

THE PREVALENCE AND PROGNOSIS OF SARCOPENIC DYSPHAGIA IN PATIENTS WHO REQUIRE DYSPHAGIA REHABILITATION

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Abstract: *Objectives:* The purpose of this study was to assess the prevalence and prognosis of sarcopenic dysphagia in patients who require dysphagia rehabilitation. *Design:* Prospective cohort study. *Setting:* Tertiary-care acute general hospital. *Participants:* One hundred and eight patients referred to the Department of Rehabilitation Medicine for dysphagia rehabilitation. *Measurements:* The Food Intake Level Scale (FILS), a 5-step diagnostic algorithm for sarcopenic dysphagia. *Results:* The study included 72 males and 36 females (mean age, 76±7 years). Comorbid diseases included brain and nervous system disease (36%), cardiovascular disease (25%), respiratory disease (14%), and cancer (11%). Median energy intake was 1159 kcal (interquartile range: 648, 1502). Median FILS at admission and discharge was 4 (interquartile range: 2, 7) and 8 (interquartile range: 5, 8), respectively. Sarcopenic dysphagia was observed in 35 patients (32%). Sarcopenic dysphagia was associated with lower FILS at referral and discharge, lower calf circumference, lower handgrip strength, lower body mass index, lower serum albumin, and higher C-reactive protein at referral. Tongue pressure, energy intake, and Barthel index did not differ significantly between patients with or without sarcopenic dysphagia. Ordered logistic regression analysis of the FILS at discharge adjusted for presence of sarcopenic dysphagia, age, sex, and the FILS at admission revealed that presence of sarcopenic dysphagia ($\beta=-1.603$, 95% confidence intervals=-2.609, -0.597, $p=0.002$), sex, and the FILS at admission were independently associated with the FILS at discharge. *Conclusions:* The prevalence of sarcopenic dysphagia in patients who require dysphagia rehabilitation was quite high. Sarcopenic dysphagia was independently associated with poor swallowing function at discharge.

Key words: Sarcopenia, deglutition disorders, malnutrition, epidemiology.

Introduction

Sarcopenic dysphagia is characterized by swallowing difficulty due to loss of muscle mass and function in whole-body skeletal and swallowing muscles (1, 2). Patients with sarcopenic dysphagia have lower tongue muscle mass and higher tongue muscle echo-intensity on ultrasound than patients without sarcopenic dysphagia (3). In patients with aspiration pneumonia, activity-, disease-, and nutrition-related sarcopenia of whole-body skeletal and swallowing muscles may develop into sarcopenic dysphagia (1). Indeed, aspiration pneumonia induced muscle atrophy in the respiratory, skeletal, and swallowing systems in a preclinical animal model and in human patients (4). Atrophy of swallowing muscles is a major cause of sarcopenic dysphagia. Of 82 inpatients aged 65 years or older without dysphagia who had restricted oral intake for longer than 2 days, 21 (26%) developed dysphagia, all of whom had whole body sarcopenia (5). Furthermore, a recent meta-analysis showed that whole-body sarcopenia was independently associated with dysphagia (6).

The prevalence and prognosis of sarcopenic dysphagia is unknown, although a reliable and validated diagnostic algorithm for sarcopenic dysphagia (7) has been developed. Several case reports of patients with sarcopenic dysphagia have been published (8-11), and it is clear that treatment improves outcome. In a cluster, randomized, controlled trial examining the effects of resistance training of swallowing muscles on

dysphagia, patients with sarcopenic dysphagia showed greater improvement than patients with other diseases (12). However, the prevalence and prognosis of sarcopenic dysphagia have not been reported. These data are important, because sarcopenic dysphagia can be treated with a combination of rehabilitation and aggressive nutrition care intervention, with an energy intake of approximately 35kcal/kg/day (ideal body weight) to improve muscle mass and function (8-10).

The purpose of this study was to assess the prevalence and prognosis of sarcopenic dysphagia in patients who require dysphagia rehabilitation.

