Research

Comparison of fiberoptic endoscopic examination of swallowing findings between neurogenic and non-neurogenic dysphagia patients

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ABSTRACT

Background: Dysphagia is the difficulty or discomfort on swallowing which can affects a person's quality of life. Based on pathophysiology, dysphagia can be classified as neurogenic and non-neurogenic. One method of diagnosis is to use a flexible endoscope called the Fiberoptic Endoscopic Examination of Swallowing (FEES). The basic findings obtained from the FEES examination were standing secretion, silent aspiration, hypopharyngeal sensitivity, leakage, residue, penetration and aspiration. **Objective:** To compare the findings of the FEES examination between patients with neurogenic and non-neurogenic dysphagia. **Method:** Observational research using cross sectional design. Data collection was carried out using medical record data on 94 subjects with dysphagia who underwent FEES examination at Dr. Mohammad Hoesin Hospital Palembang from January 2019 to January 2021. **Result:** The most common FEES finding in neurogenic dysphagia were filtered purée residue, milk residue, and biscuit residue. In the non-neurogenic dysphagia group, the most common FEES finding was filtered purée residue. There were significant differences in FEES findings between neurogenic dysphagia and non-neurogenic dysphagia in filtered purée residue (p=0.014), rice purée residue (p=0.017), flour purée residue (p=0.007), and biscuit puree penetration (p=0.017). **Conclusion:** There were significant differences in FEES findings between neurogenic dysphagia and non-neurogenic dysphagia concerning residue of filtered purée, residue of rice purée, residue of flour purée, and biscuit penetration. From regression analysis, the dominant factors found in neurogenic dysphagia were filtered purée penetration, flour purée residue, biscuit penetration, and found in non-neurogenic dysphagia were flour purée penetration and biscuit puree leakage.

Keywords: neurogenic dysphagia, non-neurogenic dysphagia, fiberoptic endoscopic examination of swallowing (FEES)

ABSTRAK

Latar belakang: *Disfagia adalah kesulitan atau gangguan proses menelan, yang dapat memengaruhi kualitas hidup seseorang. Berdasarkan patofisiologinya, disfagia dapat diklasifikasikan menjadi neurogenik dan non-neurogenik. Salah satu metode diagnosis adalah dengan menggunakan* Fiberoptic Endoscopic Examination of Swallowing (FEES). *Temuan dasar yang diperoleh dari pemeriksaan FEES adalah standing secretion, silent aspiration, sensitivitas hipofaring, leakage, residu, penetrasi dan aspirasi.* ***Tujuan:*** *Membandingkan hasil pemeriksaan FEES antara pasien disfagia neurogenik dan non-neurogenik.* ***Metode:*** *Penelitian observasional dengan desain potong lintang. Pengumpulan data dilakukan dengan menggunakan data rekam medis pada 94 subjek disfagia yang menjalani pemeriksaan FEES di Rumah Sakit Dr. Mohammad Hoesin Palembang dari Januari 2019 hingga Januari 2021.* ***Hasil:*** *Temuan FEES yang paling umum pada disfagia neurogenik adalah residu bubur saring, residu susu, dan residu biskuit. Pada kelompok disfagia non-neurogenik, temuan FEES yang paling umum adalah residu bubur saring. Terdapat perbedaan yang signifikan dalam temuan FEES antara disfagia neurogenik dan disfagia non-neurogenik pada residu bubur saring (p=0,014), residu bubur nasi (p=0,017), residu bubur tepung (p=0,007), dan penetrasi bubur biskuit (p=0,017).*

Kesimpulan: *Terdapat perbedaan yang signifikan dalam temuan FEES antara disfagia neurogenik dan disfagia non-neurogenik pada residu bubur saring, residu bubur beras, residu bubur tepung, serta penetrasi bubur biskuit. Dari analisis regresi ditemukan faktor dominan di disfagia neurogenik adalah penetrasi bubur saring, residu bubur tepung, penetrasi bubur biskuit, dan di disfagia non-neurogenik adalah penetrasi bubur tepung dan kebocoran bubur biskuit.*

Kata kunci: disfagia neurogenik, disfagia non-neurogenik, pemeriksaan menelan (FEES) endoskopi serat optik

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INTRODUCTION

Dysphagia is the difficulty or discomfort on swallowing, which can affect a person's quality of life. Dysphagia could be categorized of three types as oral, pharyngeal and esophageal depending on the affected stage process of swallowing. Swallowing disorders experienced by individuals with dysphagia are caused by several changes in the structures responsible for the feeding process, either neurologically or anatomically.[1-3]

