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Research Article

Evaluation of Dysphagia and Associated Factors in Patients with Neuromuscular Disorders: Do the Oral Factors Deserve Some Focus too?

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Abstract

Aim: Dysphagia may occur during neuromuscular disorders. As it may cause serious morbidity and mortality, it is important to define the characteristics and burden of this problem among these individuals. This study aimed to evaluate the dysphagia status and associated factors in patients with neuromuscular disorders in a tertiary care center.
Material and Method: Two-hundred fifty-two patients in the three groups were included in this study (59 Duchenne or Becker muscular dystrophies (DMD-BMD), 130 other muscular diseases, and 63 neuropathies). The patients were carefully assessed clinically, and their dysphagia status was evaluated using the EAT-10 questionnaire. Dysphagia prevalence was defined for each diagnosis, and patients in each group were compared in terms of their clinical characteristics, depending on the presence of dysphagia.
Results: The prevalence of dysphagia was 17%, 18.4%, and 47.6% in the DMD-BMD, other muscular diseases, and neuropathy groups, respectively. Moreover, dysphagia was associated with worse ambulatory status, poor oral hygiene, dry mouth, dental implants, and pneumonia ($p<0.05$).
Conclusion: Dysphagia is an important problem in neuromuscular diseases and requires inquiry and assessment by caregivers and clinicians. Studies focusing on more detailed evaluations, especially for oral health status, and the effectiveness of possible treatment methods will improve this problem.

Keywords: Neuromuscular disorders, dysphagia, muscular dystrophy, neuropathy, oral health

INTRODUCTION

Neuromuscular disorders are a group of diseases that impair the function of the locomotor system, which consists of the nervous and muscular systems (1). These include polyneuropathies, motor neuron diseases, spinal muscular atrophy, neuromuscular junction diseases, myopathies, muscular dystrophies, and inflammatory muscle diseases. While there have been great efforts to search for a cure or prevent the disabilities they bring, the majority of these disorders are progressive with no definitive cure (2).

While neuromuscular disorders mainly cause impairments in physical functioning and movement, these diseases usually result in problems beyond locomotion (3). One of these problems is dysphagia, which is defined as discomfort or difficulty while swallowing (4). It can range from mild discomfort while swallowing to a swallowing disorder that prevents oral intake. Swallowing dysfunction in neuromuscular disorders is attributed to the lack of synergy between or weakness in oropharyngeal muscles, as these diseases may affect the nerves and muscles (5). Dysphagia may result in a reduction in quality of life, dietary restrictions, nutritional problems, and complications such as pneumonia (5,6).

Several methods can be used to assess the presence of dysphagia. Although videofluoroscopy (VFS) and oropharyngeal examination with videofibrolaryngoscopy provide the best insight into the presence and mechanisms of dysphagia, these methods are expensive and time-consuming (7). Moreover, their results may vary between assessors and carry risks for complications. The recent opinion for the evaluation of dysphagia in neuromuscular disorders such as muscular dystrophy does not recommend routine evaluation with invasive methods unless there are signs or symptoms of dysphagia (6). Thus standardized questionnaires have been developed to screen and evaluate dysphagia, including EAT-10 (Eating Assessment tool-10) (8). These tools were found to be

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strong indicators of dysphagia, and are widely used in both clinical settings and studies (8,9).

The presence of dysphagia in neuromuscular disorders has been shown in several studies in the literature (4,10,11). These studies relied on medical history, with or without face-to-face interaction, rather than standardized assessments. Although other studies use extensive methods such as VFSS, they are hindered by a small number of patients (12,13). Finally, little is known about the features and prevalence of dysphagia in some uncommon or rare neuromuscular disorders, which underlines the importance of studies or reports on these patients.

Oral health problems are known to contribute to the presence and severity of dysphagia in many groups of patients, and a healthy process of mastication and delivery of food with adequate consistency to the pharynx is a requirement for all individuals, regardless of their risk of dysphagia (14,15). Although it can be inferred that the maintenance of oral health applies to patients with neuromuscular disorders, none of the studies focused on the effects of oral problems on dysphagia in this group of patients.