Methods

This prospective cohort study was performed in consecutive older patients with dysphagia who had been admitted to the Yokohama City University Medical Center, a tertiary-care acute general hospital (mean length of stay, 12 days), and referred to the Department of Rehabilitation Medicine between August 2016 and March 2018 by an attending physician. All patients underwent speech therapy 2 to 5 times a week at the bedside or gymnasium. Each session lasted between 20 and 40 minutes.

Patients aged 65 years and older who were prescribed speech therapy for dysphagia rehabilitation by psychiatrists, could provide informed consent, and were without moderate or severe conscious disturbance and/or higher brain dysfunction

were included in the study. Patients with missing values were excluded. The ethics committee of the Yokohama City University Medical Center approved the study. All participants provided informed consent prior to enrollment.

Sarcopenic dysphagia was diagnosed using a reliable and validated 5-step diagnostic algorithm for sarcopenic dysphagia (7). The diagnostic algorithm divides participants into three categories: probable sarcopenic dysphagia, possible sarcopenic dysphagia, and no sarcopenic dysphagia. The diagnostic algorithm consisted of 5 steps:

1) Whole body sarcopenia (skeletal muscle strength). Cut-off values: handgrip strength (26 kg for men and 18 kg for women) or/and usual gait speed (0.8 m/s) according to the Asian Working Group for Sarcopenia criteria (13).

2) Whole body sarcopenia (skeletal muscle mass). Cut-off value: calf circumference (30 cm for men and 29 cm for women) (14).

3) The presence of dysphagia. Cut-off value: Food Intake Level Scales (FILS) (15) < 9. Levels 1-3 relate to various degrees of non-oral feeding, levels 4-6 to various degrees of oral food intake and alternative nutrition, levels 7-8 to various degrees of oral food intake alone, level 9 to no dietary restriction but medical considerations are given, and level 10 indicates normal oral food intake.

4) The causes of dysphagia. Patients who had a disease that was the obvious cause of dysphagia were excluded from the study. However, patients with stroke, brain injury, neuromuscular disease, head and neck cancer, or connective tissue disease in whom the main cause of dysphagia was considered to be age-, activity-, nutrition-, invasion-, or cachexia-related sarcopenia were included (7).

5) Swallowing muscle strength. Cut-off value: 20 kPa tongue pressure (7).

Tongue pressure was measured using a balloon placed between the front palate and the tongue. The strength of the swallowing muscles was assessed using a maximum tongue pressure-measuring instrument (JMS, Hiroshima, Japan) (16). Measurements were performed after calibration of the inner-balloon pressure had stabilized at 19.6 kPa. Calibration was automatically performed by the instrument, with the display screen showing 0.0 kPa when the instrument was calibrated successfully. During the procedure, the participant compressed a balloon attached to the tip of the probe between the tongue and the front of the hard palate using maximum voluntary effort. Tongue pressure was measured three times and the maximum value recorded.

Participants were divided into 2 categories as “probable sarcopenic dysphagia and possible sarcopenic dysphagia” or “no sarcopenic dysphagia”. Dysphagia severity was assessed by the FILS (15) at referral and at discharge by speech therapists.

Activities of daily living were evaluated by the Barthel Index (17). The Barthel Index consists of 10 items: 1) feeding, 2) moving from wheelchair to bed and return, 3) grooming, 4) transferring to and from the toilet, 5) bathing, 6) walking

on a level surface, 7) going up and down stairs, 8) dressing, 9) continence of bowels, and 10) continence of bladder. Nutritional status was assessed by the Geriatric Nutritional Risk Index (GNRI) (18). The GNRI is calculated as: $[14.89 \times \text{serum albumin (g/dl)}] + [41.7 \times (\text{body weight} / \text{ideal body weight})]$. The ideal body weight was defined as the value calculated from height and a body mass index (BMI) of 22. In cases of $(\text{body weight} / \text{ideal body weight}) > 1$, the value was replaced by 1 (18). Total energy intake was calculated by adding oral intake, enteral nutrition, and parenteral nutrition on the day of referral. Energy intake / present body weight and energy intake / ideal body weight were also calculated.