Dysphagia can be classified as neurogenic dysphagia and non-neurogenic dysphagia based on the pathophysiology. Neurogenic dysphagia will occur if there is a disturbance in the sensory control of the swallowing system in the central nervous system, peripheral nervous system, neuromuscular junction, or muscles; while non-neurogenic dysphagia can occur if there is a luminal disturbance, due to intrinsic or extrinsic compression. Dysphagia caused by damage to the central nervous system is termed as central nervous dysphagia. Neurogenic dysphagia can be caused by neurological disturbances in the sensorimotor aspect of the oropharynx. Causes of neurogenic dysphagia may include weakness of the oral muscles and tongue movement, failure to form a cohesive bolus, decreased sensitivity of pharyngeal receptors, and buccolingual apraxia.[1,2,4-6]

The prevalence of dysphagia in the general population varies, but the average rate is more than 8%. The latest research of an epidemiological study in China claimed that the prevalence of dysphagia was 39.4% from a total of 14 provinces in China. Previous studies in the United States revealed that the problem of dysphagia occurs in one in 25% of all adult population. Not much different result also obtained from the Netherlands in 2014, which said that the prevalence of oropharyngeal dysphagia in the general population was more than 12.1%. In another study, the prevalence of oropharyngeal dysphagia in cerebrovascular disorders was around 30%, 52%-82% in patients with Parkinson's disease, 84% in Alzheimer's disease, and more than 40% in adults aged over 65 years.[3,7-11]

Dysphagia can cause complications and significant functional constraints in the form of aspiration of food in the lower respiratory tract, pneumonia, dehydration, weight loss, malnutrition, airway obstruction that interfere with quality of life in several aspects including emotional, physical and social. Complications may include malnutrition, dehydration, pneumonia due to aspiration, airway obstruction (laryngeal spasm or bronchospasm), decreased quality of life, activity, and work productivity.[3,6]

One of the diagnostic investigations for dysphagia is to use a flexible endoscope called the Fiberoptic Endoscopic Examination of Swallowing (FEES). FEES nowadays is the leading choice for evaluation of patients with dysphagia because it is easy, more practical, and cheaper. This procedure can assess the anatomy and physiology of swallowing, protection of the airway and its relationship to the function of swallowing solid and liquid foods, as well as diagnosis and further treatment plans. The purpose of FEES is to identify disturbances in the pharyngeal structure, detect anatomical and physiological abnormalities that cause dysphagia, and determine a safe and more efficient position for swallowing in dysphagia patients.[3,6,12]

FEES is, however, not a bona fide substitute for other tests such as the Videofluoroscopic Swallow Study (VFSS), but its potential is highly promising. Various literatures state that FEES can detect aspiration, penetration and pharyngeal residue better than VFSS. The basic findings obtained from the FEES examination were standing secretion, silent aspiration, hypopharyngeal sensitivity, leak, residue, penetration and aspiration. After the FEES examination is performed, information can be obtained such as anatomy and physiology, secretion/fluid handling, airway protection, type of food consistency, strategies and maneuver, size and condition of the bolus which are optimal/ should be given and therapeutic technique.[3,6,12]

METHOD

This was an observational study using a cross-sectional design and aimed to compare the findings of the FEES examination between patients with neurogenic and non-neurogenic dysphagia at Dr. Mohammad Hoesin Hospital Palembang. This research was conducted at the Medical Record Installation of Dr. Mohammad Hoesin Hospital Palembang during the period January 2019 to January 2021. The study population was all medical records of patients with deep neck abscesses at Dr. Mohammad Hoesin Hospital Palembang during the period July 2018 to May 2021. The research sample was the medical record data of dysphagia cases who underwent FEES examination at Dr. Mohammad Hoesin Hospital Palembang and met the research criteria. Inclusion criterion was patients with complete medical record data for dysphagia. The data was analyzed univariately which was described and presented the characteristics of subjects, bivariately where the findings were compared between dependent variables, and multivariately where variables contribution were compared with each other to define the probability of having neurogenic dysphagia.

RESULT

The univariate analysis in this study included the demographic factors of the research subjects, namely age and sex (Tabel 1). A total of 94 patients were included in this study who developed neurogenic dysphagia or non-neurogenic dysphagia. The more common type of dysphagia was neurogenic dysphagia, which was found in 50 patients (53.2%). In the neurogenic dysphagia group, the more frequent age group was the 60-year-old and older, with 27 patients (54%). On the other hand, in the non-neurogenic dysphagia, the more common age affected was younger than 60 years old, with 30 subjects (68%). Based on gender, both in the group of neurogenic and non-neurogenic dysphagia, male patients were more dominant in number than female.