This study aimed to evaluate the prevalence of dysphagia in patients with different types of neuromuscular disorders at a specialized center. Another aim was to investigate the factors associated with dysphagia and determine whether they correlated with the EAT-10 score, which is an indicator of dysphagia.

MATERIAL AND METHOD

Two-hundred and fifty-two patients who were admitted to the outpatient clinics of the Neuromuscular Diseases Center of a Training and Research Hospital were included in this study (59 Duchenne or Becker muscular dystrophies (DMD-BMD), 130 other muscular diseases and 63 neuropathies). Written informed consent was obtained from all patients and their caregivers, and the study was approved by the Institutional Review Board for Ethics before initiation (number: 2019/11-16).

The inclusion criteria were as follows:

- Patients with a definite diagnosis of neuromuscular disease based on clinical, genetic, and biopsy findings,
- Those aged 8 and over,
- Women and men,
- Those who did not use nasogastric or PEG,
- Those who can understand and speak Turkish.

The exclusion criteria were as follows:

- Patients without a diagnosis of neuromuscular disease,
- Age under 8 years,
- Presence of percutaneous gastrostomy/jejunostomy and nasogastric catheter,
- Those who do not understand or speak Turkish,
- Gastrointestinal, rheumatic, rheumatological, and malignant diseases that cause dysphagia.

After being evaluated by a team of physicians experienced in this field to confirm their diagnosis through history, physical examination, and laboratory/imaging, clinical and demographic data were obtained from the eligible patients. The patients were then questioned about their dysphagia status and problems with oral intake or swallowing, including a history of pneumonia. Physical activity levels of the patients were recorded by a self-reported measure, being either sedentary, seldomly exercising or regularly exercising. The same team also obtained a history of oral health and performed a physical examination of the mouth, teeth, and periodontal tissues, and gave an overall score ranging from 1 to 4, with lower scores being worse.

Functional Ambulation Classification (FAC): Patients were evaluated for their physical functioning and ambulatory status using the FAC. It consists of 6 stages, ranging from 0 to 5. Non-functional ambulation corresponds to 0, while independent ambulation corresponds to 5 (16).

EAT-10: The Eating Assessment Tool in 10 questions (EAT-10) was used to assess the swallowing function. First described by Belafsky et al. in 2008 (17), the EAT-10 is widely used to assess symptom severity and treatment response in dysphagia. The questionnaire consists of 10 multiple-choice questions, each of which is marked from 0 to 4. Although there are different cutoffs described in various patient groups, scores ≥3 are associated with the present risk of oropharyngeal dysphagia (17). The Turkish version of the test was also shown to be valid and reliable (18).

Using this EAT-10 score cut-off (≥3), patients were grouped as having dysphagia (Dysphagia +) or not (Dysphagia -). The factors associated with swallowing disorders and ambulatory status were analyzed to determine whether there was a correlation between them and the EAT-10 scores in patients with neuromuscular disorders.

Statistical Analysis

Statistical analyses were conducted using the Statistical Package for the Social Sciences (IBM Corporation, Armonk, NY, USA), version 23 for Windows. The demographic and clinical characteristics of the participants were analyzed using descriptive statistics. Categorical variables were analyzed using Pearson's chi-square test and Fisher's Exact Test. The normality of the data was tested using the Shapiro-Wilk test. As the numerical variables did not meet the criteria for normality, the Mann-Whitney U test was used to compare numerical variables among the groups. Correlation analysis was performed using Spearman's rank-order correlation test. The homogeneity of variances was tested using the Levene's test. As the variances could not meet the criteria for a parametric covariance test, non-parametric covariance analysis (Quade's test) was used (19). Statistical significance was defined as $p<0.05$.