Statistical analyses were performed using IBM Statistical Package for the Social Sciences (SPSS) version 25 software (IBM Corporation; Armonk, New York, US). Parametric data were reported as the mean \pm standard deviation (SD), whereas nonparametric data were expressed as the median and 25th – 75th percentiles. The t-test, chi-square test, and Mann-Whitney U test were used to analyze the differences between patients with and without sarcopenic dysphagia. The Spearman rank correlation was used to analyze correlations between the FILS, age, GNRI, C-reactive protein (CRP), the Barthel Index, and energy intake. Ordered logistic regression analysis was used to examine whether FILS at discharge was independently associated with the presence of sarcopenic dysphagia following adjustment for covariates including age, sex, and the FILS at referral. A p-value <0.05 was considered statistically significant.

Results

During the research period, 141 older patients requiring speech therapy for dysphagia rehabilitation were referred to the Department of Rehabilitation Medicine. Thirty-three patients with missing values such as handgrip strength and tongue pressure were excluded. The remaining 108 patients, 72 males and 36 females (mean age \pm SD, 76 ± 7 years), participated in this prospective cohort study. Whole body sarcopenia was observed in 53 patients (49%). The number of patients with probable sarcopenic dysphagia was 9, possible sarcopenic dysphagia 26, and no sarcopenic dysphagia 73. The number of patients diagnosed with sarcopenic dysphagia was therefore 35 (32%).

Table 1 summarizes the comparative tests for differences between subjects with or without sarcopenic dysphagia. Common causes of admission were brain and nervous system disease (36%), cardiovascular disease (25%), respiratory disease (14%), and cancer (11%). Cardiovascular and respiratory diseases were major causes of admission in the sarcopenic dysphagia group. In contrast, brain and nervous system diseases were major causes of admission in the no sarcopenic dysphagia group. FILS at referral and at discharge, calf circumference, handgrip strength, body mass index, serum albumin, GNRI, and CRP differed significantly between the

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Table 1

Results of comparative tests for differences between subjects categorized by presence of sarcopenic dysphagia^a

	Total N = 108	Sarcopenic dysphagia N = 35	No sarcopenic dysphagia N = 73	p-value
Age, years	76 ± 7	77 ± 6	75 ± 7	0.126 ^b
Sex, n (%)				0.561 ^c
Males	72 (67%)	22 (63%)	50 (68%)	
Females	36 (33%)	13 (37%)	23 (32%)	
Causative diseases of admission				
Brain and nervous diseases	39 (36%)	2 (6%)	37 (51%)	
Cerebral infarction	15 (14%)	0 (0%)	15 (21%)	
Parkinson's disease	8 (7%)	1 (3%)	7 (10%)	
Cerebral hemorrhage	3 (3%)	0 (0%)	3 (4%)	
Brain tumor	2 (2%)	0 (0%)	2 (3%)	
Hypoxiaencephalopathy	2 (2%)	1 (3%)	1 (1%)	
Motor neuron disease	2 (2%)	0 (0%)	2 (3%)	
Other brain and nervous diseases	7 (6%)	0 (0%)	7 (10%)	
Cardiovascular diseases	27 (25%)	12 (34%)	15 (21%)	
Aortic aneurysm	8 (7%)	4 (11%)	4 (5%)	
Heart valve diseases	6 (6%)	2 (6%)	4 (5%)	
Aortic dissection	5 (5%)	2 (6%)	3 (4%)	
Heart failure	3 (3%)	2 (6%)	1 (1%)	
Other cardiovascular diseases	5 (5%)	2 (6%)	3 (4%)	
Respiratory diseases	21 (19%)	13 (37%)	7 (10%)	
Pneumonia/Aspiration pneumonia	15 (14%)	9 (26%)	6 (8%)	
Pyothorax	2 (2%)	1 (3%)	1 (1%)	
Chronic obstructive pulmonary disease	2 (2%)	2 (6%)	0 (0%)	
Other respiratory diseases	2 (2%)	1 (3%)	1 (1%)	
Cancer	12 (11%)	4 (11%)	8 (11%)	
Head and neck cancer	5 (5%)	0 (0%)	5 (7%)	
Esophageal cancer	3 (3%)	1 (3%)	2 (3%)	
Prostate cancer	2 (2%)	1 (3%)	1 (1%)	
Other cancers	2 (2%)	2 (6%)	0 (0%)	
Cervical cord injury/Cervical myelopathy	3 (3%)	0 (0%)	3 (4%)	
Other diseases	6 (6%)	4 (11%)	2 (3%)	
FILS at referral	4 (2, 7)	2 (1, 6)	5 (2, 7)	0.033 ^d
1	24	9	15	
2	19	10	9	
3	5	1	4	
4	11	4	7	
5	6	1	5	
6	8	4	4	
7	15	3	12	
8	15	3	12	
9	5	0	5	
FILS at discharge	8 (5, 8)	7 (3, 8)	8 (7, 8)	0.004 ^d
1	3	2	1	
2	15	6	9	
3	3	1	2	

