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Validation of the Korean Version of the Standardized Swallowing Assessment and the National Institute of Health Stroke Scale Among Acute Stroke Patients

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Abstract

Proper management and prevention of dysphagia are urgently needed in acute care of stroke patients in Korea. However, no highly sensitive and accessible nurse-led screening tools have been validated within the Korean settings. The purpose of this study was to validate a screening tool led by nurses to identify dysphagia and aspiration risks among acute stroke patients. Registered nurses (RNs) screened 131 residents from a university hospital in South Korea using the Korean version of the Standardized Swallowing Assessment (K-SSA). Results were validated against those from the Gugging Swallowing Screen (GUSS). Compared to results from the GUSS, with 9- and 14-point cutoffs, the K-SSA had a sensitivity of 0.80 and specificity of 0.90 [95% CI 0.806, 0.992] for screening dysphagia and 1.00 sensitivity and 0.94 specificity [95% CI 0.862, 1.000] for screening aspiration risks. The K-SSA demonstrated excellent sensitivity and specificity for screening individuals at risk of dysphagia and aspiration when led by RNs for acute stroke patients.

Keywords: *Stroke, Swallowing, Assessment, Validity, Nurses*

1. Introduction

Stroke refers to non-traumatic brain injuries caused by rupture or occlusion of the cerebral blood vessels causing sudden neurological symptoms such as loss of motor function, sensory disorders, cognition, language disorders, and coma [1]. According to 2017 Statistics, cerebrovascular disease is the third leading cause of death in South Korea, following cancer and heart disease, and stroke is the most common cause of death among cerebrovascular diseases [2]. A total of 85% of stroke survivors experience challenges in daily living and deterioration in quality of life from paraplegia, facial paralysis, dysphagia, language disorder, and cognitive impairment [3]. In particular, dysphagia, observed within 3 days from the onset of stroke (incidence between 42% and 67%) is known to have an important effect on the prognosis of stroke [4].

Dysphagia may result in a number of problems such as dehydration, aspiration pneumonia, and malnutrition, and can cause death in severe cases [5]. In particular, aspiration pneumonia due to dysphagia is the most common complication of stroke, accounting for approximately 12% cases, with a mortality rate of approximately 5% [6]. According to Hammond [7], early detection of dysphagia in stroke patients and use of food concentration control or compensatory swallowing techniques reduce the incidence of complications, thus emphasizing the importance of early detection and intervention.

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Fiberoptic endoscopic evaluation of swallowing (FESS) and video fluoroscopy (VF) are commonly used gold standard methods for dysphagia screening [8]. These invasive methods provide dynamic imaging swallowing functions through radioscopy, and can confirm risk of aspiration pneumonia. However, the patient has to visit the radiological room for examination, requires special equipment, skilled personnel, and is exposed to radiation whenever examined. For this reason, bedside screening tests for dysphagia have been developed by nurses who can observe the patient's dietary process in a short time. The Standardized Swallowing Assessment (SSA) is a relatively popular screening test, similar to the Gugging Swallowing Screen (GUSS), which assesses the basic condition of the patient before gradually assessing the dysphagia. However, the sensitivity (47-68%) and specificity (67-86%) for SSA differ widely depending on the study [9].

GUSS is a dysphagia-screening test developed by Trapl et al. [10] for stroke patients. Easy to use and score, it can show the graded evaluation, providing more clinical information than the swallowing screening test, which is graded as "pass" and "fail". Trapl et al. [10] used GUSS to determine the cut point of a risk of aspiration based on whether or not it was aspirated in a fiberoptic endoscopic evaluation (Fiberoptic Endoscopic Evaluation) for patients within 24 hours of a stroke. Sensitivity and specificity were determined and GUSS showed validity as a screen aspiration test for acute stroke patients. If the SSA results correlate highly with the GUSS results, the SSA may be more likely to be used for screening dysphagia.

The scale mostly used for the assessment of neurological damage in stroke patients is the National Institutes of Health Stroke Scale (NIHSS), a simple, validated scale permitting identification of neurological signals and clinical changes or a potential response to therapy and consisting of 11 items; consciousness, language, dysarthria, eye movements, visual field, neglect, facial paresis, proximal limb strength, extremity ataxia and sensorial function [11, 12]. It is advantageous in that the medical staff, not the neurologist, can use the neurological examination quickly and without fail [13]. We also investigated the feasibility of NIHSS for dysphagia screening. If the nurse can use the NIHSS for the screening, the swallowing disorder can be detected early and the complication caused, prevented, leaving a positive effect on patient outcomes.

Therefore, based on the proven clinical usefulness of GUSS, in this study, nurse-led SSA and NIHSS will be applied to stroke patients admitted to the hospital to measure sensitivity and specificity. In addition, the SSA and NIHSS will check the validity of the screening tests and confirm availability of clinical measures.