RESULTS

Demographic and clinical data of the groups are shown in Table 1. 73 patients (30.1%) of the 242 recruited were under 19 years old. The DMD-BMD group constituted a special population among the other patient groups, since this group consisted of only males and was younger. They also had worse ambulatory status compared to the

other groups (p<0.05). Moreover, as most of them were already using corticosteroids and other supplementary drugs, they had a higher number of prescription drugs (p<0.05). Dysphagia was worse in the neuropathy group (p<0.05), mostly due to the inclusion of amyotrophic lateral sclerosis and other motor neuron diseases, which are known to affect swallowing function immensely. The dysphagia prevalence measured using the EAT-10 scores (cutoff: ≥3) in different diagnoses is given in Table 2. The prevalence of dysphagia was 17% in the DMD-BMD group, 18.4% in the other muscular diseases group, and 47.6% in the neuropathy group.

A comparison of the clinical characteristics and ambulatory status of patients with and without dysphagia is shown in Table 3. Ambulatory status was worse in patients in the DMD-BMD and neuropathy groups (p<0.05). Although the prevalence of pneumonia was higher in patients with dysphagia in all groups, statistical significance was obtained only in the DMD-BMD group (p<0.001). Problems in maintaining oral hygiene were significant in patients with dysphagia in both groups (p<0.05). Moreover, all groups reported a higher presence of dry mouth and limitations for certain types of food in patients with dysphagia (p<0.05). Muscular disorders other than the DMD-BMD and neuropathy groups also had higher numbers of dental implants in the dysphagia + group, while the DMD-BMD group, which consisted of younger patients, did not report any presence of dental implants at all.

The correlations between EAT-10 scores and clinical characteristics commonly associated with swallowing disorders and ambulatory status are shown in Table 4. These results show that poor ambulatory status, poor oral hygiene, dry mouth, food limitations dental implants, and pneumonia are correlated with higher EAT-10 scores (p<0.05).

We performed covariance analysis to determine whether oral factors were independent factors for the presence of dysphagia and pneumonia. When a model where FAC and age were used as covariates to show the progression of the disease, oral hygiene was not shown to be an independent factor for dysphagia and pneumonia (F (3.248)=0.51, p=0.67, and F (3.248)=0.23, p=0.87, respectively).

Table 1. Demographical and clinical characteristics of the participants (n%) or mean (SD)

	DMD/BMD (n: 59)	Other muscle diseases (n: 130)	Neuropathy (n: 63)	p
Gender (male)	59 (100)	58 (44.6)	30 (47.6)	**<0.001**
Education				0.38
Elementary	41 (70.7)	74 (56.9)	39 (61.9)	
High school	14 (24.1)	34 (26.2)	14 (22.2)	
University	3 (5.2)	17 (13.1)	7 (11.1)	
Mastery or higher	0 (0)	5 (3.8)	3 (4.8)	
Marital status (married)	1 (1.7)	62 (47.7)	32 (50.8)	**<0.001**
Physical activity level				**0.001**
Sedentary	26 (44.1)	76 (58.5)	41 (65.1)	
Seldom	3 (5.1)	21 (16.2)	3 (4.8)	
Regular exercise	30 (50.8)	33 (25.4)	19 (30.2)	
Comorbidities (yes)	17 (28.8)	47 (36.2)	33 (52.4)	0.057
FAC				**<0.001**
0	33 (55.9)	18 (13.8)	12 (19)	
1	2 (3.4)	10 (7.7)	9 (14.3)	
2	0	7 (5.4)	2 (3.2)	
3	3 (5.1)	7 (5.4)	8 (12.7)	
4	5 (8.5)	24 (18.5)	10 (15.9)	
5	16 (27.1)	64 (49.2)	22 (34.9)	
Swallowing problems (yes)	12 (20.3)	31 (23.8)	35 (55.6)	**<0.001**
Pneumonia	5 (8.5)	6 (4.6)	3 (4.8)	0.53
Number of drugs used	0-9 (1)	0-15 (0)	0-10 (2)	**0.006**
Food limitations				0.016
None	52 (88.1)	116 (89.2)	44 (69.8)	
Solid	4 (6.8)	8 (6.2)	9 (14.3)	
Liquid	3 (5.1)	3 (2.3)	8 (12.7)	
Semi-solid	0	3 (2.3)	2 (3.2)	
EAT-10 scores	1.3 (3.2)	1.96 (5)	6.5 (9.9)	**<0.001**
EAT-10 (>=3)	10 (17)	24 (18.4)	30 (47.6)	**<0.001**