4	5	5	0	
5	2	0	2	
6	3	2	1	
7	17	5	12	
8	43	13	30	
9	17	1	16	
Tongue pressure	21.4 ± 9.4	22.3 ± 9.7	21.0 ± 9.4	0.530 ^b
Calf circumference	29.7 ± 3.5	26.7 ± 2.4	31.2 ± 3.0	<0.001 ^b
Handgrip strength	17.0 ± 8.0	12.9 ± 6.5	19.1 ± 7.9	<0.001 ^b
Body mass index	21.1 ± 3.4	18.5 ± 2.8	22.4 ± 2.9	<0.001 ^b
Serum albumin	2.9 ± 0.7	2.6 ± 0.5	3.0 ± 0.7	<0.001 ^b
GNRI	81.2 ± 11.8	73.2 ± 9.2	85.3 ± 10.8	<0.001 ^b
CRP	2.5 (0.7, 5.4)	3.7 (0.9, 6.2)	2.0 (0.3, 4.7)	0.042 ^d
Barthel Index	35 (5, 55)	30 (0, 50)	38 (5, 64)	0.268 ^d
Energy intake (kcal)	1159 (648, 1502)	1109 (630, 1450)	1200 (652, 1565)	0.470 ^d
Energy intake, kcal/kg/day (present body weight)	23.0 (14.6, 29.5)	24.9 (15.8, 30.4)	21.5 (12.2, 27.8)	0.140 ^d
Energy intake, kcal/kg/day (ideal body weight)	21.6 (13.5, 27.1)	21.3 (14.0, 25.6)	22.6 (13.3, 27.8)	0.716 ^d
Duration between referral and discharge	19 (10, 28)	22 (13, 33)	18 (10, 26)	0.088 ^d

a. Values represent the mean ± SD for age, psoas muscle area, BMI, albumin, and hemoglobin and the median (25th-75th percentiles) for the Barthel Index, CRP, and number of days from admission to speech therapy and from speech therapy to discharge; b. t-test; c. chi-square test; d. Mann-Whitney U test; BMI, body mass index; CRP, C-reactive protein; GNRI, geriatric nutritional risk index; SD, standard deviation

patients with and without sarcopenic dysphagia in the univariate analysis. FILS at referral and at discharge were significantly lower in the sarcopenic dysphagia group. Median energy intake was 1159 (interquartile range: 648, 1502) kcal, 23.0 kcal/kg/day (present body weight), and 21.6 kcal/kg/day (ideal body weight), and did not differ significantly between the two groups.

Table 2 shows the Spearman rank correlation between the FILS, age, GNRI, CRP, the Barthel Index, and energy intake. The FILS at discharge was significantly correlated with the FILS at referral. In contrast, the FILS at discharge was not significantly correlated with age, GNRI, CRP, Barthel Index, or energy intake.

Ordered logistic regression analysis of the FILS at discharge adjusted for presence of sarcopenic dysphagia, age, gender, and the FILS at referral revealed that presence of sarcopenic dysphagia ($\beta = -1.603$, 95% confidence intervals = $-2.609, -0.597$, $p = 0.002$), gender, and the FILS at referral were independently associated with the FILS at discharge.

Discussion

This is the first study examining the prevalence and prognosis of sarcopenic dysphagia in patients who require dysphagia rehabilitation. The prevalence of sarcopenic dysphagia was 32%. Sarcopenic dysphagia was independently associated with poor swallowing function at discharge.

