively) (Table 1).

The FAQ scores of the aMCI group were significantly higher than those of the control group ($z=-2.921$ and $p<0.01$). The aMCI group scored significantly lower than the control group on the Eyes Test; SMMSE; Immediate Memory, Learning Score, Spontaneous Recall, Recognition, BNT, WAIS-R/VST; CDT; and Hinting Test ($t=-5.013$ and $p<0.001$; $z=-5.681$ and $p<0.001$; $z=-4.487$ and $p<0.001$; $z=-6.009$ and $p<0.001$; $z=-6.925$ and $p<0.001$; $z=-3.346$ and $p<0.01$; $z=-3.543$ and $p<0.001$; $z=-5.249$ and $p<0.001$; $z=-3.710$ and $p<0.001$; $z=-3.386$ and $p<0.01$, respectively) (Table 3).

According to the result of linear regression analysis, the score of the aMCI group on the Eyes Test and Hinting Test were not predicted by the independent variables (Table 4 and 5).

Table 1. Comparison of the aMCI and control groups in terms of sociodemographic data.

	aMCI (n= 38)	Control (n= 34)		
	mean±sd	mean±sd	t/z	P
Age	64.89±6.00	62.38±5.03	1.911	0.060
Duration of education (year)*	8.92±4.21	11.53±4.41	-2.36	0.018
Monthly income*	2329.47±1751.11	3295.88±2319.50	-2.09	0.036
	n (%)	n (%)	x ²	P
Gender			1.583	0.208
Female	19(46.3%)	22(53.7%)		
Male	19(61.3%)	12(38.7%)		
Marital Status			0.632	0.729
Single	2 (40.0%)	3(60.0%)		
Married	31 (52.5%)	28 (47.5%)		
Widowed/divorced	5 (62.5%)	3 (37.5%)		
Education Level			8.943	0.011
Primary school	22 (73.3%)	8 (26.7%)		
High school	8 (42.1%)	11(57.9%)		
University	8 (34.8%)	15(65.2%)		
Employment			1.496	0.473
Housewife	13 (61.9%)	8 (38.1%)		
Employed	3 (37.5%)	5 (62.5%)		
Retired	22 (51.2%)	21 (48.8%)		

* Mann–Whitney U test

Table 2. The comparison of aMCI and control groups in terms of some characteristics.

	aMCI (n=38)	Control (n=34)		
	n (%)	n (%)	x ²	p
Amnesia (relative)			5.105	0.024
Yes	20 (69.0%)	9 (31.0%)		
No	19 (61.3%)	12 (38.7%)		
Amnesia (self-report)			3.512	0.061
Yes	31 (59.6%)	21 (40.4%)		
No	7 (35.0%)	13 (65.0%)		
History of head trauma			2.316	0.128
Yes	1 (20.0%)	4 (80.0%)		
No	37 (55.2%)	30 (44.8%)		
Family dementia history			1.116	0.291
Yes	12 (61.9%)	7 (38.1%)		
No	26 (49.1%)	27 (50.9%)		
History of psychiatric treat.			3.453	0.063
Yes	8 (80.0%)	2 (20.0%)		
No	30 (48.4%)	32 (51.6%)		
General anesthesia after 50			0.317	0.574
Yes	10 (47.6%)	11 (52.4%)		
No	28 (54.9%)	23 (45.1%)		
Smoking			0.399	0.819
Yes	6 (54.5%)	5 (45.5%)		
No	22 (50.0%)	22 (50.0%)		
Gave up	10 (58.8%)	7 (41.2%)		

Table 3. Comparison of the aMCI and control groups in terms of neurocognitive tests, ToM, and scales.

	aMCI (n=38)	Control (n=34)		
	mean±sd	mean±sd	t/z	p
Eyes Test	15.00±4.15	19.82±3.98	-5.013	<0.001
SMMSE*	27.60±1.28	29.47±0.74	-5.681	<0.001
Immediate Memory*	5.07±1.66	7.38±2.01	-4.487	<0.001
Learning*	103.39±18.32	130.82±11.57	-6.009	<0.001
Achieving Criteria*	4.00±4.23	5.26±2.01	-1.182	0.237
Spontaneous Recalling*	10.34±1.69	14.11±1.00	-6.925	<0.001
Recognition*	13.55±1.75	14.67±0.58	-3.346	<0.01
BNT*	28.00±2.73	30.00±1.45	-3.543	<0.001
WAIS-R (VTS)	47.78±10.28	60.41±6.37	-5.249	<0.001
CDT*	4.42±0.85	4.97±0.17	-3.710	<0.001
Hinting Test*	1.52±0.55	1.91±0.28	-3.386	<0.01
GDS*	11.50±6.18	9.73±4.82	-1.175	0.240
FAQ*	0.65±1.23	0.06±0.34	-2.921	<0.01

* Mann-Whitney U



Table 4. Regression analysis results of the factors predicting the total score of the aMCI group on the Eyes Test.

Independent Variables	B	SE	Standardized β	t	p
Constant	-2.428	22.251	-	-0.109	0.914
Education	-1.372	1.736	-0.427	-0.790	0.439
Period of education	0.308	0.517	0.311	0.596	0.558
Monthly income	0.001	0.001	0.367	1.124	0.275
Amnesia (relative)	-2.110	1.773	-0.282	-1.190	0.249
SMMSE	0.445	0.761	0.138	0.585	0.565
Immediate memory	0.003	0.746	0.001	0.004	0.997
Learning	0.062	0.091	0.265	0.677	0.507
Spontaneous recalling	0.757	0.839	0.303	0.902	0.379
Recognition	-0.832	0.766	-0.319	-1.087	0.291
BNT	-0.273	0.553	-0.178	-0.493	0.628
WAIS-R (VTS)	0.210	0.169	0.512	1.245	0.228
CDT	0.056	1.275	0.11	0.44	0.965
Hinting test	2.155	1.658	0.288	1.304	0.208
FAQ	0.144	1.023	0.034	0.112	0.912

Table 5. Regression analysis results of the factors predicting the total score of the aMCI group in the Hinting Test.

