

Application of the GUSS test on adult Egyptian dysphagic patients

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Background

The evaluation of swallowing disorders and their rehabilitative modalities is an important topic. The benefit to the patient, in terms of improvement in quality of life, cannot be underestimated. Bedside tests might be used to identify patients with oropharyngeal dysphagia and to identify those who are at a risk for aspiration.

Aim

The aim of the present study was to evaluate the validity and reliability of the Gugging Swallowing Screening (GUSS) test for the detection of aspiration and swallowing abnormalities in dysphagic Egyptian patients. This helps in better management.

Study design

The present study was a comparative, cross-sectional study.

Patients and methods

A total of 42 patients were referred from the outpatient clinics with a complaint of dysphagia. All patients were evaluated using flexible endoscopic examination of swallowing (FEES) and the GUSS test. The results of these two methods were compared to assess validity. Reliability was approved by the assessment of the Cohen's κ agreement between the two independent raters.

Results

The mean age of the patients was 51.6 ± 12.2 years. According to the results of FEES, 28 (66.7%) patients were at a risk for aspiration, whereas 30 (71.4%) patients were rated to be at a risk according to the GUSS test results. According to the cutoff of 14 points, GUSS reached 93.3% sensitivity and 83.3% specificity when compared with FEES. Positive predictive value was 93.3% and negative predictive value was 83.3%. The results of reliability (by comparing the scores of the two raters as regards the degree of severity) showed excellent agreement between the two raters ($\kappa = 0.84$, $P > 0.05$, PO = 91%).

Conclusion

GUSS test proved to be an easy, valid, and reliable test to predict the risk for aspiration among the adult Egyptian patients.

Keywords:

aspiration, dysphagia, flexible endoscopic examination of swallowing, Gugging Swallowing Screening test

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Introduction

Dysphagia, or impaired swallowing, results from abnormal changes in the structures or movements that are necessary for normal swallowing. It is a disorder of deglutition that affects the oral, pharyngeal, and/or esophageal phases of swallowing [1]. Oropharyngeal dysphagia is an underestimated symptom in neurological and neuromuscular diseases, especially in geriatric population. Dysphagia is a relatively common condition, occurring in 16% of the general population, 33% of the elderly, 80% of patients who have suffered a stroke, 81% of patients with Parkinson's disease, 24% of patients with myasthenia gravis, and 72% of patients with a head or neck cancer [2]. Dysphagia can lead to malnutrition, aspiration, pneumonia, psychological distress (including anxiety and depression), restricted social activities, increased healthcare costs, and

decreased work productivity [1,3–5]. Most stroke-related pneumonias are believed to result from dysphagia and the subsequent aspiration of oropharyngeal material. Aspiration is defined as the entry of food or liquid into the airway below the level of the true vocal folds, and aspiration pneumonia is defined as the entrance of swallowed materials into the airway resulting in lung infection [6]. In addition, treatment of dysphagic patients by a multidisciplinary team, including early evaluation by a speech-language pathologist, has been associated with improved outcomes [7].

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Videofluoroscopy and the flexible endoscopic examination of swallowing (FEES) are considered to be the gold standard for dysphagia assessment; however, their use requires access to sophisticated equipment and trained specialists [8]. Alternatively, simple dysphagia screening, based on the bedside assessment of patients, can be used to identify individuals who require further diagnostic investigation. Such screening can decrease the incidence of pneumonia, a serious complication of dysphagia, especially in patients with an acute stroke [9].

A variety of dysphagia screening tests exist; however, none of them has been endorsed as the single most useful dysphagia screening method [6]. Most studies that have focused on the development of such tests enrolled patients who had suffered from a stroke [10]. Nevertheless, some studies focused on more heterogeneous patient populations. A study by Cichero *et al.* [11] enrolled patients from general medical wards. One important issue was the sequence of the subtests of a swallowing screen. Nearly every dysphagia screen reported starts with liquids [12]. Clinical observation of acute-stroke patients showed that most of them had more problems swallowing liquids than semisolid textures [13]. Studies of dysphagic patients during motion fluoroscopy found that penetration into the larynx was more likely when swallowing liquids compared with semisolid textures [8]. In Egypt, there are many primary healthcare units and hospitals in remote areas that are not equipped with swallowing evaluation tools such as FEES and modified barium swallow. Thus, the physicians in Egypt are in need for simple, rapid, easy to use, and valid screening test for abnormal swallowing. The aim of this study was to investigate the validity and reliability of the Gugging Swallowing Screening (GUSS) test [7] on Egyptian dysphagic patients for the early detection of patients at risk for aspiration and to decrease the incidence of pneumonia.

