Original Article

Bedside assessment protocol and grading scale for dysphagia in adults: A preliminary study

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Abstract

Objectives: The present study aimed to construct a bedside assessment protocol and grading scale to assess and grade orophayngeal dysphagia in a heterogeneous sample of the patients. This study also aimed to determine the utility of the constructed assessment and grading scale in terms of reliability and validity. **Materials and Methods:** The Nair hospital bedside swallowing assessment (NHBSA) and Nair hospital swallowing ability scale (NHSAS) were constructed after reviewing pertinent literature. Fifty individuals with oropharyngeal dysphagia were assessed and graded using the constructed assessment and grading scale. Of the total sample, 10 individuals were subjected to a modified barium swallow (MBS) evaluation. **Results:** The NHBSA and NHSAS show high reliability and high face and content validity. Comparison with MBS revealed that the NHBSA appears to be promising in accurately identifying dysphagia and aspiration. Also, the NHBSA and MBS diagnosed the same phases of swallowing to be affected in eight out of ten patients. 'Wet-gurgly voice quality,' 'cough after/during swallow,' and 'weak/absent volitional cough' were the clinical indicators that appeared to correctly identify presence of aspiration risk. The NHSAS shows sensitivity to change in swallow function and oral intake overtime. **Conclusion:** The NHBSA appears to be a simple, quick, reliable and valid clinical assessment that can be used to assess the oropharyngeal dysphagia at the individual's bedside with minimal risk for discomfort or aspiration. Also, the NHSAS appears to be useful tool for clinically grading individuals with dysphagia into categories based on swallowing ability, and enables making recommendations.

Key words: Aspiration, dysphagia, modified barium swallow, sensitivity

Introduction

Dysphagia evaluation comprises of a case history, a clinical bedside evaluation and objective evaluation (modified barium swallow, flexible fiber-optic endoscopic evaluation of swallowing etc). No consensus currently exists on a standard method of assessment.[1] The clinical bedside evaluation is the first evaluation procedure conducted after which an instrumental evaluation may be performed. It provides a preliminary assessment of the patient's current medical status, his or her needs for nutrition, the need for an instrumental evaluation, and helps to plan rehabilitation and evaluates the outcome of treatment. In the clinical evaluation, the clinician tests the individual's ability to swallow food and/or liquid of varying consistencies and volumes without placing the patient at increased risk of aspiration.[2] The clinician may auscultate the individual's laryngeal area with a stethoscope (cervical auscultation) or palpate the individual's hyolaryngeal area as he swallows using Logemann's four-finger test.[3]

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The bedside examination is reported to have variable sensitivity and specificity in detecting oropharyngeal dysphagia and aspiration.[4-6] This indicates that the bedside examination of swallowing may lead to an underestimation of the presence of dysphagia as well as the risk of aspiration, particularly silent aspiration.[7] Hence there exists a need for objective evaluation. However, an objective evaluation may not always be possible due to reasons such as medical instability, lack of cooperation etc. Martino *et al*., reported survey data, which indicated that 71% of the respondent dysphagia clinicians (SLPs) performed a complete clinical examination of dysphagia.[8] Conversely, only 36% of these clinicians completed an instrumental swallowing examination. Moreover, the instrumental examinations were rarely completed in the absence of the full clinical examination. This strongly suggests that the clinical examination of swallowing is the primary and most practiced method of swallow assessment among the practicing clinicians.

In India, with limited availability and high cost of objective evaluation procedures, most clinicians rely only on clinical assessments and their clinical judgments to assess and treat oropharyngeal dysphagia. However, very few clinical assessment protocols are commercially available. The only available protocol[9] is extremely comprehensive, for testing swallowing ability (and dysphagia), but not for swallow safety. This may lead to under diagnosis of aspiration, especially by beginner clinicians. Also, its detailed nature renders it time consuming for use in an acute care setup, making it more suitable for use only in out-patient care and rehab-care settings.

Therefore, we attempted to construct a clinical assessment protocol, which is comprehensive, accurate yet quick and easy to administer across all clinical settings, especially for the Indian context where even in the metropolitan cities extremely few centers have the means for an objective evaluation.

A grading scale enhances the effectiveness of assessment by helping in estimating the severity of dysphagia, tracking outcome, and judging the appropriateness of the initiated intervention program. To the best of researchers' knowledge, no such scale is available in India, and very few of the grading scales available from western literature apply to a heterogeneous clinical population. Thus, we constructed a clinical scale that enables a functional classification of all patients with dysphagia based on their performance during the clinical bedside swallow assessment, and aids in decision-making regarding the mode of nutritional intake.

This study aimed to construct a bedside assessment protocol and grading scale to assess and grade orophayngeal dysphagia in a heterogeneous sample of patients. It also aimed to determine the reliability and clinical utility (validity) of the constructed assessment and grading scale.

Materials and Methods

This study was carried out in two parts:

Part I – Construction of a bedside dysphagia assessment protocol and a grading scale

The Nair Hospital bedside swallowing assessment (NHBSA) was prepared after reviewing pertinent protocols.[3,10,11] It includes the individual's medical history, examination of the oral, pharyngeal, laryngeal and respiratory mechanism, and a swallow evaluation. The swallow evaluation includes testing the individual's ability to swallow saliva, and different food and liquid consistencies. A 40-item dysphagia assessment checklist was prepared to identify the phase of swallowing that is impaired, and to ascertain the presence of aspiration. This checklist was prepared in the form of a 'Yes/No' checklist, which the clinician has to rate every 'Yes' as 1 and every 'No' as 0 such that 'yes' indicates the presence of swallowing difficulty or presence of aspiration and 'No' indicates the normal functioning [See Appendix A]. This checklist is to be scored after the swallowing evaluation with different food and liquid consistencies. Logemann's four-finger test is to be used to assess hyolaryngeal movement with respect to initiation and excursion. A stop-watch, is to be used to calculate the time the individual's swallow in order to calculate the swallow duration for saliva and all the tested consistencies (adapted from Bhinderwala).[12]

Swallow duration for dry swallow

Operational definition: The time duration between the end of instruction given for swallowing and the first palpable hyoid elevation.