Independent Variables	B	SE	Standardized β	t	p
Constant	4.800	2.747	-	1.748	0.097
Education	-0.26	0.235	-0.061	-0.113	0.912
Period of education	-0.018	0.069	-0.134	-0.256	0.800
Monthly income	-1.915	0.000	-0.061	0.181	0.858
Amnesia (relative)	-0.034	0.244	-0.034	-0.139	0.891
SMMSE	-0.109	0.099	-0.254	-1.105	0.283
Immediate memory	-0.109	0.096	-0.328	-1.137	0.270
Learning	0.009	0.012	0.296	0.763	0.455
Spontaneous recalling	-0.104	0.111	-0.310	-0.930	0.364
Recognition	0.002	0.105	0.005	0.016	0.987
BNT	0.015	0.074	0.075	0.208	0.837
WAIS-R (VTS)	0.009	0.023	0.168	0.396	0.696
CDT	-0.034	0.169	-0.051	-0.200	0.843
FAQ	-0.185	0.129	-0.413	-1.429	0.169
Eyes Test	0.038	0.029	0.285	1.304	0.208

DISCUSSION

The number of primary school graduates in the aMCI group was higher than those in the control group, whereas the mean of duration of education and the average monthly income of the aMCI group was lower than those of the control group. Although it is not exactly known to what extent a higher level of education affects AD, it has been indicated that a higher level of education may have an important function, because people with higher education more easily develop strategies to compensate for the possible adverse effects of cognitive impairment in the early stages of AD, and hence the effects of symptoms on daily life present late (21). The risk of developing AD decreases at a rate of 17% for each extra year of education, while having a lower economic level and a lower status occupation poses an increased risk of AD development (22). Considering that aMCI poses a risk of AD development, the results of this study suggest that duration of education and economic level also influence the risk of aMCI. Since there are few studies, there is a need for more studies to be performed on this aspect.

When the groups were compared in terms of complaints about amnesia, the relatives of the aMCI group reported more cases of amnesia complaints than those of the control group. Concurrently, the aMCI group scored lower than the control group on the Öktem-VMPT (Immediate Memory, Learning, Spontaneous Recalling, and Recognition), which was performed to evaluate verbal memory. Among the clinical diagnostic criteria for aMCI are the items of "memory problem expressed by the patient himself" and "identifying the memory problem adjusted for age" (1). The scores of the aMCI group on the FAQ were higher than those of the control group. However, the average score of the aMCI group was within the normal limits when the normal scores for these age

groups was considered. Therefore, the aMCI group met the "the daily life activities of the patient are normal with regard to his/her age" criterion, which is requisite for the diagnosis of aMCI.

The language skills scores of the aMCI group in the BNT and WAIS-R/VST were lower than those of the control group. Impaired language skills in aMCI patients have also been proven by similar studies performed with the same tests as those used in this study (23). The aMCI group scored lower than the control group on the Hinting Test. While ToM functions are typically impaired with increasing age, several studies have indicated that particularly second-tier ToM functions are deteriorated in aMCI patients, posing a risk for AD development (24). For this reason, as the deterioration of ToM functions in aMCI patients could be observed in clinical presentation, it is important that this deterioration has the potential to identify patients who will develop AD. This result agrees with that of a similar study in which aMCI patients scored lower than healthy elderly in terms of first- and second-tier false-belief tasks. The performance of aMCI patients in the Eyes Test was also lower than that of the control group, although the difference was not significant. The aMCI group was also compared with healthy controls in terms of ToM functions by using brain imaging methods, and it was concluded that activation of the superior temporal sulcus (STS) in the right hemisphere, which is related to affective ToM, is lower in aMCI patients than in healthy controls. Researchers have indicated that the decrease in STS activation in aMCI patients is an early neural finding of the deterioration of affective ToM functions that will develop in the future (24). According to the results of this study, the Eyes Test performance of aMCI patients was significantly lower than that of healthy controls, which disagrees with the aforementioned study. The possible reason for this difference may be that this study was performed on a larger sample.



It was indicated in this study that language and memory functions expected to deteriorate in aMCI patients did not predict the impaired cognitive and affective ToM functions, contrary to the case in healthy controls. It has been reported that ToM and cognitive functions are independent of each other (10). Our study supports this result, and we conclude that cognitive and affective ToM functions also become impaired independently of language and memory functions in aMCI patients.

The limitations of this study are that it is of a cross-sectional nature, was conducted on a small sample, did not evaluate first-tier ToM functions, and there were differences between the groups in terms of period of study and the level of income.

The fact that the Hinting Test used in this study is easier to administer than other tests measuring the second-tier ToM functions and the narrow scoring range may have affected the results. On the other hand, this test may be insufficient in terms of measuring ToM functions compared to complex tests. The inadequacy of SMMSE in the differential diagnosis of MCI is another limitation of our study.

Finally, this study indicates that cognitive and affective ToM functions deteriorate independently of language and memory functions in aMCI patients. There is a need for further detailed studies to determine whether cognitive and affective ToM functions play a role in the evaluation of the risk of aMCI transformation into AD.

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