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Dysphagia handicap index and fibre-optic endoscopic examination of swallowing in assessment of dysphagia

Nihal Hisham Abdelhamid^{1*} and Iman Mohamed Elrouby¹

Abstract

Oropharyngeal dysphagia is a swallowing disorder characterized by difficulty in transferring foods and/or liquids from the oral cavity to the stomach, affecting safe oral feeding. The main complications caused by dysphagia are tracheobronchial aspiration, pneumonia, malnutrition, and dehydration. Fibre-optic endoscopic evaluation of swallowing (FEES) is the first choice for studying swallowing disorders, it is easy to use, very well tolerated, allows bedside examination, and is economic. The dysphagia handicap index (DHI) is a 25-item self-administered questionnaire. It is a noninvasive tool measuring the handicapping effect of dysphagia in three aspects: the physical, functional, and emotional aspects of life, so a patient can rate the impact of his swallowing problem. The aim of this study is to test the correlation between DHI scores and fibre-optic endoscopic examination of swallowing and the ability of DHI to predict penetration and aspiration. For all patients, FEES examination was done as an assessment tool for dysphagia and DHI. Testing the correlation between DHI scores and penetration and aspiration on FEES results in a positive significant correlation, so we can apply DHI as a predictor of aspiration and penetration at medical centres where FEES examination is not accessible.

Keywords Dysphagia, Dysphagia handicap index, FEES, Swallowing, Stroke, Aspiration, Penetration

Background

Oropharyngeal dysphagia is a swallowing disorder characterized by difficulty in transferring foods and/or liquids from the oral cavity to the stomach, affecting safe oral feeding. The main complications caused by dysphagia are tracheobronchial aspiration, pneumonia, malnutrition, and dehydration [1].

Swallowing is a complex physiological action which is rapid from its beginning to the end, and for that, morphological studies of the structures and functional evaluation of the action itself are technical problems that are not easy to solve [2]. According to the American Speech-Language-Hearing Association (ASHA)

[3], a clinical-instrumental evaluation of swallowing should reveal the following: any alterations in organic structures or functions involved, the efficacy of swallowing in its all stages, protection of the lower airways, and co-ordination of breathing and swallowing and should detect and quantify any penetration of the bolus in the airway. It should assess the various oropharyngo-oesophageal movements that take place during swallowing in relation to the bolus type, as well validity and efficacy of compensation postures and manoeuvres [3].

The instrumental method currently considered the “gold standard” for studying swallowing is videofluoroscopy, which gives a real-time investigation of all stages [4, 5]. Fibre-optic endoscopic evaluation of swallowing (FEES) is now the first choice for studying swallowing

*Correspondence:

Nihal Hisham Abdelhamid
Rulucky_23@hotmail.com

¹ Phoniatrics Department, Hearing and Speech Institute, Giza, Egypt



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disorders; it is easy to use, very well tolerated, allows bedside examination, and is economic [6, 7].

The dysphagia handicap index (DHI) is a 25-item self-administered questionnaire. It is a noninvasive tool measuring the handicapping effect of dysphagia in three aspects: the physical, functional, and emotional aspects of life, so a patient can rate the impact of his swallowing problem.

The DHI has 9 questions in the functional, 9 questions for the physical, and 7 questions in the emotional sub-scale [2]. For each question, there are three choices for the answer which is as follows: never, sometimes, and always, with a suggested scoring of 0, 2, and 4, respectively, making the range of the total DHI score from 0 to 100. In addition, at the end of the questionnaire, there is a question about the general subjective impression of swallowing difficulty, with the answer ranging from 1 (normal) to 7 (severe). The DHI is a valid and reliable tool assessing the psychosocial handicapping effects for dysphagia.

The aim of this study is to test the correlation between DHI scores and penetration and aspiration on fibre-optic endoscopic examination of swallowing (FEES) and its ability to predict penetration and aspiration, so we can apply it in all medical centres, ICU units, and other units where FEES is not available and who should refer the patient for further assessment.