In the pre-swallowing FEES examination (Table 2), the neurogenic dysphagia group showed a higher percentage of experiencing standing secretion (59.1%) than the non-neurogenic dysphagia (48%). Based on the analysis using Chi-Square, there was no significant difference between neurogenic dysphagia and non-neurogenic dysphagia

based on the findings of standing secretion on FEES. In the study, the higher number of silent aspiration findings was in the non-neurogenic dysphagia group with 14 samples (31.8%) compared to 11 samples (22%). There was no significant difference between neurogenic dysphagia and non-neurogenic dysphagia based on the findings of silent aspiration on FEES. Comparison of decreased hypopharyngeal sensitivity between neurogenic dysphagia and non-neurogenic dysphagia was found to be more in the non-neurogenic group (59.1%) than the neurogenic group (58%). There was no significant difference between the two dysphagia groups based on the findings of hypopharyngeal sensitivity in FEES.

In the examination of FEES swallowing (Table 3), there was some variation in the results. The results showed that there was a significant effect of neurogenic and non-neurogenic dysphagia groups on the incidence of filtered purée residue (p=0.014), rice purée residue (p=0.017), and flour purée residue (p=0.007) on FEES examination. While the residues of milk, biscuits, and water were not found significant differences. The results showed that there was no significant effect of neurogenic and non-neurogenic dysphagia groups on the incidence of leakage in all types of swallowing materials. The results also showed that there was no significant difference between neurogenic and non-neurogenic dysphagia groups on the incidence of aspiration in all types of swallowing materials. Ultimately, our results showed that there was a significant effect of neurogenic and non-neurogenic dysphagia groups on the incidence of biscuit purée penetration (p=0.017).

Multivariate logistic regression analysis with 25 eliminations of 29 variables resulted in 5 factors that had the most influence on the incidence of neurogenic dysphagia or non-neurogenic dysphagia. These factors are filtered purée penetration, flour purée residue, flour purée penetration, biscuit purée leakage, and biscuit purée penetration. The findings of the FEES examination in the form of filtered purée penetration were 17 times more likely to have neurogenic dysphagia than non-neurogenic dysphagia. The results of the FEES examination in the form of flour purée residue were 20.6 times more likely to have neurogenic type than non-neurogenic dysphagia. The findings of the FEES examination in the form of biscuit purée penetration were 27.1 times more likely to experience neurogenic dysphagia than non-neurogenic dysphagia. Meanwhile, the results of the FEES examination found more incidence of flour puree penetration and biscuit puree leakage in non-neurogenic dysphagia compared to neurogenic dysphagia.

Table 1. Distribution of characteristics of subjects

Variabel	Neurogenic dysphagia N (%)	Non-neurogenic dysphagia N (%)
Age		
< 60 y.o.	23 (46)	30 (68.2)
≥ 60 y.o.	27 (54)	14 (31.8)
Sex		
Male	30 (60)	34 (77.3)
Female	20 (40)	10 (22.7)

Table 2. Comparison of neurogenic and non-neurogenic dysphagia based on pre-swallowing findings on FEES

FEES Finding(s)	Dysphagia	Found (%)		*P-value**
		Yes	No	
Standing Secretion	Neurogenic Non-Neurogenic	24 (48) 26 (59.1)	26 (52) 18 (40.9)	0.282
Silent Aspiration	Neurogenic Non-Neurogenic	11 (22) 14 (31.8)	39 (78) 30 (68.2)	0.282
Hypopharynx sensitivity	Neurogenic Non-Neurogenic	21 (42) 18 (40.9)	29 (58) 26 (59.1)	0.915

**Pearson Chi-Square*

Table 3. Comparison of neurogenic and non-neurogenic dysphagia based on swallowing findings on FEES

