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Original Article

The Ability of the Eating Assessment Tool-10 to Detect Aspiration in Patients With Neurological Disorders

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Background/Aims
Dysphagia is common in patients with neurological disorders. There is a need to identify patients at risk early by a useful clinical tool to prevent its serious complications. The study aims to determine the ability of the Turkish version of Eating Assessment Tool-10 (T-EAT-10) to detect aspiration in patients with neurological disorders.

Methods
Two hundred fifty-nine patients with neurological disorders who had complaints about swallowing difficulty and referred for a swallowing evaluation were included. Oropharyngeal dysphagia was evaluated with the T-EAT-10 and videofluoroscopic swallowing study in the same day. The penetration-aspiration scale (PAS) was used to document the penetration and aspiration severity.

Results
The mean age of the patients was 59.72 ± 17.24 years (minimum [min] = 18, maximum [max] = 96), of which 57.1% were male. The mean T-EAT-10 of patients who had aspiration (PAS > 5) was 25.91 ± 10.31 (min = 1, max = 40) and the mean T-EAT-10 of patients who did not have aspiration (PAS < 6) was 15.70 ± 10.54 (min = 0, max = 40) ($P < 0.001$). Patients with a T-EAT-10 score higher than 15 were 2.4 times more likely to aspirate. A linear correlation was found between T-EAT-10 and PAS scores of the patients ($r = 0.416$, $P < 0.001$). The sensitivity of a T-EAT-10 higher than 15 in detecting aspiration was 81.0% and the specificity was 58.0%. A T-EAT-10 score of higher than 15 has a positive predictive value of 72.0% and a negative predictive value of 69.0%.

Conclusion
The T-EAT-10 can be used to detect unsafe airway protection in neurology clinics to identify and refer dysphagic patients for further evaluation.
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Key Words
Aspiration; Deglutition; Deglutition disorders; Dysphagia; Screen

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Introduction

Neurogenic dysphagia is the sensorimotor impairment of the oropharyngeal swallowing phases as a result of a neurological disorder including cerebrovascular diseases, Parkinson's disease (PD), motor neuron disease, multiple sclerosis (MS), and myopathy.[1-3] Dysphagia symptoms include impaired labial closure, difficulty in initiating swallowing, residue, choking/coughing during swallowing, and piecemeal deglutition, which allow caregivers and clinicians suspect from dysphagia. It is important to detect dysphagia symptoms in an early period because neurogenic dysphagia can result in dehydration, malnutrition, respiratory complications, and also reduce the quality of life of the patients and their families due to its psychosocial consequences if untreated.[4] Thus, patients with a suspicion of oropharyngeal dysphagia should undergo an instrumental swallowing evaluation as a videofluoroscopic swallowing study (VFSS) or fiberoptic endoscopic evaluation of swallowing (FEES) to evaluate airway protection to detect and manage dysphagia.[5,6]

In busy neurology clinics, there is not enough time to evaluate each patient with instrumental swallowing evaluations. However, early identification and management of oropharyngeal dysphagia is crucial to ensure safe oral intake and reduce the serious dysphagia complications. Thus, there is a need for a useful clinical tool to identify oropharyngeal dysphagia and aspiration risk accurately in patients with neurological disorders. The 10-item Eating Assessment Tool (EAT-10) is a clinical instrument to document the initial dysphagia symptom severity in patients with swallowing disorders.[7] It is rapidly administered, simply calculated, and easy to use scale which has excellent internal consistency, test retest reliability, and criterion-based validity.[7] The EAT-10 is also used in clinics worldwide, and translated and validated in English, Italian, Spanish, Brazilian, Japanese, and Turkish languages.[7-12] There are 2 studies performed in the general patient population and 1 study in patients with amyotrophic lateral sclerosis (ALS) to show the ability of the EAT-10 to identify individuals who are at risk of aspiration.[2,13,14] Besides the approximately 85.0% of ALS patients suffer from dysphagia due to progressive weakness and/or spasticity in the muscles of oropharyngeal and esophageal regions,[2,15] 8.1-80.0% of patients with stroke, 11.0-81.0% of patients with PD, and 33.0-43.0% of MS patients also encounter dysphagia.[1-3] Thus, this ability of the EAT-10 could be used in all neurological patient groups who are at risk of aspiration in clinical settings. With this in mind, the results of the EAT-10 may be used as a direct instrument to perform further detailed evaluation of the swallowing function for clinicians. This current study aims to determine the ability of the Turkish version of EAT-10 (T-EAT-10) to detect aspiration in patients with neurological disorders.

