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ORIGINAL ARTICLE

Relationship Between Dysphagia and Sarcopenia with Comprehensive Geriatric Evaluation

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Abstract

Oropharyngeal dysphagia has features of geriatric syndromes and is strongly associated with sarcopenia. In this cross-sectional study, we aimed to evaluate the association between dysphagia and sarcopenia, in a practical way, accompanied by comprehensive geriatric assessment. Dysphagia and sarcopenia were defined by the EAT-10 and SARC-F questionnaires, respectively. Cognition and mood, was evaluated by the Mini-mental State Examination (MMSE) and Geriatric Depression Scale (GDS), respectively. Physical performance was assessed by the Timed up and Go Test (TUG) and muscle strength was determined by Hand Grip Strength (HGS). Functionality was stated by Katz and Lawton Indexes. Serum levels of hemoglobin, triglyceride, albumin, and total cholesterol were recorded. A total of 512 (151 male/361 female) patients age 60 and older were included in the study. Prevalences of dysphagia and sarcopenia were 23% and 40.6%, respectively. In multivariate analysis sarcopenia (OR:2.596, $p=0.008$), depressive symptoms (OR:1.115, $p<0.001$), and lower KATZ scores (OR:0.810, $p=0.036$) were independently related with dysphagia. Dysphagic patients with sarcopenia had lower scores on the Katz and Lawton scales ($p<0.001$, $r_{pb}=0.380$ and $p<0.001$, $r_{pb}=0.447$ respectively) and TUG performances were worse ($p=0.009$, $r_{pb}=-0.254$). Serum hemoglobin and albumin levels were significantly low in dysphagic patients with sarcopenia ($p<0.001$, $r_{pb}=0.345$, $p=0.008$, $r_{pb}=0.243$). Dysphagia is independently associated with sarcopenia, depressive symptoms, and functionality. Dysphagia coexist with sarcopenia is associated with worse clinical consequences than without sarcopenia.

Keywords Dysphagia · Sarcopenia · Dependency · Depression · Deglutition · Deglutition disorders

Introduction

Dysphagia is defined as symptom of difficulty in swallowing function and is observed in 13–35% of the geriatric population [1]. In recent years, it has been recognized that oropharyngeal dysphagia has the features of geriatric syndromes, as it is highly prevalent in the geriatric population and it has common risk factors with other geriatric syndromes like multimorbidity and polypharmacy [2]. Additionally it is related with poor outcomes such as aspiration pneumonia, malnutrition, institutionalization, and mortality [2]. Dysphagia is often associated with underlying diseases such as Parkinson's disease, dementia, and stroke but the exact causes of dysphagia are unclear in many cases [3, 4]. Dysphagia may also be associated with other geriatric syndromes like sarcopenia and may cause worse outcomes when accompanied by sarcopenia [5]. Sarcopenia is characterized by a decrease in muscle strength, muscle function, and muscle mass. The prevalence of sarcopenia in the geriatric population varies between 1 and 33% and the prevalence of such a wide range is due to differences in sarcopenia measurement techniques and cut off values [6]. Dual energy X-ray absorptiometry (DEXA) and Bio impedance analysis (BIA) are widely used to measure skeletal muscle mass in research but are not practical to apply during clinical evaluation in outpatient clinics. The SARC-F, recommended for screening of sarcopenia in the EWGSOP2 is an easy questionnaire and has high specificity [7, 8]. Its validity and reliability has been achieved in many institutions and countries [9].

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Loss of muscle strength and mass observed in sarcopenia is systematic [10]. Influence of respiratory muscles due to sarcopenia may affect respiratory function, and pharyngeal muscles may cause dysphagia [11]. A new term introduced in recent years is sarcopenic dysphagia [10, 12]. In 2013, in addition to the confirmation of dysphagia and sarcopenia according to the criteria defined in 5 items, the confirmation of decreased oropharyngeal muscle mass by imaging was added to the criteria [13, 14]. At present, the real prevalence of sarcopenic dysphagia is unknown, due to the difficulty of technical methods, but the inevitable association of sarcopenia and dysphagia is a fact. Screening tests, bedside swallowing evaluation tests, and advanced video fluoroscopic imaging can be performed to determine dysphagia [15–17]. Functional tests are the gold standard but are not practical for population studies, because they require swallowing specialists and technical equipment. The Eating Assessment Tool (EAT-10) is an easy and applicable test that can be used for screening of dysphagia in ambulatory patients [15].