n	Dysphagia	Found (%)		P-value*	OR (CI 95%)
		Yes	No		
Residue					
Filtered purée	Neurogenic Non-Neurogenic	37 (74) 41 (93.2)	13 (26) 3 (6.8)	0.014	4.80 (1.268-18.187)
Rice purée	Neurogenic Non-Neurogenic	34 (68) 39 (88.6)	16 (32) 5 (11.4)	0.017	3.67 (1.216-11.077)
Flour purée	Neurogenic Non-Neurogenic	34 (68) 40 (90.9)	16 (32) 4 (9.1)	0.007	4.70 (1.436-15.426)
Milk	Neurogenic Non-Neurogenic	37 (74) 38 (86.4)	13 (26) 6 (13.6)	0.136	
Water	Neurogenic Non-Neurogenic	34 (68) 33 (75)	16 (32) 11 (25)	0.454	
Biscuit purée	Neurogenic Non-Neurogenic	37 (74) 38 (86.4)	13 (26) 6 (13.6)	0.136	
Aspiration					
Filtered purée	Neurogenic Non-Neurogenic	21 (42) 24 (54.5)	29 (58) 20 (45.5)	0.224	
Rice purée	Neurogenic Non-Neurogenic	21 (42) 23 (52.3)	29 (58) 21 (47.7)	0.319	
Flour purée	Neurogenic Non-Neurogenic	24 (48) 25 (56.8)	26 (52) 19 (43.2)	0.393	
Milk	Neurogenic Non-Neurogenic	27 (54) 23 (52.3)	23 (46) 21 (47.7)	0.867	
Water	Neurogenic Non-Neurogenic	28 (56) 24 (54.5)	22 (44) 20 (45.5)	0.887	
Biscuit purée	Neurogenic Non-Neurogenic	21 (42) 26 (59.1)	29 (58) 18 (40.9)	0.098	

Leakage					
Filtered purée	Neurogenic Non-Neurogenic	16 (32) 16 (36.4)	34 (68) 28 (63.6)	0.656	
Rice purée	Neurogenic Non-Neurogenic	22 (44) 20 (45.5)	28 (56) 24 (54.5)	0.887	
Flour purée	Neurogenic Non-Neurogenic	27 (54) 22 (50)	23 (46) 22 (50)	0.698	
Milk	Neurogenic Non-Neurogenic	27 (54) 18 (40.9)	23 (46) 26 (59.1)	0.205	
Water	Neurogenic Non-Neurogenic	27 (54) 17 (38.6)	23 (46) 27 (61.4)	0.136	
Biscuit purée	Neurogenic Non-Neurogenic	30 (60) 23 (52.3)	20 (40) 21 (47.7)	0.451	
Penetration					
Filtered purée	Neurogenic Non-Neurogenic	28 (56) 33 (75)	22 (44) 11 (25)	0.054	
Rice purée	Neurogenic Non-Neurogenic	28 (56) 29 (65.9)	22 (44) 15 (34.1)	0.326	
Flour purée	Neurogenic Non-Neurogenic	30 (60) 31 (70.5)	20 (40) 13 (29.5)	0.289	
Milk	Neurogenic Non-Neurogenic	32 (64) 32 (72.7)	18 (36) 12 (27.3)	0.365	
Water	Neurogenic Non-Neurogenic	28 (56) 27 (61.4)	22 (44) 17 (38.6)	0.598	
Biscuit purée	Neurogenic Non-Neurogenic	23 (46) 31 (70.5)	27 (54) 13 (29.5)	0.017	2.799 (1.192-6.573)

**Pearson Chi-Square*

DISCUSSION

The distribution of the incidence of dysphagia was more found in male than the female group. According to research conducted by Tamin et al.[13], the ratio of male and female was 2:1. Meanwhile, based on Iqbal et al.[14] research, it was found that there were more female than male with a percentage of 52% compared to 48%. In the neurogenic dysphagia group by age category, the prevalence of oropharyngeal dysphagia is very high in elderly patients but is not always explored and detected systematically. This condition affects >30% of patients with stroke; 60–80% of patients with neurodegenerative disease, up to 13% of adults aged 65 years and over, and >51% of elderly patients. Based on the literature, it is estimated that 35-68% of people aged 65 years or older have some degree of swallowing dysfunction. Dysphagia in people older than 60 years is found in 15% to 40%. Based on the category of type of dysphagia experienced by the patient, neurogenic dysphagia was more common.[3] According to Sasegbon et al.[15], the incidence of neurogenic dysphagia reaches 29% to 80%. Several factors such as the high incidence of stroke and other neurodegenerative diseases worldwide may explain this. The population of dysphagia patients increases in the elderly caused by cerebrovascular disease or age factors that cause changes in physiology and anatomical structures that play a role in the swallowing process.

