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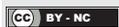
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RELATIONSHIP BETWEEN PNEUMONIA AND SWALLOWING FUNCTION IN ELDERLY

ORIGINAL ARTICLE

ABSTRACT

Purpose: Anatomical and physiological changes due to aging decrease the efficiency of swallowing and increase the risk of aspiration pneumonia. One of the underlying causes of recurrent pneumonia is swallowing dysfunction, with aspiration. This study aimed to compare the swallowing function in elderly patients with and without pneumonia and to investigate its association with malnutrition.

Methods: A total of 44 elderly individuals with 22 aspiration pneumonia history (age=73.00±7.93 years) (study group) and 22 without aspiration pneumonia history (age=70.00±6.39 years) (control group) were included in the study. The swallowing function was evaluated using the Swallowing Ability Function Evaluation (SAFE) and water-swallowing test. Nutritional assessment was performed using the Turkish version of the Mini-Nutritional Assessment.

Results: Decreased swallowing ability was observed in 59.1% of the study group and 9.1% of the control group (p<0.001). While the study group had severe disorder the 22.7% of the oral phase and 31.8% of the pharyngeal phase, the control group had no severe disorder. However, there was a 9.1% moderate disorder in the oral and pharyngeal phases in the control group (p<0.001). There was a relationship between the nutritional assessment results of the study group and the oral (r=0.498, p=0.018) and pharyngeal phases of SAFE (r=0.622, p=0.002).

Conclusion: Our study showed that the swallowing function is affected in the elderly with a history of pneumonia. It was also observed in the elderly without a history of pneumonia. For this reason, a detailed swallowing evaluation must be performed both elderly patients with and without pneumonia, and a protective swallowing rehabilitation program should be developed through an interdisciplinary approach.

Key Words: Dysphagia; Elderly; Pneumonia; Swallowing.

YAŞLI BİREYLERDE PNÖMONİ VE YUTMA FONKSİYONLARI ARASINDAKİ İLİŞKİ

ARAŞTIRMA MAKALESİ

ÖZ

Amaç: Yaşlanma ile birlikte oral motor yapılarıdaki zayıflık, reflekslerde yavaşlama gibi anatomik ve fizyolojik değişimler yutma etkinliğinde azalmaya yol açarak aspirasyon pnömonisi riski oluşturmaktadır. Tekrarlayan pnömoninin altında yatan nedenlerden biri, aspirasyon ile birlikte yutma disfonksiyonudur. Bu çalışmada pnömoni öyküsü olan ve olmayan yaşlılarda yutma fonksiyonlarının karşılaştırılması ve malnutrisyon ile ilişkisini incelenmesi amaçlandı.

Yöntem: Çalışmamıza 22 aspirasyon pnömoni öyküsü bulunan (yaş=73,00±7,93 yıl) (çalışma grubu) ve 22 aspirasyon pnömoni öyküsü bulunmayan (yaş=70,00±6,39 yıl) (kontrol grubu) toplam 44 yaşlı birey dahil edildi. Yutma fonksiyonu değerlendirmesinde Yutma Yeteneği ve Fonksiyonu Değerlendirmesi (SAFE) ve su yutma testi kullanıldı. Beslenme değerlendirmesi, Mini-Nutrisyonel Değerlendirme'nin Türkçe versiyonu ile yapıldı.

Sonuçlar: Çalışma grubunun % 59,1'inde yutma becerisinde azalma bulunurken, kontrol grubunda bu oran % 9,1'di (p<0,001). Çalışma grubunda oral fazın % 22,7'sinde ve faringeal fazın % 31,8'inde şiddetli bozukluk gözlenirken, kontrol grubunda şiddetli bozukluk yoktu ancak kontrol grubunda oral ve farengeal fazlarda % 9,1 oranında orta düzeyde bozukluk gözlendi (p<0,001). Çalışma grubunun beslenme değerlendirme sonuçları ile SAFE'nin oral (r=0,498, p=0,018) ve farengeal (r=0,622, p=0,002) evreleri arasında ilişki olduğu görüldü.

