ORIGINAL RESEARCH ARTICLE

Validation Study of Kaiser Permanente Bedside Dysphagia Screening Tool in Acute Stroke Patients

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ABSTRACT

Introduction: Dysphagia occurs in up to 50% of patients with acute stroke symptoms, resulting in increased aspiration pneumonia rates and mortality. The purpose of this study was to validate a health system's dysphagia (swallow) screening tool used since 2007 on all patients with suspected stroke symptoms. Annual rates of aspiration pneumonia for ischemic stroke patients have ranged from 2% to 3% since 2007.

Methods: From August 17, 2015 through September 30, 2015, a bedside dysphagia screening was prospectively performed by 2 nurses who were blinded to all patients age 18 years or older admitted through the emergency department with suspected stroke symptoms at 21 Joint Commission accredited primary stroke centers in an integrated health system. The tool consists of 3 parts: pertinent history, focused physical examination, and progressive testing from ice chips to 90 mL of water. A speech language pathologist blinded to the nurse's screening results performed a formal swallow evaluation on the same patient.

Results: The end study population was 379 patients. Interrater reliability between 2 nurses of the dysphagia screening was excellent at 93.7% agreement (K = 0.83). When the dysphagia screenings were compared with the gold standard speech language pathologist professional swallow evaluation, the tool demonstrated both high sensitivity (86.4%; 95% confidence interval = 73.3-93.6) and high negative predictive value (93.8%; 95% confidence interval = 87.2-97.1).

Conclusion: : This tool is highly reliable and valid. The dysphagia screening tool requires minimal training and is easily administered in a timely manner.

INTRODUCTION

This study was performed to test the validity, sensitivity, and positive predictive value of a bedside screening tool to detect risk of aspiration pneumonia due to dysphagia. Difficulty swallowing or dysphagia is common among acute stroke patients, occurring in approximately 30% to 78% of the population.[1-3] About 50% of patients aspirate, and one-third of those who aspirate develop pneumonia.[3-5] Dysphagia is associated with a 3-fold increase in mortality risk, mainly attributable to pneumonia.[3,4] Other adverse consequences of dysphagia may include dehydration, malnutrition, weight loss, increased morbidity, increased length of stay, reduced rehabilitation capabilities, and psychological illness.[2,6] Rapid screening for dysphagia by a bedside nurse was developed to optimize resource utilization and to improve patient satisfaction. Speech language pathology services are limited. Waiting for these services may unnecessarily lengthen the time the patient is without oral intake.[7]

Dysphagia screening tools have been developed, such as the Barnes Jewish Hospital Stroke Dysphagia Screen, the Modified Mann Assessment of Swallowing Ability, the Emergency Physician Swallowing Screening, the Toronto Bedside Swallowing Screening Test,[8] and Gugging Swallow Screen.[9] Agreed-upon criteria for a dysphagia screening tool include adequate sensitivity and specificity to identify dysphagia and aspiration risk, a scoring system of "pass/fail," ease of use for health care providers other than a speech language pathologist (SLP), and the ability to rescreen with a change in clinical condition.[10,11] The use of dysphagia protocols to reduce the risk of pneumonia, death, or dependency has not been proven; however, the American Heart Association 2018 Guidelines for Early Management of Acute Stroke Guidelines state that it is reasonable to screen patients before oral intake.[12,13]

The bedside dysphagia screening tool used at the large integrated health system was developed in 2007. The annual aspiration rates for ischemic stroke patients have averaged 2% to 3% over a period of 12 years. The tool incorporates components of the Massey Bedside Swallowing Screen and the Burke dysphagia screening tool.[14,15] The dysphagia screening tool is divided into 3 parts. Part I includes selected history with a failed test for a tracheostomy, history of aspiration pneumonia, or currently nothing by mouth (NPO) with tube feeding. Part II includes a cognitive and motor skills

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assessment by the registered nurse (RN). Patients must effectively swallow their own secretions, move the tongue, smile and pucker the lips, and cough on command. In Part III, the patient must swallow without coughing or throat clearing during and 1 minute after taking ice chips. Then the patient may progress to drinking 90 mL of water continuously (Figure 1). The patient may fail the screening at any point or may pass and be allowed oral intake.