The coexistence of sarcopenia and dysphagia has been shown in previous studies with a wide variety of methods. Here we aimed to investigate the relationship between sarcopenia and dysphagia, in a practical way by applying the SARC-F and EAT -10 questionnaires respectively, in the context of comprehensive geriatric evaluation and compare related clinical consequences in dysphagic patients with and without sarcopenia.

Methods

Participants

We conducted a cross sectional study and data was evaluated retrospectively. Patients at age 60 years and older, admitted to the geriatric outpatient clinic of a tertiary center between the dates of Nov 2018 and August 2019 were included in the study. The data of the patients' first admission was evaluated. Patients with missing data, restricted mobility, severe dementia, head and neck cancer, or acute diseases with clinical deterioration were not included in the study. Comorbidities and number of medications were recorded and the Charlson comorbidity index (CCI) was calculated [18]. Anthropometric measures of the patients were taken. At time of first admission, fasting laboratory values including serum albumin, hemoglobin, triglycerides, and total cholesterol were recorded.

Dysphagia and Sarcopenia

Dysphagia was evaluated by the EAT-10 questionnaire [14]. EAT-10 consists of 10 items and each item is scored from 0 (no problem) to 4 (severe problem) with total score ranges between 0 and 40, while scores of 3 or more are defined as dysphagia. Sarcopenia was assessed by the SARC-F screening questionnaire [8]. This is a 5-item questionnaire with a total score of 10. Four or higher scores are assigned as sarcopenia.

Comprehensive Geriatric Assessment

The Katz and Lawton scales were applied to patients in order to evaluate dependency in activities of daily living (ADL) and instrumental activities of daily living (IADL), respectively [19, 20]. Higher scores in both scales represent functional independency. Mood was evaluated by the Geriatric depression scale (GDS). Higher scores indicate more depressive symptoms. Fourteen points and higher were defined as depression [21]. Cognition was assessed by the mini-mental state examination (MMSE), in which scores lower than 24 points state dementia [22]. Patients with MMSE scores lower than 9, representing severe dementia were not included in the study. Nutritional status was evaluated by the mini nutritional assessment-short form (MNA-SF) [23]. Hand grip strength (HGS) and the Timed up and go (TUG) test were performed for evaluation of muscle strength and muscle performance, respectively. A jamar hand dynamometer was used for measuring HGS. Three consecutive measurements with 30 s of rest after each measurements were taken from the dominant hand. Maximum grip strength values were taken for analysis. The TUG test was performed as patients sat on a standard armchair. At the directive of "go", patients were instructed to stand up from the chair, walk to the line marked on the floor using a usual pace, turn around, walk back to the chair, and sit down again [24].

Approval of the study was obtained from the Local Ethics Committee. Informed consents were received from all patients.

Statistical Analysis

A descriptive analysis was performed based on Dysphagia status. Histogram and q–q plots were examined to assess the data normality. A two-sided independent samples *t* test and Mann Whitnay U test were conducted to compare the differences between continuous variables; while the Pearson Chi square test or Fisher exact test were used to compare differences between categorical variables. Phi correlation test was used to compare between categorical and continuous variables. Univariate and multiple binary logistic regression analysis were used to identify the risk factors of Dysphagia. Odds ratios (OR) were calculated with 95% confidence intervals (CI). Significant variables with potential for causal effect on Dysphagia at $p < 0.250$ on univariate analysis were taken into multiple models and backward stepwise selection was performed using likelihood ratio statistic at $p < 0.10$

stringency level. The calibration of the model was assessed using the Hosmer–Lemeshow goodness of fit test. $p<0.05$ was considered as statistically significant. Point biserial and Phi correlation coefficients were calculated to determine effect size of variables in dysphagic patients with sarcopenia. Spearman's rank correlation coefficients were calculated to check for multicollinearity. Analyses were conducted using SPSS version 22 and TURCOSA (Turcosa Analytics Ltd. Co., Turkey) statistical softwares. (https://turcosa.com.tr/).