Pearson's Chi Square and Fisher's Exact test, Student's T test; FAC: functional ambulation categories; significance: p<0.05

Table 2. Dysphagia prevalences according to EAT-10 (Cut-off >=3) (n%)

Diagnosis	Dysphagia (+)	Total
Duchenne muscular dystrophy	9 (19.6)	4
Becker muscular dystrophy	1 (7.7)	13
Limb-girdle muscular dystropy	2 (8)	25
Facioscapulohumeral muscle dystrophy	0 (0)	10
Myotonic dystrophy	3 (18.8)	16
Myotonia congenita	0 (0)	11
Congenital myopahty	1 (33.3)	3
Myopathy (other)	11 (28.9)	38
Non-inflammatory myopathy	0 (0)	7
Mitochondrial myopathy	3 (42.9)	1
Other muscle diseases	4 (21)	19
Polyneuropathy	9 (33.3)	27
Spinal muscular atrophy	3 (37.5)	8
Amyotrophic lateral sclerosis/motor neuron disease	15 (62.5)	24
Metabolic neuropathy	3 (75)	4

Table 3. Comparison of clinical characteristics between patients with and without dysphagia (n%)

	DMD-BMD			Other muscular diseases			Neuropathy		
	Dysphagia- (n: 49)	Dysphagia+ (n: 10)	p	Dysphagia- (n: 106)	Dysphagia+ (n: 24)	p	Dysphagia- (n: 33)	Dysphagia+ (n: 30)	p
Age (years)			0,56			0,43			0,29
10 to 19	32 (65.3)	7 (70)		18 (17)	1 (4.2)		10 (30.3)	5 (16.7)	
20 to 29	12 (24.5)	3 (30)		20 (18.9)	5 (20.8)		5 (15.2)	1 (3.3)	
30 to 39	5 (10.2)	0 (0)		25 (23.6)	5 (20.8)		4 (12.1)	4 (13.3)	
40 to 49	0 (0)	0 (0)		24 (22.6)	6 (25)		5 (15.2)	3 (10)	
50 to 59	0 (0)	0 (0)		15 (14.2)	7 (29.2)		6 (18.2)	10 (33.3)	
60 to 69	0 (0)	0 (0)		3 (2.8)	0 (0)		2 (6.1)	5 (16.7)	
70+	0 (0)	0 (0)		1 (0.9)	0 (0)		1 (3)	2 (6.7)	
FAC			**0.01**			0.9			**0.008**
<4	28 (57.1)	10 (100)		34 (32.1)	8 (33.3)		11 (33.3)	20 (66.7)	
>=4	21 (42.9)	0 (0)		72 (68)	16 (66.7)		22 (66.7)	10 (33.3)	
Swallowing problems (yes)	4 (8.2)	8 (80)	**<0.001**	15 (14.2)	16 (66.7)	**<0.001**	7 (21.2)	28 (93.3)	**<0.001**
Pneumonia	1 (2)	4 (40)	**<0.001**	4 (3.8)	2 (8.3)	0.3	0 (0)	3 (10)	0.06
Comorbidities	13 (26.5)	4 (40)	**0.45**	34 (33)	13 (54.2)	0.12	13 (39.4)	20 (66.7)	0.076
Oral hygiene problems	7 (14.3)	3 (30)	**0.04**	23 (21.7)	12 (50)	**0.048**	7 (21.3)	9 (30)	0.67
Dry mouth	3 (6.1)	5 (50)	**<0.001**	15 (14.2)	12 (50)	**0.001**	5 (15.2)	15 (50)	**0.003**
Dental implants (+)	0 (0)	0 (0)	**NA**	5 (4.7)	6 (25)	**0.001**	3 (9.1)	8 (26.7)	0.098
Food limitations			**<0.001**			**<0.001**			**<0.001**
None	47 (95.9)	5 (50)		102 (96.2)	14 (58.3)		31 (93.9)	13 (43.3)	
Solid	1 (2)	3 (30)		2 (1.9)	6 (25)		1 (3)	8 (26.7)	
Liquid	1 (2)	2 (20)		2 (1.9)	1 (4.2)		1 (3)	7 (23.3)	
Semi-solid	0 (0)	0 (0)		0 (0)	3 (12.5)		0 (0)	2 (6.7)	