Tartışma: Çalışmamız pnömoni öyküsü olan yaşlılarda yutma fonksiyonunun etkilendiğini göstermiştir. Bununla birlikte pnömoni öyküsü olmayan yaşlılarda da etkilendiği gözlenmiştir. Bu sebepten dolayı pnömoni öyküsü olan ve olmayan yaşlılara detaylı bir yutma değerlendirmesi yapılmalı ve interdisipliner bir yaklaşımla koruyucu yutma rehabilitasyon programı oluşturulmalıdır.

Anahtar Kelimeler: Disfaji; Yaşlı; Pnömoni; Yutma.

INTRODUCTION

Swallowing and chewing disorders are widely seen in the elderly and lead to severe consequences. Swallowing disorders are often asymptomatic, making early diagnosis challenging (1). Aspiration pneumonia is common as a result of the swallowing disorder. The mortality rate of aspiration pneumonia is between 20% and 65% (2). It is estimated that pneumonia due to aspiration is present in 10% of community-dwelling individuals and 30% of long-term care patients (3).

A reduction in the amount of connective tissue of tongue limits tongue movements and causes difficulties in controlling and pushing the bolus toward the posterior of the mouth (4). Increased eating duration (>30 min), fatigue while eating, food spillage, and drooling are the most commonly observed eating problems in the elderly. In addition, persistent coughing, suffocation, retching, or wet sounds while eating and drinking indicate swallowing difficulties and should not be ignored (5). Swallowing disorders lead to many severe complications in the elderly, including malnutrition, dehydration, decreased nutrition, and aspiration pneumonia (2). Aspiration is the entry of food from the oropharynx into the larynx, and problems in the pharyngeal stage of swallowing (i.e., delayed swallowing reflex and residue) may result in airway aspiration (6). Therefore, appropriate swallowing evaluation and management are crucial to prevent serious complications such as malnutrition, aspiration, and reduce the risk of malnutrition in the elderly. Several previous studies have used clinical and screening methods to evaluate the cough reflex and swallowing mechanisms in the elderly. However, a limited number of studies have evaluated the relationships among swallowing mechanisms, pneumonia, and its consequences (7-9). Thus, the current study aimed to (a) thoroughly examine the relationship between swallowing function and pneumonia in the elderly and (b) determine the relationships among swallowing function and malnutrition in elderly individuals with a history of pneumonia.

METHODS

Subjects

This study included 44 elderly who were treated in the Department of Geriatrics and Swallowing Disorders Research and Application Unit of Hacettepe University Faculty of Medicine between June and September 2014. The study was approved by Hacettepe University's Non-Interventional Clinical Research Ethics Committee with decision number GO 14/226-24 on 30/04/2014. Written informed consent was obtained from all the elderly participated in the study. All participants were informed, and they voluntarily participated in the study. Our study was conducted as a cross-sectional study. According to the SAFE test, it was calculated that a sample consisting of 44 subjects was needed to obtain 80% power, type 1 error at 5% (G*Power package, Version 3.1.9.2, Axel Buchner, Universitat Kiel, Germany). The study included two groups: the study group, 22 elderly participants with a history of recurrent aspiration pneumonia during one year and the control group, and 22 elderly participants without a history of recurrent aspiration pneumonia. Information on a history of recurrent aspiration pneumonia during one year was obtained from hospital files. Inclusion criteria for the study group were being >65 years old, having a history of recurrent aspiration pneumonia last 1 year, and a Mini-Mental Test (MMT) score >23. For the control group, the inclusion criteria were being >65 years old and MMT score of over >23; exclusion criteria for both groups were having a neurological or structural problem that causes swallowing disorder(s), non-oral feeding, dementia and lack of cooperation (10).

Measurements

Swallowing evaluation was performed using the water-swallowing test (WST) and Swallowing Ability and Functional Evaluation (SAFE).