Methods

Thirty-three patients (19 males and 14 females) were visiting our specialized dysphagia clinics in the Hearing and Speech Institute, Egypt, and complaining of dysphagia; FEES examination was done as an assessment tool for dysphagia, and DHI was done, with exclusion of affected cognitive state that could interfere the patient from filling the questionnaire, non-Arabic-speaking patients. Illiterate patients or those who are physically disabled were assisted by a family member or the physician, who read the DHI items for them. All participants signed an informed consent form. All patients in the study group underwent a full history taking and physical examination followed by FEES examination on the same day they filled the DHI. Swallowing was evaluated using Flexible video fibro-naso-laryngoscopy directly with three consistencies (liquid, semisolids, and solid). Patients had to feed themselves or with assistance as needed. Swallowing was evaluated for the presence of penetration or aspiration and scored using the Penetration-Aspiration Scale (PAS).

Eight-point Penetration-Aspiration Scale (PAS) [3] is as follows:

Score	Description of events
1	Material does not enter airway
2	Material enters the airway, remains above the vocal folds, and is ejected from the airway
3	Material enters the airway, remains above the vocal folds, and is not ejected from the airway
4	Material enters the airway, contacts the vocal folds, and is ejected from the airway
5	Material enters the airway, contacts the vocal folds, and is not ejected from the airway
6	Material enters the airway, passes below the vocal folds, and is ejected into the larynx or out of the airway
7	Material enters the airway, passes below the vocal folds, and is not ejected from the trachea despite effort
8	Material enters the airway and passes below the vocal folds, and no effort is made to eject

The collected data was revised, coded, tabulated, and introduced to a PC using Statistical Package for Social Science (SPSS 15.0 for windows; SPSS Inc., Chicago, IL, USA, 2001). Data was presented, and suitable analysis was done according to the type of data obtained for each parameter.

Results

Demographic analysis

The studied group was 33 patients (19 males and 14 females) and mean age 61 years \pm 13.8 years, with residence (urban 29 and rural 4 patients) and occupation varied from official work, housewife, and retired.

There were no statistically significant differences between gender regards FEES score. Although that the percentage of score 8 for male was higher than that for female, but that difference was not statistically significant.

There were no statistically significant differences between gender regards DHI cut off value for penetration and aspiration.

Also, there were no statistically significant differences between residence and occupation regards DHI cut off value for penetration and aspiration (Fig. 1).

We had chosen the cut off value for the DHI score 41 for penetration while for aspiration is 68 (ROC curve, Figs. 2 and 3) with P -value < 0.001 highly significant.

Regarding the penetration, there were 11 cases with no penetration problem, diagnosed by FEES finding, while DHI decided cut off value for penetration (score 41) detected 8 (72.7%) cases from 11 cases with no penetration problems {specificity}.

There were 22 cases, with yes have penetration problems, diagnosed by FEES finding. DHI decided cut off value for penetration (score 41) and detected 21 (95.5%) cases from 22 cases with yes have penetration problems {sensitivity}.

