Stroke

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Dysphagia Bedside Screening for Acute-Stroke Patients
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Background and Purpose—Acute-onset dysphagia after stroke is frequently associated with an increased risk of aspiration pneumonia. Because most screening tools are complex and biased toward fluid swallowing, we developed a simple, stepwise bedside screen that allows a graded rating with separate evaluations for nonfluid and fluid nutrition starting with nonfluid textures. The Gugging Swallowing Screen (GUSS) aims at reducing the risk of aspiration during the test to a minimum; it assesses the severity of aspiration risk and recommends a special diet accordingly.

Methods—Fifty acute-stroke patients were assessed prospectively. The validity of the GUSS was established by fiberoptic endoscopic evaluation of swallowing. For interrater reliability, 2 independent therapists evaluated 20 patients within a 2-hour period. For external validity, another group of 30 patients was tested by stroke nurses. For content validity, the liquid score of the fiberoptic endoscopic evaluation of swallowing was compared with the semisolid score.

Results—Interrater reliability yielded excellent agreement between both raters ($\kappa=0.835$, $P<0.001$). In both groups, GUSS predicted aspiration risk well (area under the curve=0.77; 95% CI, 0.53 to 1.02 in the 20-patient sample; area under the curve=0.933; 95% CI, 0.833 to 1.033 in the 30-patient sample). The cutoff value of 14 points resulted in 100% sensitivity, 50% specificity, and a negative predictive value of 100% in the 20-patient sample and of 100%, 69%, and 100%, respectively, in the 30-patient sample. Content validity showed a significantly higher aspiration risk with liquids compared with semisolid textures ($P=0.001$), therefore confirming the subtest sequence of GUSS.

Conclusions—The GUSS offers a quick and reliable method to identify stroke patients with dysphagia and aspiration risk. Such a graded assessment considers the pathophysiology of voluntary swallowing in a more differentiated fashion and provides less discomfort for those patients who can continue with their oral feeding routine for semisolid food while refraining from drinking fluids. (*Stroke*. 2007;38:000-000.)

Key Words: acute stroke ■ assessment scales ■ dysphagia ■ outcome scores

Dysphagia is clinically present in 42% to 67% of patients within the first 3 days of stroke, and the incidence of aspiration within the first 5 days ranges from 19.5% to 42%.[1,2] Because pneumonia in stroke patients is often the result of aspiration,[3] systematic use of a dysphagia screen can result in a significantly decreased risk of pneumonia and an improved general outcome.[4,5] In addition, treatment of dysphagic patients by a multidisciplinary team, including early evaluation by a speech-language pathologist, has been associated with improved outcome.[6] In search of a rapid and reliable test for acute-onset dysphagia, we found a considerable number of swallowing screens,[7–19] but we did not find a practical, easy-to-use, bedside swallowing screen that also points out recommendations for nutrition. In addition, the weighting and interpretation of some tested items concerning their ability to indicate dysphagia differed greatly among these tests. Furthermore, most studies had a delay of >24 hours before identifying aspiration risk.[9,10,13,14,18,20] It can be

assumed that benefits from even earlier strategies might prove even greater.

One important issue is the sequence of the subtests of a swallowing screen. Nearly every dysphagia screen reported starts with liquids. Clinical observation of acute-stroke patients shows that most of them have more problems swallowing liquids than semisolid textures. Studies of dysphagic patients during motion fluoroscopy found that penetration into the larynx was more likely when swallowing liquids than semisolid textures.[21] On the basis of such findings, we developed a stepwise procedure of assessment aimed at reducing the risk of aspiration during the test to a minimum and enabling a graded rating with separate evaluations for nonfluid and fluid nutrition, starting with nonfluid textures. This would not result in an overall diagnosis of dysphagia based only on insufficient fluid swallowing and thus, in the recommendation to refrain from oral feeding altogether, but it might enable a considerable proportion of patients with acute

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stroke to continue with semisolid food while recommending that fluids should be applied via intravenous line or nasogastric tube. Such a graded approach not only would consider the pathophysiology of swallowing in a more differentiated fashion but also be more cost-effective and provide less discomfort for the patient, who could continue his/her eating routine without the notable risk of aspiration. In this study, we present a bedside dysphagia screen for acute-stroke patients that is easy to use by stroke nurses and therapists. This new instrument allows a graded assessment of the patient's swallowing abilities, measures the severity of dysphagia, and enables dietary recommendations. We devised a rating scale and tested the interrater reliability, predictive validity, content validity, and external validity.