Water Swallow Test

The water swallow test is a non-invasive method requiring no equipment, developed by Kubota et al., and previously established as valid and reliable in the elderly (11). In addition, the short application time of the test has increased the applicability of the test. Swallowing ability is evaluated with the

times required to drink water and the suspected areas in terms of the swallowing disorder. A cup containing 30 ml of water at room temperature is handed to the patient who is seated on a chair. The patient is told, "Please drink this water as you normally would." The chronometer was started when the water first touched the lips and was stopped, and then the larynx came to rest position. The time is taken to finish drinking the water, the profile, and any episodes are measured and observed. The profiles were "1: able to drink all the water in one gulp without choking," "2: able to drink all the water in two or more gulps without choking," "3: able to drink all the water in one gulp, but some choking occurs," "4: despite drinking the water in two or more gulps, some choking occurs, and "5: frequent choking, with difficulty drinking all the water." The examiner notes situations such as "Drinking carefully by holding water in the mouth and sipping," "Intense coughing," "Dripping water from the lips," and "Abnormal sounds and difficult respiration after drinking the water." The normal interval of swallowing ability is defined as 5 s. The diagnosis was a normal range (completed profile one within 5 s), suspected (completed profile one after >5 s, or Profile 2), and abnormal (profiles 3–59 (11,12).

Swallowing Ability and Functional Evaluation (SAFE) Test

The test evaluates swallowing in three phases.

The first phase was the physical oromotor functions. In this phase, peripheral evaluation of oropharyngeal swallowing mechanism were performed and scores were given between the lips, tongue, palate, cheeks, teeth, chin, all movements of the larynx and oral reflexes between 0-3 (0: intense disorder; 1: medium level disorder; 2: slight disorder; 3: functional limits). In the SAFE oral phase evaluation, physiological data related to the oral phase such as closing the lips during swallowing, lip seal, bite packing, bolus transport, number of swallows per bite, chewing speed, and strength and nasal backflow were evaluated. In the SAFE pharyngeal phase evaluation, characteristics related to the pharyngeal phase such as delay in swallowing reflex, laryngeal elevation, the existence of coughing before/during/after swallowing, repetitive swallowing, feeling of sticking in the throat, changes which take place in sounds after swallowing and backflow were tested. In the second phase of the SAFE test, the evaluation was performed by giving scores between 0 and 3 to the expected function of the patients in both stages (0: severe disorder; 1: medium level disorder; 2: slight disorder; 3: functional limits). The third phase was sensory and cognitive characteristics. In order for the patient to pass to safe oral intake in the general information stage related to swallowing ability, the required cognitive and behavioral factors were evaluated. The scores given in the first and the second phases were calculated. The

Table 1: Study Participants' Physical Characteristics, Mini Mental Test Scores and Comorbidities.

Variables	Pneumonia (n=22)	Control (n=22)	p
	Median (IQR)	Median (IQR)	
Age (years)	73 (68-96)	70 (65-88)	0.033^{*1}
Height (cm)	166.5 (120-185)	168 (154-180)	0.356 ¹
Weight (kg)	70 (25-96)	78.5 (55-115)	0.086 ¹
Body Mass Index (kg/m ²)	26.55 (15.8-42.2)	27.5 (21.37-39.7)	0.162 ¹
Mini Mental Test (0-30)	25 (24-26)	26 (24-28)	0.157 ¹
Gender, M/F, n	11/11	11/11	1.000
Comorbidities ²	n (%)	n (%)	
Diabetes	6 (27.27)	3 (13.63)	0.419
Hypertension	1 (4.5)	2 (9.09)	0.108
Cancer	2 (9.09)	8 (36.36)	0.427
Thyroid Disorder	2 (9.09)	1 (4.5)	0.249
Heart Diseases	7 (31.81)	0 (0)	0.365

*p<0.05. ¹Mann-Whitney U Test, ²Chi-square test. IQR: interquartile range.

total scores were determined for both phases and associated with the corresponding values in the test booklet. The numbers corresponding to the total score received by the patients in the booklet allowed us to have information on the intensity of the swallowing difficulty. Since the answers received as present/not present were not crucial in determining the intensity of swallowing difficulty in SAFE's third Phase and were not reflected in the total score, they were not used in the statistical analysis. However, they were considered since they would be a suitable evaluation parameter. The intermediate values by the received score were graded between 1 and 9. The intermediate values corresponding to the total score received in the test, and their meanings were as follows: 1-2, intense disorder in swallowing, 3-4-5, medium level disorder in swallowing, 6-7, slight disorder in swallowing, and 8-9, swallowing function within normal limits (13).

