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The simple and fast swallowing function assessment in acute stroke patients

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ABSTRACT

OBJECTIVE: The dysphagia associated pulmonary aspiration is one of the important reasons for mortality and morbidity in stroke. In this study, we evaluated the early swallowing functions of the acute ischemic stroke patients, and tried to choose the right way to start feeding with simple tests.

METHODS: Seventy-three inpatients with acute stroke were included in this study. Age, gender, type of stroke, NIHSS and RANKIN scores, risk of aspiration and feeding route were recorded for all the subjects. Dysphagia was evaluated with the bedside clinical evaluation of swallowing function score (BDS) tests. These BDS tests are the assessment of dysphagia with neurological examination score (DSNE) and the bedside water drinking test (BWT) and the Swallowing score (SS) ratio (combining BWT and DSNE scores). All tests to evaluate swallowing were planned to be carried out 24 hours after the last known time of the patient's healthy and 48 hours after hospitalized. The tests were performed in awake patients who were able to manage to cooperate at the scheduled time. In addition, stroke patients were evaluated quantitatively using the Gugging Swallowing Screen (GUSS) test for dysphagia and compared with BDS tests. All patients were evaluated for aspiration pneumonia seven days after admission. If the patients had drowsiness or were unable to cooperate, they were not included in this study.

RESULTS: Seventy-three (26F/47M) patients were included in this study if they were conscious and the Glasgow coma scale was above 10 points. When only BDS tests were performed, we decided that 74% (n=54) of the patients could be fed by the oral route, 13.7% of the patients could be fed only by NG route (n=10) and the patients who had the worst BWT and DSNE scores preferred to be feed with PEG route (11% of all the patients, n=8). In 41.1% of the patient (n=30) established the risk of aspiration on referral clinic and 23.3% of the patients (n=17) developed aspiration pneumonia in the clinical follow-up. When 30.1% (22) of the patients had dysphagia with GUSS test, 23.3% (n=17) of the patients were dysphagic with DSNE and 30.1% of the patients (n=22) were dysphagic with BWT and 22% (n=16) of the patients were moderate-severe, 11% (n=8) of the patients were mild dysphagic with the SS ratio.

CONCLUSION: These BDS tests concluded are fast and reliable methods for evaluating the dysphagia and risk of aspiration pneumonia without laborious and very few clinically applicable methods, such as endoscopic or video fluoroscopy, in patients who are hospitalized with stroke.

Keywords: Aspiration; bedside tests; dysphagia; ischemic stroke.

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The frequency of dysphagia varies according to the localization of the stroke (anterior or posterior circulation), and the assessment methods and duration of the stroke (acute or chronic). Dysphagia is usually seen range between 19% and 81% after ischemic stroke [1]. Dysphagia and associated pulmonary aspiration are the important reasons for morbidity and mortality, especially in stroke patients. The presence of dysphagia is associated with an increased risk of pulmonary complications and nutritional deficiency. There are important evidence about the early detection of dysphagia in acute stroke patients that reduces the complications mentioned before, shorten hospital stay and decreases healthcare expenditures [1–3]. In this study, we aimed to evaluate early swallowing functions of acute ischemic stroke patients and to prevent aspiration pneumonia by choosing the appropriate feeding method.

MATERIALS AND METHODS

Seventy-three inpatients hospitalized with acute stroke were taken for this study. Age, gender, type of stroke, NIHSS (The National Institutes of Health Stroke Scale) and RANKIN scores, risk of aspiration, feeding method were recorded for all the patients. Swallowing score (SS) ratios were calculated with the assessment of dysphagia with neurological examination score (DSNE) and the bedside water swallowing score (BWT). All tests to evaluate swallowing were planned to be performed 24 hours after the last known time of the patient's healthy and 48 hours after inhospitalized. The tests were performed in awake patients who were able to manage to cooperate at the scheduled time. In addition, stroke patients were evaluated quantitatively with Gugging Swallowing Screen (GUSS) test for dysphagia and compared with BDS tests. The risk of aspiration assessed as DSNE score and occurrences of subfebrile fever and increased CRP/sedimentation values on time that the case referred to the hospital. All patients were evaluated for aspiration pneumonia seven days after admission and PEG was decided to be performed in eight patients.