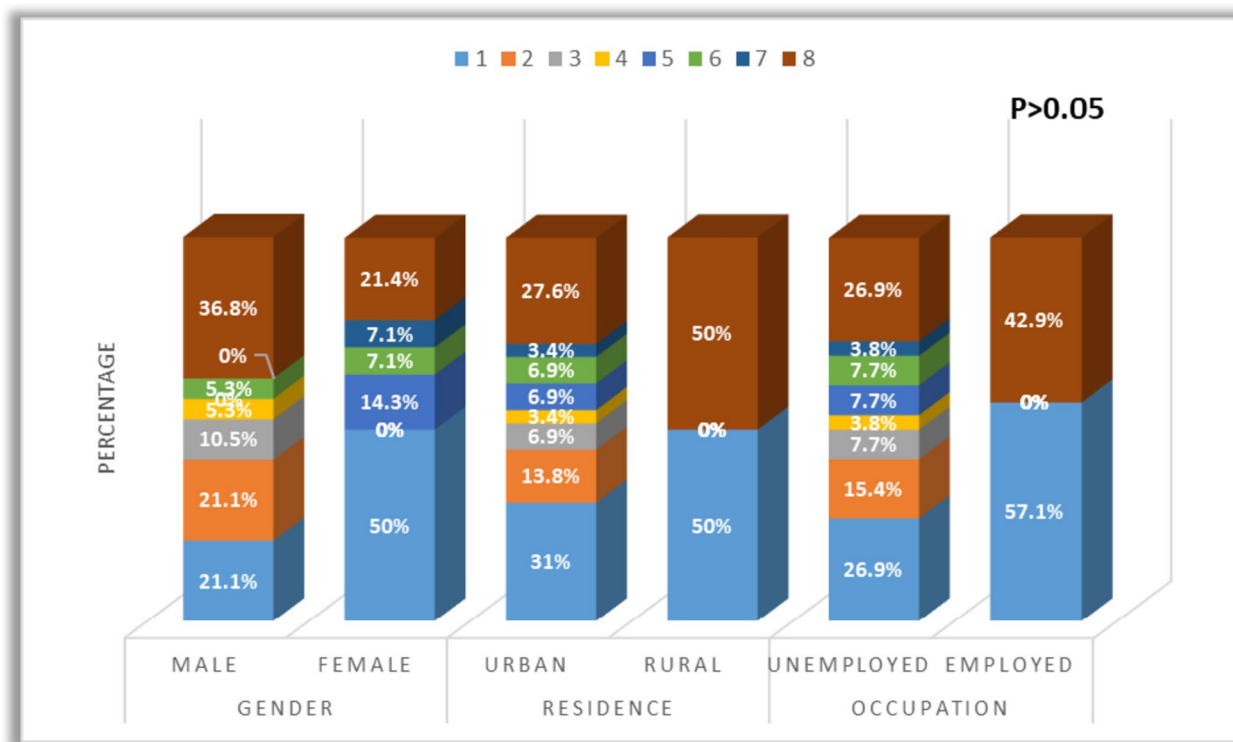


Fig. 1 Bar chart representing comparison between demographic data regards FEES

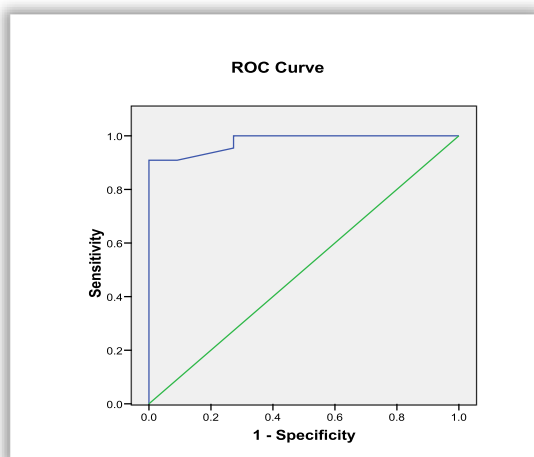


Fig. 2 Penetration

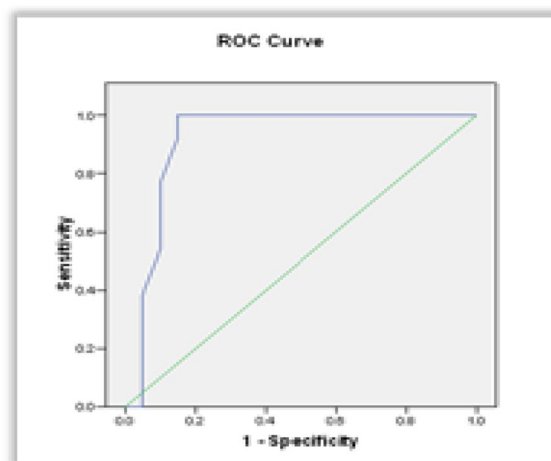


Fig. 3 Aspiration

Regarding the aspiration, there were 20 cases with no aspiration problems, diagnosed by FEES finding, while DHI decided cut off value for aspiration (score 68) detected 17 (85%) cases from 20 cases with no aspiration problems {specificity}.