Subjects and Methods

Development of the Gugging Swallowing Screen
The development of the Gugging Swallowing Screen (GUSS) is presented in supplemental Figure I, available online at http://stroke.ahajournals.org.

General Criteria/Test Construction
GUSS is divided into 2 parts: the preliminary assessment (part 1, indirect swallowing test) and the direct swallowing test (part 2), which consists of 3 subtests. These 4 subtests must be performed sequentially. A point system was chosen in which higher numbers denote better performance, with a maximum of 5 points that can 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. Normal deglutition is assigned 2 points, a delayed swallow is assigned 1 point, and pathologic swallowing is assigned 0 points. Patients must successfully complete all repetitions in the subtest to achieve the full score of 5 points. If a subtest results in <5 points, the examination must be stopped and a special oral diet and/or further investigation by videofluoroscopy or fiberoptic endoscopy is recommended. Twenty points are the highest score that a patient can attain, and it denotes normal swallowing ability without aspiration risk.

Before starting the GUSS screen, the patient should sit in bed in at least a 60° upright position. Because neglect and apraxia can bias the swallowing test, the investigator should ensure that the patient is able to perceive the tester's face, the spoon, and the textures in front of him/her.

The evaluation criteria used in the direct swallowing test are as follows. Deglutition, involuntary cough, drooling, and voice change are checked in each subtest. In the indirect swallowing test, additional evaluation is performed for vigilance, voluntary coughing, deglutition of saliva, drooling, and voice change. Deglutition is determined by observing an effectual larynx elevation. Voice change, in particular, wet and gurgling voice qualities after swallowing or permanent, were found to be reliable parameters for detecting aspiration.[1,14,20,22–27] Drooling was discussed as a valid item indicating dysphagia.[11,14,18] This item was included in the test because it is easy to assess. Larynx elevation has also been discussed as a valid clinical sign of swallowing. However, because of the difficulty in measuring this function during clinical observation and the absence of standard guidelines, we decided not to include it as an evaluation criterion.[28] A weak or absent voluntary cough and/or throat clearing,[20,22,23] as well as spontaneous cough before, during, or after swallowing, are regarded as predictive of aspiration risk.[14,20,23] Massey et al[14] found alertness to be an indispensable item for detecting dysphagia; therefore, patients must be completely awake before bolus testing. Vigilance was determined during the preliminary assessment.

GUSS Part 1, Preliminary Assessment: Indirect Swallowing Test
A simple successful saliva swallow is the precondition for the second part of the swallowing observation. Most swallowing tests start with a specified quantity of water. The smallest used volume described in the literature is 1 mL in the bedside test of Logemann et al[19] and Daniels et al.[20] This volume is very similar to the saliva swallow. According to our clinical experience, most patients are often unable to sense such a small amount of water. For this reason, we decided to start our bedside test (GUSS) with a simple saliva swallow. Patients who are unable to produce enough saliva because of dry mouth are given saliva spray as a substitute. Vigilance, voluntary cough, throat clearing, and saliva swallowing are assessed.