Results

A total of 512 (151 male/361 female) patients were included in the study. The mean + standard deviation (range) age of the study population was 72.1 ± 7.3 (60–98). Patients with the diagnosis of diabetes mellitus (DM), hypertension, cerebrovascular diseases, chronic obstructive pulmonary diseases (COPD), Alzheimer's, and Parkinson's disease were 236 (46.1%), 336 (65.6%), 26 (5.1%), 32 (6.3%), 63 (12.3%), and 16 (3.1%), respectively. Prevalence of dysphagia and sarcopenia was 23% and 40.6%, respectively. Number of patients with both dysphagia and sarcopenia was 83 (16.6%). Patients with dysphagia were older ($p=0.011$), more dependent in ADL and IADL ($p<0.001$, $p<0.001$), had more depressive symptoms ($p<0.001$), and had lower MMSE scores ($p=0.038$). Demographic characteristics of the patients and relation with dysphagia are represented in Table 1. In multivariate analysis, sarcopenia (OR:2.596, $p=0.008$), depressive symptoms (OR:1.115, $p<0.001$), and lower KATZ scores (OR:0.810, $p=0.036$) were independently related with dysphagia (Table 2). Effect size of each significant variable in dysphagic patients in case of sarcopenia was pointed out by r_{pb} and phi values. Dysphagic patients with sarcopenia had lower scores on ADL ($p<0.001$, $r_{pb}=0.380$) and IADL ($p<0.001$, $r_{pb}=0.447$). HGS was lower ($p<0.001$, $r_{pb}=0.434$ and $p=0.038$, $r_{pb}=0.244$ in male and female respectively) and TUG performances ($p=0.009$, $r_{pb}=-0.254$) were worse. Serum levels of hemoglobin ($p<0.001$, $r_{pb}=0.345$) and albumin ($p=0.008$, $r_{pb}=0.243$) were significantly low in dysphagic patients with sarcopenia. However, triglyceride and total

Table 1 Patient characteristics and Dysphagia status

Variables	Total ($n=512$)	Dysphagia ($n=118$)	No Dysphagia ($n=394$)	p
Age, year	71 (66–77)	72.5 (67.5–80)	71 (66–76)	0.011
Gender, n(%)				
Female	361 (70.5)	90 (76.3)	271 (68.8)	0.072
Male	151 (29.5)	28 (23.7)	123 (31.2)	
BMI, kg/m^2				
Female	32.1 ± 6.3	32.6 (7.3)	31.9(5.9)	0.524
Male	27.1 ± 4.3	25.7 ± 4.23	27.4 ± 4.2	0.103
Smoker, (%)n	29 (5.7)	6 (5.1)	23 (5.9)	0.470
Number of drugs	4 (2–6)	5 (3–7)	4 (2–6)	0.004
CCI	4 (3, 4)	4 (3–5)	3.5 (3–4)	0.005
Katz score	12 (12)	12 (10–12)	12 (12–12)	< 0.001
Lawton score	16 (12–16)	11.2 (5.2)	13.6 (4.0)	< 0.001
MNA-SF score	12 (10–13)	10 (9−12)	12 (11−14)	< 0.001
GDS score	11 (5–17)	16 (11–22)	9 (4–16)	< 0.001
MMSE score	26 (24–28)	26 (23–28)	27 (24–28)	0.038
TUG s	10.00 (7.17–13.00)	10.02 (8.00−13.87)	9.90 (7.00–12.65)	0.126
HGS kg				
Female	19.0 (13.6–21.8)	14.9 (11.3–20.0)	20.0 (17.9–23.1)	0.001
Male	28.9 (21.3–34.9)	20.5 (16.5–30.0)	30 (24.2–36.5)	0.024
Sarcopenia, n (%)	208 (40.6)	84 (71.2)	124 (31.5)	< 0.001
Albumin	4.5 ± 0.3	4.5 ± 0.3	4.5 ± 0.3	0.475
Hemoglobin	13.9 (12.9–14.8)	13.4 (12.2–14.2)	14.1 (13.0–14.9)	< 0.001
Total cholesterol	195 (169–225)	191 (163–226)	197 (171–224)	0.282
Triglycerides	159 (78)	136 (109–185)	142 (99–194)	0.631