There were 13 cases, with yes have aspiration problems, diagnosed by FEES finding. DHI decided cut off

value for aspiration (score 68) and detected 13 (100%) cases from 13 cases with yes have aspiration problems {sensitivity}.

There was a direct correlation between DHI score and FEES score. Also, there was direct correlation between DHI score and age, there was no correlation between FEES score and age (Table 1 and Fig. 4).

Table 1 Correlation between FEES, age, DHI score

		FEES	Age
DHI score	<i>R</i>	0.835 ^b	0.386 ^a
	<i>P-value</i>	<0.001	0.026
	<i>Sig</i>	HS	S
Age	<i>r</i>	0.287	
	<i>P-value</i>	0.106	
	<i>Sig</i>	NS	

Pearson correlation, ^aS, ^bHS

There was statistically highly agreement between FEES finding and DHI score cut off value regards penetration and aspiration problems (Table 2 and Fig. 5).

Regarding the comparison between diagnosis and FEES score and the DHI cut off value, the higher percentages of neurological and cancer dysphagia diagnosis were in score 8 {aspiration (material enters the trachea with no attempt to clear)}. The higher percentages of GERD and trauma were in score 1 {(none) (no entry of material into the larynx or trachea)}. The higher percentage for autoimmune disease was in score

3 {penetration (entry of material into larynx without cleaning)}. These differences were statistically highly significant (Table 3 and Fig. 6).

The higher percentage of neurological, cancer, and autoimmune diseases show a DHI cut off value either at >41 for penetration or >68 cut-off for aspiration, while the higher percentage of GERD and trauma show DHI cut off value <41 for penetration or <68 cut-off for aspiration among DHI score. Those differences were statistically highly significant (Table 4 and Fig. 7).

Discussion

DHI is a multiple self-evaluation questionnaire, allowing evaluation of swallowing quality of life and monitoring the efficacy of a treatment [4]. In contrast with the objective assessment for the patient with FEES or videofluoroscopy, this self-evaluated questioner has an important advantage of being inexpensive, fast, and easily reproducible over time; however, it is important to remember that its sensitivity, specificity, and positive predictive value are inferior to that of the objective tools [5]. There are many questioners for dysphagia, but Timmerman et al. revealed that the SwAL-QOL has the