Swallow duration for thin-liquid via spoon and glass, thick liquid, and soft solid

Operational definition

The time duration between placement of food material in the mouth and the first palpable hyoid elevation.

Continuous drinking of thin liquid with glass is not timed. Normative data for swallow durations for dry (saliva) swallow, thin liquid and soft solid were obtained from Bhinderwala.[12] This did not include swallow duration for thick liquids. Thus, normative data was collected for the same in 30 typical adults in the age range of 18–70 years.

The Nair hospital swallowing ability scale (NHSAS) was constructed after reviewing scales such as Functional Oral Intake Scale, Dysphagia Outcome and Severity Scale, and ASHA-National Outcome Measurement system for swallowing.[13-15] The NHSAS is an ordinal 7- point scale ranging from 0 indicating normal swallow function and 6 indicating complete dysphagia [see Appendix B]. The grading scale was based on parameters such as the extent of difficulty in swallowing, presence of aspiration and its type (audible, weak, silent), number of consistencies tolerated by the individual, modification of consistency of food and use of swallowing maneuvers to swallow successfully, and ability to manage secretions. Based on this, each grade has a recommendation.

Procedure

During the swallow evaluation of food and liquid, the patient needs to be seated in an upright position. First, a dry swallow is assessed using Logemann's four-finger test after adequate oral hygiene.[16] Once safe swallow is ensured for saliva, food trials can be conducted as shown in [Table 1].

A regular tablespoon is used, and at each step, the swallow duration for that consistency is measured. If the patient can swallow 5 ml water via spoon adequately, then continuous drinking of 30 ml of water via glass is tested. If the patient can tolerate soft solid, then swallowing of hard solids should be assessed. At each step, the clinician looks for signs of dysphagia and aspiration as mentioned in the checklist. For patients with tracheostomy, food dye (blue or green in color) should be mixed with the food or liquid used for the swallow trial. Tracheal suctioning should be done post swallow to look for presence of the dye color in the suctioned secretions. Presence of color should be considered as an indicator of aspiration.

Once all the consistencies have been tested and observations are recorded, the speech-language pathologist (SLP) then has to use the grading scale to determine the severity of the dysphagia faced by the individual. Accordingly, recommendations for nutritional intake are made.

Face and content validity

The NHBSA and NHSAS were given to 10 SLPs, 1 Otolaryngologist, and 1 Radiologist for face and content validity. They had to rate every item in the bedside assessment protocol, give an overall rating for the bedside assessment, and give an overall rating for the grading scale as 'appropriate', inappropriate, or 'fairly appropriate'. Items that received a rating of 'appropriate', 'fairly appropriate, and 'inappropriate' by more than 80% judges were to be retained, revised, and removed, respectively. However, none of the items were rated as 'fairly appropriate' or 'inappropriate' by more than 80% judges. Hence, all the items were retained. The assessment and grading sale were then used on the participants.

Table 1: Order of food trials for swallow assessment

Thin liquid	5 ml water via spoon; 30 ml water via glass
Thick liquid	5 ml biscuit-milk mixture
Soft solid	Small piece of biscuit dipped in milk

Testing with NHBSA and NHSAS

Participants

Participants for this study included 50 patients with dysphagia from two municipal hospitals in South Mumbai. Convenience sampling was used.

Group A

30 individuals with neurogenic dysphagia.

Group B

20 individuals with mechanical dysphagia.

Operational definitions

Neurogenic Dysphagia

Dysphagia due to stroke and other neurologic disorders (parkinson's disease, multiple sclerosis), and connective tissue diseases (polymyositis, muscular dystrophy).

Mechanical Dysphagia

Dysphagia due to structural lesions (neoplasm, ingestion of caustic material etc) and iatrogenic causes (surgical resection, radiation fibrosis, medications etc).

Individual who were to maintain strict 'Nil by mouth' status by the respective medical faculty, with impaired cognition, and those with impaired auditory comprehension, were excluded. After taking informed consent, clinical swallowing evaluation using the NHBSA was conducted on the patient. KADIO KD-1069 stop-watch was used to time the swallows. Each patient was graded using the NHSAS based on the assessment findings.

Reliability

Inter-rater reliability

The researcher and another SLP assessed and graded swallowing in 10% (n = 6) of the patients within 24 hours of the researcher's first assessment using the constructed NHBSA and NHSAS.

Intra-rater reliability

The researcher repeated the bedside assessment and grading in 10% (n = 5) of the patients within 24 hours of the first assessment.

The parameters compared were the checklist scores, the phase(s) of swallowing affected, presence of aspiration risk, oral swallow duration for dry swallow and food, and the grade ascribed on the grading scale.

Part II: Determining the clinical utility of the constructed assessment protocol and grading scale

Nair hospital bedside swallow assessment

Criterion based validity of the NHBSA was done by comparing its results with that of a modified barium swallow (MBS) in 20% of the sample. Of the 50 patients tested, ten (5 from each group) were subjected to a MBS procedure. Individuals who were not able to stand independently for at least 5 minutes, or those who are not able to alter their head position were excluded.