Our study found no significant difference between the two groups based on the findings

of standing secretion in FEES. According to Tamin et al.[13] research, 56.3% of stroke patients had standing secretion. Still from the same study, standing secretion was also obtained as much as 92.4% of nasopharyngeal carcinoma after chemoradiation who underwent FEES. Description of standing secretion based on Nayoan[16] research at Dr. Kariadi Hospital, Semarang showed the results of 28 dysphagia patients who had a FEES examination where mostly were oropharyngeal dysphagia, which 47% had standing secretions. Standing secretions are secretions that pool in the laryngeal vestibule consistently, continuously, and the patient is unable to clear both the amount and the location. Standing secretion occurs due to hypopharyngeal hyposensitivity so that pharyngeal peristalsis is not optimal. The difference which was considered insignificant in this study between neurogenic and non-neurogenic dysphagia based on the findings of standing secretions may occur because the standing secretion is a common finding in all types of dysphagia. Standing secretion, which is the accumulation of secretions in the hypopharynx, indicates that the pharyngeal response during swallowing is weak and less efficient at cleaning accumulated secretions. In neurogenic dysphagia, there is a disturbance of sensorimotor control which causes hypopharyngeal hyposensitivity and secretion accumulation in the hypopharyngeal area. Likewise in non-neurogenic dysphagia, secretions that consolidate in the hypopharynx can be caused by luminal disturbances or extrinsic compression.[5]

In our study, there was no significant difference between the two groups based on the findings of silent aspiration in FEES. According to Tamin et al.[13], 73.7% of stroke patients had silent aspiration. Horner et al.[17] conducted two small studies on clinical predictors of aspiration in stroke patients with dysphagia and showed that 28%-38% of patients had silent aspiration. Ramsey et al.[18] studied medical complications in acute stroke patients with dysphagia undergoing rehabilitation and found that 2%-25% had silent aspiration. Silent aspiration is a term used to describe aspiration that occurs without obvious clinical signs and symptoms. The pathological mechanism associated with silent aspiration is characterized by weakness or lack of coordination of the pharyngeal muscles and an impaired ability to produce a reflexive cough. In this study, the percentage of silent aspiration in both groups of dysphagia was smaller than that of no silent aspiration. Our finding differs from a study that states that the risk of silent aspiration is high in dysphagia patients. The reason is that the sample size is not large enough. Another reason is the uneven distribution of samples in the neurogenic dysphagia and non-neurogenic dysphagia groups. The severity of the disease on the admission of the research subject will certainly affect the findings on FEES.[13]

Based on our results, there was no significant difference between the two groups related to hypopharyngeal sensitivity in FEES. Nayoan[16] study of 28 samples found that 14 patients (50%) had hypopharyngeal hyposensitivity. The cohort study by Deutschmann,[19] found that 4% of laryngeal cancer patients did not experience hyposensitivity in the epiglottis and 6% did not experience hyposensitivity at the base of the tongue. In the case of dysphagia, either in dysphagia due to neurological problems or mechanical problems, there is usually a weakness in the muscle tone of the lateral pharyngeal wall. The researchers assumed that this was influenced by impaired sensory control or luminal and extrinsic compression in the patient. The output is a decreased level of sensitivity in the hypopharyngeal area, which will cause leakage that can lead to standing secretions.[13,20]

Leakage is the entry of food into the hypopharynx before the swallowing reflex begins so that aspiration is instigated. Pre-swallowing leakage occurs when food passes

directly through the base of the tongue and reaches the piriform sinus without any oral preparation before the initiation of swallowing. Impaired function of the posterior part of the tongue, which forms the glossopharyngeal valve, could cause leakage. The glossopharyngeal muscle is not strong enough to contract for approximation to the posterior pharyngeal wall. Moreover, motor and sensory disturbances in the tongue and palate cause solid or liquid food to reach the vallecula before swallowing begins. The factors that cause leakage may be the reason why in this research we found no significant difference between the two groups in leakage. Malformation of anatomical structures in the oropharynx makes it difficult to distinguish the leakage in neurogenic and non-neurogenic dysphagia. In neurogenic dysphagia (post stroke/head trauma), leakage occurs due to impairment on glossopharyngeal (n.XI), which carries sensory components or on n. hypoglossal (n. XII), which carries motoric components.[2,6,13,21]