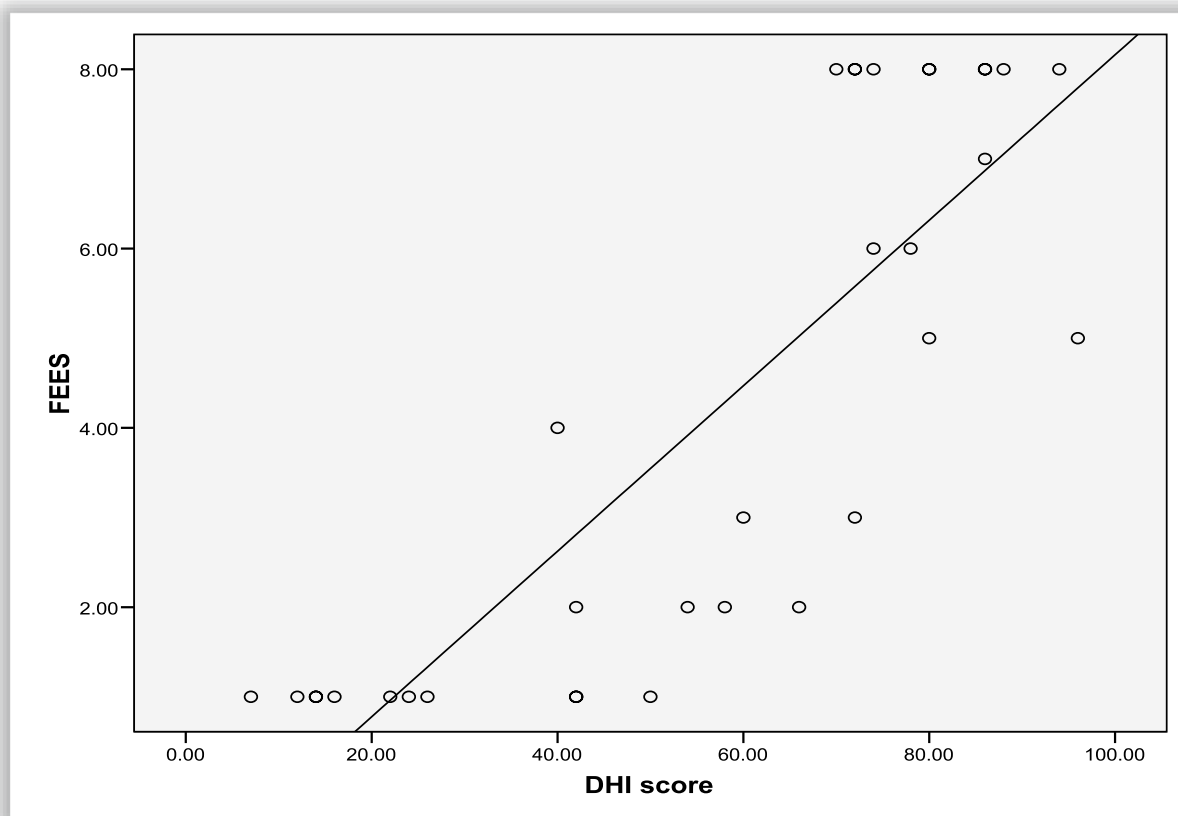


Fig. 4 Scatter dot representing correlation between DHI score and FEES

Table 2 Measure of agreement between FEES finding regards DHI cut off value for penetration and aspiration

		Penetration			Kappa	p-value	Sig
DHI cut off value		No	Yes	Total			
Penetration	< 41	8 (72.7%)	1 (4.5%)	9 (27.3%)	0.71	<0.001	HS
	> 41	3 (27.3%)	21 (95.5%)	24 (72.7%)			
	Total	11 (100%)	22 (100%)	33 (100%)			
		Aspiration			Kappa	p-value	Sig
DHI cut off value		No	Yes	Total			
Aspiration	< 68	17 (85.0%)	0	17 (51.5%)	0.82	<0.001	HS
	> 68	3 (15.0%)	13 (100%)	16 (48.5%)			
	Total	20 (100%)	13 (100%)	33 (100%)			

Measure of agreement (Kappa test)

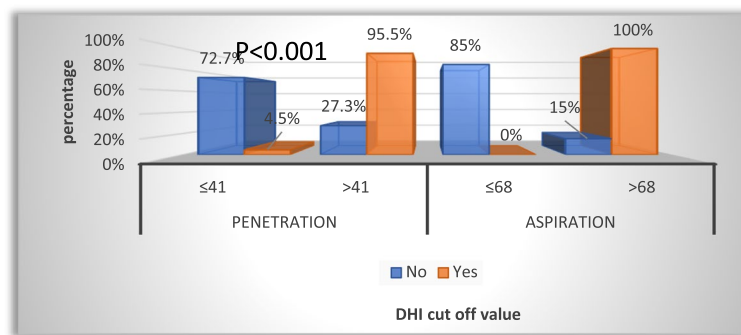


Fig. 5 Bar chart representing measure of agreement between FEES finding regards DHI cut off value for penetration and aspiration

