Research Article

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Validity and reliability of Turkish version of the gugging swallowing screen test in the early period of hemispheric stroke

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Abstract

Objective: The Gugging Swallowing Screen (GUSS) test is a bedside screening test for the assessment of all phases of swallowing in acute-period stroke. The present study aimed to evaluate whether GUSS was effective for the detection of dysphagia in the early period after stroke, as well as to conduct Turkish translation, and validity and reliability studies.

Methods: The scale was administered to 113 patients within the early periods of stroke (within 30 days after stroke). The procedures were scored by two blinded independent expert observers. Cronbach's alpha and item-to-total correlations were used to assess internal consistency. Inter-rater reliability studies were also conducted. Endoscopic evaluations were performed within the first 4 hours following the application of the screening tests. The fiberoptic endoscopic evaluation of swallowing (FEES) method was used to describe the validity of measures.

Results: The mean time since the stroke was 14.34±5.23 days. Internal consistency was found to be good with Cronbach's α values between 0.844 and 0.846. The intraclass correlation coefficient scores indicated excellent inter-rater reliability with scores ranging from 0.881 to 1.000. A strong negative correlation was found between FEES stage and the total T-GUSS scores of the raters (r=-0.547 p<0.001; r=-0.515, p=0.001, respectively).

Conclusion: T-GUSS has good internal consistency and very good reliability between raters, as well as good correlation with FEES evaluation regarding the detection of aspiration risk in the early period of stroke in Turkish patients.

Keywords: Dysphagia, early period of hemispheric stroke, Gugging Swallowing Screen Test, validity, reliability

INTRODUCTION

Dysphagia is the disturbance of the passage of a bolus (incl. all kinds of consistency) from the mouth into the stomach (1). The most common cause of dysphagia is neurologic diseases and especially stroke. Dysphagia is one of the most common and important complications of stroke. It is especially observed within two weeks of a stroke with an incidence ranging from 42% to 67% (2, 3). Moreover, minor swallowing abnormalities can be seen in almost all patients with stroke (3).

Dysphagia may result in a number of problems such as dehydration, malnutrition, aspiration pneumonia, and even death (1). Aspiration pneumonia is the most severe complication of dysphagia and it is seen in half of all patients with stroke with dysphagia during the first year; 40-70% of these aspirations are "silent" and the mortality rate is high (1).

Stroke management guidelines recommend the evaluation of patients with stroke for aspiration risk as soon as possible. Also, recent studies indicated that early diagnosis of aspiration is correlated with improved functional status, quality of life, and decreased mortality and morbidity in patients with stroke (4, 5).

Various methods and tools are available in the literature for the early diagnosis and identification of dysphagia, such as bedside screening tests, endoscopic, radiologic, electrophysiologic and ultrasonographic evaluations (6, 7). Videoflu-

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oroscopy (VF) and endoscopic evaluations are commonly used gold standard tools for dysphagia screening. However, these methods are invasive and expensive, requiring special equipment and skilled personnel. Thus, bedside screening tests are preferred as the first-line evaluation by many researches due to their easy and repeatable, cost-effective, and non-invasive properties (7). A wide range of bedside screening tests have been defined in the literature. These tests may include observation of swallowing or questionnaires for oral-motor symptoms, relevant cranial nerve, and gross motor and cognitive functions (7-9).

Observation of swallowing is a part of bedside screening methods and commonly includes a water test. However, swallowing action does not only involve drinking water. Therefore, this method may lead to false positive or negative results. Recent studies indicated that liquid swallowing was commonly disturbed in patients with stroke and the premature leaks may lead to aspiration and some complications. Evaluation of aspiration with the administration of liquids to these patients may lead to aspiration pneumonia and airway obstruction leading to death (10). Therefore, an optimal bedside screening tool should include the evaluation of swallowing of liquid, semisolid, and solid foods that are commonly consumed in daily life for the exact assessment of swallowing action, and it should minimize aspiration risk during evaluation process (11).