Pearson's Chi Square and Fisher's Exact test; FAC: functional ambulation categories; significance: p<0.05

Table 4. Correlation of EAT-10 scores with the clinical characteristics		
FAC	**R**	-0.242
	p	**<0.001**
Oral hygiene	**R**	-0.189
	p	**0.003**
Dry mouth	**R**	-0.416
	p	**<0.001**
Food limitation	**R**	0.546
	p	**<0.001**
Dental implants	**R**	-0.27
	p	**<0.001**
Pneumonia	**R**	0.243
	p	**<0.001**

Spearman's rank correlaton test; FAC: functional ambulation categories; significance: p<0.05

DISCUSSION

The results of this study show that dysphagia is a significant problem in patients with neuromuscular disorders. Even in the absence of food administration routes other than oral administration, a considerable number of patients across all groups showed signs of dysphagia. Moreover, dysphagia was correlated with pneumonia in these patients. The severity of dysphagia was found to scale with worse ambulatory status, probably due to the progressive course of many of these pathologies, which affect motor functions, as well as swallowing.

In recent decades, the prevalence of dysphagia in neuromuscular disorders has been the focus of research. A case-control study by Jaffe et al. focused on patients with DMD and reported that upper gastrointestinal functional problems were prevalent in these patients (20). A study that used a survey with questions regarding swallowing in various neuromuscular disorders by Willig et al. was among the first studies (4). While the prevalence of dysphagia is reported to be around 25-45% in patients with myotonic dystrophy (21,22), which is an adult-onset form of muscular disease, it is difficult to estimate the actual prevalence of many of these disorders due to their progressive nature, especially in patients with DMD, motor neuron disease, some forms of polyneuropathies, or other progressive muscular diseases (6,7,12). Thus, although our study reports prevalence from our spectrum of patients, these findings may be drastically different if these patients are in different stages of their pathologies. In addition, the study involved only a few patients with some of the rarer diseases. While these reports can be valuable in estimating the potential impact of swallowing disorders, low numbers may cause overestimation or underestimation of this problem in these populations. As our groups, especially those other than DMD-BMD, involved diverse pathologies with different involvement of swallowing function, the group with neurological involvement had the highest rate of dysphagia, partly due to the considerable proportion of patients with motor neuron disease (23).

The link between limited ambulation and dysphagia is a relatively novel focus of research in the general population. It has been shown that poor ambulatory status is associated with dysphagia (24,25). This link is mostly thought to originate from the presence of lower muscle mass and strength and sarcopenia, which contributes to both ambulation and swallowing functions, as the impairment of muscle mass and strength also affects muscles in the oropharynx as well (26,27). Moreover, in patients whose movements are severely limited, the inability to adjust posture and compensate for neck maneuvers or scoliosis of cervical and upper-thoracic levels may contribute to swallowing disorders as well (28). Our findings suggest that a possible link between ambulatory status and swallowing disorders may be valid in patients with neuromuscular disorders. However, the mechanisms of this association may not be the same as that in the general population. While sarcopenia, comorbidities, and frailty might be the main predictors of dysphagia in the general population, neuromuscular disorders have different characteristics. As many neuromuscular disorders are progressive and affect both neuromuscular systems involved in swallowing and ambulation, the actual progress of the disease may be the main mechanism for the severity of dysphagia and limited ambulation. As our findings were more robust in the DMD-BMD and neuropathy groups, which consisted solely of progressive disorders or had a large number of them, this assumption can be true. The cross-sectional design of our study makes it impossible to make a cause-effect relationship in this issue, though. Nevertheless, it might be interesting to study whether interventions for strength training that can improve ambulation or posture can also alleviate dysphagia in patients with neuromuscular diseases as well (29).