2. Method

2.1 Purpose and period of study

This study is a methodological study to evaluate the sensitivity, specificity, and positive and negative predictive values of nurse-led SSA and NIHSS, for the selection of dysphagia in stroke patients based on GUSS. The specific objectives are as follows:

1) To measure the sensitivity, specificity, area under ROC (AUC), and accuracy of SSA for dysphagia screening in acute stroke patients.
2) To measure the sensitivity, specificity, area under ROC (AUC), and accuracy of NIHSS for screening of dysphagia in acute stroke patients.

This study was conducted after review and approval from the institutional Review Board of G-University Hospital in J-City. The candidates were patients admitted to G-University Hospital Neurology Ward and Stroke Intensive Care Unit. The selection criteria for the subjects were as follows: Patients with acute stroke, in-patients who do not have other neurological disorders that cause dysphagia and who have enough cognitive function to follow directions, and persons who had agreed in writing to understand and participate in the purpose of the study. In cases of people aged 70 or older, the study was conducted when the caregiver agreed with participation.

2.2 Materials

2.2.1 GUgging Swallowing Screen (GUSS)

The grade of dysphagia was assessed using the Gugging Swallowing Screen (GUSS) developed by Trapl et

al. [10]. The GUSS test consists of two sections: a direct swallowing test comprising three subtests, followed by an indirect swallowing test, which includes four subtests. Each subtest is valued between 0 and 5 points according to the presence or absence of the symptom and the lower the score, the more severe the dysphagia. The first section of GUSS consists of three subtests of food textures, starting with a semisolid, then a liquid, and then solid textures. The second section assesses the four signs of aspiration: delayed swallowing, coughing, salivation, and changes in speech. If there is a problem at each sub-step of the indirect and direct swallow test, the test is stopped at that stage and the scores added up. The total score of indirect and direct examination of GUSS is 20 points; points 0 to 9 are rated as high, 10-14 points as moderate, 15-19 as low, and 20 points as minimal risk of aspiration due to dysphagia. The cutoff point was 14, the predicted validity for aspiration was 0.933 (95% CI) in the area under the ROC curve, and the inter observer reliability was kappa = 0.835 ($p<.001$) [10]. In this study, the results of each observer were measured after training until more than 90% of the measurements were consistent.

2.2.2 Korean Standardized swallowing assessment (K-SSA)

The SSA comprises three stages. The first consists of two questions to determine if the patient has a physical condition to be screened. The patient should be able to follow the instructions of the healthcare provider and be able to move their neck and sit down. If these conditions are not met, the test is stopped. The second stage assesses the physical function. It checks whether the patient can cough, control saliva, suck lips, and breathe well. If any of these cannot be performed, the test is stopped. The third stage is a water swallow test: A spoonful of water is provided to check for changes in coughing, choking, apnea, and wet voices. The second and third steps are repeated and half a cup of water is provided if there is no problem. However, if a problem occurs, it is regarded as abnormal. In Perry's study, sensitivity was 0.94 and specificity was 0.75 [14].

2.2.3 National Institute of Health Stroke Scale (NIHSS)

The NIHSS, developed by a stroke expert to measure the neurological severity of acute stroke patients, comprises 11 components including consciousness, language, dysarthria, eye movements, visual field, neglect, facial paresis, proximal limb strength, extremity ataxia, and sensorial function [11]. Each component involves a question. The level of consciousness comprises three measures (alertness, naming, obey command) and the items of upper limb paralysis and paralysis, evaluated on the right and left sides, respectively total 15 items. The total score ranges from 0 to 42, being directly proportional to the neurological severity.

3. Procedure

The subjects were assigned to 131 acute stroke patients who met the criteria for participating in this study, and the GUSS, SSA, and NIHSS were directly measured by trained nurses.

4. Analytical Methods

SPSS 22.0 was used for statistical analysis. The subjects' general characteristics were analyzed using descriptive statistics. Sensitivity, specificity, and accuracy were calculated by differentiating the cut points to find the appropriate cutoff point of SSA compared to the GUSS results and that of NIHSS compared to the GUSS results, respectively. Receiver operating characteristic (ROC) curves were calculated and area under the curve (AUC) was presented.

5. Results

5.1 The General Characteristics of the Study Subjects

Of the 131 participants, 76 (58%) were male and all participants' average age was 70.2 (±12.0), with 35 (26.7%) in the under 65 age group, 30 (22.9%) in the 75-79 age group, and 10 (7.6%) people in the over 80 age group. Fifty-seven (43.5%) were elementary school graduates, with 21 (16%) middle school graduates, 21 (16%) high school graduates, 17 (13%) uneducated, and 14 (10.7%) college graduates. Ninety-five (72.5%) were married and 27(20.6%) widowed. The occupational status showed 65 (49.6%) unemployed and 28 (21.4%) others (in agriculture). The majority of the respondents, 72 (55%) were religious, with 50 (38.2%) Buddhists.

