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RESEARCH

HEARING LEVELS IN PATIENTS WITH ALZHEIMER'S DEMENTIA

ABSTRACT

Introduction: It has been assumed that hearing loss may be related to dementia and prevents social interaction by decreasing stimulus input. The current study investigated the relationship between hearing loss and dementia by comparing Alzheimer's dementia patients to non-dementia patients.

Materials and Methods: Between January 2011 and January 2013, 124 Alzheimer's dementia patients diagnosed by the mini-mental state examination and 224 non-dementia controls who applied to the Psychiatry Clinic of Elazığ Training and Research Hospital were included in the study. Hearing levels of the Alzheimer's dementia patients and non-dementia controls were obtained using a pure tone audiometry test.

Results: The pure tone average was determined to be 50.96±12.25 dB and 50.49±12.15 dB, consecutively, in the right and left ears of Alzheimer's dementia patients. In the Alzheimer's dementia group of patients, researchers detected 6 (4.8%) patients with normal hearing, 23 (18.5%) patients with mild hearing loss, 57 (46%) patients with moderate hearing loss, and 38 (30.6%) patients with severe hearing loss. The pure tone average was determined to be 30.66±9.33 dB and 30.62±9.39 dB, consecutively, in the right and left ears of the control patients. In non-dementia controls, the researchers also detected 83 (38.8%) patients with normal hearing, 106 (45.5%) patients with mild hearing loss, 21 (9.8%) patients with moderate hearing loss, and 4 (1.9%) patients with severe hearing loss. The differences in the pure tone average of the right and left ears between Alzheimer's dementia patients and non-dementia controls were statistically significant ($p<0.05$). Nine (7.2%) Alzheimer's dementia patients and 6 (2.8%) controls were already using hearing devices.

Conclusion: The current study revealed that hearing loss was significantly higher in Alzheimer's dementia patients compared to non-dementia patients; this result indicates a relationship between dementia and hearing loss. Therefore, the researchers believe that hearing aids should be proposed for patients with geriatric hearing loss, with or without dementia, if they have relatively good cognitive functionality. Use of hearing aids could increase their cognitive and daily functioning.

Key Words: Alzheimer Dementia; Hearing Loss; Geriatrics.

ARAŞTIRMA

ALZHEİMER DEMANS TANILI HASTALARDA İŞİTME DÜZEYİ

ÖZ

Giriş: İşitme kaybının, uyarı girişini azaltarak, sosyal etkileşimi engellediği ve demansla ilişkili olabileceği düşünülmektedir. Bu çalışmada Alzheimer demanslı ve demansı olmayan gönüllü bireyler değerlendirilerek, işitme kaybı ile demans arasındaki ilişki ortaya konmaya çalışıldı.

Gereç ve Yöntem: Bu çalışma, Elazığ Eğitim ve Araştırma Hastanesi psikiyatri polikliniğine Ocak 2011 ile Ocak 2013 tarihleri arasında başvuran ve Mini Mental Test ile Alzheimer demans tanısı alan 124 hasta ile kulak burun boğaz kliniğine başvuran ve demansı olmayan 224 gönüllüden oluşmaktadır. Hastalara ve gönüllü bireylere saf ses odyometri testi yapılarak saf ses ortalamaları belirlendi.

Bulgular: Yapılan odyolojik incelemede Alzheimer demanslı grupta sağ kulak saf ses ortalaması 50,96±12,25 dB, sol kulak saf ses ortalaması ise 50,49±12,15 dB olarak belirlendi. Hastaların 6'sı (%4,8) normal, 23'ü (%18.5) hafif derecede, 57'si (%46) orta derecede, 38'i (%30.6) ise ileri derecede işitme kaybı yaşıyordu. Kontrol grubunda sağ kulak saf ses ortalaması 30,66±9,33 dB, sol kulak saf ses ortalaması ise 30,62±9,39 dB olarak belirlendi. Hastaların 83'ü (%38,8) normal, 106'sı (%45,5) hafif derecede, 21'i (%9.8) orta derecede, 4'ü (%1,9) ise ileri derecede işitme kaybı yaşıyordu. Sağ kulak ve sol kulak saf ses ortalamalarının Alzheimer demanslı ve kontrol grubundaki farkı istatistiksel olarak anlamlı bulundu ($p<0.05$). AD hastalarından 9'u (%7,2), kontrol grubunda ise 6 (%2,8) kişi işitme cihazı kullanmaktaydı.