For this reason, we aimed to perform the Turkish translation, and validity and reliability study of the Gugging Swallowing Screen (GUSS) test to be used as a safe and realistic bedside assessment method in patients with stroke in our country.

The studies that developed and performed the validity/reliability of GUSS included patients with acute stroke in the first 24 hours. However, we know that the swallowing disorders of patients with stroke can be recovered after the first few days and screening tests conducted in the first 24 hours may give false positives. Thus, we aimed to perform this study in the early period, which has patients with real dysphagia.

METHODS

Study design

This study was performed at physical medicine and rehabilitation (PMR) clinic of our tertiary center hospital. A total of 128 patients with early-period stroke who were admitted to our inpatient clinic between January 2016 and February 2017 were enrolled in the study. Fifteen patients who refused endoscopic evaluation or who had an instable medical condition that posed a contraindication for the endoscopic evaluation were excluded. A total of 113 patients were included in the study.

The study was approved by the local Institutional Ethics Committee. Before the evaluation, the patients and where appropriate, the caregivers (legal guardians), were given verbal and written information on the nature of the study. Informed consent forms were signed upon admission to the trial. All procedures were conducted by the relevant principles of the 2004 Helsinki Declaration.

Patients aged 55-75 years who had a major stroke as confirmed using magnetic resonance imaging (MRI) within one month and who had sufficient consciousness state (24 points or more with the mini-mental test) and at least 15 minutes of alertness were included in the study.

Patients with a history of malignancy, head and neck surgery, previous recurrent and/or bilateral hemispheric stroke, pulmonary or swallowing disorder, gastroesophageal reflux disease, dementia or psychiatric disorder, and contraindications for fiberoptic endoscopic evaluation of swallowing (FEES) (medical instability, presence of contagious or infectious disease, bleeding diathesis, bilateral nasal obstruction and decompensated heart disease) were excluded from the study. In addition, patients with brainstem and hemorrhagic stroke were excluded to create a homogeneous patient group.

Data Collection

Demographic features and disease characteristics age, sex, educational status, stroke type, affected hemispheric side, and time since the stroke were recorded.

Instruments

The stroke severity of the patients was measured using the National Institutes of Health Stroke Scale (NIHSS) in which patients are evaluated in 11 categories including consciousness, language, dysarthria, eye movements, visual field, neglect, facial paresis, proximal limb strength, extremity ataxia and sensorial function. The total score is between 0 and 42. Motor functional status was graded from 1 to 6 using the Brunnstrom stage for upper extremity, hand, and lower extremity.

Gugging Swallowing Screen Test (GUSS)

The GUSS test consists 2 sections (12); the first section is the indirect swallowing test including 3 subtests, and the second section is the direct swallowing test, which includes 4 subtests. Subtests are scored as yes/no (0-1) or between 0-2 points. The first section comprises vigilance for at least 15 minutes for voluntary coughing and/or throat clearing ability and saliva swallowing ability including drooling, voice changes such as hoarse, gurgerly, coated, and weak voice, and choking on own saliva. Each subtest is valued between 0 and 5 points according to the presence or absence of the symptom of interest and higher points indicate better performance. If the total score of the first subset is ≤4 points, the test should be stopped and further evaluation of the patient using FEES or VF is recommended. Patients who fulfill 5 points proceed to the second section, which assesses direct swallowing function with different types of nutriments. The evaluation

criteria include deglutition, involuntary cough, drooling, and voice changes. The direct swallowing test starts with intake of semi-solid food (1/3, 1/2, 3, and 5 tea spoons of water with a thickener (pudding-like consistency), respectively, continues with intake of liquids (3.5, 10, 20, and 50 milliliters), and finally solid food (a piece of bread). This food trial is used for the direct assessment of swallowing in categories of normal deglutition (2 points), delayed swallowing (1 point) or swallowing not possible (0 points). The following subtest including an involuntary cough, drooling, and voice changes are assessed according to the presence (0 points) and absence (1 point) of the symptom of interest. The second section of the test is scored to a maximum 15 points, and higher points indicate successful swallowing. For patients who receive 1-4 points for every food, alimentation through FEES or VF is recommended as the first choice. The GUSS test evaluates swallowing over 20 points in total as follows: 0-9 points: severe dysphagia with a high aspiration risk; 10-14 points: moderate dysphagia with moderate aspiration risk, 15-19 points: slight dysphagia with a low aspiration risk, and 20 pts: no dysphagia. The test also allows for diet recommendation according to the scores obtained by the patients.