GUSS Part 2: Direct Swallowing Test
The direct swallowing test consists of 3 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 into the consistency of pudding. One-third to one-half teaspoon is offered as a first bolus, followed by 5 more half-teaspoons. The investigator should observe the patient closely after each spoonful. Abort the investigation if 1 of the 4 aspiration signs (deglutition, 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.[15] 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.[13]

Solid Swallowing Trial
A small piece of dry bread is the first bolus at the beginning of this subtest. The test is repeated 5 times. Ten seconds 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 in the GUSS (supplemental Figure I, available online at http://stroke.ahajournals.org). For each severity code, we advocate a special diet in the style of the functional oral intake scale modified according to the stepwise recommendations by Crary et al.[29]

Subjects and Study Protocol
Fifty consecutive patients with first-ever acute stroke and suspected dysphagia who were admitted to the acute stroke unit on weekdays between Monday and Thursday were included in this study. The data of the first group were collected for 5 months (May to October 2005); patients in the second group were included between September and December 2006. Exclusion criteria were multiple infarcts visible on computed tomography or magnetic resonance imaging scans, dysphagia of other known cause, and somnolence or coma within 24 hours. Patients were informed about the study procedure and consent for the study was obtained. Within 24 hours of stroke onset, patients were tested for dysphagia according to the GUSS and assessed by fiberoptic endoscopic evaluation of swallowing (FEES). The neurologist performing the FESS was unaware of the patients' GUSS scores. FEES compares well with the results from videofluoroscopic examinations of swallowing[21,30] and was therefore considered the "gold standard" for the purpose of this study.

The GUSS results were compared with FEES results at the clinically significant cutoff point of aspiration risk versus no or minimal aspiration risk. To measure interrater reliability, 2 therapists independently assessed the swallowing ability of 20 participants. The time span between the 2 assessments was 2 hours at most. For

external validation, 30 patients were tested with GUSS by trained nurses and were evaluated by FEES within 24 hours of stroke onset.

Statistical Evaluation

The GUSS scores yielded 4 categories of severity. Zero to 9 points are rated severe, 10 to 14 points moderate, 15 to 19 points mild, and 20 points as no dysphagia. These categories also represent the cutoff points for reliability testing. Interrater 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 κ statistics and the proportion of overall agreement (P0) as a raw agreement index. A κ coefficient between 0.4 and 0.8 was rated substantial, and values >0.8 were considered excellent.[31] Positive and negative predictive values, as well as sensitivity and specificity, were determined by comparing the results of GUSS with the results of FEES.

The ratios of false-positives and false-negatives were contrasted by comparison with FESS results. To compare the results of FESS, they were graded according to the Penetration Aspiration Scale (PAS) of Rosenbek et al.[32] 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 at the stage of laryngeal penetration of material (liquid or semisolid) reaching to the vocal folds. The ability to eject this material from the airway was therefore the crucial characteristic for risk of aspiration. The GUSS cutoff point for aspiration risk was chosen between the total scores of 14 and 15. At this point of the bedside test, patients show the first slight difficulties in swallowing liquids after having successfully completed the semisolid swallowing subtest. The receiver operating characteristic curves were plotted, and the areas under the curves were calculated. For content validity, the test scores of routine liquid and semisolid FEES trials were compared by Wilcoxon signed rank tests. Statistical analyses were performed with SPSS 11.5 for Windows. Descriptive analyses were performed according to data characteristics.

Results

Demography and Patient Characteristics

The first group included 11 (55%) women and 9 (45%) men, and the external validation sample contained 14 women (46.7%) and 16 men (53.3%). The mean ages of the patients were 74.6±2.4 (SE) and 76.8±1.85 (SE) in the first and second trials, respectively. According to the PAS dysphagia classification, 3 (16%) patients had no dysphagia (PAS score=1 to 2), mild dysphagia was seen in 3 (16%) patients (PAS score=3 to 4), moderate dysphagia was present in 4 (21%) patients (PAS score=5 to 6), and almost half of the population had severe dysphagia (9 patients, or 47%; PAS score=7 to 8). One patient refused the endoscopy investigation. In the 30-patient group, 14 (47%) patients had no dysphagia; mild dysphagia was seen in 2 (7%) patients, moderate dysphagia was present in 5 (17%) patients, and 9 (30%) had severe dysphagia.