Patients and methods

Methods

All patients were assessed by using the FEES and the GUSS, which was proposed in a study by Trapl *et al.* [7]. Informed consents were taken from all patients included in this study. The study protocol was approved by the ethical committee, Faculty of medicine, Ain Shams University.

Description and criteria of the Gugging Swallowing Screening

The GUSS test is divided into two parts: the preliminary assessment (part 1, indirect swallowing test) and the direct swallowing test (part 2), which consists of three

subtests. These four subtests must be carried out sequentially. A point system is chosen in which higher numbers denote better performance, with a maximum of 5 points to be reached in each subtest. This maximum must be attained to continue to the next subtest. Each tested item is valued as pathologic (0 points) or physiologic (1 point). Within the evaluation criteria for 'deglutition' in the direct swallowing test, we used a different rating system. Normal deglutition was scored 2 points, a delayed swallow was scored 1 point, and pathologic swallowing was assigned 0 points. Patients must successfully complete all repetitions in the subtest to achieve the full score of 5 points. If the score of a subtest is less than 5, the examination must be stopped and a special oral diet and/or further investigation by using videofluoroscopy or fiberoptic endoscopy is recommended. In total, 20 points are the highest score that a patient can attain, and it denotes normal swallowing ability without the risk for aspiration.

Before starting the GUSS test, the patient should sit in a bed in at least a 60° upright position. The clinical markers used in the direct swallowing part were deglutition, involuntary cough, drooling, and voice change. The evaluation of patient vigilance (wakefulness) was added to the previous clinical markers in indirect swallowing part.

In indirect swallowing part, the bedside screen starts with a simple saliva swallow. Patients who were unable to produce enough saliva because of dry mouth were given saliva spray as a substitute.

The direct swallowing test consists of three sequentially performed subtests, starting with semisolid, then liquid, and finally solid textures.

Semisolid swallowing trial: Distilled water (aqua bi) is thickened with an instant food thickener (yoghurt and concentrated guava) into the consistency of pudding. One-third to one-half teaspoon is offered as a first bolus, followed by five more half-teaspoons. The investigator should observe the patient closely after each spoonful, and must abort the investigation if one of the four risk signs for aspiration (nondeglutition, cough, drooling, and voice change) is positive.

Liquid swallowing trial: Starting with 3 ml aqua bi in a beaker, the patient should be observed closely while swallowing the first amount. When swallowing is successful, the test is continued with increasing amounts of 5, 10, and 20 ml of aqua bi. A 50-ml test is the last task for the patient. The patient should drink the 50 ml as fast as he or she can.

Solid swallowing trial: A small piece of dry bread is the first bolus at the beginning of this substest. The test is repeated five times. In the present study, 10 s were established as the time limit for a small solid bolus, including the oral preparatory phase.

Diet recommendations: Recommendations are given according to the points reached after the GUSS test.

Flexible endoscopic examination of swallowing

All patients were assessed using the FEES. Digital Swallowing Workstation by KayPENTAX (Lincoln Park, NJ07035-1488, USA) was used for this purpose. For FEES, the patient was asked to remain in the sitting position (whenever possible). However, in some cases, this was not possible; instead, a semi-upright position on the bed was chosen. A flexible fiberoptic laryngoscope was inserted transnasally into the pharynx. It provided detailed information about the anatomy of the nose, pharynx, and larynx. Sensation could be tested by touching with the tip of the endoscope various areas of the larynx, and also reflex adduction of the vocal folds or reflex cough and choking were observed. Different food consistencies, such as fluids (water), semisolids (thick juice/yoghurt), and solids (piece of biscuits or bread), mixed with blue dye, were used to evaluate swallowing. The salient findings noted were residue, penetration, and aspiration into the larynx.