Materials and Methods

Participants

Two hundred fifty-nine patients with neurological disorders who had complaints about swallowing difficulty and referred for a swallowing evaluation after routine ear, nose, and throat examination with endoscopy were included in the study. A neurology specialist at Hacettepe University confirmed the diagnosis of the patients. The inclusion criteria were (1) having a confirmed diagnosis of neurological disease, (2) having normal cognitive function according to the Mini Mental State Examination (> 24 points),[16] (3) complaining about dysphagia for at least 1 month, (4) no organic causes for dysphagia according to endoscopy, no tracheotomy or mechanical ventilation, and (5) no allergies to barium. The Hacettepe University Noninvasive Clinical Research Ethics Committee approved the study protocol. The patients signed the written informed consent to participate in the study and all data were collected in a prospective manner.

Evaluation Procedures

The demographical information including age, gender, height, weight, and diagnosis of the patients were noted. The T-EAT-10 was used for screening oropharyngeal dysphagia in all patients and the VFSS was performed for evaluation of swallowing function instrumentally in the same day. Independent clinicians who were blinded to each other performed clinical and instrumental swallowing evaluations.

All patients completed the T-EAT-10. It is a reliable, valid, quick, and practicable outcome tool specific to dysphagia.[12] The T-EAT-10 includes 10 questions about the severity of symptoms of oropharyngeal dysphagia. Each question will be scored from 0 to 4 ("no problem" to "severe problem"). The total T-EAT-10 score is calculated by adding up the scores of each question, and higher scores indicate a self-perception of a high level of dysphagia severity. The time to complete the instrument is less than 2 minutes. Patients completed the T-EAT-10 by themselves, and if they need guidance, their relatives helped.

The VFSS was performed as a reference test. Patients were seated on a chair in the lateral plan to monitor the oral cavity, pharynx, larynx, and just below the upper esophageal sphincter in front

of the X-ray machine. All images were full resolution, continuous and recorded at 30 frames per second. During the VFSS study, oropharyngeal swallowing function was evaluated during swallowing of 3 mL liquid barium. The parameters including impaired labial seal closure, oral residue, pharyngeal residue, and piecemeal deglutition for swallowing function were analyzed and scored as either "absent" or "present." Identification of at least 1 of these signs was considered as an impairment of the efficacy of swallowing.[14] The penetration-aspiration scale (PAS) was used to describe the penetration and aspiration severity. The PAS is an ordinal scale ranging between 1 to 8, which has adequate intra and inter-rater reliability. The PAS scores are determined according to the depth to which food passes in the airway and whether or not food entering the airway is removed.[17] The PAS score 1 shows normal airway protection without penetration and aspiration during swallowing. Scores between 2 to 5 are considered as penetration, which means that food enters the larynx but do not pass below the vocal folds, and scores between 6 to 8 are considered as aspiration, which means that the food passes below the vocal folds. When a penetration or an aspiration was detected, an impairment of the safety of swallowing was considered.[14]

Statistical Methods

The IBM-SPSS for Windows version 20 (IBM Corp, Armonk, NY, USA) was used to perform all statistical analyses. Descriptive statistics were calculated as a number per percent for qualitative data and mean ± standard deviation for quantitative data. The mean T-EAT-10 for patients who had aspiration (PAS > 5) was compared to the mean T-EAT-10 for patients who did not have aspiration (PAS < 6) with the independent-samples *t* test. We determined the cut-off score according to the mean T-EAT-10 scores of patients without dysphagia. A receiver operating characteristic curve was created with area under the curve. The sensitivity, specificity, and relative risk for the association between T-EAT-10 and aspiration on VFSS were calculated. A *P*-value of less than 0.05 was considered statistically significant.