Translation Procedures

This part was performed according to the report of Beaton et al. (13). Permission to use and translate the questionnaire was obtained from the authors Trapl et al., and GUSS Group-International (12). The GUSS test was independently translated into Turkish by 2 PMR specialists. After comparing all translations and making necessary corrections, a Turkish version of the tool was created. It was then translated into English in collaboration with a professional linguist. The final Turkish-GUSS (T-GUSS) was accepted following a comparison of the meaning and format with the original English form. After the pilot study was completed on 8 patients, the form was finalized using the feedback obtained.

Reliability

Cronbach's alpha and corrected item-total correlations were used to assess internal consistency. Inter-rater reliability studies were also conducted. Agreement between the two independent raters was analyzed using the Intraclass Correlation Coefficient (ICC). A maximum of 2 hours between the examinations was considered to be sufficient to prevent bias because swallowing functions may change over time.

Validity

The validity was assessed using the dysphagia level defined using FEES by Dziewas et al. (14). Endoscopic evaluation was performed by an otolaryngology specialist who was blinded to the design of the trial within the first 4 hours after performing the second T-GUSS test.

FEES was performed by the same otolaryngology specialist using a non-ducted fiberoptic nasopharyngoscope of 3.4 mm diameter, a light source, camera, and monitor (Karl Storz GmbH & Co KG; Tuttlingen, Germany). The assessments were performed with the patient at the highest possible upright sitting position. Water was used as the liquid nutriment, liquid with food thickener as the semisolid, and bread as the solid food during evaluations. Findings were recorded as video images. Dysphagia level was scored from 1 to 6 according to the protocol of assessment of dysphagia developed by Dziewas et al., in which 1 point is considered as normal swallowing, 2-3 points as mild, 4-5 points as moderate, and 6 points as severe dysphagia (14).

Statistical Analysis

All statistical analyses were performed by using SPSS 22.0 Statistical Packages for the Social Sciences (IBM Corp.; Armonk, NY, USA). Descriptive statistics are demonstrated as mean (standard deviations) for continuous variables and as percentage (%) for nominal variables. Internal consistency was measured using Cronbach's alpha, >0.70 indicating an acceptable value. Corrected item-total correlations were calculated using Spearman rho correlation coefficients. Correlation coefficients above 0.3 were considered as acceptable (15). Inter-rater reliability was estimated using ICC. According to the ICC results, positive values ranging from 0 to 0.2 indicate poor agreement; 0.2 to 0.4 indicate fair agreement; 0.4 to 0.6 indicate moderate agreement; 0.6 to 0.8 indicate good agreement; and 0.8 to 1 indicate very good agreement (16). For validity, Spearman rho correlation test and receiver operating curve (ROC) analyses were used to indicate an association between FEES and T-GUSS. The correlation coefficient (r) was used to show the power of the correlation. Cut-off values were accepted as 19 points in T-GUSS test or stage 2 in FEES evaluation for dysphagia, and 14 points in the T-GUSS test or stage 4-5 (a critical level that absence of protective reflex for aspiration risk) in the FEES evaluation for aspiration. Accordingly; <0.30 points indicated weak, 0.30 to 0.50 points indicated moderate, 0.50 to 0.75 points indicated good correlation, and 0.75 to 1.0 point indicated a very good correlation between the variables (17). With the ROC analyses, the best diagnosis indices [area under ROC curve (AUC), sensitivity, specificity, positive and negative predictive value (PV), as well as positive and negative likelihood ratio (LR)] for dysphagia were calculated. P<0.05 values were accepted as statistically significant.