Participants and study protocol

A total of 42 patients with suspected dysphagia who were referred from otorhinolaryngology, oncology, neurology, and geriatric clinics were included in this study between December 2014 and April 2015. Exclusion criteria (based on clinical evaluation and history) were patients with receptive dysphasia, oral apraxia, and patients with impaired degree of consciousness. Patients were informed about the study procedure and the consent for the study was obtained from them. Patients were tested for dysphagia according to the GUSS test (Appendix A) and assessed by using the FEES. FEES is a gold standard for the examination of swallowing [9], and thus it was used in this study and its results were compared with the results of the GUSS test. The phoniatrician performing the FEES was unaware of the patients' GUSS scores. To measure inter-rater reliability, two expert phoniatricians independently assessed the swallowing ability of the patients using the GUSS test. The time span between the two assessments was 1 h.

Statistical evaluation

The GUSS scores yielded four categories of severity: 0–9 points were rated severe, 10–14 points moderate, 15–19

points mild, and 20 points as no dysphagia. Inter-rater reliability for GUSS was calculated for the severity rating and the cutoff points classifying dysphagia versus no dysphagia (19 points), risk of aspiration versus no risk of aspiration (14 points), and severe dysphagia versus all others (9 points) by using the κ statistics (Cohen's κ) and the percentage of agreement (P0). A κ coefficient between 0.4 and 0.8 was rated substantial, and values greater than 0.8 were considered excellent [14]. Positive (PPV) and negative predictive values (NPV), as well as sensitivity and specificity, were determined by comparing the results of the GUSS test with the results of FEES.

FEES was graded according to the Penetration Aspiration Scale (PAS), as proposed by Rosenbek *et al.* (Appendix B) [15]. The highest score achieved in either the semisolid or the fluid trial was taken as the final score. As cutoff points for validation, we chose aspiration risk versus minimal or no aspiration risk. For the FEES, therefore, the PAS cutoff point was between 4 and 5. The GUSS cutoff point for aspiration risk was chosen between the total scores of 14 and 15. The receiver operating characteristic curve was plotted, and the area under the curve were calculated.

Results

Sociodemographic data

Out of the 42 patients included in the study, 22 (52.4%) were men and 20 (47.6%) were women. The mean age of the patients was 51.6 ± 12.2 years with a range from 35 to 71 years. There were many causes for dysphagia in our patients. Stroke represented 52.4% of the causes, as illustrated in Table 1. The χ^2 -test was carried out and no relationship was found between the different causes of dysphagia in the studied group; the risk for aspiration as detected by using FEES [$\chi^2 (7, N=42) = 10.8, \rho = 0.14$].

According to patients, the most difficult food texture causing dysphagia was the solid texture (represented 47.6%). Only 23.8% of the studied patients complained that all food textures were the cause of their dysphagia, as shown in Fig. 1. The χ^2 -test showed a significant relation between the fluid texture and the risk for aspiration [$\chi^2 (2, N=42) = 1.5, \rho = 0.04$]. In contrast, the χ^2 -test showed no relation between semisolid and solid texture and the risk for aspiration [for semisolid texture, $\chi^2 (2, N=42) = 2.7, \rho = 0.3$; for solid texture, $\chi^2 (3, N=42) = 3.5, \rho = 0.29$].

Inter-rater reliability

As regards severity rating, there was an excellent agreement between the two raters ($\kappa = 0.84, P >$

0.05, PO=91%). The first rater confirmed the presence of dysphagia in 90.5% of the patients, whereas the second rater estimated that 93% of the patients had dysphagia ($\kappa=0.53$, $P>0.05$, PO=92.9%). According to the first rater's evaluation, 30 patients (71.4%) had a risk for aspiration, but the second rater found 31 patients (73.8%) with a risk for aspiration ($\kappa=0.82$, $P>0.05$, PO=93.1%).

Validity

According to FEES results, 28 (66.7%) patients were at a risk for aspiration, whereas 30 (71.4%) patients were rated to be at a risk according to the GUSS results. By using the

GUSS test, two patients were diagnosed as having silent aspiration, and the diagnosis was confirmed by using FEES, and thus the sensitivity of GUSS to detect silent aspiration reached 100%.