Interrater Reliability

The overall severity rating achieved excellent agreement ($\kappa=0.835$, $P<0.001$, P0=0.90) Both raters confirmed the estimated diagnosis of dysphagia in 95% of the sample (n=19, $\kappa=1.00$, $P<0.001$, P0=1.00). The raters differed in their GUSS scores with respect to the patients' risk of aspiration (ie, the cutoff between mild and moderate dysphagia). The first rater classified 18 patients (90%) as being at risk of aspiration, whereas the second rater classified 17
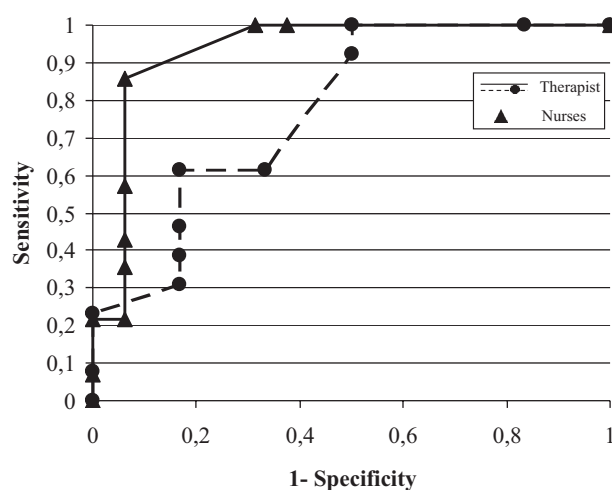
Figure 1. Receiver operating characteristic curves for the GUSS used by therapists (patient group 1, n=19; filled circles, solid line) or nurses (patient group 2, n=30; filled triangles, broken line) as a predictor of aspiration risk in stroke patients.

patients (85%) as being at risk ($\kappa=0.773$, $P<0.001$, P0=0.95). According to the first rater's assessment, 10 patients (50%) had severe dysphagia, but the second rater found severe dysphagia in 9 (45%) patients ($\kappa=0.900$, $P<0.001$, P0=0.95).

Predictive Validity and External Validation

The receiver operating characteristic curve showed that GUSS predicted aspiration risk well. In the first validation, the area under the curve was 0.77 (95% CI, 0.53 to 1.02), and in the second validation, the area under the curve was 0.933 (95% CI, 0.833 to 1.033; Figure 1).

According to the FEES results, 13 (68.4%) patients in the first sample were at risk of aspiration, whereas 16 (84.2%) were rated to be at risk in the GUSS results. According to the cutoff at 14 points, GUSS reached 100% sensitivity and 50% specificity when compared with FEES. The positive predictive value was 81% and the negative predictive value, 100% (the Table). κ Values between the clinical rater and the results of endoscopy were 0.578 ($P=0.005$).

In the second sample used for external validation, 14 (46.6%) patients were found to be at risk of aspiration during FEES investigation, whereas 19 (63.3%) patients were judged to be at risk according to the GUSS. This resulted in 100% sensitivity and a specificity of 69%, with a positive predictive value of 74% and a negative predictive value of 100% (the Table). The κ value was 0.672 ($P<0.001$).

Content Validity

Thirteen (68.4%) of the 19 patients investigated by endoscopy in the first trial had an aspiration risk with liquid textures. However, 8 of these (42.1% of all patients) had no risk with semisolid textures, whereas 5 (26.3%) had an aspiration risk with both textures. The remaining 6 (31.6%) patients had aspiration risk with neither semisolid nor fluid textures. Overall median scores for semisolid textures (3; interquartile range, 2 to 5) were lower than for fluid textures

Table.   Sensitivity, Specificity, and Predictive Values of GUSS

	FEES, Highest Score		
	Aspiration Risk, PAS (5–8)	No Aspiration Risk, PAS (1–4)	
GUSS results, first group, n=19			
Aspiration risk (0–14)	13	3	PPV=81%
No aspiration risk (15–20)	0	3	NPV=100%
	Sensitivity=100%	Specificity=50%	Prevalence=68%
GUSS results, second group, n=30			
Aspiration risk (0–14)	14	5	PPV=74%
No aspiration risk (15–20)	0	11	NPV=100%
	Sensitivity=100%	Specificity=69%	Prevalence=10%

NPV indicates negative predictive value; PPV, positive predictive value. Sensitivity, specificity, and predictive values of GUSS in the first validation of stroke patients (n=19) were compared with "gold standard" FEES results. Aspiration risk was grouped according to the PAS of Rosenbek et al.[32]

(6; interquartile range, 4 to 7), thus indicating a higher aspiration risk with liquids (n=19, P=0.002).