Nutritional assessment was performed with the Turkish version of the Mini-Nutritional Assessment (MNA). The validity and reliability of MNA have been previously established in Turkish individuals (14). It is used to evaluate malnutrition risk and classify nutritional conditions in the elderly. The MNA (maximum score: 30 points) separates respondents into three categories: sufficient nutrition (≥ 24 points), risk of malnutrition (17–23.5 points), and malnutrition (< 17 points). Permission to use the assessment has been obtained.

The Turkish version of the MMT was used for the evaluation of the cognitive state. The validity and reliability of MMT have been previously established in Turkish individuals with a slight dementia diagnosis (threshold value=23/24 points) (15).

Scoring is as follows: cognitive disorder (0–9 points), medium-level cognitive disorders (10–23 points), and normal (24–30 points). This study included patients with MMT scores > 23 points. Permission to use the assessment has been obtained.

Statistical Analysis

SPSS 21.0 (SPSS Inc., Chicago, IL, USA) for Windows software program was used in all statistical analyses. In the evaluation of data, mean \pm standard deviation, median, interquartile range, and minimum and maximum values were used for descriptive statistics. Whether measurements obtained from the study and control groups display normal distribution or not was tested with the Shapiro Wilk test. In the two-group comparisons of the numerical values, the Mann-Whitney u test and Student's t-test were performed. Spearman correlation analysis was performed. In the comparisons of the qualitative characteristics in the two groups, crosstab analysis of Chi-square analysis, Fisher exact test, and Fisher-Freeman-Halton test were used. A $p < 0.05$ was accepted as statistical significance.

RESULTS

Table 1 displays the participants' physical characteristics, MMT scores, and comorbidities. A comparison of the WST scores by groups is shown in Table 2. Results indicated that 59.1% of participants of study group showed experienced decreased swallowing ability and 27.3% carried a risk in terms of swallowing function while 9.1% of participants of the control group showed experienced decreased swallowing ability and 9.1% carried a risk in terms of swallowing function ($p < 0.001$). The two groups significantly differed in

Table 2: Comparison of Groups by Total Scores on the Water Swallowing Test.

Water Swallowing Test	Pneumonia (n=22)		Control (n=22)		p
	n	%	n	%	
Normal Swallowing Ability (Normal Range)	3	13.6	18	81.8	$< 0.001^{*1}$
Possibility of Decrease in Swallowing Ability (Suspected)	6	27.3	2	9.1	$< 0.001^{*1}$
Decrease in Swallowing Ability (Abnormal)	13	59.1	2	9.1	$< 0.001^{*1}$
Time Taken to Drink 30 mL Water (s) [§]	6.50 \pm 2.70		5.00 \pm 1.68		$< 0.001^{*2}$

* $p < 0.05$. ¹Chi-square test, ²Student's t-test.

Table 3: Comparison of groups by the Swallowing Ability and Function Evaluation and Mini Nutritional Assessment.

Phases of SAFE		Pneumonia (n =22)		Control (n =22)		p
		n	%	n	%	
Physical Oromotor Function	Normal	1	4.5	8	36.4	0.001*
	Slight Disorder Level	5	22.7	9	40.9	0.001*
	Medium Disorder Level	12	54.5	5	22.7	0.001*
	Intense Disorder	4	18.2	0	0	0.001*
Oral Phase	Normal	1	4.5	10	45.5	<0.001*
	Slight Disorder Level	3	13.6	10	45.5	<0.001*
	Medium Disorder Level	13	59.1	2	9.1	<0.001*
	Intense Disorder	5	22.7	0	0	<0.001*
Pharyngeal Phase	Normal	1	4.5	16	72.7	<0.001*
	Slight Disorder	5	22.7	4	18.2	<0.001*
	Medium Disorder	9	40.9	2	9.1	<0.001*
	Intense Disorder	7	31.8	0	0	<0.001*
MNA	Normal Nutritional Status	4	18.2	18	81.8	<0.001*
	Risk of Malnutrition	8	36.4	3	13.6	<0.001*
	Malnutrition	10	45.5	1	4.5	<0.001*