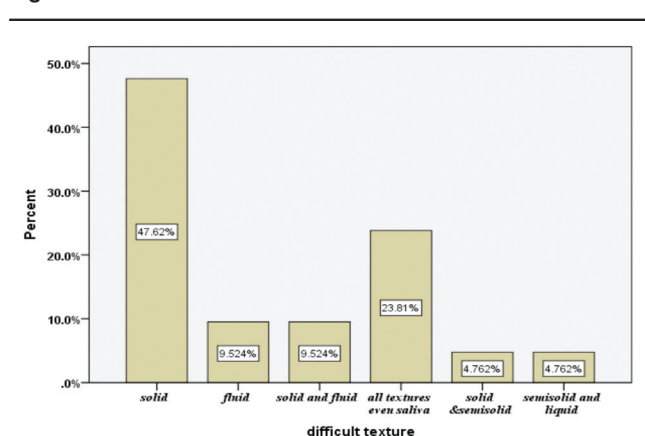
According to the cutoff of 14 points, the GUSS test reached 93.3% sensitivity and 83.3% specificity when compared with FEES. PPV was 93.3% and NPV was 83.3%, as illustrated in Table 2. The receptive operating characteristic curve showed that the GUSS test predicted aspiration risk efficiently. The area under the curve was 0.94 (95% confidence interval 0.85–1) (Fig. 2).

Table 1 Sociodemographic data of the patients

Age (mean±SD)	51.6±12.2
Sex [n (%)]	
Male	22 (52.4)
Female	20 (47.6)
Dysphagia causes [n (%)]	
Stroke	22 (52.4)
Post-treatment of laryngeal cancer	4 (9.5)
Post-treatment of tongue cancer	2 (4.8)
Vocal fold immobility	4 (9.5)
Rhinolaryngoscleroma	4 (9.5)
GERD	2 (4.8)
Myasthenia gravis	2 (4.8)
Inflammatory conditions	2 (4.8)

GERD, gastroesophageal reflux disease.

Figure 1

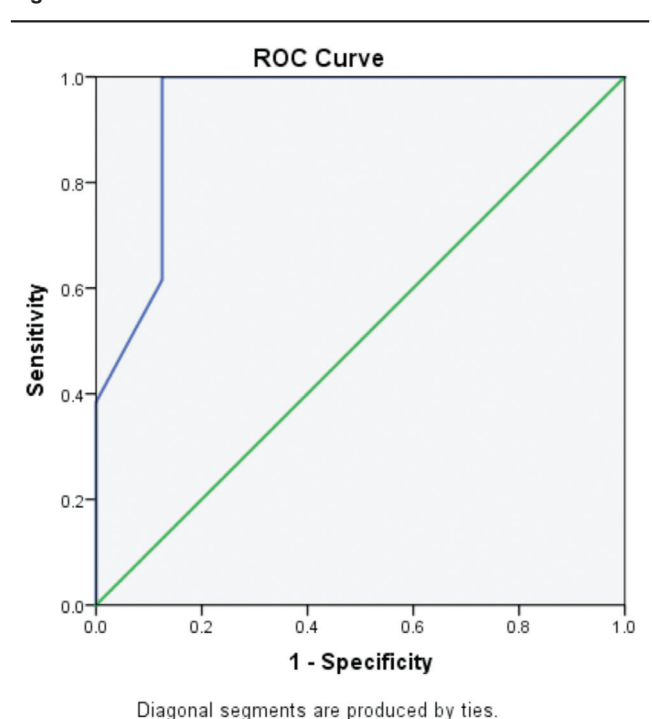


Bar graph represents the percent for each difficult food texture that causes dysphagia.

Discussion

Diagnosing and treating swallowing disorders represent a major challenge in everyday clinical practice. The most common diagnostic procedures for oropharyngeal dysphagia are FEES and videofluoroscopy. Bedside

Figure 2



Receiver operating characteristic curve (ROC) for the GUSS as a predictor of aspiration risk.

Table 2 Sensitivity, specificity and predictive values of Gugging Swallowing Screening

FEES highest score (gold standard)			
Aspiration risk, PAS (5–8)	No aspiration risk, PAS (1–4)		
GUSS results			
Aspiration risk (0–14)	28	2	PPV = 93.3%
No aspiration risk (15–20)	2	10	NPV = 83.3%
	Sensitivity = 93.3%	Specificity = 83.3%	

FEES, flexible endoscopic examination of swallowing; GUSS, Gugging Swallowing Screening; NPV, negative predictive value; PAS, Penetration Aspiration Scale; PPV, positive predictive value.

screening needs to be informal, noninvasive, non-technical, quickly interpretable, reliable, and accurate [16].