Fourteen of the 30 patients investigated in the second trial had an aspiration risk with liquids. Three (9.9%) of these patients had an aspiration risk with both textures, whereas 11 (36.6%) had no aspiration risk with semisolid textures. The other 16 (53.3%) patients showed aspiration risk with neither semisolids nor fluids. Again, median scores for semisolid textures were lower than for fluid textures (semisolid textures, 2; interquartile range, 1 to 4; fluid textures, 3.5; interquartile range, 1 to 7; P=0.002; Figure 2).

Discussion

We developed a simple, easy-to-use, bedside dysphagia screen that has substantial to excellent interrater reliability for all classification categories. In both patient groups, the area under the curve was similarly good, ranging between 0.8 and 0.9, thus demonstrating that GUSS is a valid instrument for predicting aspiration risk even when used by nonspecialized staff. In addition, for the chosen cutoff of 14 points, GUSS had 100% sensitivity and very acceptable predictive values. Although the high sensitivity revealed that all patients with dysphagia and aspiration risk can be identified by the clinical test, the satisfactory specificities of 69% and 50%, respectively, indicated that some healthy patients were graded with

a higher severity code. The consequence for these patients is a special dysphagia diet for the first few days, a consequence that can easily be accepted as a margin of safety. However, to adjust for this effect, we recommend daily reevaluation with the GUSS to identify false-positive patients.

Whereas other dysphagia screens start their direct swallowing test with liquids[19,20] or evaluate the ability to swallow water only and neglect other consistencies,[1,9,10,12–14,17,18,26,33,34] the novel approach of our test is the stepwise approach to the tested items. This was based on the observation that stroke patients are better at swallowing semisolid textures than liquids. We demonstrated that stroke patients have a significantly higher aspiration risk with liquids than with semisolid textures. For this reason, it is essential to examine semisolid swallowing ability before liquid swallowing ability because this stepwise procedure helps reduce the risk of aspiration during the test to a minimum and identifies patients who tolerate semisolid intake but not fluids.

The classification into 4 severity codes is another advantage of the GUSS. With this gradation, it is possible to assess the extent of risk of aspiration as well as the severity of dysphagia by modifying the recommendations[29] into 4 simplified categories. Therefore, this system is superior to other more categorical bedside screens that restrict themselves to dysphagia and/or
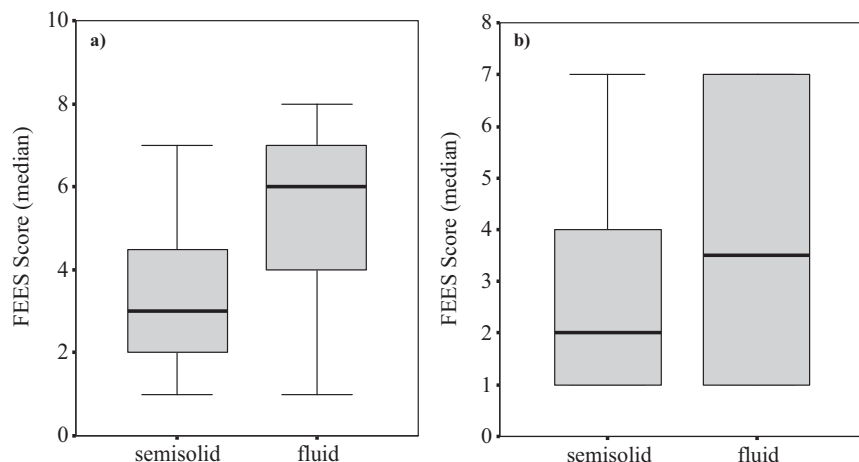
Figure 2. Box-and-whisker plots of overall median FEES scores for semisolid and liquid swallowing tests in the 2 patient groups: a, first group, n=19; b, second group, n=30.

aspiration being present or absent.[1,9–14,17–21,26,34,35] In such screens, the terms "aspiration" and "dysphagia" often are used interchangeably, whereas in our study, we described both the severity of dysphagia and the risk of aspiration. Differentiation between dysphagia with risk and without risk of aspiration is important because it can lead to different dietary recommendations.