The Evaluation of Swallowing Functions

We evaluated head control, sitting balance, faringeum and velum retching reflex, palatal movements, tongue movements and facial paresis of all patients for DSNE. Palatal movement: normal: 0, asymmetric movement: 1, no palatal movement: 2, Tongue movement: protrusion weakness: 1, lateral movement weakness: 1 and 1 point for each of the other pathological findings (head control, sitting balance, faringeum and velum retching reflex, facial paresis), calculated on a total of 9 points were recorded as a quote; DSNE: 0–3: normal, 4–9: dysphagic. BWT applied by water drinking test for all patients while arterial O_2 saturation evaluated by pulse oximetry. It was observed whether the patients drank water at once or by dividing, and then, the presence of cough, hoarseness bifurcation, drooling, laryngeal movement and whether there was a 2% or more decreasing in saturation during and after 10 minutes of drinking water were evaluated. 1 point was given for each pathological findings, then, BWT was calculated as 0–2: normal, 3–6: dysphagic. The main differences between the BWT and the GUSS scale were that we used only water to evaluate dysphagia and screened to arterial O_2 saturation in the BWT for 10 minutes. Then, after BWT test, we applied the rest of the GUSS test. At the end of the tests, the swallowing score (SS) ratio was calculated combining BWT with DSNE scores and this was named as "swallowing rating", 0–3 points are normal, 4–9 points are mild dysphagia and 10–15 points are moderate-severe dysphagia [2].

Ethical Approval for this work was obtained from the Istanbul Training and Research Hospital ethical committee (date: 07.07.2017, number: 1038).

Informed consent was obtained from all patients or their legal guardians, following the provision of detailed information on the study examinations and tests.

Statistics: The assumption of normality was checked by a Q-Q plot and histogram. Numerical data were analyzed with student t-test, logistic and linear regression analysis and ROC analysis. Estimates were given with 95% confidence intervals. Statistical analysis was performed using Stata 16 (Stata Corp LP, Texas, USA).

RESULTS

The mean age of patients (26F/47M) was 68.06±12.5 years. While 42 patients were anterior circulation stroke, 26 patients were posterior circulation stroke; five patients were both anterior and posterior circulation stroke. According to the TOAST (Trial ORG 10172 in Acute Stroke Treatment System) classification, 56.1% of the patients were atherothrombotic stroke (large artery atherosclerosis) (n=41), 27.4% of the patients were cardioembolic stroke (n=20), 12.3% of the patients were cryptogenic stroke (n=9), 4.1% of the patients were small

Table 1. Distribution of the AP and AR in stroke type

Stroke type	Atherothrombotic	Cardioembolic	Cryptogenic	SVD and other
Aspiration risk (n=30)	16	10	3	1
Aspiration pneumonia (n=17)	10	6	1	0

SVD: Small vessels diseases.

Table 2. The underlying disease and risk factors in dysphagia

	Coef.	Std. Err.	t	p>|t|	95% CI		R-sq
Aspiration risk (AR)							
AF	-0.003	0.060	-0.05	0.960	-0.124	0.118	0.0000
DM	0.104	0.119	0.88	0.382	-0.132	0.34	0.0108
HT	0.102	0.105	0.97	0.334	-0.0107	0.311	0.0132
HL	-0.128	0.113	-1.13	0.260	-0.354	0.097	0.0178
Alcohol	-0.059	0.060	-0.99	0.327	-0.180	0.060	0.0135
Smoke	-0.028	0.117	-0.24	0.807	-0.626	0.205	0.0008
Other	0.153	0.073	2.10	**0.04**	0.007	0.299	0.0584
Aspiration pneumonia (AP)							
AF	-0.012	0.070	-0.18	0.859	-0.153	0.128	0.0004
DM	0.272	0.135	2.01	**0.004**	0.001	0.542	0.0537
HT	0.185	0.121	1.53	0.130	-0.055	0.427	0.0321
HL	-0.063	0.133	-0.47	0.637	-0.328	0.202	0.0032
Alcohol	-0.012	0.070	-0.18	0.859	-0.153	0.128	0.0004
Smoke	-0.116	0.130	-0.86	0.394	-0.387	0.154	0.0103
Other	0.087	0.087	1.00	0.320	-0.086	0.260	0.0139

CI: Confidence interval; AF: Atrial fibrillation; DM: Diabetes mellitus; HT: Hypertension; HL: hyperlipidemia.