Inclusion/Exclusion Criteria

Study inclusion criteria were all patients 18 years or older exhibiting suspected stroke symptoms who were admitted to the emergency department (ED) at 1 of the 21 participant hospitals and had a diagnosis of stroke or transient ischemic attack (TIA) upon discharge. Exclusion criteria were a history of dysphagia, pre-existing gastrostomy tubes, being currently intubated, having had received alteplase upon admission, and not having a diagnosis other than stroke or TIA upon discharge. Patients who received alteplase were excluded because they may change rapidly between the RN screening and evaluation by speech therapy.

METHODS

This study received approval from the governing Institutional Review Board. Informed consent was waived because both the dysphagia screening tool and speech language therapy evaluation were considered standard of care. The study was conducted from August 17, 2015 through September 30, 2015. The dysphagia screening tool was prospectively performed by 2 ED nurses who were blinded. The first nurse recorded the results of the dysphagia screening on a paper form. A second nurse completed a second dysphagia screening within 1 hour and recorded the results in the electronic medical record. The goal was to conduct both screens within a short period of time. An SLP consult was requested for all patients screened. The SLPs were asked to complete their dysphagia evaluation within 12 hours. Per usual practice, the patient was allowed oral intake before the SLP evaluation if both screenings were passed. If either dysphagia screening was failed, the patient was kept NPO until the SLP evaluation was completed. The SLP was blinded to the results of the screening and did not review the electronic medical record. In usual practice, they do not use the presence of food or drink at the bedside as an indication of NPO status because family members may unknowingly bring in food or give their loved ones water.

Results of the first and second dysphagia screenings were entered into a database. The portion of the screening prompting a fail result was recorded. The results of the SLP formal swallow evaluation, including the type of liquids tolerated by the patient (eg, honey thick, nectar thick, or nectar thin), were entered. For purposes of this study, only tolerance of thin liquids was considered a passing score; tolerance of all other modified liquids was considered to be a fail. Validity was determined by a comparison of the second RN dysphagia screening to the results of the SLP dysphagia evaluation.

Statistics were calculated using a SAS computer program. Reproducibility of the dysphagia screening was quantified by the percent agreement and the interrater reliability. To assess the performance of the dysphagia screening in comparison to the formal assessment by an SLP, both the sensitivity and negative predictive value were quantified. The specificity and positive predictive value (PPV) were analyzed. The point estimate and 95% confidence interval (CI) were determined.

RESULTS

There were 726 patients screened using the Dysphagia Screening Tool. After applying the exclusion criteria, 392 stroke patients were enrolled. The average age was 70 ± 14 years, and 48% were female (n = 188). The group was composed of 52% (n = 203) white non-Hispanic, 12% (n = 45) Black, 11% (n = 44) Asian/Pacific Islander, 20% (n = 78) Hispanic, and 6% (n = 22) Other/Unknown (Table 1). Members of the health system constituted 86% (n = 338) of the population. Seventy-one percent (n = 278) of subjects had experienced an ischemic stroke, 25% had experienced a TIA (n = 96), and 5% had experienced a hemorrhagic stroke (n = 18). The screening was done on all patients presenting with suspected stroke symptoms. The median National Institutes of Health Stroke Scale score was 1, with a range of 0 to 23. Sixty-nine percent (n = 272) of patients were discharged home, and 9% (n = 34) had home health assistance. Four percent (n = 15) were discharged to a rehabilitation facility and 7% (n = 28) to a skilled nursing home. Less than 1% (n = 3) of patients died (Table 1).

Seventy-seven percent (n = 297) of patients passed the dysphagia screening. In Part I, 4 patients failed the medical history section, and an additional 4 failed by not being able to sit properly for the examination. In Part II, which assessed cognitive and motor skills, 79 patients failed: 16 failed due to altered level of consciousness or inability to attend to cues; 24 failed to control saliva, lacked tongue control, or were unable to smile and/or pucker; and 39 failed voice quality. In Part III, which included water tests, 2 patients failed because they did not respond to ice chips in the mouth, 4 did not tolerate ice chips, and 2 did not tolerate water without clearing the throat during and 1 minute afterward (Table 2).