Although not tested in a separate fashion, GUSS was also designed to allow nutritional recommendations to be adjusted according to the severity of dysphagia. Most other validated bedside screens recommend no peroral food intake at all and rely on further evaluation by videofluoroscopy and/or a speech-language therapist. At most, these assessments give only general information about dysphagia diets.[9–11,13,16] Recent studies have recommended a combination of bedside tests with measurement of oxygen saturation, videofluoroscopic examinations of swallowing, or FEES to identify all acute-stroke patients at risk of aspiration for further evaluation and management.[34,36,37]

In summary, we have shown that a simple assessment protocol for dysphagia can be used as a quick screening tool for detecting aspiration risk in acute stroke. Further validation studies are necessary to evaluate the screen's capability of preventing aspiration pneumonia, to standardize the specific diet recommendation, and to measure the effects on outcome.

Disclosures

None.

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G U S S

(Gugging Swallowing Screen)

1. Preliminary Investigation /Indirect Swallowing Test

	YES	NO
Vigilance *(The patient must be alert for at least for 15 minutes)*	1 ☐	0 ☐
Cough and/or throat clearing *(voluntary cough)* *(Patient should cough or clear his or her throat twice)*	1 ☐	0 ☐
Saliva Swallow: • Swallowing successful	1 ☐	0 ☐
• Drooling	0 ☐	1 ☐
• Voice change (hoarse, gurgly, coated, weak)	0 ☐	1 ☐
SUM:		(5)
	1 - 4= Investigate further¹ 5= Continue with part 2	

2. Direct Swallowing Test (Material: Aqua bi, flat teaspoon, food thickener, bread)

In the following order:	1 →	2 →	3 →
	SEMISOLID*	**LIQUID****	**SOLID *****
DEGLUTITION: ▪ Swallowing not possible	0 ☐	0 ☐	0 ☐
▪ Swallowing delayed (> 2 sec.) (Solid textures > 10 sec.)	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 further¹ 5= Continue Liquid	**1 - 4**= Investigate further¹ 5= Continue Solid	**1 - 4**= Investigate further¹ 5= Normal

SUM: (Indirect Swallowing Test AND Direct Swallowing Test)   _____ (20)

*	First administer ⅓ up to a half teaspoon Aqua bi with food thickener (pudding-like consistency). If there are no symptoms apply 3 to 5 teaspoons. Assess after the 5th spoonful.
**	3, 5, 10, 20 ml Aqua bi - if there are no symptoms continue with 50 ml Aqua bi (Daniels et al. 2000; Gottlieb et al. 1996) Assess and stop the investigation when one of the criteria is observed!
***	Clinical: dry bread; FEES: dry bread which is dipped in coloured liquid
¹	Use functional investigations such as Videofluoroscopic Evaluation of Swallowing (VFES) , Fiberoptic Endoscopic Evalutation of Swallowing (FEES)

Figure I. GUSS.

G U S S
(Gugging Swallowing Screen)
G U S S - E V A L U A T I O N

	RESULTS	SEVERITY CODE	RECOMMENDATIONS
20	Semisolid / liquid and solid texture successful	Slight / No Dysphagia minimal risk of aspiration	• 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	• Dysphagia Diet (pureed and soft food) • Liquids very slowly – one sip at a time • Funcional 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	Dysphagia diet beginning with : • 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) *Supplementation with nasogastric tube or parenteral*
0-9	Preliminary investigation unsuccessful or Semisolid swallow unsuccessful	Severe dysphagia with a high risk of aspiration	• NPO (non per os = nothing by mouth) • Further functional swallowing assessment (FEES, VFES) • Refer to Speech and Language Therapist (SLT) *Supplementation with nasogastric tube or parenteral*

Figure I Continued.