vessel disease (SVD) (n=3) (Table 1). When Partial anterior circulation infarct (PACI) were 42.5% (n=31), posterior circulation infarct (POCI) were 34.2% (n=26), total anterior circulation infarct (TACI) were 12.3% (n=9), and others were 9.6% (n=7) [PACI+POCI, Lacunar infarct (LACI)] according to the Oxfordshire Community Stroke Project classification (OCSP). 43.8% DM (n=32), 74% HT (n=54), 34.2% hyperlipidemia (n=25), 6.85% (n=5) atrial fibrillation (AF) and 10.96% (n=8) others were as underlying disease, and 6.85% (n=5) alcohol and 38.36% (n=28) smoking were risk factors. Systemic diseases (except DM, HT, HL) were significantly related to AR increase (Rsq=5%) and DM was significantly related to AP risk increase (Rsq=5%), but rest of the underlying diseases or any of the existing risk factors were significantly associated with early (AR) or late (AP) swallowing dysfunction. A detailed assessment of these risk factors is given in Table 2. The stroke risk score that related to chronic disease history was 93.2% (n=68) low and 6.8% (n=5) moderate stroke risk.

The mean RANKIN score was 3.00±1.6. The mean NIHSS score was 7.4±6.3 on admission, and the mean NIHSS score was 5.9±5.5 at discharge. NIHSS score was mild in 63% and moderate in 21.9% and severe in 15.1% of all patients at the admission when NIHSS severity was mild in 68.5% moderate in 26% and severe in 5.5% of all patients at the discharge. When the BDS tests applied we found that 74% of patients (n=54) could be fed with the oral route, 13.7% of the patient could be fed only with NG route (n=10) and 4% of the patient (n=1) could be fed any

Table 3. Feeding routes that preferred with BDS tests

	AR*, n=30	AP, n=17
NG (n=10)	10	8
Oral (n=54)	11	3
PEG (n=8)	8	6
Parenteral (n=1)	1	0

NG: Nasogastric gastrostomy; PEG: Percutaneous endoscopic gastrostomy; BDS: Bedside dysphagia score; DSNE: Dysphagia with neurological examination; AP: Aspiration pneumonia; *AR (Aspiration risk): The clinical aspect of the first neurological exam (DSNE) and occurrences of subfertile fever and increased CRP/sedimentation values on time that the case referred to hospital.

enteral route so that preferred parenteral route. The patients who had the worst BWT and DSNE scores planned to be feed with PEG route and when patients were evaluated for aspiration pneumonia (7 days after hospitalized) PEG was decided to be performed in eight (11%) patients. When 41.1% of the patients (n=30) had aspiration risk on referral clinic, 23.3% of the patients (n=17) developed aspiration pneumonia in the clinical follow-up (Table 3).

In neurological examination (DSNE), facial paralysis and sitting balance disorder were more common, while other findings were close to each other (Table 4).

In the BWT, drinking water intermittently, coughing and hoarseness sound rates were higher. 76.7% of the patients (n=56) were normal and 23.2% (n=17) were dysphagic with DSNE and 30.1% of the patients (n=22) were dysphagic with BWT. According to the SS ratio, 22% (n=16) of the patients had moderate-severe dysphagia, 10% (n=8) of the patients had mild dysphagia and 67% (n=49) of the patients had a normal score. In the GUSS test, 30.1% (22) of the patients had dysphagia and 69.8% (51) of the patients were normal. 56.6% (n=17) of all the patients who established as at risk of aspiration according to referral clinic, developed pneumonia in course of stroke. The patients who were dysphagic in the BDS test and the patients who developed aspiration pneumonia are shown in Table 5.

In this study, 13 patients were dysphagic and four patients were normal with BWT test in subjects that developed aspiration pneumonia in the course of the stroke. When evaluating the relationship between the feeding methods and aspiration pneumonia, we observed that the patients feeding with NG route have aspiration pneumonia most frequently, but aspiration risk was similar in both NG and oral feeding patients. Mean ages and the average NIHSS scores of the patients who had aspiration risk and pneumonia were high in admission to the hospital. Mean age was higher in the group who had severe SS ratio. There was no significant relationship between the all applied dysphasia tests (DSNE, BWT, SS GUSS) with the age of patients (p=0.20, 0.19, 0.08, 0.08, respectively), but there was a significant relationship between RANKIN score (means of dysphagic patients: 4.31±0.77) and dysphasia tests (p=0.000 for all tests). Similarly, there was a significant correlation between admission NIHSS score (means of dysphagic patients: 14.22±6.30) with the all applied dysphagia tests (DSNE, BWT, SS, GUSS) (p=0.01, 0.00, 0.00, 0.00, respectively). When the patients who developed aspiration pneumonia were compared to stroke localization with OCSP groups (Table 6), in regression analysis between AP and OCSP groups was significant (R-squared=0.16, Prob>F=0.006). AP was more corre-

Table 4. BDS test results

DSNE	%	BWT	%
Head control malfunction	6.8	Drinking water intermittently	42.5
Sitting balance disorder	32.9	Coughing	32.9
Velum reflex abnormality	19.2	Hoarseness sound	30.1
Faringeum reflex abnormality	20.5	Water leakage from the mouth	26.0
Palatal movement abnormality	5.5	Absence of larynx movement	12.3
Tongue protrusion disorder	16.4	Falling in oxygen saturation (>%2)	23.3
Tongue lateral movement disorder	17.8		
Facial paralysis	38.4		

BDS: Bedside dysphagia score; DSNE: Dysphagia with neurological examination; BWT: Bedside water swallowing.