Table 1. Diagnosis and Videofluoroscopic Swallowing Study Results of the Patients

Variables	
Diagnosis (n [%])	
Stroke	118 (45.6)
Motor neuron disease	48 (18.5)
Parkinson's disease	26 (10.0)
Myasthenia gravis	25 (9.7)
Multiple sclerosis	24 (9.3)
Myopathy	18 (6.9)
VFSS results (n [%])	
Impaired labial seal closure	15 (5.8)
Oral residue	15 (5.8)
Pharyngeal residue	133 (51.4)
Piecemeal deglutition	82 (31.7)
Impaired swallowing efficacy	141 (54.4)
Impaired swallowing safety	181 (69.9)
Penetration aspiration scale (mean [SD])	5 (3.1)

VFSS, videofluoroscopic swallowing study.

Results

Two hundred fifty-nine patients with neurological disorders were included in the study. The mean age of the patients was 59.72 ± 17.24 years (min = 18, max = 96), of which 57.1% were male. The mean weight was 68.16 ± 16.15 kg, and the mean height was 165.57 ± 9.87 cm. Table 1 reports the diagnosis and VFSS results of the patients.

The mean T-EAT-10 score of patients who had aspiration (PAS > 5) was 25.91 ± 10.31 (min = 1, max = 40) and the mean T-EAT-10 of patients who did not aspirate (PAS < 6) was 15.70 ± 10.54 (min = 0, max = 40) ($P < 0.001$). A linear correlation between T-EAT-10 and PAS scores of the patients was found ($r = 0.416$, $P < 0.001$). The T-EAT-10 was significant to detect patients with aspiration (PAS > 5) (area under the curve: 0.76, $P < 0.001$). We determined the cut-off as 16 for risk and predictive assessment because the mean T-EAT-10 score of the patients who did not aspirate was 16. Patients with a T-EAT-10 score higher than 15 were 2.4 times more likely to aspirate. The sensitivity of a T-EAT-10 score higher than 15 in predicting aspiration was 81.0% and the specificity was 58.0%. A T-EAT-10 score of higher than 15 has a positive predictive value of 72.0% and a negative predictive value of 69.0%. Table 2 summarizes the results, and Figure displays

Table 2. Aspiration results on Videofluoroscopic Swallowing Study

T-EAT-10 Score	Aspiration		
	Present (n)	Absent (n)	Total
> 15	119 (a)	47 (b)	166
< 16	28 (c)	65 (d)	93
Total	147	112	259

T-EAT-10, Turkish Eating Assessment Tool.
Sensitivity: a/(a + c) = 81.0%; specificity: d/(b + d) = 58.0%; positive predictive value = a/(a + b) = 72.0%; negative predictive value = d/(c + d) = 69.0%; relative risk = a/(a + b)/c/(c + d) = 2.4.

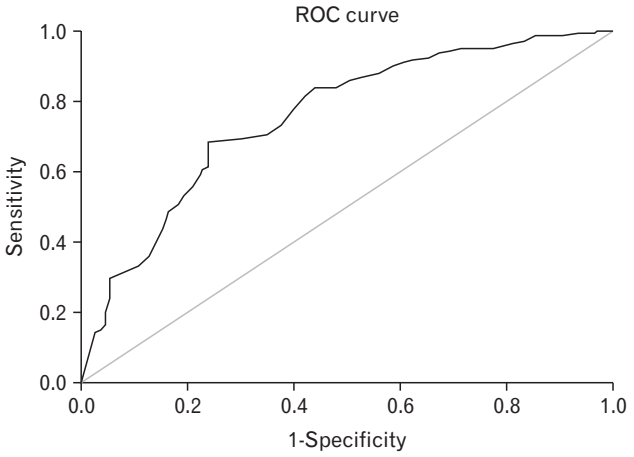

Figure. Receiver operating characteristic (ROC) curves for the ability of the Eating Assessment Tool-10 to identify neurological patients who aspirate (penetration-aspiration scale ≥ 6).

the receiver-operating characteristic graphs.