The findings of our study suggest that dysphagia was also correlated with higher rates of pneumonia, worse oral hygiene, dryness of the mouth, and the presence of dental implants. The link between pneumonia and dysphagia is well established, and dysphagia, especially when not treated properly, can cause aspiration pneumonia in both the general population and patients with neuromuscular disorders (6,30). Our findings confirm this link, especially in patients with DMD or BMD. We could not show this association for muscular disorders other than DMD-BMD, which involved myopathies or myotonic dystrophies. While the association between pneumonia and dysphagia is clearer in cases with neuropathies or DMD in the literature (6,31), it is not always possible to show this link in some muscular disorders with milder involvements, such as myotonic dystrophy (32). However, the lack of findings in this particular group should not undermine the importance of addressing dysphagia in these patients.

Disturbances in oral hygiene are among the most important issues affecting swallowing and nutrition. Studies have shown that oral health is associated with dysphagia and malnutrition (33,34). Poor oral hygiene is also known to contribute to pneumonia, and maintaining good oral health can help reduce pneumonia in susceptible

populations (35,36). Our findings underscore the importance of oral health in patients with neuromuscular disorders. Thus, maintaining good oral hygiene in these patients may improve their swallowing problems and help reduce the incidence of pneumonia. Our data showed that oral hygiene status is not an independent factor that contributes to pneumonia and dysphagia. As neuromuscular diseases progress, the maintenance of oral health encounters many problems, including the loss of manual dexterity to perform self-care tasks such as brushing teeth and impaired control of the saliva and head and neck muscles, resulting in xerostomia. These factors may have shadowed the possible contribution of oral hygiene to dysphagia since these problems are encountered more commonly in patients with progressive disease. Since the effects of oral health problems are well known in other patient groups susceptible to aspiration pneumonia, proper oral and dental care should be provided to these patients, especially in the advanced stages of the disease. Dental implants were found to be common in patients with neuropathy in the group that included patients over 50 years of age. Dental problems and implant applications are known to be more prevalent in older age (37). As dysphagia is more common in older patients with neuropathy, this finding can be attributed to the progression of oropharyngeal muscle weakness with increasing age in this population (38).

This study is the first to evaluate the dysphagia status in patients in a neuromuscular disease clinic in Türkiye. Moreover, this is the first study to highlight the importance of oral health in swallowing problems in patients with neuromuscular disorders. The strengths of this study include its considerable number of patients. We also used a validated tool, EAT-10, to screen for dysphagia. All patients were evaluated face-to-face, without a remote tool such as telephone or e-mail, which reduces the potential problems in clinical evaluations.

The main limitation of this study was the lack of objective tests to evaluate dysphagia in detail, such as videofluoroscopic swallowing studies. However, the use of such a test in a large number of patients is not possible, especially when we consider a large number of asymptomatic patients with no apparent problems in the early stages. It is not routinely recommended to perform such invasive tests to screen for dysphagia, such as muscular diseases, in some of our patient groups, such as muscular diseases (6). However, the use of such tests after screening at-risk patients can drastically improve future studies. Another limitation was the lack of additional tools and questionnaires to evaluate dysphagia and nutritional status in greater detail. Screening for nutrition would allow us to determine the potential impact of dysphagia in these patient groups. Although these patients underwent an oral examination by a team of physicians, there were many composite and organized assessment scores and validated questionnaires to determine the oral health status of the patients, and this study was unable to employ them (39). While the results can hold a light for the future studies in these rare groups of patients, this is a study which enrolled patients from a single tertiary care center. Since these results may vary from center to center, or may not be the same for other countries, the generalizability of the results should be evaluated with caution. Finally, the patients in the defined groups other than the DMD-BMD group were quite heterogeneous, which raises questions about the validity of reported differences between groups.

CONCLUSION

Dysphagia is a common neuromuscular disorder. Dysphagia can lead to significant complications. When evaluating patients, they should be questioned absolutely and directed to further investigations in their presence. The evaluation should also include inquiry and assessment of oral health status, and further studies should focus on a more detailed examination and use validated tools to evaluate this problem. Moreover, patients should be informed of the importance of regular oral examinations and maintenance of oral hygiene.

Studies that include a more detailed examination through the use of specialized methods and assessment of treatment methods for dysphagia in neuromuscular diseases may help clinicians alleviate swallowing disorders.

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