Sonuç: Çalışmamızda demans hastalarında kontrol grubuna kıyasla anlamlı düzeyde işitme kaybı mevcut olup bu sonuç demans ile işitme kaybı arasındaki ilişkiyi ortaya koymaktadır. Bu nedenle demansı olan ve olmayan geriatrik işitme kayıplı hastalara kognitif işlevselliği görece iyi olup kullanabilecekse hastalara işitme cihazı önerilebileceğini, bu durumun bilişsel işlevselliklerini ve bu sayede günlük işlevselliklerini artırabileceğini düşünmekteyiz.

Anahtar Sözcükler: Alzheimer Demans; İşitme Kaybı; Geriatri.

Introduction

Dementia is a neuropsychiatric disturbance in which various cognitive functions, (primarily memory disturbances), personality changes, and various and variable psychiatric and behavioral symptoms are observed together. It is reported that in the United States of America (USA), there is a severe dementia rate of 5% and a slight dementia rate of 15% in populations aged 65 and above, and this ratio reaches 20% for severe dementia at ages 80 and above (1,2).

In the 21st century, as average life becomes longer and the ratio of elderly in the general population in Turkey increases, it is inevitable that dementia will become a public health problem.

Hearing loss is an important problem as it causes loneliness, decreases social activities, and leads to communication defects in the elderly. Some researchers report that by decreasing the stimulus, hearing loss prevents social interactions, which might be related to dementia (2-3).

In the present study, the researchers aimed to identify the correlation between hearing loss and dementia by evaluating volunteers with Alzheimer's dementia (AD) and patients without dementia.

Materials and Methods

One hundred twenty-four patients admitted to Elazığ Training and Research Hospital Psychiatry Clinic and 224 volunteers without dementia admitted to the Ear Nose Throat Clinic between January 2011 and January 2013 were included in the study.

Evaluation of Dementia

The diagnosis of dementia was made according to the dementia diagnostic criteria of DSM-IV-TR (4) by a specialist in psychiatry, at the end of a clinical interview. Additionally, the mini-mental state examination was performed on all patients. The mini-mental state examination (MMSE) was first published by Folstein et al. Although the test has limited specificity in the differentiation of clinical syndromes, it is a short, useful, and standardized method that can be used in the detection of cognitive level (5). The mini-mental state examination consists of eleven items under five main topics (orientation, record memory, attention and calculation, recall, and language) and is evaluated for a total of 30 points. It is composed of items that measure 10-point time and place orientation functions, 6-point memory functions (3 for record and 3 for recall), 5-point attention functions, 8-point language functions, and 1-point visual-spatial functions. The threshold value for the MMSE was determined to be 23/24 (6). Alzheimer dementia has been staged according to MMSE scale as follow: 20-23 point is slight, 10-19 is moderate and 0-9 is severe (7).

Evaluation of Hearing

After performing ear nose throat examinations on geriatric volunteers with Alzheimer's dementia and patients without dementia, an audiological examination (Interacoustic AC 40, Denmark) was performed in the audiology unit and hearing thresholds at 250, 500, 1000, 2000, 4000, and 6000 Hertz (Hz) were determined. Pure tone averages (PTA) at frequencies of 500, 1000 and 2000 Hz were determined. Hearing level was classified as normal hearing loss (0-25 dB), slight hearing loss (26 - 40 dB), moderate hearing loss (41-55 dB), moderate-severe hearing loss (56-70 dB), severe hearing loss (71-90 dB), and very severe hearing loss (91 dB and above) (8). Patients who could not adapt to the test, who had hearing loss in one ear, who had middle ear pathology, and who had hearing loss other than sensorineural loss were excluded from the study.

Statistical Analysis

SPSS (Statistical Package for Social Sciences for Windows 15.0.9) was used to evaluate the data obtained in the present study. After a database was created, statistical analyses were performed. Correlations between the parameters of the study in the AD group and the control group were evaluated using one-way analyses of variance and t-tests for continuous variables; categorical variables were evaluated using chi-square and multinomial logistical regression tests. Values of $p<0.05$ were accepted as statistically significant.