Discussion

Early identification of the risk for dysphagia in neurological patients is very important to prevent the complications including dehydration, malnutrition, and aspiration pneumonia.[1] The findings from this current study show that the T-EAT-10 can detect risk of aspiration in patients with neurological disorders, and that T-EAT-10 correlated with PAS scores. When determining the ability of the T-EAT-10 for identifying neurological patients with aspiration (PAS > 5), a T-EAT-10 score of 16 correctly identified 81.0% of neurological patients with aspiration and patients with a T-EAT-10 > 15 were 2.4 times more likely to aspirate.

Instrumental swallowing evaluation methods including VFSS and FEES are essential to assess the swallowing efficacy, airway protection, and determine any food penetration into the airway. These methods are the gold standards for swallowing evaluation, however, there are some limitations for their use in busy clinics. These methods require special equipment, place, trained staff, and time.[18,19] Thus, it is not possible to perform these methods for each patient in neurology clinics to detect potential aspiration risks. Accordingly, there is a need for a valid, reliable, and feasible screening tool to be used in patients with neurological disorders. Validity encompasses sensitivity, which is the capability of a test to accurately show the presence of a problem, and specificity, which is the capability of a test to accurately present the absence of a problem.[20] The EAT-10 was reported as a discriminative tool for identification of aspiration risk in 2 previous studies.[2,13,14] Our findings regarding high discriminant ability of the T-EAT-10 in detecting aspiration in neurological patients are similar to the findings of these studies.[2,13,14] Different criterion scores were used due to methodological differences in these studies. For instance, Rofes et al[14] investigated the ability of the EAT-10 in identifying oropharyngeal dysphagia, thereby used a cut score of 2, and presented 89.0% of sensitivity and 82.0% of specificity. Plowman et al[2] and Cheney et al[13] determined their cut-off scores according to the mean EAT-10 of patients without aspiration as our methodology. The earlier investigation used a cut value of 8, and reported that this score correctly identified 85.7% of ALS aspirators with 71.9% specificity.[2] The cut score according to the mean EAT-10 of non-aspirators in the study of Cheney et al[13] was 16 as our cut score from our neurological patient population. Cheney et al[13] reported that the sensitivity of EAT-10 was 71.0%, the specificity was 53.0%, and the negative predictive value was 89.0%. Although there are differences between these studies, the general interpretation of the results is that these authors suggested the EAT-10 as a discriminative instrument for identification of aspiration risk in general dysphagic population.

In our study, the ability of the T-EAT-10 to detect aspiration was investigated in a group of neurological patients with different diagnoses. Our clinical experiences about the neurology clinic in our university showed that neurology clinics need a practical and valid tool to determine the aspiration risk by health professionals including not only dysphagia specialists but also physicians, nurses, etc to refer patients for further evaluation of swallowing. Because each patient cannot be evaluated by a dysphagia specialist and an instrumental swallowing evaluation cannot always be performed. Early identification of dysphagia provides early intervention therefore contributes to reduce dysphagia complications, length of hospital stay, and healthcare costs especially for patients with neurological patients.[21] We found that the T-EAT-10 correlated with PAS scores, which means that neurological patients with aspiration presented higher scores in T-EAT-10. To support our findings, we investigated the sensitivity and specificity of the T-EAT-10.[2] The cut score was found as 16 according to the mean EAT-10 of patients without aspiration from our mixed neurological patient population. Neurological patients who had a T-EAT-10 score of higher than 15 were 2.4 times more likely to be a patient with aspiration. This score accurately detected 81.0% of patients with neurological disorders in terms of aspiration, and 69.0% of neurological patients without aspiration had a T-EAT-10 score of below this criterion score. Thus, the T-EAT-10 is clinically useful and has ability to detect aspiration in patients with neurological disorders.

Besides the ability of the T-EAT-10 to identify aspiration, we should also mention that the T-EAT-10 should not be considered equivalent to a clinical bedside evaluation or instrumental assessment.

In conclusion, the T-EAT-10 can be safely used to screen patients with neurological disorders who are at risk of unsafe airway protection for referral to further swallowing evaluation.

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