Instrumentation

Siemens Sireskop CX (X-ray system with fluoroscopy) was used with an image acquisition rate of 8 frames/second.

After taking informed consent, MBS was done in a lateral view by a radiologist and the researcher. The patient was tested in standing position using liquid barium of 2 consistencies (i.e. thick liquid and thin liquid). Two head positions (normal head position and head back or chin tuck as indicated by the bedside assessment previously performed) were tested. The MBS was interpreted by the radiologist and the SLP.

Nair hospital swallowing ability scale

The clinical utility of the constructed grading scale was determined by testing its sensitivity to change in swallowing ability overtime. Of the 50 patients tested and graded, 15% (n = 7) were followed up till the time of discharge. Grading was repeated with the NHSAS.

Statistical analyses

Cronbach's alpha was calculated for inter-rater reliability of the NHBSA and NHSAS. Pearson's product moment correlation coefficient and Spearman's rank correlation was used for intra-rater reliability. For criterion-based validity of the NHBSA, the results of the bedside assessment and MBS were compared. Chi-square test and Fisher's exact test were used to calculate the difference in the results between the NHBSA and MBS.

Results

Of the 50 patients tested with the constructed NHBSA and NHSAS, the mean age of patients with mechanical dysphagia was 42.5 years and that of neurogenic dysphagia group was 50.5 years. [as shown in Table 2].

As seen in Figure 1, majority of the individuals with mechanical dysphagia had cancer of the oral cavity, pharynx, and larynx in situ or had undergone treatment for it (i.e. surgery, chemotherapy, radiation, or a combination). As seen in Figure 2, individuals with Cerebrovascular accident (CVA) formed the majority followed by individuals with unilateral vocal fold paralysis (UVFP) in the neurogenic dysphagia sample.

Reliability

Reliability of the NHBSA

The inter-rater and intra-rater reliability of the bedside assessments were seen to be very strong for all parameters except for the measurement of swallow duration for dry swallow, for which inter-rater correlation was moderate

Table 2: Mean, standard deviation, minimum and maximum age (in years) for individuals with mechanical and neurogenic dysphagia

Dysphagia type	*N*	Mean (years)	S.D. (years)	Minimum (years)	Maximum (years)
Mechanical	20	42.45	16.75	18	80
Neurogenic	30	50.53	16.97	23	80

SD: Standard deviation

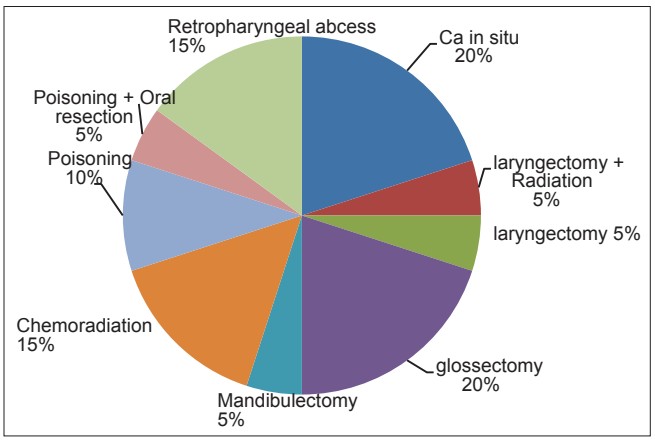

Figure 1: Distribution of etiologies in mechanical dysphagia group

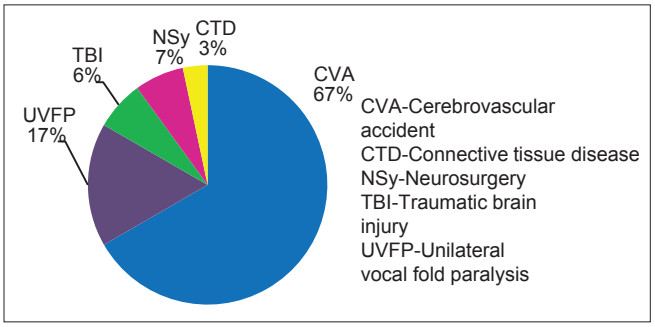

Figure 2: Distribution of etiologies in neurogenic dysphagia group

(Cronbach's alpha = 0.49) and intra-rater correlation was found to be poor (r = 0.29) [Tables 3-5].

Reliability of the NHSAS

Perfect positive correlation was found for both inter-rater (Cronbach's alpha = 1.0) and intra-rater reliability (Spearman's ρ =1.0).

Validity of the NHBSA and NHSAS

Face and content validity of the NHBSA and NHSAS

Face and content validity was done by 12 professionals (10 SLPs, 1 Radiologist, and 1 Otolaryngologist). All the items included in the bedside assessment were judged as appropriate by more than 90% of the judges. No item was judged as fairly appropriate or inappropriate by more than 80% of the judges. Thus, all items were retained and no revisions were required. The grading scale was also judged to be appropriate by all the judges (100%).

Criterion-based Validity of the bedside assessment tool

The results of the NHBSA were compared with the findings of the MBS, on the three parameters: Identifying dysphagia, identifying the impaired phase of swallowing, and identifying aspiration. These parameters were compared for head in normal (neutral) position, i.e. effect of positional changes on aspiration and swallowing ability were not used for statistical comparison.

Identifying dysphagia

It was seen that the NHBSA diagnosed dysphagia (abnormal swallowing) in all the 10 patients who underwent MBS. The MBS also interpreted all 10 patients to have abnormal swallowing. This suggests that the NHBSA appears to correctly identify an abnormal swallow and therefore diagnose dysphagia [Table 6].