In the present study we tried to prove the validity of the GUSS test for the early detection of aspiration and swallowing problems. The GUSS test is simple and easy to use. It has moderate to excellent inter-rater reliability for the four categories of the test. The area under the curve for it was good (0.92), which means good predictor ability for this screening test to detect aspiration. The GUSS test has high sensitivity (93%) and high specificity (83%).

Although the concept of 'bedside screening' may refer to actual testing at a patient's bedside, screening may also be administered at different settings. The purpose of screening, however, remains unchanged, namely to screen for patients at a risk for oropharyngeal dysphagia. There have been many screening tests for dysphagia [5].

In general, the sensitivity of these tests was high but the specificity was low. This finding was in contrast to the findings of the present study, and those of the studies by Trapl *et al.* [7] and Hassan and Aboloyoun [17]. On the other hand, our findings were in agreement with those of DePippo *et al.* [18], Daniels *et al.* [19], Hinds and Wiles [20], Logemann *et al.* [21], and Edmiaston *et al.* [22].

In addition, many of these tests have limitations in practical use; for example, a test may require a highly trained examiner or have limited applicability to the patients. Furthermore, the usefulness of these tests to screen for aspiration has been reported, but the ability to detect silent aspiration is not mentioned. However, the GUSS test was characterized by its ability of diagnosing silent aspiration (two patients), which was confirmed by FEES results, and thus the sensitivity of the GUSS test to detect silent aspiration reached 100%.

According to Hassan and Aboloyoun [17], bedside tests are important predictors of aspiration during swallowing and they are the most widely used tests. FEES is one of the important tests for dysphagia evaluation. FEES is a valid, effective, low-cost technique that assesses swallowing in a bedside examination. Therefore, we used FEES as the gold standard for dysphagia assessment, and the results of the GUSS test were compared with FEES results according to the PAS [15].

The results showed that the most difficult food texture causing dysphagia was the solid texture (47.6%). Only

23.8% of the studied patients complained that all food textures were the cause of their dysphagia (fluid 9.5%, solid and fluid 9.5%, solids and semisolid 4.76%, and semisolids and fluids 4.76%). Difficulty with solids may be explained by reduced tongue strength (including tongue base movement), reduced pharyngeal contraction, and cricopharyngeal dysfunction, which are common signs in stroke (22, 52.4%), post-treatment of laryngeal cancer (four, 9.5%), post-treatment of tongue cancer (two, 4.8%), vocal fold immobility (four, 9.5%), and myasthenia gravis (two, 4.8%).

These results are in contrast to the results of a study by Norton *et al.* (1996) [23], which concluded that thin liquids are the most difficult consistency to swallow in poststroke patients.

The results showed that the GUSS sensitivity was 93.3% and specificity was 83.3%, when compared with FEES. PPV was 93.3% and the NPV was 83.3%, which was an indication that the test was showing high validity, sensitive, and specificity to predict early aspiration.

The results also showed excellent agreement between the two raters ($\kappa=0.84$, $P>0.05$, PO = 91%). The first rater confirmed the presence of dysphagia in 90.5% of the patients, whereas the second rater estimated that 93% of the patients had dysphagia ($\kappa=0.53$, $P>0.05$, PO = 92.9%). According to the first rater's evaluation, 30 patients (71.4%) had a risk for aspiration, but the second rater found 31 patients (73.8%) with a risk for aspiration ($\kappa=0.82$, $P>0.05$, PO = 93.1%), which was an indication that the test was reliable in predicting the high risk for aspiration.

The severity of dysphagia could be graded according to the scores obtained by applying the test as follows: 0–9 points are rated severe, 10–14 points moderate, 15–19 points mild, and 20 points as no dysphagia.