RESULTS

Patient Characteristics

The mean age of the 113 patients [52 (46.0%) females, 61 (54.0%) males] included in the study was 66.71 years (SD 8.36) and the time since the stroke duration was 14.34 days (SD 5.23). The mean NIHSS score of the patients was 4.88 (SD 2.31). All patients had ischemic infarct. The demographic features and disease characteristics of the patients are shown in Table 1.

Table 1. Demographic features and disease characteristics of the patients

Characteristics (n=113)	
Age (years)	
Mean (SD)	66.71 (8.36)
Sex (n/%)	
Female	52/46.0
Male	61/54.0
Time since stroke (day)	
Mean (SD)	14.34 (5.23)
Educational status (n/%)	
Illiterate	36/31.9
<5-year	7/6.2
5-year	52/46.0
8-year	12/10.6
11-year	5/4.4
>11-year	1/0.9
Hemispheric infarct region (n/%)	
Right	66/58.4
Left	47/41.6
NIHSS score (0-42)	
Mean (SD)	4.88 (2.31)
Brunnstrom stage (1-6)	
Mean (SD)	
Upper extremity	4.41 (1.54)
Hand	4.21 (1.83)
Lower extremity	4.46 (1.28)

SD: standard deviation; NIHSS: National Institutes of Health Stroke Scale

Table 2. Corrected item-total correlation results according to the two raters

Subtests	1st rater r	2nd rater r
Vigilance (0-1)	0.640	0.612
Cough and/or throat clearing (0-1)	0.506	0.448
Saliva swallowing (0-3)	0.973	1.000
Semisolid trial (0-5)	0.849	0.811
Liquid trial (0-5)	0.742	0.713
Solid trial (0-5)	0.659	0.603

r: correlation coefficient

Table 3. Inter-rater reliability of two sections and their subtests and correlation of T-GUSS scores between inter-raters

Questions	ICC (95%CI)	p
Vigilance (0-1)	1.000 (1.00-1.00)	0.001
Cough and/or throat clearing (0-1)	0.907 (0.865-0.936)	0.001
Saliva swallowing (0-3)	0.925 (0.846-0.979)	0.001
Semisolid trial (0-5)	0.944 (0.919-0.961)	0.001
Liquid trial (0-5)	0.941 (0.914-0.959)	0.001
Solid trial (0-5)	0.894 (0.847-0.927)	0.001
Indirect swallow test (part 1)	0.881 (0.828-0.918)	0.001
Direct swallow test (part 2)	0.966 (0.950-0.976)	0.001
T-GUSS score	0.955 (0.935-0.969)	0.001

ICC: intra-class correlation coefficient; CI: Confidence interval; T-GUSS: Turkish version of Gugging Swallowing Screen test

Summary of T-GUSS

All patients were evaluated by both the 1st and 2nd raters. The median T-GUSS scores evaluated by the both the 1st [mean: 8.52 (SD 2.09)] and the 2nd [mean: 18.38 (SD 1.94)] PMR specialists were 19.00. The 1st and 2nd raters detected "no dysphagia" in 39 (34.5%) vs. 43 (38.1%), "mild dysphagia" in 51 (45.2%) vs. 58 (51.3%), "moderate dysphagia" in 14 (12.4%) vs. 15 (13.3%) and "severe dysphagia" in 2 (1.8%) vs. 4 (3.5%) patients, respectively. The median dysphagia level score as estimated using FEES was 2.00 [mean: 2.41 (SD 1.31)]. According to evaluation by the otolaryngology specialist with FEES, "no dysphagia" (n=36; 31.9%), "mild dysphagia" (n=55; 48.7%), "moderate dysphagia" (n=19; 16.8%) and "severe dysphagia" (n= 3; 2.7%) were detected.