*p<0.05, Chi-square test. SAFE: Swallowing Ability and Function Evaluation, MNA: Mini Nutritional Assessment.

terms of WST scores and drinking time ($p<0.001$). The participants' SAFE and MNA results are shown in Table 3. According to SAFE test results, the study group had an intense disorder in physical oromotor function 18.2%, in the oral phase 22.7%, in the pharyngeal phase 31.8%. However, no intense disorder was observed in the control group. ($p<0.001$). According to MNA results, malnutrition was seen in 45.5% of the study group and 4.5% of the control group ($p<0.001$).

Correlations between swallowing evaluations (SAFE, WST) and MNA and drinking time are shown in Table 4. A positive, strong correlation was found between the study group's MNA scores and SAFE pharyngeal phase values ($r=0.622$, $p<0.002$). Positive relationships were also determined between the study group's SAFE oral ($r=0.565$, $p<0.006$) and pharyngeal phase values ($r=0.473$, $p=0.026$) and between the control group's SAFE pharyngeal phase values and drinking time ($r=0.654$, $p<0.001$).

There was positive, significant correlation was found between drinking time and WST in the study group ($r=0.471$, $p=0.027$) and WST in the control group ($r=0.427$, $p=0.048$).

DISCUSSION

The results of our study, which examined the relationship between swallowing function and pneumonia in the elderly, show that individuals with a history of pneumonia should be evaluated in terms of swallowing function. However, our findings, which indicate swallowing dysfunction in individuals without a history of pneumonia, also reveal that aging is a risk factor for swallowing dysfunction and forms a basis for pneumonia. Therefore, the entire geriatric population should be evaluated in detail for the swallowing function.

A study that examined swallowing disorders in the elderly concluded that WST was a practical and straightforward method but must be used with the support of other tests (16). A study using WST reported that 34% of the elderly population had to swallow dysfunction (8). Similar studies showed that aging decreases tongue pressure and motor function in the lips, resulting in increased swallowing time and impaired swallowing function (9,17).

A study using video fluoroscopy, which is considered the gold standard for swallowing evaluation, found serious penetration and aspiration during

Table 4: Correlation between Evaluations of Swallowing Ability and Mini-Nutrition Assessment, and Time Taken to Drink 30 mL Water.

Groups		SAFE			WST
		Physical Evaluation	Oral Phase	Pharyngeal Phase	
Pneumonia (n=22)					
MNA (Study group)	r	0.374	0.498	0.622	0.394
	p	0.086	0.018*	0.002*	0.069
Time Taken to Drink 30 mL Water (s)	r	0.298	0.565	0.473	0.471
	p	0.178	0.006*	0.026*	0.027*
Control (n=22)					
MNA	r	-0.045	0.076	0.292	0.408
	p	0.842	0.735	0.187	0.059
Time Taken to Drink 30 mL Water (s)	r	0.406	0.350	0.654	0.427
	p	0.061	0.111	0.001*	0.048*

*p <0.05. r: Spearman correlation analysis, MNA: Mini Nutritional Assessment, SAFE: Swallowing Ability and Function Evaluation, WST: Water Swallowing Test.

swallowing in 52.8% of individuals with pneumonia (aged ≥ 70 years) (18). Many other studies have shown that aging can affect swallowing function and cause aspiration, leading to a risk of vital. These studies also suggested that increased prevalence of pneumonia with age in dementia patients with and without a history of aspiration pneumonia is due to the weakening of the swallowing function and decreased the sensitivity of the cough reflex (7,19). Studies also suggest that swallowing phase is affected by age (8,16). In our study, similar results were obtained using the WST and SAFE tests. According to the results of the WST, Abnormal swallowing function was found in more than half of the study group. In the control group, only two subjects had abnormal swallowing function. We thought that the decrease in swallowing function in the study group leads to the development of frequent recurrent pneumonia by caused by aspiration. The relatively young age in the control group might be responsible for this. The prevalence of swallowing disorder increases with aging. In one study, the prevalence of swallowing disorders in elderly individuals has been found 16% in the 70-79 years-old group and 33% in the 80 years-old group (20). In addition, the 30 ml² of water drinking times of the study group were longer than the control group. We thought that the reason for the longer duration in the study group might be the water in order not to aspirate; carefully drinking and keeping it in the mouth.