TABLE 5. BDS test scores and aspiration pneumonia

	DSNE		OR	BWT		OR	SS		OR
	Normal	Dysphagic		Normal	Dysphagic		Normal	Dysphagic	
	56 (76.4%)	17 (23.2%)		51 (69.9%)	22 (30.1%)		49 (67.0%)	24 (33.0%)	
AP* n=17	7	10	2.06±1.75	4	13	4.66±5.55	1	16	3.08±2.14

BDS: Bedside dysphagia score; DSNE: Dysphagia with neurological examination; OR: Odd ratio; BWT: Bedside water swallowing; SS: Swallowing score; AP: Aspiration pneumonia. *The patients who developed aspiration pneumonia in clinical follow up. OR: Aspiration pneumonia risk ratio in terms of the GUSS test.

TABLE 6. Relation of BDS tests and OCSP groups

OCSP	PACI (n=31)	POCI (n=26)	TACI (n=9)	Other (n=7)
DSNE				
Dysphagia (n=17)	6	5	6	0
Normal (n=56)	25	21	3	7
BWT				
Dysphagia (n=22)	8	6	7	1
Normal (n=51)	23	20	2	6
SS				
Dysphagia (n=24)	9	7	7	1
Normal (n=49)	22	19	2	6
GUSS				
Dysphagia (n=22)	9	5	7	1
Normal (n=51)	22	21	7	6

BDS: Bedside dysphagia score; OCSP: Oxfordshire Community Stroke Project classification; PACI: Partial anterior circulation infarct; POCI: Posterior circulation infarct; TACI: Total anterior circulation infarct; Other: e.g., Lacunar, watersheet; DSNE: Dysphagia with neurological examination; BWT: Bedside water swallowing; SS: Swallowing score; GUSS: Gugging Swallowing Screen.

lated to the TACI subgroup than PACI, POCI and LACI (p=0.000, p=0.002, p=0.14, p=0.34, respectively).

The SS tests (as combining of DSNE and BWT) showed statistically significant superiority than GUSS and other BDS tests concerning pneumonia; however, specificities of the tests were higher in DSNE (87.5%) than BWT (83.9%) and SS (83.9%). The sensitivities were 58.8% in DSNE, 76.5% in BWT, 88.2% in SS (Table 7).

DISCUSSION

Dysphagia is a common condition after stroke, and evaluation of this is an important part of acute stroke management [4]. Many areas in the brain, mainly brain stem and basal ganglion, thalamus, motor cortex, have a role in the control of swallowing function. If one patient has an ischemic or hemorrhagic stroke that damaged these areas, this may result in various severe dysphagic conditions. In many cases of ischemic stroke, even in the early stage of the disease, mild dysphagia may occur, and most of these can improve over time. NG and PEG feeding routes can be preferred instead of early oral feeding, especially by considering lesion localization, underlying disease, risk factors and age of the patient in the course of the stroke. However, aspiration pneumonia could be seen even if this procedure is preferred in the early course of the disease. In our study, the vast majority of patients fed with oral route. However, although the number of cases at increased risk of aspiration was higher, aspiration pneumonia was less developed in patients that preferred the oral route; on the other hand, in the NG group, the rate of aspiration pneumonia was higher. This may be due to that NG feeding is preferred in more severe stroke patients. The dysphagia rates were increased with high admission NIHHS scores and RANKIN scores. In our results, only systemic diseases (except DM, HT, HL) were significantly related to AR increase, and DM was significantly related to AP risk increase. When the relationship between lesion localization and dysphagia is evaluated in stroke cases, oral phase disorders of swallowing are higher than other phases, and oral phase disorder is less common in brain stem lesions. However, the pulmonary aspiration was seen at higher rates in subcortical infarct cases [5]. In other studies, it was stated that dysphagia frequently occurred in the supratentorial anterior circulation stroke and prolonged dysphagia frequently occurred in the frontal and insular cortex lesions [6, 7]. There was no detailed evaluation according to lesion localization in our study; but we observed that