Table 2
Spearman rank correlation between the FILS, age, GNRI, CRP, the Barthel Index, and energy intake

	FILS at discharge	Age	GNRI	CRP	Barthel Index	Energy intake
FILS at referral	0.465*	-0.131	0.363*	-0.211*	0.417*	-0.008
FILS at discharge		-0.106	0.187	-0.134	0.189	-0.013
Age			-0.240*	0.199	-0.138	-0.175
GNRI				-0.651*	0.365*	0.115
CRP					-0.189	-0.179
Barthel Index						-0.035

* P value < 0.05; CRP: C-reactive protein; FILS: Food Intake Level Scale; GNRI: geriatric nutritional risk index

The prevalence of sarcopenic dysphagia in patients who require dysphagia rehabilitation was quite high. Bock JM, et al (19) reported that the causes of dysphagia in patients who aspirate included surgery (n=133, 24%), stroke (n=122, 22%), chronic neurologic disease (n=112, 20%), generalized nonspecific dysphagia due to deconditioning or frailty (n=92, 16%), trauma (n=60, 11%), esophageal pathology (n= 35, 6%), and laryngeal pathology (n=9, 2%). It is possible that most of the patients with generalized nonspecific dysphagia due to deconditioning or frailty had probable or possible sarcopenic dysphagia, because no obvious causes of dysphagia were observed. Another study investigating the prevalence of dysphagia among adults in the United States showed that stroke was the most commonly reported etiology, followed by other neurologic causes, head and neck cancer, and advanced age (20). However, more than 70% of cases were caused by something else (20). Sarcopenic dysphagia may be included in “something else” and in dysphagia caused by advanced age. Therefore, it appears that sarcopenic dysphagia is a common cause of dysphagia. The possibility of sarcopenic dysphagia should be suspected in all older patients with dysphagia.

Sarcopenic dysphagia was independently associated with poor swallowing function at discharge. Bock JM, et al. (19) reported that dysphagia etiology was highly associated with the development of pulmonary events, particularly in patients with generalized nonspecific dysphagia due to deconditioning or frailty. Furthermore, dysphagia etiology was associated with increased mortality in patients with generalized nonspecific dysphagia due to deconditioning or frailty (19). Hence, sarcopenic dysphagia appears to be more severe than other types of dysphagia. Therefore, rehabilitation, including resistance exercises of the swallowing and general muscles, and aggressive nutrition intervention to increase muscle mass and strength should be performed in patients with sarcopenic dysphagia.

Median energy intake was low in patients with and without sarcopenic dysphagia. Previous case reports (8-10) showed that energy intake around 35 kcal / ideal body weight kg was useful for treating sarcopenic dysphagia. However, we found that the median and 25th percentile energy intakes in the sarcopenic dysphagia group were 21.3 and 14.0 kcal/kg/day (ideal body

weight), respectively. Lower energy intake was associated with poor rehabilitation outcome. Iwamoto et al. (21) reported that patients with dysphagia who had a nutrition intake <22 kcal/kg/day had a more modest recovery than those ingesting >22 kcal/kg/day. Several studies have shown that higher energy intake (22-24) and nutrition improvement (23, 25, 26) were associated with better rehabilitation outcome in patients with stroke and hip fracture. Therefore, adequate nutrition management and nutrition improvement are important to improve swallowing function in patients with sarcopenic dysphagia.

This study has several limitations. First, the study was performed at a single acute care hospital, possibly limiting the generalization of our results. Second, patients with consciousness disturbances and higher brain dysfunction were not included in this study, because written informed consent could not be obtained. This may have affected the calculation of sarcopenic dysphagia prevalence. Further studies in multiple settings such as rehabilitation hospitals, nursing homes, and communities are necessary to understand the true prevalence of sarcopenic dysphagia.

In conclusion, the prevalence of sarcopenic dysphagia in patients who require dysphagia rehabilitation was 32%. Sarcopenic dysphagia was independently associated with poor swallowing function at discharge. More aggressive nutritional intervention combined with physical rehabilitation to improve muscle mass, strength, and swallowing function should be performed in the clinical setting.

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