5.2 Validation of SSA based on GUSS

Results of the SSA were validated based on GUSS with two different cutoffs. When the GUSS score was ≤9 points, the SSA – presented a sensitivity of 1.00, specificity of 0.80, AUC of 0.90, and accuracy of 0.80, based on the presence of dysphagia. When the GUSS score was ≤14 points, the SSA-presented a sensitivity of 0.88, specificity of 1.00, AUC of 0.94, and accuracy of 0.97 ($p<0.001$, Table 1).

Table 1. Validation of the standardized swallowing assessment (N=131)

SSA		GUSS≤9		GUSS≤14	
		Dysphagia	No Dysphagia	Dysphagia	No Dysphagia
Section I+II+III	Positive	2	26	28	0
	Negative	0	103	4	99
Sensitivity		1.00		0.88	
Specificity		0.80		1.00	
AUC (95% CI)		0.90 [CI 0.806, 0.992]		0.94 [CI 0.862, 1.000]**	
p value		0.53		<.001	
Accuracy		0.80		0.97	

Note. GUSS=Gugging Swallowing Screen; AUC=area under the curve; CI=confidence interval.
*p<.05; **p<.01

The AUC was calculated using the ROC curve based on the cutoff point of GUSS. When the GUSS score was ≤9 points, it was 0.90, and when the GUSS score was ≤14 points, it was 0.94 (Figure 1).

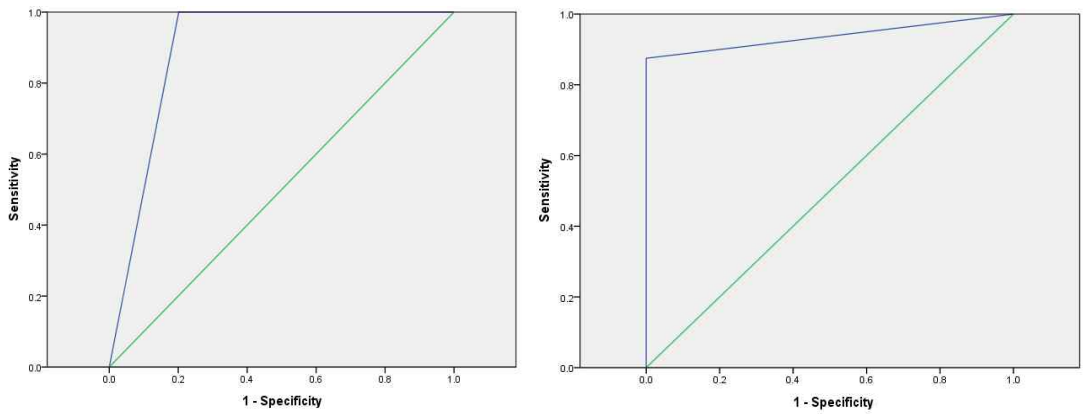

Figure 1. Receiver operating characteristic (ROC) curves of the power of two methods to discriminate between the Gugging Swallowing Screen (GUSS) and Korean Standardized Swallowing Assessment, using the 9-point (A) and 14-point (B) cutoffs of the GUSS

5.3 Validation of NIHSS based on GUSS

Results of the NIHSS were validated based on GUSS with two different cutoffs. When the GUSS score was

≤9 points, the sensitivity of NIHSS ≤12 points was 0, specificity was 0.97, AUC was 0.48, and accuracy was 0.95, based on the presence of dysphagia. Sensitivity of NIHSS ≤12 points was 0.13, specificity was 1.00, AUC was 0.563, and accuracy was 0.79 when the GUSS score was ≤14 points (Table 2).

Table 2. Validation of the NIHSS (N=131)

NIHSS		GUSS≤9		GUSS≤14	
		Dysphagia	No Dysphagia	Dysphagia	No Dysphagia
≤12 point	Positive	0	45	4	0
	Negative	2	125	28	99
Sensitivity		0.00		0.13	
Specificity		0.97		1.00	
AUC (95% CI)		0.48 [0.092, 0.877]		0.563 [0.442, 0.683]	
p value		0.94		0.29	
Accuracy		0.95		0.79	

Note. NIHSS=National Institute of Health Stroke Scale; GUSS=Gugging Swallowing Screen.

6. Discussion

The purpose of this study was to investigate the validity of SSA and NIHSS as screening tests for swallowing by confirming the sensitivity and specificity of nursing-led SSA and NIHSS in stroke patients admitted to a general hospital.