A total of 379 subjects received 2 dysphagia screenings for comparison; 13 patients had only one dysphagia screening. Seventy-two percent (n = 272) of patients passed both dysphagia screenings; 22% (n = 83) failed both screens. The reliability of the dysphagia screening across nurses was high, with 93.7% agreement and interrater reliability of $\kappa = 0.83$ (Table 3).

A total of 169 subjects had both a screening and an evaluation completed to determine the validity of the dysphagia

	Admission (Discharged) 03/21/12 Discharge Unit: TCE						
	3/21/12						
	1600	1622	1635	1650	1700	1715	1730
Tracheostomy	No			No			
Aspiration Pneumonia	No			No			
Currently NPO with Tube Feeding	No			No			
	PART I - PREPARE PATIENT						
Is patient seated appropriately for eating	Yes			Yes			
Oral Cavity and back of throat clear	Yes			Yes			
	PART II - LEVEL OF CONSCIOUSNESS - If NO, refer immediately to ST/OT for dysphagia evaluation. Keep patient NPO including meds. Initiate Aspirations Precautions - Place aspiration precautions sign, elevate head of bed at least 30 degrees, place suction at bedside, no water or straws at bedside. Notify MD to consider need for alternative nutrition, hydration, and route to administer medications.						
Is patient awake/alert for 20 min continuously	Yes			Yes			
Does the patient attend with cues	Yes			Yes			
	PART II - SECRETIONS TONGUE CONTROL - If NO, refer immediately to ST/OT for dysphagia evaluation. Keep patient NPO including meds. Initiate Aspirations Precautions - Place aspiration precautions sign, elevate head of bed at least 30 degrees, place suction at bedside, no water or straws at bedside. Notify MD to consider need for alternative nutrition, hydration, and route to administer medications.						
Able to swallow own secretions	Yes			Yes			
Handles secretions without drooling	Yes			Yes			
Able to manage saliva without coughing	Yes			Yes			
Able to move tongue side to side up and down	Yes			Yes			
Able to smile and pucker	Yes			Yes			
	PART II - SOUNDS AND COUGH - If NO, refer immediately to ST/OT for dysphagia evaluation. Keep patient NPO including meds. Initiate Aspirations Precautions - Place aspiration precautions sign, elevate head of bed at least 30 degrees, place suction at bedside, no water or straws at bedside. Notify MD to consider need for alternative nutrition, hydration, and route to administer medications.						
Able to make sounds (e.g. grunting OR Speech)	No			Yes			
Able to cough on command	No			Yes			
	PART II - LARYNGEAL MOVEMENT - If NO, refer immediately to ST/OT for dysphagia evaluation. Keep patient NPO including meds. Initiate Aspirations Precautions - Place aspiration precautions sign, elevate head of bed at least 30 degrees, place suction at bedside, no water or straws at bedside. Notify MD to consider need for alternative nutrition, hydration, and route to administer medications.						
A rise in the larynx is felt when patient swallows							
	PART III - LARYNGEAL MOVEMENT WITH 1/2 TSP ICE CHIPS - If NO, refer immediately to ST/OT for dysphagia evaluation. Keep patient NPO including meds. Initiate Aspirations Precautions - Place aspiration precautions sign, elevate head of bed at least 30 degrees, place suction at bedside, no water or straws at bedside. Notify MD to consider need for alternative nutrition, hydration, and route to administer medications.						
Patient responds to ice (1/2 tsp) in mouth							
Rise in the larynx is felt when patient swallows ice							
Tolerates w/o coughing during AND 1 minute after							
Tolerates w/o throat clearing during AND 1 minute							
Voice clear when saying and extended "ahh"							
	PART III - IF PT PASSES ICE CHIP TEST: REPEAT WITH WATER progressing from sip , from cup and then 90ml (3oz) drinking CONTINUOUSLY without interruption (may use straw) - If NO, refer immediately to ST/OT for dysphagia evaluation. Keep patient NPO including meds. Notify MD to consider need for alternative nutrition, hydration, and route to administer medications; *initiate Aspiration Precautions						
Patient responds to water (90 ml) in mouth							
Rise in the larynx is felt when patient swallows water							
Tolerates w/o coughing during AND 1 minute after							
Tolerates w/o throat clearing during AND 1 minute							
Voice clear when saying and extended "ahh"							
Patient passed swallow screen							

Figure 1. Dysphagia screening tool.