Values are expressed either as n(%), mean ± SD or median(1st–3rd quartiles)

BMI body mass index, *CCI* Charlson comorbidity index, *GDS* geriatric depression scale, *MNA-SF* mininutritional assessment-short form, *TUG* timed up and go, *HGS* hand grip strength, *MMSE* mini-mental state examination

Table 2 Univariate and multivariate logistic regression analysis in identifying the risk factors of dysphagia

Variables	Univariate		Multivariate	
	OR (95% CI)	*p*	OR (95% CI)	*p*
Katz score	0.769 (0.686–0.862)	< 0.001	0.810 (0.665–0.986)	0.036
Lawton score	0.892 (0.854–0.931)	< 0.001		
Number of drugs	1.149 (1.060–1.244)	0.001	–	–
CCI	1.274 (1.077–1.507)	0.005		
GDS score	1.114 (1.080–1.149)	< 0.001	1.115 (1.063–1.169)	< 0.001
MNA-SF score	0.792 (0.731–0.858)	< 0.001	–	–
TUG, s	1.040 (1.004–1.077)	0.028	–	–
HGS kg			–	–
Male	0.937 (0.889–0.989)	0.017		
Female	0.917 (0.874–0.962)	< 0.001		
Sarcopenia, *n*	5.380 (3.425–8.450)	< 0.001	2.596 (1.283–5.252)	0.008
MMSE score	0.945 (0.904–0.988)	0.013	–	–

The variables adjusted for Age, Gender. BMI and presence of Alzheimer disease, Chronic obstructive pulmonary disease and Parkinson's disease

CCI Charlson comorbidity index, *GDS* geriatric depression scale, *MNA-SF* mininutritional assessment-short form, *TUG* timed up and go, *HGS* hand grip strength, *MMSE* mini-mental state examination

cholesterol level did not differ between the two groups. Comparison of variables between dysphagic patients with and without sarcopenia are shown in Table 3.

Correlations between all relevant variables with dysphagia yielded low to moderate relationship ($r < 0.7$) (Table 4). Distribution of EAT-10 and SARC-F scores of study population are shown in Fig. 1.

Discussion

We have observed the prevalence of dysphagia and sarcopenia as 23% and 40.6%, respectively. 16.6% of all participants and 72.2% of dysphagic patients had both sarcopenia and dysphagia. The term sarcopenic dysphagia should include sarcopenia in swallowing muscles alongside the dysphagia and the generalized sarcopenia [10, 25]. Though we did not show the sarcopenia in muscles working in swallowing function, we do not claim that our results define the entity of sarcopenic dysphagia. However, our findings promote the strong relationship between sarcopenia and dysphagia. The prevalence of sarcopenic dysphagia has been reported in a wide range, from 26% to 42.3% [10, 26, 27]. Actually, the assessment methods of sarcopenia and dysphagia were different throughout these studies, but the final conclusions were common, emphasizing the strong association between dysphagia and sarcopenia [6]. One of the possible underlying mechanisms of sarcopenic dysphagia is that, sarcopenia affects Type II fibers more than type I fibers and the swallowing muscles are heavily composed of type II fibers [6, 28]. Dysphagia associated with sarcopenia appears to be more severe than other types of dysphagia [5]. In our study, the total EAT-10 scores were significantly higher in dysphagic patients with sarcopenia. Dysphagic patients with sarcopenia had lower HGS. Laboratory results including serum Hb and albumin levels were lower in dysphagic patients with sarcopenia than without. However serum albumin levels did not differ between patients with and without dysphagia. Similarly, Wakabayahi et al. reported that sarcopenic dysphagia was associated with lower HGS, calf circumference, and serum albumin levels [5]. Functionality revealing dependency in ADL and IADL measured by performing Katz and Lawton scales yielded poor scores in dysphagic patients with sarcopenia with higher effect sizes than other variables ($r_{pb} = 0.380$ $r_{pb} = 0.447$). In addition, lower scores on the Katz scale were independently related with dysphagia. Basic functional impairment seems to be one of the high risk factors for dysphagia, as well as being one of the poor outcomes of sarcopenia [10]. Furthermore, dysphagia was independently associated with depressive symptoms besides sarcopenia and functionality in our results. Prevalence of depression among dysphagic patients was 63.6%. Hence, the data in literature is insufficient. Mood disorders, especially depression, are highly prevalent in patients with dysphagia and prevalence of depression in patients with dysphagia has been reported as 32.6 and 62.2% in ambulatory and hospitalized patients, respectively [29, 30]. There are many triggering factors for dysphagia in Parkinson's disease, such as the stage and severity of disease. Indeed an independent relationship between depression and dysphagia has been shown in this patient group as well [31].

