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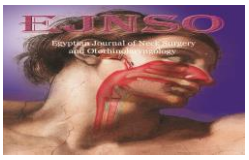

The application of 3-Ounce-Water Swallow Test on The Dysphagic Patients

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Abstract:

Introduction: Dysphagia is a dysfunction of swallowing process that prevents the optimal transfer of food and fluid from the mouth to the stomach and may give rise to life-threatening complications such as dehydration, malnutrition, and aspiration. Rapid diagnosis and management of the swallowing disorder is, therefore, mandatory and should aim at early identification of those patients. The 3 Ounce-water swallow test (WST) is a commonly used test worldwide for assessing oropharyngeal dysphagia and aspiration. However, the clinical usefulness of the test is not yet studied in our region.

Objectives: To determine the value of the 3- Ounce water test as a screening tool for aspiration detection. To compare WST with instrumental tools to detect its reliability for confirmation of suspected patients.

Participants and methodology:104 patients, 59 (57% %) males and 45 (43%) females (mean age = 59.68±14 years), were included in the study. Most of the patients, 44 (42%) admitted to the hospital because of Cerebrovascular accidents with a duration of dysphagia of 14±7 days. Other causes of admission include Recurrent aspiration (10%), Traumatic brain injury (9%), Multi-organ failure (8%), Cardiac causes (6%), Head and neck cancer (4%), and Other causes (9%). All patients were subjected to full assessment, including history, examination, flexible endoscopic evaluation of swallowing (FEES), and WST test.

Results: The use of WST on 104 adult patients of different diagnostic categories after comparing the test results to FEES results for liquid aspiration revealed: 88.5% sensitivity and 71 % specificity of the 3-ounce WST

Conclusion: The water swallow test is a rapid, costless, and non-invasive screening test for detecting dysphagia. It showed fair sensitivity and specificity

Keywords: Water swallow test, sensitivity, specificity, silent aspiration, FEES

Introduction

Detection of the people having the risk of oropharyngeal dysphagia is an essential need due to the increase in the occurrence of pneumonia associated with undiagnosed aspiration.[1-4] The valuable bedside screening test for dysphagia should be characterized with high sensitivity and specificity, i.e., precise detection of the patients with aspiration risk and need additional investigations and excluding the safe people who will not need any further

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assessment. [5, 6] The screening test in the clinical application should take the following decisions: (a) Detect the presence of aspiration (b) the necessity for instrumental objective swallowing assessment, and (c) The possibility of restarting the oral feeding safely.

The Joint Commission on the Accreditation of Healthcare Organizations' stroke performance measures assumed that a screening test for swallowing should be performed for all stroke patients before going back to any food ingestion, drugs or drink consumption. [7] However, the standard methods for screening the subjects with oropharyngeal dysphagia and the risk of aspiration still lack and controversial. [8,9] The 3-ounce water swallow test (WST) is a commonly mean for assessing the subjects who have the risk for oropharyngeal dysphagia and aspiration. The candidates are required to drink 3 ounces (90 cc) of water without interruption. The subject will need instrumental assessment if any of the following conditions occurred: The candidate could not complete the test, presence of coughing, choking, or a wet-voice quality existed during or immediately after the test. [10] The usage of the WST test for the detection of aspiration through the clinical (bedside) swallowing screening has been documented.[10,12-15] The clinical usefulness of the 3-ounce water swallow test in the Arabic speaking patient populations is not researched before.

Although the 3-ounce water swallow test is a clinical test used to assess patients with aspiration and oropharyngeal dysphagia. Also, it is used worldwide for the assessment of stroke patients and those with other neurological diseases. Up to our knowledge, the 3-ounce water swallow test is not documented previously in a scientific work on the Saudi dysphagic patients. Also, the clinical usefulness of the 3-ounce water swallow test in the Saudi dysphagic patient is still unknown. This raised the need for rapid bedside, a screening test for detection of oropharyngeal dysphagia and aspiration in the Saudi population.

Patients and Methods:

It is an analytical cross-sectional study carried out during the period from December 2017 to May 2019. The study proposal was approved by the institutional review boards.

104 patients with suspected oro-pharyngeal dysphagia who were referred from otorhinolaryngology, oncology, neurology and geriatric admissions were included in this study. Exclusion criteria (based on clinical evaluation and history) were patients with receptive dysphasia, oral apraxia, patients with impaired degree of consciousness and Patients with tracheostomy. Patients were informed about the study procedure and consent for the study was obtained.