Table 1. Demographic information

Characteristics	Received swallow screening and evaluation (n = 169) Total (%)	Received swallow screenings (n = 223) Total (%)	p value	Overall (n = 392) Total (%)
Patient characteristics				
Female, %	74 (43.8)	114 (51.1)	0.15	188 (48.0)
Age (mean ± SD)	72 ± 13	68 ± 14	0.01	70 ± 14
Race, %			0.41	
White, non-Hispanic	85 (50.3)	118 (52.9)		203 (51.8)
Black	18 (10.6)	27 (12.1)		45 (11.5)
Asian/Pacific Islander	16 (9.5)	28 (12.6)		44 (11.2)
Hispanic	41 (24.3)	37 (16.6)		78 (19.9)
Other/unknown	9 (5.3)	13 (5.8)		22 (5.6)
NIHSS			<0.001	
Mean ± SD	4 ± 5	2 ± 3		3 ± 4
Median	3	1		1
Range	0-23	0-23		0-23
Case characteristics				
Discharge status			<0.001	
Home	83 (49.1)	155 (69.5)		238 (60.7)
Home health	22 (13.0)	12 (5.4)		34 (8.7)
Rehab facility	11 (6.5)	4 (1.8)		15 (3.8)
Skilled nursing facility	20 (11.8)	8 (3.6)		28 (7.1)
Expired	2 (1.2)	1 (0.4)		3 (0.8)
Other	31 (18.3)	43 (19.3)		74 (18.9)
Type of stroke			0.07	
Ischemic	130 (76.9)	148 (66.4)		278 (70.9)
Hemorrhagic	6 (3.6)	12 (5.4)		18 (4.6)
TIA	33 (19.5)	63 (28.2)		96 (24.5)
Time between screenings, minutes (median)	22	19.5		20
Time from screening to SLP evaluation, h	13	NA		13

NIHSS = National Institutes of Health Stroke Scale; SLP = speech language pathologist; TIA = transient ischemic attack.

screening tool. Among the 97 patients who passed the RN dysphagia screening, 91 also passed the SLP swallow evaluation. Of the 72 patients who failed the RN dysphagia screening, 38 also failed the SLP swallow evaluation (Table 4). The dysphagia screening performed well when compared with the formal SLP swallow evaluation, demonstrating both high sensitivity (86.4%; 95% CI = 73.3-93.6) and high negative predictive value (93.8%; 95% CI = 87.2-97.1). It also demonstrated moderately high specificity (72.8%; 95% CI = 64.4-79.8), with a PPV of 52.8% (95% CI = 45.3-60.2) (Table 4).

DISCUSSION

The tool demonstrated high sensitivity (86.4%) to accurately detect dysphagia. The dysphagia screening tool had high specificity (72.8%) to identify patients who do not have dysphasia, which minimizes the time spent without oral intake. The low PPV (52.8%) indicates an increased failure rate by the nurse vs the SLP evaluation, providing increased safety for the patient. Patients without dysphagia may be mistakenly identified as positive; however, the patients can then be cleared by the SLP evaluation. Thus, the risk of those with dysphagia receiving fluids or medications is reduced.[8,16] This dysphagia screening tool compares favorably with other screening tools for reliability and validity.[8] The tool also includes necessary components: identification of possible dysphagia, a simple scoring system, ease of completion for health care workers outside of an SLP, and the ability to rescreen when clinical changes indicate.[17,19,20] The screening is a reliable preliminary assessment of a patient's ability to swallow. The protocol's validity was measured against the gold