Identifying the phase affected

Four patients were identified to have pharyngeal phase affected on MBS. The NHBSA also identified the same phase to be affected in 3 of these patients. Out of the remaining 6 patients identified as 'oral and pharyngeal' phases affected on the MBS, 5 were correctly identified by the NHBSA with the remaining one identified as only 'pharyngeal' phase affected. On Chi-Square analysis, Fisher's exact test showed that the differences observed in the diagnoses between the MBS and NHBSA are statistically not significant (Chi-square = 3.403, P = 0.190). Thus, in the present study both the diagnostic tools (NHBSA and MBS) appear to diagnose the same phases of swallowing to be impaired in most of the (8/10 i.e. 80%) patients [Table 7].

Identifying aspiration

Out of the ten patients tested with MBS, aspiration was present in five. The NHBSA correctly identified aspiration to be present in all the five patients seen to aspirate on MBS. Out of the five patients seen to have the aspiration absent, the NHBSA gave false positive results for aspiration in four patients. However, in two of these four patients, laryngeal penetration was seen on MBS. The NHBSA correctly judged aspiration to be absent for one patient, and did not give any false negative results. This indicated that there is a very low possibility of aspiration being missed on this NHBSA. Fisher's exact test showed that the differences observed in the diagnoses of aspiration between the two tools are statistically not significant (Chi-square = 1.667, P = 0.400) [Tables 8 and 9].

Table 3: Cronbach's Alpha results for inter-rater reliablity

Parameters	*N*	Cronbach's alpha	Correlation
Checklist score	6	0.992	Very strong
Phase affected	6	1.00	Perfect
Aspiration risk	6	1.00	Perfect
Swallow duration-dry	6	0.488	Moderate
Swallow duration-thin liquid	6	0.992	Very strong
Swallow duration-thick liquid	5	0.779	Strong
Swallow duration-soft solid	5	0.997	Very strong

Table 4: Pearson's product moment correlation results for intra-rater reliability

Parameters	*N*	Pearson's correlation	Correlation
Checklist score	6	0.998	Very strong
Swallow duration-dry	6	0.288	Poor
Swallow duration-thin liquid	6	0.981	Very strong
Swallow duration-thick liquid	5	0.935	Very strong
Swallow duration-soft solid	5	0.999	Very strong

Table 5: Spearman's rank order correlation results for intra-rater reliability

	N	Spearman's ρ	Correlation
Phase affected	6	1.00	Perfect
Aspiration	6	1.00	Perfect

Table 6: Crosstabulation of results of diagnosis of dysphagia obtained on bedside assessment with MBS

	MBS		Total=10
	Abnormal	Normal	
Bedside			
Abnormal	10 (TP)	0 (FP)	10
Normal	0 (FN)	0 (TN)	0

MBS: Modified barium swallow; TP: True positive; FP: False positive; FN: False negative; TN: True negative

Accuracy of individual clinical indicators of aspiration in the checklist of NHBSA

The clinical indicators 'wet, gurgly voice quality', 'cough during/after swallow', and 'weak/absent volitional cough' correctly identified the presence of aspiration in the patients seen to have aspiration present on MBS. However, they have poor values of correctly identifying absence of aspiration. Indicators such as 'poor management of secretions' and 'no volitional attempt to clear throat' were seen to correctly judge aspiration to be absent [Table 10].

Comparison of swallow duration between typical individuals and individuals with dysphagia

An increase in the swallow duration was observed with change in consistency from dry swallow, thin liquid through soft solids for all individuals (typical and individuals with dysphagia). The swallow duration of the individuals in the two groups (neurogenic dysphagia and mechanical dysphagia) was compared with normative data. Findings revealed that the swallow duration for both the groups are significantly longer than in typical individuals for dry (saliva) swallow as well as food swallows [Tables 11 and 12].

Sensitivity to change of NHSAS

Out of the total 50 patients tested with the NHBSA and graded with the NHSAS, 15% (n = 7) were followed up till the time of discharge from swallowing rehabilitation services. They demonstrated improvement in swallowing ability through the course of therapy. At the time of discharge, they were graded using the NHSAS again. It was observed that all of them had moved to a better grade on the scale. For e.g., one patient was graded as 'severe dysphagia' (grade 5) on initial assessment and was graded as 'slight dysphagia' (grade 1) after a period of swallowing therapy. This indicates that the NHSAS is sensitive to change in swallow function. This adds to the utility of the constructed NHSAS and indicates that it can be used in the clinical context as an outcome tracking tool in individuals with dysphagia.

Correlation of the NHBSA checklist scores and grading ascribed on NHSAS

Spearman's rank order correlation coefficient rho was calculated at 0.01 level (2-tailed). A moderate positive correlation exists between the NHBSA checklist scores and grading on NHSAS for both the groups i.e. mechanical dysphagia and neurogenic dysphagia [Table 13].

Discussion

The clinical bedside examination of swallowing is the most widely used method of assessing oropharyngeal dysphagia worldwide. In India, in most clinical set ups, it is the only assessment performed by the SLP to evaluate and treat dysphagia. Therefore, a comprehensive and user friendly assessment protocol i.e the NHBSA and a simple clinical grading scale i.e. the NHSAS for oropharyngeal dysphagia were developed. After obtaining face and content validity, the constructed assessment and NHSAS were used on 50 patients with dysphagia. Reliability was tested in 10% of the sample. Criterion-based validity was attempted by subjecting 10 out of the 50 patients (20% of the sample) to a MBS, as MBS is considered as the gold standard for swallow evaluation.