Essentially, in our study the MMSE scores were lower in patients with dysphagia, though cognitive status was not independently related with dysphagia. In agreement,

Table 3 Characteristics of dysphagic patients with and without sarcopenia

Variables	Dysphagia with sarcopenia	Dysphagia without sarcopenia	*p*	r_{pb}/*phi*
Age, year	74.00 (69.00–80.75)	69.00 (66.75–74.00)	0.004	–0.265
Gender, *n*(%)				
Female	69 (82.1)	21 (61.8)	0.030	−0.217
Male	15 (17.9)	13 (38.2)		
BMI, kg/m^2				
Female	31.66 ± 07.22	36.38 ± 06.98	0.032	0.257
Male	24.20 ± 03.28	27.34 ± 4.61	0.083	
Smoker, *n*(%)	4 (4.8)	2 (5.9)	0.558	–
Number of drugs	5 (3–7)	4 (2.25–8)	0.850	–
CCI	4 (3–5)	3 (3, 4)	0.018	−0.219
Katz score	11 (10–12)	12 (12–12)	< 0.001	0.380
Lawton score	9.5 (6–15)	16 (14–16)	< 0.001	0.447
MNA-SF score	10 (8–11)	12 (11–13)	< 0.001	0.497
GDS score	17 (12–22)	15 (7.5–20.5)	0.092	–
MMSE score	25 (22–27)	27 (24–29)	0.009	0.242
TUG s	10.66 (8.70–16.00)	9.10 (6.85–12.00)	0.009	−0.254
HGS kg				
Male	19 (15–25.2)	31.2 (22.5–35.8)	< 0.001	0.434
Female	14.7 (10.6–19.2)	20.0 (13.4–22.0)	0.038	0.244
Albumin	4.5 ± 0.3	4.7 ± 0.3	0.008	0.243
Hemoglobin	13.1 (11.9–14)	14 (13.3–14.6)	< 0.001	0.345
Total cholesterol	189 (154–227)	197 (171–226)	0.273	–
Triglycerides	130 (109–174)	149 (111–247)	0.067	–

Values are expressed either as *n*(%), mean ± SD or median(1st–3rd quartiles)

BMI body mass index, *CCI* Charlson comorbidity index, *GDS* geriatric depression scale, *MNA-SF* mininutritional assessment-short form, *TUG* timed up and go, *HGS* hand grip strength, *MMSE* mini-mental state examination

Tagliaferri et al. observed a significant and negative correlation between EAT-10 scores and cognitive status but the relevance was not independent [32]. Recently, Özsürekçi et al. evaluated dysphagia in Alzheimer disease and observed the association of dysphagia with sarcopenia and cognitive impairment even in early stages of the disease [33]. We observed significantly lower MMSE scores in dysphagic patients with sarcopenia than without.

Parkinson's disease, Alzheimer's disease, and COPD all have high risk of dysphagia [4]. Albeit, these patient groups have been excluded from some studies to preclude the misleading interference of the results, we did not excluded patients with the above diagnosis and significant relation between dysphagia and sarcopenia continued after adjusting for these diseases.