This study found that residual dysphagia occurred more frequently in non-neurogenic dysphagia than neurogenic dysphagia. Iqbal et al.[14] in 2014 stated that water residue was 16 times greater in neurogenic dysphagia than in mechanical dysphagia. Nayoan[16] found that out of 28 dysphagia patients, residue occurred in 22 patients. A residue is a build-up of food debris in the vallecula area or piriform fossa after the swallowing process (post deglutition residual). In non-neurogenic dysphagia, there is a pharyngeal phase disorder, such as a decrease in the elevation of the hyoid, a lack or diminished elevation of the epiglottis, or a weak contraction of the pharyngeal muscles due to suppression by a mass or pressure from the use of a tracheostomy cannula, all of which cause difficulty in bolus clearance. According to Bass et al.[12], a residue is the presence of food residue in the hypopharynx after the swallowing process is complete. The higher the bolus viscosity, the higher the chance of residue.[6,22]

From several comparisons of FEES findings in the form of penetration in the six types of food consistency, statistical analysis found that only biscuit penetration had a significant difference between neurogenic dysphagia and non-neurogenic dysphagia. Our result was in line with Iqbal[14] study, which stated that there was no significant difference between neurogenic dysphagia and mechanical dysphagia in the penetration of milk, filtered puree, flour puree, rice puree, and biscuit puree. Penetration is the entry of food into the vestibule of the larynx but not yet through the vocal cords. The malfunction causes aspiration of food into the airway during inhalation. The presence of penetration is usually due to elevation and asymmetry or incomplete closure of the velopharyngeal. Weak closure of the laryngeal structures, such as epiglottic retroversion, arytenoid closure of the glottis, and impaired closure or elevation of the vocal folds, leads to penetration-aspiration. In patients with non-neurogenic dysphagia, luminal disturbances occur that make it hard to digest denser boluses. For food consistency that requires more tongue movement, this will accelerate the occurrence of the pharyngeal phase in non-neurogenic dysphagia patients with food boluses that have not been digested properly. This physiology leads to findings of penetration of solid foods such as biscuits in non-neurogenic dysphagia conditions. In this study, the penetration of liquid-consistent foods such as milk and water did not show a significant difference between neurogenic dysphagia and non-neurogenic dysphagia. This finding was in contrast to many studies, which stated that the incidence of penetration of liquid-consistent foods was high in dysphagic patients. The researchers assumed this happened because of our small number of samples. Most of our subjects with non-neurogenic dysphagia might have an unrecorded underlying disease that heavily influences the incidence of dysphagia. Therefore, the penetration rate of liquid-based food turned to be poor.[6,23,24]

Our study revealed that statistically there was no significant difference between neurogenic dysphagia and non-neurogenic dysphagia based on the findings of FEES in the form of aspiration on six types of food consistency. Research in China showed a significant relationship between penetration-aspiration in 4 kinds of food bolus consistency (water, milk, pasta, and bread) with a bolus volume of 5 ml in stroke patients compared to non-stroke samples, because of delayed pharyngeal contractions and pharyngeal transit time.[26] One study in 2009 by Diniz et al.[27] showed that a high proportion of stroke patients experienced aspiration of water compared to non-stroke patients with a ratio of 21:3, and found no evidence of aspiration in patients who were given semi-solid food and solid food compared to liquid administration. Aspiration is the entry of food into the airway through the vocal cords which plays a very important role in pulmonary complications. Although aspiration does not occur in all patients with dysphagia, it is very common in patients with certain conditions. Aspiration during swallowing or aspiration during the swallowing reflex is properly described as aspiration when the larynx is raised. This occurs as a result of impaired laryngeal elevation, failure or incomplete closure of the glottis, or if the timing of glottic closure is delayed due to brainstem damage or other causes. In this study, there was no significant difference of aspiration incidence between neurogenic dysphagia and non-neurogenic dysphagia. This might be because the number of samples in this study could not describe the causes of dysphagia as a whole. It is possible that most of the samples also had an underlying disease that greatly influences the incidence of dysphagia but was not reported in the patient's status.[6,14,25-28]

In this study, there were significant differences in FEES findings between neurogenic dysphagia and non-neurogenic dysphagia in the residue of filter purée, rice purée, flour purée, besides biscuit purée penetration. The factors that most accounted in the incidence of neurogenic dysphagia or non-neurogenic dysphagia were filtered purée penetration, flour purée residue, biscuit purée penetration, flour purée penetration, and biscuit purée leakage. The limitation of this study was that the research used secondary data taken from medical record data. The limited number of patients makes this study less effectual to analyze the possible association between dysphagia and FEES findings. Moreover, this study did not have a long-term follow-up which limiting the evaluation of the results of swallowing function tests in each subject. In this study, the authors could only saw a comparison between neurogenic dysphagia and non-neurogenic dysphagia based on the findings of the FEES examination, but could not assess the severity of dysphagia problems in research subjects. Further research is needed to produce better results.

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