Table 7: Cross tabulation of results of 'phase affected' obtained on bedside assessment with MBS

		MBS		Total=10
	Phase affected	Pharyngeal	Oral+ pharyngeal	100%
Bedside	Pharyngeal	3 (30%)	1 (10%)	4 (40)
Assessment	Oral+pharyngeal	1 (10%)	5 (50%)	6 (60)

MBS: Modified barium swallow

Table 8: Cross tabulation of results of 'Aspiration' obtained on bedside assessment with MBS

		MBS		Total=10
		Present	Absent	
Bedside	Present	5 (TP)	4 (FP)	9
Assessment	Absent	0 (FN)	1 (TN)	1

MBS: Modified barium swallow; TP: True positive; FP: False positive; FN: False negative; TN: True negative

Table 9: Chi-square analysis for comparison of results of beside assessment and MBS

	N	Pearson Chi-square	Fisher's exact test (2-sided)	df	Statistical significance
Phase affected	10	3.403	0.190	1	Not significant
Aspiration	10	1.667	0.400	1	Not significant

MBS: Modified barium swallow; df: Degree of freedom

Table 10: Sensitivity and specificity values of bedside aspiration items for aspiration on MBS

Clinical indicators	Correct identification of aspiration	Correct rejection
Wet, gurgly voice quality	5/5	3/5
Eyes watering/reddening	3/5	3/5
Cough during/after swallow	5/5	1/5
Poor management of secretions	3/5	5/5
Weak/absent volitional cough	5/5	1/5
No volitional attempt to clear throat	0	5/5
Impaired gag	3/5	3/5

MBS: Modified barium swallow

Table 11: Results of one sample *t* test of comparison of swallow duration of various consistencies between typical individuals and patients with mechanical dysphagia

Consistency	Mean+S.D.		*t*-value	df	Sig (2-tailed)	Comment
	Normative	Mechanical dysphagia				
Dry (saliva)	1.20+0.27	1.58+0.73	2.366	19	0.029	Significant difference
Thin liquid	1.31+0.28	1.87+1.24	2.118	19	0.047	Significant difference
Thick liquid	1.76+0.28	2.89+1.79	2.775	18	0.012	Significant difference
Soft solid	7.22+1.74	11.88+5.56	3.655	18	0.002	Significant difference

SD: Standard deviation; df: Degree of freedom

Table 12: Results of one sample *t* test of comparison of swallow duration of various consistencies between typical individuals and patients with neurogenic dysphagia

Consistency	Mean+S.D.		*t*-value	df	Sig (2-tailed)	Comment
	Normative	Neurogenic dysphagia				
Dry (saliva)	1.20+0.27	1.59+0.59	13.87	2526	0.0001	Significant difference
Thin liquid	1.31+0.28	2.03+0.98	3.934	28	0.001	Significant difference
Thick liquid	1.76+0.28	3.82+2.85	3.897	28	0.001	Significant difference
Soft solid	7.22+1.74	12.08+5.4	4.764	27	0.00	Significant difference

SD: Standard deviation, df: Degree of freedom

Table 13: Spearman's rank correlation results for checklist score and grading

Dysphagia type	*N*	Spearman's rho	Correlation
Mechanical	20	0.609	Moderate
Neurogenic	30	0.673	Moderate

NHBSA

Reliability

The inter-rater and intra-rater reliability of the NHBSA was seen to be excellent for all parameters except for the measurement of swallow duration for dry swallow for which inter-rater correlation was moderate (Cronbach's alpha = 0.49) and intra-rater correlation was found to be poor (r = 0.29). This could be due to the method followed for measurement of the swallow duration i.e. the patient is instructed to swallow and the swallow is timed starting from the end of instruction till the first palpable hyoid elevation. Therefore, this being a volitional task will be affected by response time and response proclivity, which can vary depending on a lot of variables such as alertness, ability to follow instructions promptly, generalised weakness, emotional state, compliance etc., that do not interfere as much with measurement of swallow durations of food swallows. Also, since the assessments were repeated within 24 hours, any change in the patient's overall status will result in a change in all these parameters thus causing changes in the swallow duration measured for dry swallow only. Therefore, the dry swallow assessment must be followed by trial with different consistencies with maintenance of due safety precautions, even when the swallow duration of dry swallow is prolonged. This is supported by Christiansen.[17] On the other hand, although the swallow duration for dry swallow is subject to much variation, it is still important to assess it and measure its duration as it indicates if the patient has a safe swallow and thus helps in deciding if trial with food can be initiated. Dry swallow assessment is even more important for planning rehabilitation in patients for whom trial feed assessments are contraindicated due to safety considerations. This is supported by Logemann.[3]

Validity

The NHBSA protocol appears to have face and content validity. Due to the small number of patients who underwent MBS, measures of criterion validity such as sensitivity and specificity cannot be calculated. However, an attempt in that direction has been made. On comparison with MBS, it was seen that the NHBSA could correctly identify an abnormal swallow and therefore diagnose dysphagia in all ten patients who were interpreted to have an abnormal swallow on the MBS. This value is higher than the specificity reported by Edelman, Sheehy-Deardorff, and White who examined burn patients and found that of the 11 abnormal bedside assessments performed, ten (91%) were associated with an abnormal MBS.[18] Also, the NHBSA and MBS identified the same phase of swallowing to be impaired in eight out of ten patients. The MBS identified six patients to have oral and pharyngeal phase impaired and four patients to have only pharyngeal phase impaired. Out of six patients were identified to have 'oral and pharyngeal' phase affected on the MBS, five were identified so also on the NHBSA with the remaining one identified as only

'pharyngeal' phase affected. In this one patient, MBS showed premature spillage of bolus in to the pharynx which is indicative of oral phase impairment. Premature spillage can be identified with objective evaluation only and cannot be identified on clinical examination unless a large amount of the bolus spills into the patent airway and causes a cough before swallow. Out of total four patients identified as only 'pharyngeal' phase affected on MBS, three were identified so also by the NHBSA and the remaining one was identified as 'oral and pharyngeal'. Thus, in the present study both the diagnostic tools (NHBSA and MBS) appear to diagnose the same phases of swallowing in most of the (eight out of ten) cases as confirmed by Chi-square analysis too.