The validity of SSA was verified based on GUSS. When the GUSS score was ≤14 points, the SSA- presented sensitivity was 0.88, specificity was 1.00, AUC was 0.94, and accuracy was 0.97 ($p<0.001$). The AUC was measured to 0.94 when the area under the curve in the receiver operating characteristic (ROC) curve was calculated based on the GUSS score ≤14 points. These results are higher than those of K-SSA where the sensitivity was 0.86, specificity was 0.71, accuracy was 0.79, and AUC was 0.84 when the GUSS score was ≤14 points in the study by Park et al. [15], which evaluated swallowing disorders of 395 patients living in nursing homes based on GUSS. In the study by Perry [14] that evaluated dysphagia in 200 stroke patients, the sensitivity and specificity of SSA were 0.97 and 0.9, respectively. Comparably, the sensitivity in this study was slightly lower (0.88) but the specificity was higher (1.00). Therefore, the nurse-led SSA has shown good dysphagia screening potential.

Although FESS and VF are considered standard dysphagia assessments, currently, they are limited in continuously assessing the grade of dysphagia because they are difficult and time-consuming to perform before patient's oral intake [16]. However, it is believed that the nurse-led SSA can be immediately implemented on bedside and used conveniently, without risking radiation exposure. Previous studies used VF more frequently than GUSS to verify the validity of SSA, therefore posing a limit in comparing results of this study with those of previous studies. In Lee et al.'s study [17], 55 acute stroke patients were evaluated for clinical validity of GUSS by conducting VF. Sensitivity of GUSS for dysphagia screening was 100% for all A, B, and C tests, with specificities of 61.1%, 72.2% and 85.7%, respectively; interobserver reliability showed a high agreement between A and B with kappa = 0.916. The sensitivity of GUSS was 90.9%, the specificity was 69.2%, and the AUC was high (0.92) in the study of the possibility of using GUSS in 37 subacute stroke patients admitted to rehabilitation hospital based on VF [9]. According to a study by Trapl et al. [10], who performed GUSS on acute stroke patients based on FESS, the sensitivity was 100% and the specificity was 64.3%. The above three studies suggest that the standard tests for confirmation of aspiration are different but have similar results in sensitivity and specificity. These results prove the clinical effectiveness of GUSS as a Gold standard for evaluating dysphagia grade and selection of a suitable expression for patients who cannot perform VF. However, other studies that measured SSA on the basis of VF aspiration, showed the sensitivity of the therapist at 47% and specificity at 86%, while the sensitivity of the physician was 68% and the specificity was 67%. The interobserver reliability between the therapist and the physician was kappa = 0.24–0.48, whereas that between doctors was lower with kappa = 0.5 [18]. Such a large difference in sensitivity and specificity

depending on the tester and low interobserver reliability suggests that education and training is necessary for testers who assess dysphagia. Therefore, a systematic protocol for assessment and intervention of dysphagia should be established and trainees should be trained to assess and manage dysphagia.

The validity of NIHSS was verified based on GUSS, When the GUSS score was ≤9 points, the sensitivity of NIHSS ≤12 points was 0, specificity was 0.97, AUC was 0.48, and accuracy was 0.95, based on the presence of dysphagia. Sensitivity of NIHSS ≤12 points was 0.13, specificity was 1.00, AUC was 0.563, and accuracy was 0.79 when the GUSS score was ≤14 points. Therefore, the validity of NIHSS was not verified. This is in contrast to the results of Bessenyei et al. [19] who reported that applying NIHSS to acute stroke patients more effectively reflects the patient's condition than other instruments. However, previous studies have shown NIHSS as a reliable method of predicting patient recovery after cerebral infarction. In addition, since NIHSS score is a factor affecting the quality of life of stroke patients [20], it is necessary to assess neurological problems to minimize the physical dysfunction of stroke and to improve the patient's quality of life. However, the 11 components in the NIHSS tool do not independently measure swallowing function. Hence, it is important to develop an assessment tool for dysphagia and to verify its validity and sensitivity.

6. Conclusion

This study identified the validity of the nurse-led SSA and NIHSS as screening tests for dysphagia and the availability of clinical measures. If these tools are appropriately used for screening dysphagia, it is possible to detect dysphagia more easily and to prevent complications, which may have a positive effect on the prognosis of the patient. Ultimately, it will be of great significance to lay the foundation for a strategy to improve the quality of stroke patient care.

Based on these results, we propose the following:

In this study, the validity of the nurse-led SSA was verified, but not that of the NIHSS making it necessary to repeat the nurse-led SSA and NIHSS study, to confirm their feasibility for dysphagia.

After validating the screening test for dysphagia, it is necessary to develop and apply a process guideline for assessing, evaluating, and intervention for dysphagia to identify its effects.

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