There were no "floor" effects for the total score. The ceiling effect was between 34.5% and 38.1%. The coefficients of variation of the total T-GUSS score was 8.86% for the 1st and 9.47% for the 2nd rater as acceptable values, respectively.

Reliability

Tests performed by the 1st and the 2nd PMR specialists indicated that the internal consistency was "good" with Cronbach's α values of 0.844 and 0.846, respectively.

The item-to-total correlation results according to both raters are shown in Table 2. According to the corrected item-total correlation, Spearman's rho correlation coefficients ranged between 0.444 for "a voluntary cough and/or throat clearing" to 1.000 for "saliva swallowing" for both raters and all of the subtests were above the acceptable standards (p<0.001).

The inter-rater reliability of the 2 sections and their subtests and correlation of T-GUSS scores between inter-raters are presented in Table 3.

Table 4. The T-GUSS scores with the presence of dysphagia using FEES

	Dysphagia (-)	Dysphagia (+)	p
Total T-GUSS score (1st rater) Mean (SD)	19.11 (1.84)	16.24 (2.15)	0.008
Total T-GUSS score (2nd rater) Mean (SD)	18.97 (1.59)	17.11 (2.04)	0.021

SD: standard deviation; T-GUSS: Turkish version of Gugging Swallowing Screen test; FEES: flexible fiberoptic endoscopic evaluation of swallow

Table 5. The T-GUSS scores with the presence aspiration risk by using FEES

	Aspiration (-)	Aspiration (+)	p
Total T-GUSS score (1st rater) Mean (SD)	18.66 (1.87)	13.62 (1.27)	0.001
Total T-GUSS score (2nd rater) Mean (SD)	18.49 (1.78)	14.11 (1.29)	0.003

SD: standard deviation; T-GUSS: Turkish version of Gugging Swallowing Screen test; FEES: flexible fiberoptic endoscopic evaluation of swallow

Table 6. ROC curve analysis results for dysphagia and aspiration risk

	AUC	Sen (%)	Spc (%)	Positive PV (%)	Negative PV (%)	Positive LR	Negative LR
Dysphagia (rater 1)	0.822	97.1	72.2	73.6	80.0	5.1	0.16
Dysphagia (rater 2)	0.791	95.3	69.6	78.4	81.3	5.4	0.16
Aspiration risk (rater 1)	0.913	97.5	75.2	84.3	95.1	6.1	0.05
Aspiration risk (rater2)	0.885	95.3	76.2	84.3	95.3	6.4	0.06

AUC: area under ROC curve; sen: sensitivity; sps: specificity; PV: predictive value; LR: likelihood ratio

Figure 1. ROC curve analysis results for dysphagia

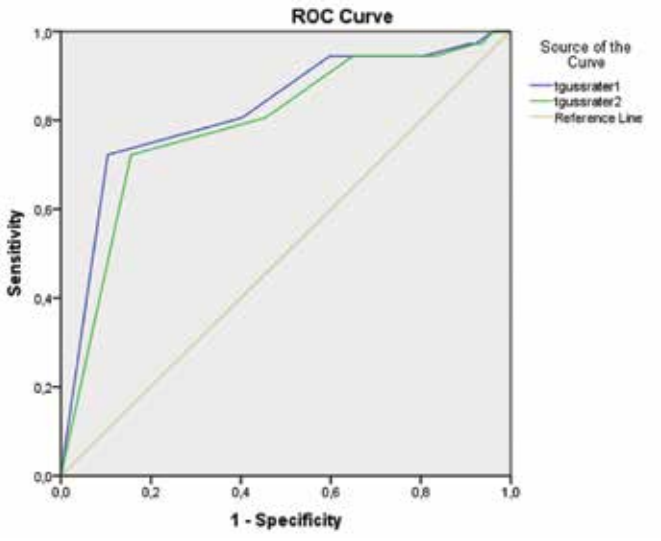
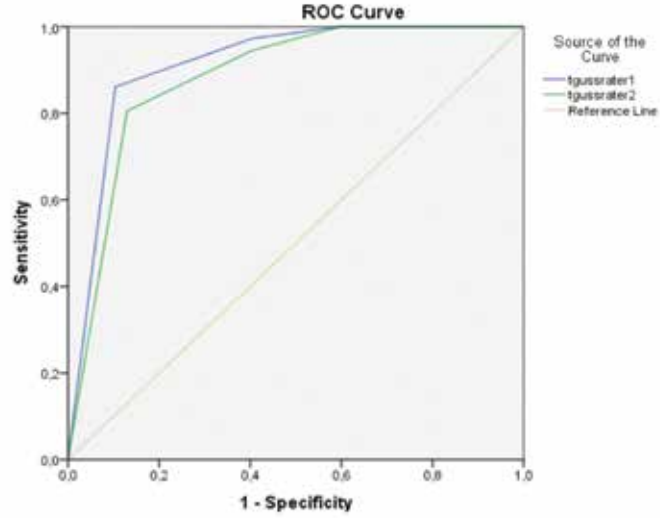