In the present study, MBS showed aspiration to be present in five patients and absent in five patients. Comparison of the NHBSA with MBS for detection of aspiration revealed that the NHBSA correctly identified aspiration to be present in the five patients aspirating on MBS. It also correctly identified aspiration to be absent in one patient who did not aspirate on MBS. For the remaining four patients who did not aspirate on MBS, the NHBSA gave false positive results. It did not give any false negatives. The high number of true positives suggests that the NHBSA appears to have good accuracy in identifying aspiration. Poor sensitivity values have been reported by Smithard *et al*., who reported a sensitivity of 47%.[5] This could be due to the fact that the SLPs were asked to make an overall clinical judgment about aspiration after conducting their bedside assessment, whereas in the present study judgment regarding aspiration was made on the basis of presence of the clinical indicators in the assessment checklist along with overall clinical judgment.

Our extremely poor value of true negatives could be due to the fact that patients who were clearly judged to not aspirate were not subjected to an MBS as it was not indicated. Also, the NHBSA mistook laryngeal penetration for aspiration. Poor specificity values have been reported by DePippo, Holas, and Reding who reported their 3-oz water swallow test to have 26% specificity, Leder and Espinosa who found their clinical examination to have 30% specificity, and Clavé *et al*., who reported the bedside volume viscosity swallow test (V-VST) to have 28.8% specificity for aspiration too.[19-21] The NHBSA gave four false positive results for aspiration i.e., incorrectly interpreted aspiration to be present in four patients who were not seen to aspirate on MBS. Two of these patients were seen to have laryngeal penetration on MBS. Therefore, it seems that the NHBSA had mistaken penetration for aspiration. This is also reported by Smith, Lee, O'Neill, and Connolly who found that both bedside swallowing assessment and oxygen saturation assessment at ≥ 2% desaturation mistook laryngeal penetration for aspiration.[22] This is because differentiation between penetration and aspiration cannot be done clinically, and requires objective tools. The fact that the NHBSA identifies penetration and aspiration (although it does not differentiate between them) indicates that the NHBSA correctly identifies an inadequate airway protection mechanism causing an unsafe swallow. Thus, it identifies the risk of aspiration and not aspiration *per se*. The poor value for identifying absence of aspiration (i.e. true negative) and high number of false positives indicate that this NHBSA may over identify aspiration. This is supported by Leder and Espinosa who concluded that the clinical swallow examination overestimated aspiration risk in patients who did not exhibit aspiration on objective evaluation.[20] Even so, this does not seem to have a major negative impact on the swallowing therapist or the individual with dysphagia, as it may just lead to the therapist exercise greater caution to guard against aspiration. Also, on reassessment the therapist may change his/her judgement with respect to aspiration and modify intervention accordingly. The constructed NHBSA did not give false negative results for any patient. This indicated that there is a very low possibility of aspiration being missed on this NHBSA. Chi-square analysis also showed that the results of the NHBSA and MBS do not differ statistically and significantly for aspiration. However, it must be mentioned that in view of such limited data, results are indicative, but not conclusive, that the NHBSA is an accurate tool to assess dysphagia and identify aspiration.

Also, one must remember that differences will almost always exist between a clinical assessment such as the NHBSA and MBS because the two differ in terms of nature and procedure. The MBS is an objective tool that allows viewing the physiological action of swallowing, whereas the clinical assessment does not. The MBS assesses the patient's swallow under ideal conditions using small bolus volumes and consistencies that are not representative of the natural daily eating situations of the patient's life.[1] This is especially true in this study as during the MBS, the patient was given only 5 ml of liquid barium (thin and thick) via spoon whereas the patient's daily life involves drinking larger volumes of water via a glass/cup thereby posing a greater risk of aspiration. Also, MBS often underestimates the time taken by the patient to consume food and effects of fatigue.[1,7] The NHBSA is a subjective clinical tool that enables testing the patients' swallow in more natural conditions thus providing a greater insight into the difficulties faced by the patient and also aspiration risk.

However, it must be mentioned that all patients in this study who were judged to have aspiration present, had overt aspiration and/or could phonate on command enabling assessing voice for wetness. Not all patients seen by an SLP will have overt aspiration. In order to enhance sensitivity of a bedside swallow assessment to aspiration, particularly silent aspiration, pulse oximetry and cervical auscultation may be combined with the NHBSA. This will be useful especially in patients with poor compliance or who do not phonate on command. However, when the NHBSA is inconclusive, an MBS will prove to be extremely useful clinically.

Comparison of swallow durations for dry swallow and for different food consistencies between typical individuals and individuals with mechanical dysphagia and those with neurogenic dysphagia revealed that the swallow duration in individuals with dysphagia (both groups) is significantly longer than in typical individuals. There was no statistically significant difference in swallow duration between the two groups i.e. individuals with mechanical dysphagia and those with neurogenic dysphagia. Thus, it can be concluded that swallow duration measurement must be included in bedside testing as it provides information on efficacy of swallowing, irrespective of the etiology of dysphagia. However, swallow duration is only a rough estimate of oral transit time, as a prolonged swallow duration could be caused by a prolonged oral phase, or a delay in triggering of the pharyngeal swallow, or both. Hence, measurement of swallow duration should be used only as a part of a complete diagnostic evaluation. Also, a reduction in swallow duration brought about by therapy serves as an indicator of progress.