Table 3 Comparison between diagnosis regards FEES

FEES	Neurological	GERD	Cancer	Trauma	Autoimmune ds	Total	χ ²	p-value
None	0	10 (90.9%)	0	1 (100%)	0	11 (33.3%)	53.68	< 0.001 HS
2	2 (11.8%)	1 (9.1%)	1 (33.3%)	0	0	4 (12.1%)		
3	1 (5.9%)	0	0	0	1 (100%)	2 (6.1%)		
4	1 (5.9%)	0	0	0	0	1 (3.0%)		
5	2 (11.8%)	0	0	0	0	2 (6.1%)		
6	2 (11.8%)	0	0	0	0	2 (6.1%)		
7	1 (5.9%)	0	0	0	0	1 (3.0%)		
8	8 (47.1%)	0	2 (66.7%)	0	0	10 (30.3%)		
Total	17 (100%)	11 (100%)	3 (100%)	1 (100%)	1 (100%)	33 (100%)		

Fisher's exact chi-square test

best psychometric parameters, while DHI is the easier to use and apply [6].

PAS scores showed a high *inter-rater reliability*. The PAS was initially developed by Rosenbek et al. in 1996 to describe aspiration and penetration events [7]. It is an 8-point ordinal scale, with 1 (the least) to 8 (highest severe score). PAS scores are multidimensional, i.e. include several observations in each score: (1) depth of

airway invasion (material above, contacting, or below the level of vocal folds); (2) whether or not the material is remaining after the swallow (ejected, not ejected); and (3) the patient's response when material enters the airway (effort to clear the material).

In this study, there were statistically high significance correlation between the cut off values for penetration and aspiration with the FEES examination finding (scored by

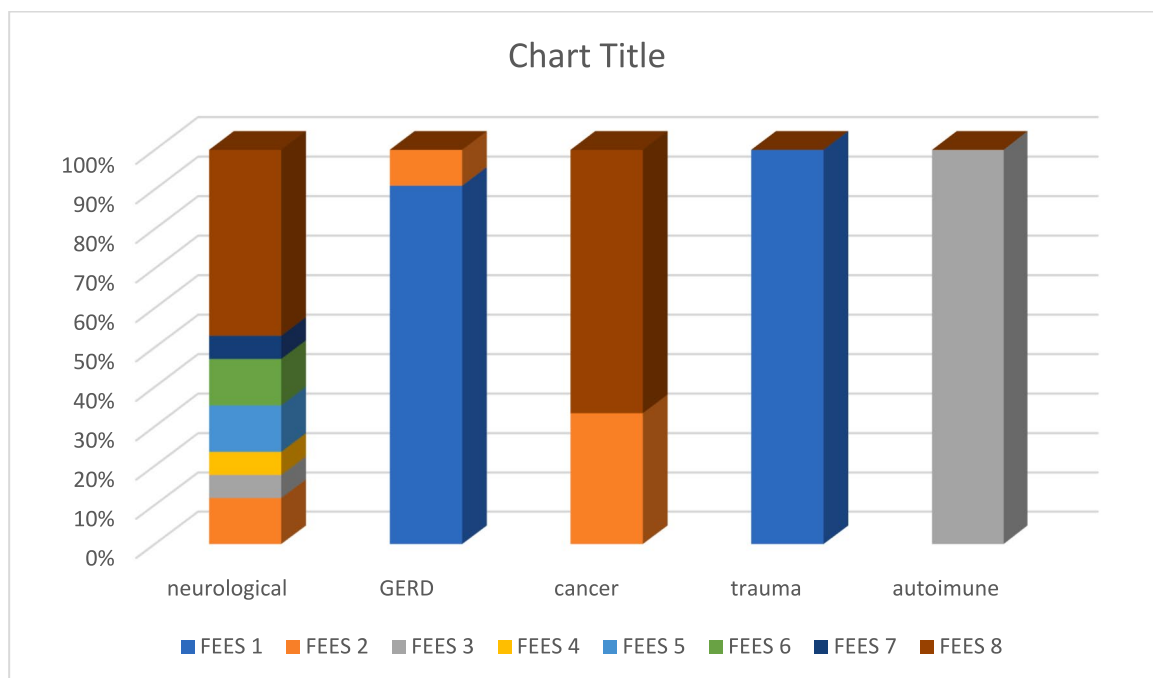


Fig. 6 Bar chart representing comparison between diagnosis regards FEES

Table 4 Comparison between diagnosis regards DHI cut off value for penetration and aspiration