Results

Eighty-three patients (66.9%) with Alzheimer's dementia were female and 41 (33.1%) were male; the mean age was 82.9±5.17 years. One hundred twenty-one patients in the control group (56.5%) were female, and 93 (43.5%) were male; the mean age was 78.9±6.21 years (Table 1). Eighty-seven (70.2%) patients with Alzheimer's dementia had hypertension, and 104 patients (48.6%) had hypertension in the control group. Seventeen patients (13.7%) in the Alzheimer's dementia group and 25 (11.7%) patients in the control group had diabetes mellitus (Table 1).

Table 1— Data of The Control and Dementia Groups.

	Control (214)	Dementia (124)	P value
Mean Pure Tone			
Right ear, mean (SD)	30.66±9.33 dB	50.96±12.25 dB	0.001
Left ear, mean (SD)	30.62±9.39 dB	50.49±12.15 dB	0.001
Hearing level			
Normal	83 (38.8)	6 (4.8)	
Slight HL	106 (45.5)	23 (18.5)	
Moderate HL	21 (9.8)	57 (46.0)	
Severe HL	4 (1.9)	38 (30.6)	
Gender			
Female	121 (56.5)	83 (66.9)	
Male	93 (43,5)	41 (33.1)	
Age, mean (SD)			
Female	78.5±8.01	82.16±9.06	
Male	77.3±4.5	82.9±5.19	
Diabetes mellitus	25 (11.7)	17 (13.7)	
Hypertension	104 (48.6)	87 (70.2)	
Hearing device	6 (2.8)	9 (7.2)	

In the audiological examination, the mean pure tone of the right ear was 50.96±12.25 dB, and the mean pure tone of left ear was 50.49±12.15 dB in the AD group. Six patients (4.8%) had normal hearing, 23 (18.5%) had slight HL, 57(46%) had moderate HL, and 38 (30.6%) had severe HL in the AD group (Table 1). Five (4.8%) patients had normal hearing, 21(19.8%) had slight HL, 54 (50.9%) had moderate HL, and 26 (24.5%) had severe HL in slight AD group. One (5.6%) patient had normal hearing, two (11.2%) had slight HL, three (16.6%) had moderate HL, and 12 (66.6%) had severe HL in moderate AD group (Table 2).

In the control group, the mean pure tone of the right ear was 30.66±9.33 dB, and the mean pure tone of left ear was 30.62±9.39 dB. Eighty-three patients (38.8%) had normal hearing, 106 (45.5%) had slight HL, 21 (9.8%) had moderate HL, 4 (1.9%) had severe HL. The difference in the mean pure tone of the both right and left ears between the AD and control groups was found to be statistically significant ($p<0.05$). Nine patients (7.2%) in the Alzheimer's dementia group and six patients (2.8%) in the control group were using hearing devices (Table 1).

In control group, between the age of 70-79 years, 60 (72.3%) patients had normal hearing and 51 (41.1%) patients had hearing loss, between the age of 80-89 years, 20 (24.1%) patients had normal hearing and 72 (58.1%) patients had hearing loss and between the age of 90-99 years, 3 (3.6%) patients had normal hearing and 1 (0.8%) patient had hearing loss. In AD group, between the age of 70-79 years, 2 (33.3%) patients had normal hearing and 22 (18.6%) patients had hearing loss, between the age of 80-89 years, 4 (66.7%) patients had normal hearing and 82 (69.5%) patients had hearing loss and between the age of 90-99 years, no patient

Table 2— Demographics and Hearing Levels of Patients with Alzheimer Dementia According to MMSE Scale.

MMSE Level	Gender			Hearing Level			
	Female	Male	Age, mean (SD)	Normal (6)	Slight HL (23)	Moderate HL (57)	Severe HL (38)
Slight AD (23-20)	75 (70.7)	31 (29.3)	82.95 ±5.24	5 (4.8)	21 (19.8)	54 (50.9)	26 (24.5)
Moderate AD (19-10)	8 (44.4)	10 (55.6)	82.66 ±4.89	1 (5.6)	2 (11.2)	3 (16.6)	12 (66.6)
Severe AD (9-0)	–	-	-	-	-	-	–

Table 3— Association Between Hearing Loss and Age of Patients in Control and AD Groups

Control Age	Normal (83)	Hearing Loss (124)
70-79	60 (72.3)	51 (41.1)
80-89	20 (24.1)	72 (58.1)
90-99	3 (3.6)	1 (0.8)
Dementia Age	**Normal (6)**	**Hearing Loss (118)**
70-79	2 (33.3)	22 (18.6)
80-89	4 (66.7)	82 (69.5)
90-99	-	14 (11.9)

had normal hearing and 14 (11.9%) patient had hearing loss (Table 3). While statistically significant difference between hearing loss and age of patients was observed in control group (p=0.001), no significance between hearing loss and age of patients was detected in AD group (p=0.508).