All the participants were exposed to the following assessments:

1- Full history and examination including the demographic data for each patient (the age, sex and duration of dysphagia), etiology of the dysphagia, mode of feeding (oral, modified oral, Nasogastric Tube feeding (NGT), Percutaneous Endoscopic Gastrostomy (PEG), presence of tracheostomy and other comorbidity .

2- **Assessment of swallowing** consisted of WST and a Flexible Endoscopic Evaluation of Swallowing (FEES): The standard fiberoptic endoscopic evaluation of swallowing (FEES) protocol was performed by with few changes. [16-17] Shortly, each naris was investigated visually, and the scope passed through the most open naris without administration of a topical

anesthetic or vasoconstrictor to the nasal mucosa, for avoiding any anesthetic side effects and allow the physician of a safe physiologic examination. [18] The base of tongue, pharynx, and larynx were observed, and swallowing was evaluated directly with six food boluses of approximately 5 ml each. All patients swallow spontaneously without verbal command to swallow. For FEES assessment we used, Portable CMOS Video Rhino-Laryngoscope with Diameter 2.9 mm.

The first food challenge consisted of three boluses of semisolid consistency (yogurt) followed by three liquid boluses (water colored with blue food coloring) because these colors have excellent contrast with pharyngeal and laryngeal mucosa.[19]

Aspiration was defined as entry of material into the airway below the level of the true vocal folds [20], and silent aspiration occurred when there were no external behavioral signs such as coughing or choking. [21]

Immediately following completion of FEES, the same investigator administered the WST. Each participant was given 3 ounces of water and asked to drink from a cup or straw without interruption, and results were recorded. Criteria for test failure included inability to drink the entire amount, coughing or choking up to 1 min after completion, or presence of post-swallow wet-hoarse vocal quality. [10]

Statistical analysis :

FEES results served as the outcome variable and were the criterion standard to which the WST results were compared. A 2 x 2 contingency table was used to evaluate results of the WST. If aspiration was present on FEES when a participant failed the WST, a true-positive rating resulted. If aspiration was not present on FEES when a participant passed the WST, a true-negative rating resulted. If aspiration was not present on FEES but the participant failed the WST, a false-positive rating resulted. If aspiration was present on FEES but the participant passed the WST, a false-negative rating resulted. Sensitivity, specificity, positive predictive value, negative predictive value, positive likelihood ratio, and negative likelihood ratio were computed.

Sensitivity is the proportion of patients with aspiration (detected with FEES) that have a positive result when tested with WST. A test that is 100% sensitive means all individuals with aspiration are correctly identified by WST i.e. there are no false negatives. Specificity is the proportion of patients without aspiration (detected with FEES) that have a negative result when tested with WST. A test that is 100% specific means all individuals without aspiration are correctly identified by WST i.e. there are no false positives. The positive and negative predictive values (PPV and NPV respectively) are the proportions of positive and negative results in statistics and diagnostic tests that are true positive and true negative results, respectively. [11]

Results:

102 patients, 58 (57%) males and 44 (43%) females (mean age = 59.68±14 years), were included in the study. Most of the patients 43 (42%) admitted to the hospital because of Cerebrovascular accidents with duration of dysphagia of 14±7 days. Other causes of admission include, recurrent aspiration due to chronic general medical disease (10%), Traumatic brain injury (9%), Multi-organ failure (8%), Cardiac causes (6%), Head and neck cancer (4%) and Other causes (9%). Duration of dysphagia

varied between the former groups as shown in **Table 1**.

Table 1 – Demographic Data of the patients

Primary diagnosis	Number of patients (%)	Duration of dysphagia in days Mean+ SD
Cerebrovascular stroke	43(42%)	14±7
Recurrent aspiration due to chronic general medical disease	10(10%)	16±8
Neurological diseases	9(9%)	21±9
Traumatic brain injury	9(9%)	18±12
Multiorgan failure	9(9%)	26±11
Cardiac causes	6(6%)	10±4
Head and neck cancer	4(4%)	12±7
Extensive burn	3(3%)	20±12
Others	9(9%)	18±8

Modes of feeding:

75% of patients were on Nasogastric tube (NGT), 15% Oral Feeding, and 5% were on Gastrostomy tube. 5% of patients were on modified oral feeding in the form of using special spoon, cups, straw or by adding a thickener to change the consistency of thin fluids.

The results obtained using WST compared with the results obtained using FEES to determine sensitivity, specificity and predictive values. Also, Negative Likelihood Ration and Positive Likelihood Ration are obtained **Table (2)**.