DHI cutoff	Diagnosis	Neurological	GERD	Cancer	Trauma	Autoimmune Ds	Total	χ^2	p-value
Penetration	≤ 41	1 (5.9%)	7 (63.6%)	0	1 (100%)	0	9 (27.3%)	13.96	0.001 HS
	> 41	16 (94.1%)	4 (36.4%)	3 (100%)	0	1 (100%)	24 (72.7%)		
	Total	17 (100%)	11 (100%)	3 (100%)	1 (100%)	1 (100%)	33 (100%)		
Aspiration	≤ 68	4 (23.5%)	11 (100%)	1 (33.3%)	1 (100%)	0	17 (51.5%)	19.37	<0.001 HS
	> 68	13 (76.5%)	0	2 (66.7%)	0	1 (100%)	16 (48.5%)		
	Total	17 (100%)	11 (100%)	3 (100%)	1 (100%)	1 (100%)	33 (100%)		

Fisher’s exact chi-square test

PAS score), with a strong direct correlation between the DHI score and the FEES finding, so when DHI score is 41 or more, we should suspect penetration, and when the DHI score is 68 or more, we should suspect aspiration.

Which strengthen the idea of generalizing the use of DHI as a simple way to screen for patients with high risk of penetration and aspiration. The targeted clinics are not only ICU unit but also all other medical units especially the neurology clinic, rheumatology clinic, and oncology clinic.

Regarding our results, the majority of high scores of DHI and also for FEES PAS score 8 was for neurological diseases especially stroke patient with agreement to the results of Ramsey et al. who postulated that dysphagia is very common in stroke patients, and the most

important consideration initially is aspiration risk and suitability for oral feeding [8].

GERD also causes dysphagia symptoms but not that severity of neurological causes; also, Nesrine et al. found a highly statistically significant positive correlation between the overall severity of swallowing and GERD. This relation was higher before medical treatment than after the treatment as food modification and medication [9].

Conclusion

DHI can be used as preliminary tool for rapid assessment of patients with swallowing difficulties as a fast, easy, non-expensive tool, especially in areas where