Table 7. Specificity and sensitivity and ROC analysis of BDS tests

	DSNE		BWT		SS		GUSS	
	Specificity	Sensitivity	Specificity	Sensitivity	Specificity	Sensitivity	Specificity	Sensitivity
AR %	100	56.6	97.6	70	97.7	76.7	95.3	66.7
AP %	87.5	58.8	83.9	76.5	83.9	88.2	83.9	76.5
AUC								
AR		0.79±0.04		0.84±0.04		0.88±0.04		0.81±0.05
AP		0.73±0.06		0.80±0.05		0.86±0.04		0.80±0.06

ROC: Receiver operating characteristic; BDS: Bedside dysphagia score; DSNE: Dysphagia with neurological examination; BWT: Bedside water swallowing; SS: Swallowing score; GUSS: Gugging Swallowing Screen; AR: Aspiration risk; AP: Aspiration pneumonia; AUC: Area under the curve.

the cases with swallowing disorder frequently consisted of anterior circulation strokes. Another striking case in our study was that AR and AP were both high in the atherosclerotic group, but this was probably related to the highest number of patients possible in this group (56.1% of patients). Also, swallowing scores were worse as expected, in cases with high NIHHS and RANKIN scores. An evaluation based on the nutritional methods after stroke shows that the rate of dysphagia in stroke patients is range 22–65% and that may continue for months in some patients [4]. Both early and late dysphagias are associated with poor prognosis, pneumonia, malnutrition, increased hospitalization time and increase of mortality [8]. To determine the most appropriate route (e.g., oral, NG and PEG) to start feeding, it is necessary to evaluate the presence of dysphagia in the early period. Although assessment of swallowing by endoscopic or video fluoroscopic methods is more appropriate, these are not available for most clinicians. It is suggested to use BDS tests, which can be administered quickly and simple for the evaluation of the swallowing functions in the early period of stroke (such as DSNE and BWT tests). However, these could help us start swallowing rehabilitation quickly if necessary [4, 9–14]. The studies on this subject have reported a higher incidence of pulmonary infection in patients with dysphagia on clinical examination than the patients without dysphagia (33% versus 16%, respectively) [15]. In our study, aspiration pneumonia developed in 2% of the non-dysphagic patients and in 66.6% of the dysphagic patients with BDS tests. The SS tests as combining of DSNE and BWT have shown statistically significant superiority than GUSS and other BDS tests concerning pneumonia. In dysphagic patients, aspiration risk scores and aspiration pneumonia rates were higher in SS, BWT and DSNE, respectively; but our patients' number is not enough to optimize this. Nevertheless, we could suggest that clinicians may benefit from using the DSNE assessment in addition to the BWT that is commonly used in clinical practice, at clinical follow-up. The limitations of our study could be listed as the low number of patients and the inability to thoroughly evaluate the relationship between swallowing impairment and anatomic lesion localization. Aspiration pneumonia was found to be higher in NG and PEG feeding routes, whereas patients who were at risk of aspiration were mostly in the Oral and NG feeding group. Although in 11 patients were found to have AR probability according to clinical markers (CRP, sediment, fever and first neurological examination) after BDS tests, in patients who preferred oral feeding (n=54), AP developed in only three patients during follow-up. The worst complication of the dysphagia is aspiration pneumonia in acute stroke patients. Dysphagia rates were higher as considered in patients with a high risk of aspiration in BDS tests. Similar to the literature, stroke severity, advanced age and large localization infarcts were related to high aspiration risk and also with dysphagia. We found out that aspiration risk is lower in patients with posterior infarcts, but that may be due to that most of the severe posterior stroke cases were being followed in intensive care units, not in neurology clinics.

Conclusion

These BDS tests concluded are fast and reliable methods for evaluating the dysphagia and risk of aspiration pneumonia in patients who are hospitalized with the stroke. These tests can be used as simple and quick tests to help

us choose the best feeding route at the earliest stages of stroke before choosing laborious and very few clinically applicable methods, such as endoscopic or videofluoroscopy, to investigate dysphagia. This will reduce the length of hospital stay, medical costs, and, most importantly, the rate of permanent disability in stroke patients.

Ethics Committee Approval: For this work was obtained from the Istanbul Training and Research Hospital ethical committee (date: 07.07.2017, number: 1038).

Informed Consent: Was obtained from all patients or their legal guardians, following the provision of detailed information on the study examinations and tests.

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