Table 2. Results of dysphagia screening

	Passed	Failed	Passed	Failed	Passed	Failed
Screen section	Region 1		Region 2		Combined	
Part I History	284	3	104	1	388	4
Part I Patient able to sit properly	281	3	103	1	384	4
Part I Patient level of consciousness: Patient awake for 20 min	269	12	99	4	368	16
Part II Patient level of consciousness: Able to attend to cues	260	9	96	3	356	12
Part II Secretions tongue control: Able to swallow secretions/handle secretions without drooling	258	2	95	1	353	3
Part II Secretions tongue control: Able to manage saliva without drooling	256	2	94	1	350	3
Part II Secretions tongue control: Able to move tongue side to side	254	2	94	0	348	2
Part II Secretions tongue control: Able to smile and pucker	251	3	93	1	344	4
Part II Sounds and cough: Able to make sounds	249	2	93	0	342	2
Part II Vocal quality and speech: Speech is clear, not slurred/dysarthric	224	25	90	3	314	28
Part II Vocal quality and speech: Voice sounds strong and clear	221	3	88	2	309	5
Part II Vocal quality and speech: Voice does not sound wet/weak/hoarse	221	0	87	1	308	1
Part II Vocal quality and speech: Able to say extended "ahh"	221	0	86	1	307	1
Part II Laryngeal movement: A rise in larynx is felt with swallow	219	2	86	0	305	2
Part III Ice chip test: Patient responds to ice in mouth	217	2	86	0	303	2
Part III Ice chip test: Rise is felt in larynx when patient swallows	217	0	86	0	303	0
Part III Ice chip test: Tolerates w/o coughing during AND 1 min after	213	4	86	0	299	4
Part III Ice chip test: Tolerates w/o throat clearing during AND 1 min after	213	0	86	0	299	0
Part III Ice chip test: Voice is clear when saying an extended	213	0	86	0	299	0
Part III Water test: Patient responds to water in mouth	213	0	86	0	299	0
Part III Water test: Rise is felt in larynx when patient swallows	213	0	86	0	299	0
Part III Water test: Tolerates without coughing during AND 1 min after	211	2	86	0	297	2
Part III Water test: Tolerates without throat clearing during AND 1 min after	211	0	86	0	297	0
Part III Water test: Voice is clear when saying an extended "ahh"	211	0	86	0	297	0

standard of an SLP evaluation.[20] The tool is easy to learn and quick to perform, taking an average of 10 minutes to complete.

Limitations

There was variation in the elapsed time between the 2 RN dysphagia screenings and between the RN screenings and the SLP evaluation. The demands on the RN's time due to unit acuity affected the time between RN screenings. The time between RN screenings and SLP evaluation was affected by the SLP's availability. However, the impact was minimal because the median time between the 2 dysphagia screenings was 20 minutes, and there were 13 hours between the dysphagia screening and the SLP evaluation (Table 1). Blinding between the 2 RNs was done on the honor system because the subinvestigators were not present for all dysphagia screenings. Hospitalists were informed of the study. However, there were subjects who had passed the screening but did not receive a physician order for an SLP evaluation. These subjects were eliminated. Individual outcome data for the occurrence of aspiration pneumonia in

Table 3. Interreliability of 2 registered nurse-blinded dysphagia screenings

Swallow evaluation agreement	n	%
Both pass	272	71.8
Both fail	83	21.9
No agreement	24	6.3
Total	379	
Measure of reliability	Reliability estimate	
Percent agreement	93.7%	
Probability of passing	74.9%	
Expected Agreement	62.4%	
Interrater reliability (kappa)	83.1%	

Table 4. Validation of registered nurse swallow screening against the speech language pathologist swallow evaluation

	Combined Region 1 and Region 2		
	Speech evaluation result		
Swallow screening result	Pass*	Fail*	Total
Pass	91	6	97
Fail	34	38	72
Total	125	44	169
	Validation estimate		
Measure of validation	Estimate	95% CI lower	95% CI upper
Sensitivity	86.4%	73.3	93.6
Specificity	72.8%	64.4	79.8
PPV	52.8%	45.3	60.2
NPV	93.8%	87.2	97.1

* "Pass" (low dysphagia risk) = thin liquids; "Fail" (high dysphagia risk) = nothing by mouth or modified liquids. For predictive value: "positive" = dysphagia (fail screen); "negative" = no dysphagia (pass screen).

CI = confidence interval; NPV = negative predictive value; PPV = positive predictive value.

patients who passed the screening were not available. Only the aggregate rate of aspiration pneumonia is known.

CONCLUSION

The Dysphagia Screening Tool is reliable and valid and has minimal training requirements. Thousands of patients in both large and smaller acute care settings have been screened in a timely manner by nurses. Although this study was not able to correlate use of the tool with outcomes, the healthcare system overall has low aspiration rates (2%-3%) for patients with acute ischemic strokes. ❖

Disclosure Statement

The author(s) have no conflicts of interest to disclose.

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