Figure 2. ROC curve analysis for aspiration risk



In the measurements performed with ICC, the values varied from 0.881 to 1.000, suggesting satisfactory stability and very good reliability of the subtests, parts, and total scores. None of the items showed good, poor or fair agreement.

Validity

A strong negative significant correlation was found between FEES stage and the total T-GUSS scores of the raters (r= -0.547 p<0.001; r= -0.515, p=0.001, respectively). The T-GUSS scores for dysphagia and aspiration risk as estimated using FEES are given in Tables 4-5, and ROC analysis results are shown in Table 6 and Figures 1-2, respectively.

Total T-GUSS scores for dysphagia as estimated using FEES had 97.1%-95.3% sensitivity and 72.2%-69.6% specificity. Also, moderate AUC and high positive PV and LR showed high sensitivity and moderate specificity. These results indicate that T-GUSS has a moderate diagnostic accuracy for dysphagia. Total T-GUSS scores for aspiration risk had 97.5-96.1% sensitivity and 75.2-76.2% specificity. The higher AUC, and positive and negative PV and LR for the detection of aspiration risk showed that T-GUSS was a very useful and accurate diagnostic tool in predicting aspiration risk, as well as more sensitive and specific for the detection of aspiration risk than dysphagia.

DISCUSSION

Swallowing is a complex behavior that is realized by coordinated and synergistic functioning of many oral and pharyngeal, laryngeal, and esophageal muscles. This complex action includes "oral," "pharyngeal," and "esophageal" phases, involv-

ing various muscles and nerves to open the mouth for intake of the food, prepare the bolus with nutriments, and push the pharynx to allow the passage of food into the stomach (18).

Impairment of swallowing is a condition of vital importance in patients with stroke. Recent studies have shown that every stroke is a risk factor for dysphagia (19). For this reason, it is important to evaluate swallowing function.

GUSS is a bedside screening test developed by Trapl et al. for the assessment of all phases of swallowing and the determination of the necessity for further evaluation in patients with acute stroke, and making necessary modifications in diet according to the results of this evaluation, as well as to minimize aspiration risk during all of these evaluation processes (12). Unlike the commonly used water drinking test, different volumes and consistencies are evaluated with minimum aspiration risk.

GUSS has been translated into various languages such as Chinese, Czech, Danish, English, French, German, Korean, Portuguese, Spanish, Russian, Thai, and Vietnamese in 14 countries, and validation studies have shown its effectiveness for patients in the acute, subacute, and chronic phases of aspiration. It has also been a reference and an inspiration test for the development of new screening tools and accepted as a "high-quality screening test" (7, 20-30). Therefore, we wanted to investigate whether this test was appropriate for our country and the present study aimed to approve the validity and reliability of GUSS.

The initial cohort of Trapl et al. included 20 patients and the authors reported interrater reliability for aspiration risk as "excellent agreement" (κ=0.835) (12). Afterwards, as a validation cohort of this study, 30 patients were studied and higher rates of sensitivity (100%), specificity (50-69%), +PV (74%), -PV (100%), and +LR 2.8 were reported.