Sarcopenia and dysphagia are both geriatric syndromes, which have attracted attention in recent years and have a significant impact on older individuals, resulting in poor outcomes. They are in a vicious cycle of mutual cause and effect with each other and geriatric syndromes such as malnutrition and depression [32, 34]. The elderly population needs to be screened for these geriatric syndromes. Fast, easy, and practical screening methods are needed to reach large audiences. In this case, questionnaires with high specificity like SARC-F and EAT-10 seem to be advantageous. In addition, patients who are positive in EAT-10 screening can be candidates for instrumental evaluation of swallowing and be directed.

This study has some limitations. First, we evaluated both sarcopenia and dysphagia with questionnaires. Determining skeletal muscle mass and defining sarcopenia according to the EWGSOP may yield more objective results with respect to sarcopenia. In addition, dynamic evaluation of swallowing function, though not easily applicable and practical is the gold standard for the diagnosis of dysphagia. Secondly, due to the cross sectional design of this study, we cannot argue for the causal relationship between dysphagia and sarcopenia.

In conclusion, while managing patients with dysphagia, a detailed geriatric evaluation is needed including sarcopenia, depression, and functionality. Our results support a comprehensive treatment approach while managing dysphagia that covers psychological interventions as well as rehabilitation, exercise, and nutritional support [29, 35].

Table 4 The spearman correlation matrix between variables significantly related with dysphagia

	EAT-10	SARC-F	Age	Drugs	CCI	KATZ	LAWTON	MNA-SF	GDS	MMSE	TUG	HGS	Hb
EAT-10	1	0.396*	0.114*	0.021*	0.128*	−0.303**	−0.245**	−0.310**	0.329**	−0.122*	0.046*	−0.197**	−0.184**
SARC−F		1	0.241**	0.127*	0.191**	−0.419**	−0.402**	−0.385**	0.381**	−0.240**	0.320**	−0.478**	−0.321*
Age			1	0.145*	0.600**	−0.248**	−0.383**	−0.199**	0.000	−0.347**	0.314**	−0.209**	−0.142**
Drugs				1	0.361**	−0.125*	−0.213**	−0.144*	0.120*	−0.111*	0.087*	−0.112*	−0.116*
CCI					1	−0.247**	−0.294**	−0.218**	0.097*	−0.235**	0.195**	−0.099*	−0.123*
KATZ						1	0.523**	0.350**	−0.208**	0.345**	−0.181**	0.257**	0.132*
LAWTON							1	0.407**	−0.280**	0.407**	−0.211**	0.299**	0.145*
MNA-SF								1	−0.343**	0.267**	−0.233**	0.247**	0.221**
GDS									1	−0.166**	0.096*	−0.240**	−0.086*
MMSE										1	−0.186**	0.202**	0.056
TUG											1	−0.280**	−0.180**
HGS												1	0.416**
Hb													1

** $p < 0.001$, * $p < 0.05$ significant

CCI Charlson comorbidity index, *GDS* geriatric depression scale, *MNA-SF* mininutritional assessment-short form, *TUG* timed up and go, *HGS* hand grip strength, *MMSE* mini-mental state examination, *Hb* hemoglobin

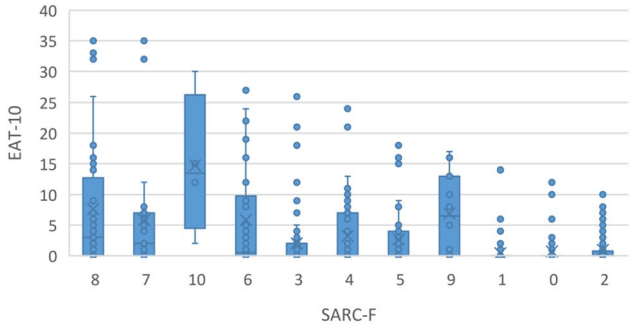

Fig. 1 Distribution of EAT-10 and SARC-F scores of the study population represented by box plot graphic

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

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