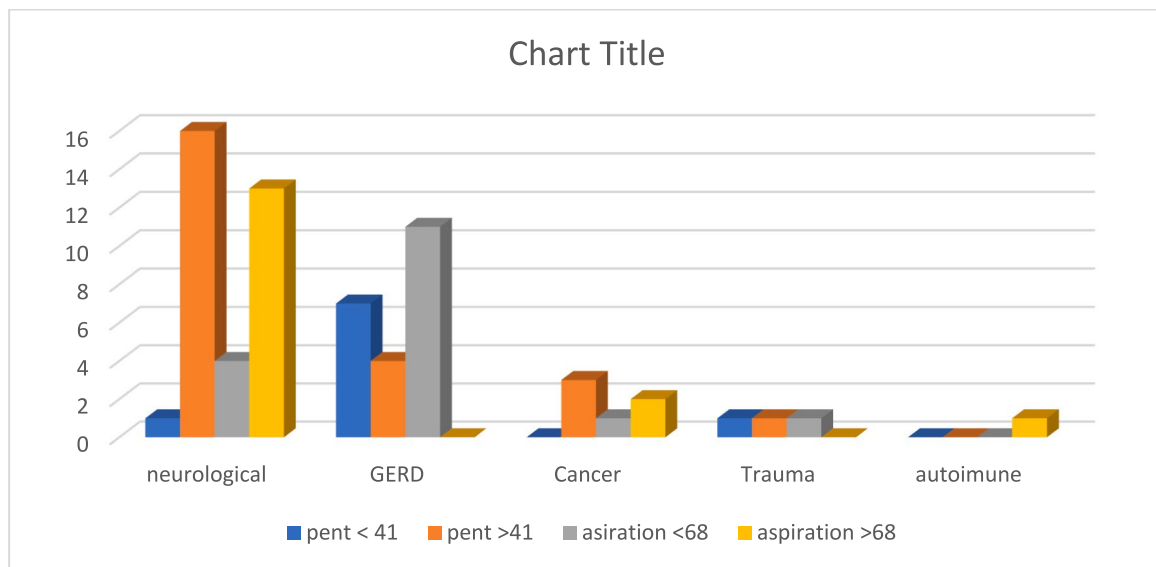


Fig. 7 Bar chart representing comparison between diagnosis regards DHI cut off value for penetration and aspiration

there is no access to apply FEES or videofluoroscopy, and upon its results, the patient should be or not referred to a specialized swallowing assessment clinic. Also, DHI should be applied in all neurological units, oncology, and rheumatology clinics to early detect swallowing disorders and referral for early intervention which should minimize possible complications.

Abbreviations

FEES Fibre-optic endoscopic evaluation of swallowing
DHI Dysphagia handicap index

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Not applicable.

Authors' contributions

Idea of the research, assessment and applying the questionnaire, scoring of dysphagia score, data collection, and writing manuscript were done by Dr. Nihal Hisham. Assessment of patients, data collection, sharing in writing manuscript were done by Dr. Iman Elrouby.

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Availability of data and materials

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Ethical approval was obtained for the current study from the ethics and research committee of the National Hearing and Speech Institute, Egypt, and the patients signed a fully written informed consent before enrolment in the study.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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References

- Sukkar SG, Maggi N, Travalca Cupillo B, Ruggiero C (2018) Optimizing texture modified foods for oro-pharyngeal dysphagia: a difficult but possible target? *Front Nutr* 5:68. <https://doi.org/10.3389/fnut.2018.00068>
- Farahat M, Malki KH, Mesallam TA, Bukhari M, Alharethy S (2014) Development of the Arabic version of Dysphagia Handicap Index (DHI). *Dysphagia* 29(4):459–67. <https://doi.org/10.1007/s00455-014-9528-7>
- Rosenbek JC, Robbins JA, Roecker EB, Coyle JL (1996) Wood JL (1969) A penetration-aspiration scale. *Dysphagia* 11(2):93–8
- Patel D, Sharda R, Hovis K, Nicholas E, Sathe N, Penson D (2017) Patient reported outcome measures in dysphagia; a systematic review of instrument development and validation. *Dis esophagus* 30(5):1–23
- Jensen K, Lambertsen K, Torkov P, Dahal M, Jensen A, Grau C (2007) Patient assessed symptoms are poor predictors of objective findings, results from a cross sectional study in patients treated with radiotherapy for pharyngeal cancer. *Acta Oncol* 46(8):1159–1168
- Timmerman A, Heijnen B, Klijn-Zwijnenberg, (2014) Psychometric characteristics of health related quality of life questionnaires in oropharyngeal dysphagia. *Dysphagia* 29(2):183–198. <https://doi.org/10.1007/s00455-013-9511-8>
- Rosenbek JC, Robbins JA, Roecker EB, Coyle JL, Wood JL (1996) A penetration-aspiration scale. *Dysphagia* 1996;11(2):93–8. <https://doi.org/10.1007/BF00417897>
- Ramsey DJ, Smithard DG, Kalra L (2003) Early assessments of dysphagia and aspiration risk in acute stroke patients. *Stroke* 34(5):1252–7. <https://doi.org/10.1161/01.STR.0000066309.06490.B8>
- Mahmoud N, Atta A, Elhamouly M, Abdelmonem A, Bassiouny, (2021) Dietary risk factors and therapy outcomes of swallowing-related problems in laryngopharyngeal reflux: patients' perspectives. *Egypt J Otolaryngol* 37:73

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