Functional utility

The NHBSA involves testing an individual's swallow for saliva as well as different food and liquid consistencies. Most bedside assessments aim to only identify presence of dysphagia and/or risk of aspiration and thus include only water swallows. These tests appear less likely to provide a deeper insight into the patient's swallowing ability and thus do not enable making appropriate decisions regarding intervention or diet recommendations. Testing with thin liquids enables assessment of the pharyngeal phase and airway protection for aspiration, whereas oral preparatory and oral phases are best assessed using solids. This is supported by Marques *et al*., who reported that their water test exhibited higher sensitivity for detection of problems in laryngeal protection, and the test with pudding was more sensitive for the functional analysis of dysphagia itself.[23] Also, it was observed that thick liquids were not easy to aspirate on as thin liquids and were also easier to swallow than solids. In addition, it was observed that a large number of individuals with neurogenic dysphagia exhibited more difficulty with thin liquids whereas individuals with mechanical dysphagia showed more difficulty with soft solids and solids. This is in accordance with Trapl *et al*., who reported that stroke patients they examined were better at swallowing semisolid textures than liquids and had a significantly higher aspiration risk with liquids than with semisolid textures.[24] Thus, it is important to test using an intermediate consistency such as thick liquid as it involves assessing the adequacy of the swallow with relatively lesser aspiration risk.

In the present study, inclusion of different consistencies enabled an in-depth assessment of the different phases of swallowing in addition to identification of dysphagia and aspiration. This enables the SLP to go beyond deciding just the appropriate mode of nutritional intake (non-oral *vs* oral) and helps to make diet recommendations regarding the food consistencies that can be included in the patient's oral diet, in order to maximise oral intake of food while minimising risk of aspiration. Also, it will enable making decisions regarding intervention strategies to be implemented. This is supported by Marques *et al*., (2008) who also recommend testing with different consistencies in order to both decrease the risk of aspiration and increase the likelihood of a safe and early reintroduction of oral feeding. This, in turn, will increase patient comfort, improve overall outcome, and enhance quality of life.

NHSAS

Reliabilty

The inter-rater reliability (Cronbach's alpha = 1.0) and intra-rater reliability (Spearman's ρ =1.0) of the NHSAS was seen to be excellent.

Validity

The NHSAS appears to have good face and content validity.

Functional utility

The constructed NHSAS categorises the given individual with dysphagia on the basis of his overall performance with respect to food intake orally and managing his dysphagia. It enables the SLP not only to determine the severity of dysphagia but also the severity of aspiration. It can be used to make decisions regarding the suitable mode of nutritional intake for a given individual i.e., non-oral, oral, or a combination. In addition, the constructed NHSAS appears to be sensitive to change in swallow function as seen in 15% of the patients followed

up. Thus, it can be used as an outcome tracking tool to measure and document progress (or the lack of it) as well as evaluate the effectiveness of the initiated intervention program.

Comparison and analysis of the NHBSA checklist scores and the grading ascribed on NHSAS revealed that a moderate positive correlation exists between the checklist scores and grading for both groups-mechanical dysphagia and neurogenic dysphagia (Spearman's ρ =0.61 and 0.67 respectively). This indicates that as the score on the bedside checklist increases, the grading also increases to become more severe. The moderate correlation suggests that this increase is not linear and that there is some difference between the bedside scores and the NHSAS. This difference could be attributed to the different aspects of swallowing being assessed by both. The NHBSA assesses swallowing impairment whereas the NHSAS assesses the impact of dysphagia on the individual's oral intake i.e assesses swallowing disability. Therefore, a patient may have a high score on the NHBSA due to presence of numerous signs and symptoms of dysphagia indicating that the swallowing impairment is severe but the impairment may not be disabling enough to be graded that severe on the NHSAS. This difference between the severity of the symptoms of dysphagia as indicated by the NHBSA scores and the functional status of the individual on the NHSAS could be due to usage of compensatory strategies by the individual. The reverse may hold true as well i.e. a patient may not show very high scores on the NHBSA but may be graded to be severe on the NHSAS.

The NHBSA protocol and NHSAS require some familiarization prior to usage by an SLP, but do not require any formal course training in its usage. This contrasts with the ASHA-NOMS[15] for swallowing that requires formal training for its usage. The NHBSA and NHSAS, together, can be completed within 15-20 minutes indicating they are time efficient tools too. This is similar to the time required to complete the Mann Assessment of Swallowing Ability.[25]

Limitations of the study include inability to assess the sensitivity of the oral and pharyngeal structures, and inability to monitor temperature for spikes due to feasibility constraints. Also, MBS was done using only 2 consistencies of barium, and inter-rater and intra-rater reliabilities could not be done for the MBS. Further studies can do the MBS in a larger number of patients for further validation of NHBSA. Also, the present NHSAS can be compared and cross validated with other scales such as the Functional oral Intake Scale, Penetration-Aspiration scale, etc., using MBS.[13,26]

Conclusion

The constructed bedside assessment protocol (NHBSA) and grading scale (NHSAS) seem to be extremely viable and useful tools, for all clinical settings especially in an acute-care hospital setup, as they seem to enable identification and intervention of dysphagia at the earliest. Also, the NHSAS appears to be useful for clinically grading individuals with dysphagia into categories based on swallowing ability, and enables making recommendations.