Our results are in concordance with Trapl et al. in terms of the results of interrater reliability and validation, but our diagnostic indicators were better (sensitivity 97.5 - 96.1%, specificity 75.2 - 76.2%, +PV 84.3%, -PV: 95.1 - 95.3%, +LR 6.1-6.4 and -LR 0.05-0.06) (12). The differences between of our results and Trapl's may be attributed to the following factors: (1) Trapl et al. evaluated patients within 24 hours of stroke, whereas in our study group, an average of 2 weeks (mean: 14.34±5.23 days) had elapsed after the stroke incident (12). Cognitive impairment and dysphagia including all swallowing phase disorders in the early days after stroke can be more severe than 14 days after stroke. Studies have shown that recovery might occur after stoke with restoration in the affected hemisphere and compensation in the contra lateral hemisphere (31). In addition, there is silent nonfunctional period that involves even the unaffected hemisphere within the first few days after stroke. Therefore, we think that Trapl et al. might have identified a larger number of patients with severe dysphagia (47% vs. 2.7%), that is, they might have had numerous false positive results when compared with ours (2, 12). Trapl et al. used an 8-step penetration and aspiration scale in their study, but we used the 6- step scale determined by Dziewas et al. (12, 14). The scale that we used to define dysphagia level is similar to the GUSS test in terms of involving intakes of solid, semi-solid, and liquid foods. We might have obtained relatively better results by using this scale.

The validity and reliability of the GUSS test was approved only in Korean and Chinese previously, as cited in the literature (25, 26). The Chinese version was tried on a similar patient group as used by Trapl et al. who demonstrated its excellent interrater reliability (κ = 0.926) and validity (0.72) with the standard swallowing test of neurologist (12, 25). However, they did not use VF or FEES, which are the gold standards for the evaluation of dysphagia. Therefore, the results of this version are not compatible with our study. The Korean version, which was performed using VF with 55 patients with acute-period stroke, demonstrated 100% sensitivity, 60%-61.1% specificity and 100% -PV in the initial cohort with 40 patients, and 100% sensitivity, 85.7%-88.9% specificity, and 100% -PV in the validation cohort of 15 patients (26). The results of this version are more favorable than our study. This may be because of the VF evaluation. Although VF has difficulties such as the necessity of transfer and orders in this acute group of patients, we think that it is possible to perform a better dysphagia evaluation than FEES because FEES can indirectly indicate aspiration problems, whereas VF allows direct observation. This can provide a more effective and realistic assessment when aspiration is used as a cut-off.

Nevertheless, we believe that our results are more realistic because our study included a higher number of patients, which conveys importance if we consider the reportedly higher prevalence of dysphagia (up to 80%) in recent years (32).

Limitations

Although dysphagia can be seen in all periods of stroke, we did not include patients with acute or chronic stroke to prevent temporary dysphagia in the acute phase, as well as to exclude possible compensation mechanisms that may have been developed by the patient in the chronic phase. Moreover, although more dysphagia may occur in non-hemispheric stroke, we excluded brainstem and hemorhagic stroke to create a homogeneous patient group. We think that future studies involving these patients will allow us to better understand the effectiveness of GUSS test for the detection of dysphagia.

In conclusion, T-GUSS has a good internal consistency and very good reliability between raters, as well as good correlation with FEES evaluation regarding the detection of aspiration risk in patients with early-period stroke, like patients with

acute-period stroke. This study is also important because it included both a high number of patients and accomplished all the steps required for the application of a GUSS test in clinical practice, namely translation, validity and reliability.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Ankara Dıskapı Yıldırım Beyazıt Training and Research Hospital (16.02.2015-20/1).

Informed Consent: Written informed consent was obtained from patients and the parents of the patients/patient who participated in this study.

Peer-review: Externally peer-reviewed.

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