According to the SAFE, swallowing dysfunction was found in the oral and pharyngeal phases of

the study group. Over half of the participants with a history of pneumonia, medium-level swallowing disorders were found in terms of oropharyngeal function. We thought that the rate in patients with a history of pneumonia may reveal that swallowing disorders cause recurrent pneumonia. In addition, the rate of swallowing disorders among control group suggested that this group was also at serious risk of swallowing disorder, highlighting the importance of protective swallowing rehabilitation in geriatric patients. In addition, when physical oromotor evaluation results were examined, it is seen that older people with a history of pneumonia had more disorders. However, the disorder was also observed in individuals who did not have a history of pneumonia. The formation of changes in structures such as lips, tongue, palate, and teeth, which are essential in the formation of effective swallowing, and decrease in movements and reflexes that provide swallowing function with aging, might be responsible for the findings.

Swallowing dysfunction and malnutrition are reliable indicators of pneumonia in the elderly. Malnutrition, emerging in swallowing difficulties, leads to a weakened immune system, lack of energy, and decreased personal hygiene, work and socialization, mobility, and performance. Insufficient nutrition leads to weight loss and (21) decreased energy. A previous study reported a risk of malnutrition of 54.7% in individuals with a history of pneumonia, and 27.4% of them have malnutrition. The authors suggest a strong correlation between malnutrition and oropharyngeal swallowing dysfunction (21).

The risk of malnutrition was seen in one in third participants with a history of pneumonia, and malnutrition was observed in nearly half. The strong correlation was found between the MNA scores and SAFE oral and pharyngeal phase values among individuals with a history of pneumonia. We thought that the high malnutrition rate among individuals with a history of pneumonia might thus be due to decreased swallowing function. The close relationship between malnutrition and swallowing disorder is due to the difficulty in swallowing and especially the aspiration of people with pneumonia, stalling of food, and coughing after eating, leading to decreased desire to eat (21). Malnutrition, as a result of swallowing disorder, also leads to severe consequences such as aspiration pneumonia (22). The struggle against malnutrition also creates a severe economic burden (23). Improving swallowing efficiency in the elderly through swallow assessments, therefore, represents a way to reduce the risk of malnutrition.

In many studies, in the elderly who had previously had pneumonia, airway protection mechanisms and cough reflexes are more affected, and older people are more exposed to aspiration. This becomes a vicious circle, and the swallowing functions could be further impaired (20,24). We thought that the findings of our study are caused by physiological and musculoskeletal system changes due to aging. In addition, reduced connective tissue restricts bolus movement in the tongue, causing difficulty in pushing the bolus posteriorly. These changes that occur with age lead to a decrease in swallowing functions of individuals.

The strengths of our study were that the number of people indicated in the power analysis was reached, and that the physiotherapists conducting the study were experienced physiotherapists in the field of swallowing. One of the limitations of the study was the lack of methods such as videofluoroscopic imaging or fiberoptic endoscopic evaluation of swallowing. In addition, the lack of a more detailed assessment by gender and age could be considered as limitations. Another limitation of our study was that the ages of the study and control groups were different. Although they are relatively younger, there were subjects in this group having swallowing dysfunction. Our study was an initial

study, and further studies are needed considering all these limitations.

In conclusion, anatomical and physiological changes that occur with age could lead to adverse effects for swallowing function. The most critical of these is aspiration pneumonia, which can be fatal. Therefore, to prevent the life threatening effects of malnutrition and swallowing disorders their risk factors need to be analyzed well. Aspiration and pneumonia could be prevented through the early diagnosis of swallowing disorders. Further, hospital expenses could be lowered, and the health quality of the elderly could be improved. Therefore, swallowing evaluations must be conducted regularly in, both elderly patients with and without pneumonia.

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Conflict of Interest: The authors have no conflicts of interest to disclose.

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