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APPENDIX –A

Nair Hospital Bedside Swallowing Assessment

Name: Gender/Age:
Tel No.: Address:
Date of Admission: Date of Administration:
Education: Occupation:

1. **Brief history and chief complaints:**
2. **Neurological evaluation/Surgery details as applicable:**
3. **Radiological evaluation:**
4. **Medical Diagnosis:**
5. **Cognitive status**:

Good Fair Poor

a. Alertness
b. Orientation
c. Attention
d. Ability to follow commands

6. **Physical status**:

a. Associated paralysis/paresis: Present/absent
b. Head and trunk control: Good/fair/poor

7. **Oral examination**:

i. Oral hygiene: Good/fair/poor
ii. Secretions: Present/absent

If present, locus:

iii. Structure Appearance Function Sensitivity
a. Lips
b. Teeth
c. Tongue
d. Soft palate
e. Anterior faucial pillar--

8. **Respiratory-Laryngeal function examination**

a. Breath holding duration:
b. MPD:
c. Voice quality
d. Cough: Normal/weak/absent
e. Ability to vary pitch and loudness: Good/fair/poor

9. **Type of Nutritional intake**:

a. Oral b. Non-oral: NGT/PEG/IV c. Oral+Non-oral

10. **Onset, nature and duration of dysphagia**:
11. **Concomitant communication disorder**:

a. Aphasia b. Dysarthria c. Apraxia d. Dysphonia e. Any other:

12. **Results of Dysphagia Assessment Checklist**:
13. **Severity of dysphagia according to the grading scale**:

Remarks: Clinician:

Dysphagia and aspiration assessment checklist

Following can be observed for a dry swallow and trial feed. Allot score of 1 for every 'Yes' and 0 for every 'No'. Add all the individual scores at the end to get the total score.

Yes (1) **No (0)**

I. SWALLOWING

A. General information

i. Difficulty in swallowing
ii. Pain while swallowing
iii. Weight loss
iv. Prolonged meal time
v. Decreased sensation of touch/temperature in oral cavity
vi. Decreased sensation of taste in oral cavity
vii. Impaired gag reflex
viii. Drooling

B. Oral preparatory phase

i. Inadequate lip seal
ii. Poor sucking
iii. Cannot align teeth
iv. Poor tongue movements (inability to lateralise or manipulate food and form bolus)
v. Poor chewing
vi. Material over mouth
vii. Requires water to wash down bolus

C. Oral phase

i. Poor tongue propulsive movements
ii. Oral residue (Pocketing of food in sulci, hard palate etc)
iii. Cough before swallow
iv. Prolonged oral phase
v. Increased difficulty with solids
vi. Swallow facilitated with head back position

Yes (1) **No (0)**

D. Pharyngeal phase:

i. Prolonged pharyngeal phase
ii. Inability to/difficulty in initiation of swallow (delayed hyoid elevation)
iii. Effortful swallow
iv. Multiple swallows
v. Incomplete hyolaryngeal excursion
vi. Globus sensation
vii. Cough during swallow
viii. Cough and/or wet gurgly voice quality after swallow
ix. Thick copious secretions
x. Nasal regurgitation
xi. In case of tracheostomy, food/liquid leaking out of stoma
xii. Increased difficulty with liquids
xiii. Swallow facilitated with head down position

II. ASPIRATION AND AIRWAY SAFETY

i. Wet, gurgly voice quality
ii. Eyes watering/reddening during/after swallow
iii. Cough before/during/after swallow
iv. Poor management of secretions
v. Weak/absent cough
vi. No volitional attempt to clear throat
vii. Spike in fever

Total Score:

Record of oral trials for swallow assessment

Consistency	Food	Quantity	Swallow duration	Comment (s)
Dry swallow				
Thin liquid				
Thick liquid				
Semi-solid				

Swallow duration: It is the time duration in seconds between placement of the food in the mouth and the first palpable hyoid elevation using Logemann's (1998) four-finger Test. It is timed using a stop-watch.

APPENDIX–B

Nair Hospital Swallowing Ability Scale
(5 consistencies- thin liquid, thick liquid, semisolid, soft solid and hard solid)

0- Normal swallow

1- Slight Dysphagia

a. Occasional difficulty in swallowing with occasional audible aspiration.
Recommend: Total oral intake- regular diet

2- Mild Dysphagia

a. Mild difficulty in swallowing with audible aspiration, if present.
b. Modification of consistency of food and use of manoeuvres required.
c. Can tolerate 4/5 consistencies.
Recommend: Total oral intake with compensatory strategies.

3- Moderate Dysphagia

a. Moderate difficulty in swallowing with audible aspiration, if present.
b. Modification of consistency of food and use of maneuvers required.
c. Can tolerate 3/5 consistencies.
Recommend: Total oral intake with compensatory strategies or combined intake (Oral intake >/= Non-oral intake).

4- Moderately severe Dysphagia

a. Moderately severe difficulty in swallowing with audible aspiration.
b. Modification of consistency of food and use of maneuvers required.
c. Can tolerate 2/5 consistencies.
d. Can manage secretions with some difficulty
Recommend: Combined intake (Non-oral intake >/= oral intake)

5- Severe Dysphagia

a. Severe difficulty in swallowing with weak audible and sometimes silent aspiration.
b. Modification of consistency of food and use of maneuvres required.
c. Can tolerate 1/5 consistencies.
d. Can manage secretions but with significant difficulty

Recommend: Total non-oral intake.

6- Complete Dysphagia.

a. Silent aspiration.
b. Cannot tolerate any consistency.
c. Cannot manage secretions.

Recommend: Total Non-oral intake.