DISCUSSION

Alzheimer's disease (AD) is a fatal neurodegenerative disease that presents with memory deficit, together with defects in language, management and decision making functions, defects in attention, orientation and personality, and a progressive loss of acquired intellectual skills. Alzheimer's dementia constitutes 50-70% of all dementia (9).

Age and gender are risk factors in Alzheimer's disease. While the disea9se incidence is rare before age 60, it increases to approximately 50% in ages 85 and above. In every five years, the risk of Alzheimer's disease increases fivefold before age 65, threefold before age 75, and 1.5 fold before age 85 (10). It is known that the disease occurs in females more frequently than males. The generally accepted female/male ratio is 2/1 (10). Advanced age was found as a risk factor for dementia in our patients. Furthermore, the number of female patients being twice the number of male patients was found to be consistent with the literature.

Different results have been reported on the effect of hypertension in Alzheimer's disease. While in some studies, hypertension does not seem to be a risk factor, in other studies it has been reported that a history of high systolic blood pressure and low diastolic blood pressure increased the risk (11,12). In the present study, there was hypertension in 87 (70.2%) patients in the AD group and 104 (48.6%) patients in the control group. Hypertension was detected more frequently in the AD group, compared to the control group. The presence of hypertension at a high rate in AD patients, compared to the control group, suggests that it might be a risk factor for AD.

While there are studies demonstrating that diabetes mellitus is not a risk factor for AD, there are also studies demonstrating that it causes a low risk (13,14). Diabetes mellitus was diagnosed in 17 patients (13.7%) in the AD group and in 25 patients (11.7%) in the control group, and the ratios of diabetes mellitus in both groups were close to each other.

Hearing loss in Alzheimer's disease develops as a result of structural changes in the ventral nucleus of the medial geniculate body and central nucleus of the inferior colliculus (15). The medial geniculate body is the station that has the most important role in central hearing function; its reflections are organized tonotopically. The dominant symptom in central hearing system disorders is the difficulty in understanding speech in the presence of background noise or a competitor auditory stimulus (16).

Hearing loss may be related to dementia due to the decrease in cognitive reserves, social isolation, and loss of environmental data (17). In studies investigating the effect of hearing loss on cognitive reserve, it was reported that in cases with poor auditory perception, more cognitive sources assume a role for auditory perception, which damages other cognitive processes such as study memory (18,19).

The allocation of neural sources to the hearing process may cause the exhaustion of cognitive sources that are reserved for other cognitive processes, and precipitate the earlier emergence of clinical symptoms of dementia (20). In animal studies that were performed to demonstrate the mechanism of the direct effect hypothesis of hearing loss on the neuropathology of AD, it was demonstrated that an increased environmental stimulus might decrease B-amyloid levels in transgenic rat models (21). This hypothesis was supported by the demonstration of low risk in individuals who perform activities in their free time (22). In the audiological examinations performed in the present study. The lower level of hearing in the AD group, compared to the control group, was found to be statistically significant ($p<0.05$). While the moderate hearing loss has been more frequently encountered in patients with slight stage AD, the patients with moderate stage AD have had more frequent severe hearing loss. We observed an association between presbyacusis and age of control patients. On the other hand, we didn't observe any association between presbyacusis and age of patients with AD.

The communication defects caused by hearing loss may cause social isolation in aged adults (23,24). The relation between poor social communication and dementia has been demonstrated in epidemiological and neuroanatomical studies (25,26). In the present study, there was hearing loss at a significant level in the dementia group when compared to the control group, and this result suggests that there might be a relationship between dementia and hearing loss. Thus, the researchers believe that hearing devices should be recommended to patients with geriatric hearing loss, with or without dementia, if they have relatively good cognitive functions. These devices could increase their cognitive, and thus daily, functions. The relation between Alzheimer's dementia and hearing loss could be further demonstrated with studies that included a greater number of patients, which would allow for the evaluation of hearing in a more extensive manner.

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