Conclusion and recommendations

The GUSS test is simple, valid, and reliable test to detect early aspiration as it has high sensitivity and specificity. It is easy, rapid, and suitable noninvasive tool to grade the severity of dysphagia. Solids are the most difficult consistency for dysphagic patient and may cause aspiration. It should be applied on larger and more variable groups of patients including children.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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Appendix

Appendix A Gugging swallowing screen (G U S S)

1-Preliminary investigations/ indirect swallowing tests

	Yes	No
Alertness The patient must be alert for 15 minutes	1	0
Cough and/or throat clearing (<i>voluntary</i> cough) Patient must cough or clear his throat voluntary twice	1	0
Saliva swallow:		
Swallowing successful	1	0
Drooling	0	1
Voice change	0	1
sum	(5)	
	1-4 investigate further # 5= continue with part 2	

2-Direct swallowing test (materials: Aqua bi, flat teaspoon, bread, food thickener)

In the following order	1→ SEMISOLID*	2→ LIQUID**	3→ SOLID***
DEGLUTITION			
• Swallowing not possible	0	0	0
• Swallowing delayed (>2sec) (Solid texture>10sec)	1	1	1
• Swallowing successful	2	2	2
COUGH (involuntary) (before, during, or after swallowing- until 3 minutes later)			
• YES	0	0	0
• NO	1	1	1
DROOLING			
• YES	0	0	0
• NO	1	1	1
VOICE CHANGE (listen to the voice before and after swallowing- patient should speak "o")			
• YES	0	0	0
• NO	1	1	1
SUM	(5)	(5)	(5)
	1-4 investigate further# 5=continue liquid	1-4 investigate further# 5=continue solid	1-4 investigate further# 5=normal
SUM: (indirect swallowing test + direct swallowing test)(20)			
*	First administer 1/3 up to half teaspoonful aqua bi to food thickener (pudding like) If there are no symptoms administer 3 to 5 teaspoons, assess after 5 th spoonful		
**	3,5,10 ml Aqua bi- if there are no symptoms continue to 50 ml Assess and stop the investigation when one of the criteria is observed		
***	Clinical: dry bread if using FEES: DRY BREAD IS DIPPED INTO COLOURED LIQUID		
#	USE functional investigation such as MBS OR FEES		

GUSS

(Gugging Swallowing Screen)

GUSS-EVALUATION

RESULTS	SEVERITY CODE	RECOMMENDATIONS
20 Semisolid / liquid and solid texture successful	Slight / No Dysphagia minimal risk of aspiration	<ul style="list-style-type: none"> Normal Diet Regular Liquids (<u>First time under supervision of the SLT or a trained stroke nurse!</u>)
15-19 Semisolid and liquid texture successful and Solid unsuccessful	Slight Dysphagia with a low risk of aspiration	<ul style="list-style-type: none"> Dysphagia Diet (pureed and soft food) Liquids very slowly – one sip at a time Functional swallowing assessments such as Fiberoptic Endoscopic Evaluation of Swallowing (FEES) or Videofluoroscopic Evaluation of Swallowing (VFES) Refer to Speech and Language Therapist (SLT)
10-14 Semisolid swallow success sful and Liquids unsuccessful	Moderate dysphagia with a risk of aspiration	<p>Dysphagia diet beginning with:</p> <ul style="list-style-type: none"> Semisolid textures such as baby food and additional parenteral feeding. All liquids must be thickened! Pills must be crushed and mixed with thick liquid. No liquid medication! Further functional swallowing assessments (FEES, VFES) Refer to Speech and Language Therapist (SLT) <p style="text-align: center;"><i>Supplementation with nasogastric tube or parenteral</i></p>
0-9 Preliminary investigation unsuccessful or Semisolid swallow unsuccessful	Severe dysphagia with a high risk of aspiration	<ul style="list-style-type: none"> NPO (non per os = nothing by mouth) Further functional swallowing assessment (FEES, VFES) Refer to Speech and Language Therapist (SLT) <p style="text-align: center;"><i>Supplementation with nasogastric tube or parenteral</i></p>

Appendix B Penetration Aspiration Scale [adapted from Rosenbek *et al.* (1996)] [15]

Category	Score	Descriptions
No penetration or aspiration	1	Contrast does not enter the airway
Penetration	2	Contrast enters the airway, remains above vocal folds; no residue
	3	Contrast remains above vocal folds; visible residue remains
	4	Contrast contacts vocal folds; no residue
	5	Contrast contacts vocal folds; visible residue remains
	6	Contrast passes glottis; no subglottic residue visible
Aspiration	7	Contrast passes glottis; visible subglottic residue despite patient's response
	8	Contrast passes glottis; visible subglottic residue; absent patient response