Table 2– Sensitivity, specificity and predictive values of WST and FEES findings to identify laryngotracheal aspiration

Statistics	Value	95% CI
Sensitivity	88.51%	79.88% to 94.35%
Specificity	71.04%	71.04% to 86.64%
Positive Likelihood Ration	4.35	3.00to 6.31
Negative Likelihood Ration	0.14	0.08 to 0.26
Positive Predictive Value	77.00%	69.76% to 82.93%
Negative Predictive Value	90.00%	83.30% to 94.20%

WST: Water Swallow Test; FEES: Fiberoptic Endoscopic Examination of swallowing; PPV: Positive predictive value; NPV: Negative predictive value; CI: Confidence interval Sensitivity and specificity test

In the present study, 31 patients had aspiration with different severity diagnosed by FEES, however, 35 patients diagnosed with aspiration by WST.

Discussion :

The WST used widely in clinical practice as an assessment tool to detect aspiration and help prevention of occurrence of pneumonia. It is the standardized test used all over the world. Most authors ask the patient to drink 3 ounces (90 ml) of water. [22]

Several studies used WST to screen dysphagia and aspiration in stroke patients comparing the result to instrumental assessment tools to validate it. FEES is used as an instrumental tool to test sensitivity and specificity of the WST. The results were extremely variable across different studies. [10,13] Also, **Zhou et al (2011)**, included stroke patients and patients with other neurological disorders. They used 3-Oz (90 ml) WST and compared the results to Modified barium study (MBS) and reported a test sensitivity of 76%, 54%, and 87% respectively and a test specificity of 59%, 79%, and 42% respectively.

Other authors studied WST with different volumes of 10 cc, 30 cc, 50 cc, 60 cc, 70 cc, 100 cc respectively and compared the results to MBS. They reported a test sensitivity of 45%, 72%, 80%,65%, 70% and 47.8% respectively, and a test specificity of 96%, 67%, 86%,79%, 66% and 91.7% respectively. [24-29]

However, Others used a 50 cc WST and compared the results to FEES. They reported a test sensitivity of 84.6%, 79.4% and 61% respectively and a test specificity of 75%, 62.5% and 81% respectively. [8,30-31]

In this study, the application of the WST on 102 adult patients of different

diagnostic categories (including 43 cerebrovascular stroke patients) and comparing the test results to FEES results for liquid aspiration to assess the test validity. The results were 88.5% sensitivity and 71% specificity of the WST to detect aspiration among our patients.

In a recent study by **Chen et al 2016**, the study included 770 stroke patients in 11 studies, the WST showed sensitivities between 64-79% and specificities between 61-81%. Meta-regression analysis showed that increasing water volume resulted in higher sensitivity, but lower specificity of the WST. They assumed that since the test accuracy was related to the water volume and the screening tests with higher sensitivity is preferred for better diagnostic accuracy in the population at risk. The WST was recommended for aspiration screening in stroke patients. [32]

FEES can be done at the bedside without a risk of radiation exposure, VFSS and FEES are gold standards in the confirmation of dysphagia and aspiration which is the most crucial factor in these tests. [33] Nevertheless, FEES is more sensitive to detect penetration and aspiration. [34-35] However, the difference between the studies administering WST in detecting aspiration does not seem to be attributed to using FEES or VFSS but mostly due to different water volumes used or other methodological variations.

Specificity is certainly related to the difficulties of the clinical method to confirm those who do not show clinical signs and did not aspirate, was on account of the possibility of silent aspiration. [15,21] The moderate specificity found in this study may also be related to the high frequency of silent aspiration found in the cerebrovascular stroke population due to prolonged aspiration and desensitization of the receptors responsible for the effective protection of the lower airways. Also, the diagnostic accuracy of the clinical evaluation depends on the preservation of the cough reflex and pharynx sensitivity; all pathological conditions which cause either impairment in pharynx innervation or silent aspiration are unlikely to be detected by the bedside assessment.

In the current study, Positive Likelihood Ration (LR) was 4.35 and Negative Likelihood Ration was 0.14.

Generally speaking, findings with LRs greater than 2 are more convincingly the finding suggests that disease; the bigger the number, the more convincingly the finding suggests that disease. Findings whose LRs lie between 0 and 1 argue against the diagnosis of interest. The reverse is applied for the Negative Likelihood Ration. [36]

Conclusion:

Screening is important for early detection of dysphagia to help in preventing silent aspiration and the long-term sequelae of pulmonary infections. WST is simple, inexpensive, and quick to perform, the WST has fair sensitivity and specificity to detect cases of aspirations.

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Declaration of interest:

There are no interests to declare

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