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The Ability of the 10-Item Eating Assessment Tool (EAT-10) to Predict Aspiration Risk in Persons With Dysphagia

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Abstract

Background: Dysphagia is common and costly. The ability of patient symptoms to predict objective swallowing dysfunction is uncertain.

Purpose: This study aimed to evaluate the ability of the Eating Assessment Tool (EAT-10) to screen for aspiration risk in patients with dysphagia.

Methods: Data from individuals with dysphagia undergoing a videofluoroscopic swallow study between January 2012 and July 2013 were abstracted from a clinical database. Data included the EAT-10, Penetration Aspiration Scale (PAS), total pharyngeal transit (TPT) time, and underlying diagnoses. Bivariate linear correlation analysis, sensitivity, specificity, and predictive values were calculated.

Results: The mean age of the entire cohort (N = 360) was 64.40 (± 14.75) years. Forty-six percent were female. The mean EAT-10 was 16.08 (± 10.25) for nonaspirators and 23.16 (± 10.88) for aspirators ($P < .0001$). There was a linear correlation between the total EAT-10 score and the PAS ($r = 0.273$, $P < .001$). Sensitivity and specificity of an EAT-10 > 15 in predicting aspiration were 71% and 53%, respectively.

Conclusion: Subjective dysphagia symptoms as documented with the EAT-10 can predict aspiration risk. A linear correlation exists between the EAT-10 and aspiration events (PAS) and aspiration risk (TPT time). Persons with an EAT-10 > 15 are 2.2 times more likely to aspirate (95% confidence interval, 1.3907-3.6245). The sensitivity of an EAT-10 > 15 is 71%.

Keywords

Eating Assessment Tool, EAT-10, Penetration Aspiration Scale, PAS, aspiration risk, screening test, dysphagia, aspiration, symptom, survey

Background

Dysphagia is common and costly. Complications of dysphagia include dehydration, malnutrition, social isolation, depression, pneumonia, pulmonary abscess, and death.[1-9] Dysphagia, however, is a symptom, not a disease, and patients with dysphagia may have none to profound evidence of objective swallowing dysfunction. It is therefore necessary to distinguish between patient dysphagia symptoms and objective evidence of swallowing dysfunction. Various instruments have been developed to quantify patient dysphagia symptoms. Some of these questionnaires include the MD Anderson Dysphagia Inventory (MDADI),[1] SWAL-QOL,[2-4] the Sydney Swallow Questionnaire (SSQ),[5] and the 10-Item Eating Assessment Tool (EAT-10).[10] The ability of subjective dysphagia symptoms to predict objective evidence of swallowing dysfunction is uncertain.

The EAT-10 is a validated, self-administered, symptom-specific outcome tool that is commonly used in clinical practice.[6] The EAT-10 was developed by a multidisciplinary team of dysphagia experts and has excellent internal consistency and high test-retest reliability.[6-8] Serial administration of the EAT-10 has been shown efficacious in documenting

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initial symptom severity and in monitoring treatment efficacy.[6,9] The purpose of this investigation was to evaluate the ability of the EAT-10 to predict aspiration and aspiration risk in patients with dysphagia.

Methods

The charts of individuals with dysphagia undergoing a videofluoroscopic swallow study (VFSS) at the Center for Voice and Swallowing of the University of California, Davis, between January 2012 and July 2013 were reviewed from an electronic dysphagia database. The database is approved for investigation by the institutional review board of the University of California, Davis. Information that was abstracted for each patient included demographics, diagnostic etiology of dysphagia, the EAT-10, the Penetration Aspiration Scale (PAS), and total pharyngeal transit (TPT) time. The PAS and TPT time were determined by a clinician blind to the EAT-10 results. Penetration Aspiration Scale grades of 1 to 5 signify no aspiration and grades of 6 to 8 are classified as aspiration. Total pharyngeal transit time is an objective measure of swallowing dysfunction and is defined as the duration of movement of a bolus from the posterior nasal spine until it clears the pharyngo-esophageal segment. It is a surrogate measure for aspiration risk and is an established risk factor for the development of aspiration pneumonia. Individuals with a TPT time > 5 seconds have a 90% increased risk of developing aspiration pneumonia.[10]

Data Analysis

All data were coded and recorded into SPSS 17.0 for Macintosh (SPSS Inc, Chicago, Illinois, USA). The mean EAT-10 for patients who aspirated (PAS > 5) was compared to the mean EAT-10 for nonaspirators (PAS < 6) with the independent-samples *t* test. The relative risk and 95% confidence interval (CI) for the association between an EAT-10 > 15 and the incidence of aspiration on VFSS were calculated. Bivariate linear correlation analysis, sensitivity and specificity values, and positive and negative predictive values were calculated. For all tests, an alpha < .05 was considered statistically significant.

Results

The charts of 360 individuals were abstracted over the study period. The mean age of the entire cohort was 64.09 (± 15.00) years and 53% were male. Causes of dysphagia were identified as gastroesophageal reflux (28%), postirradiation dysphagia (22%), cricopharyngeal bar or esophageal web (12.5%), neurologic impairment or neurodegenerative disease (7.5%), Zenker's diverticulum (7%), and other (9%), which included postsurgical dysphagia, esophageal dysmotility, traumatic brain injury, trauma, and obstruction due to osteophytes. The cause of dysphagia could not be identified in 14% of patients. The mean EAT-10 of patients who aspirated (PAS > 5) was 23.16 (± 10.88) and the mean EAT-10 of patients who did not aspirate (PAS < 6) was 16.08 (± 10.25) ($P < .001$). There was a linear correlation of EAT-10 and PAS scores for the entire cohort ($r = 0.273$, $P < .001$). Because the mean EAT-10 of nonaspirators was 16, we chose 16 as the cut-off for risk and predictive assessment. Individuals with an EAT-10 > 15 were 2.2 times more likely to aspirate (95% CI, 1.3907-3.6245). The mean TPT times for aspirators and nonaspirators were 2.03 (± 1.81) and 1.38 (± 1.04) ($P < .001$). There was a linear correlation between TPT time and PAS ($r = 0.22$, $P < .001$) and between TPT time and EAT-10 scores ($r = 0.14$, $P < .05$).

Table 1. Aspiration Results on Videofluoroscopic Swallow Study.[a]

	Aspiration		
EAT-10 Score	Present	Absent	Total
> 15	48 (a)	138 (b)	186
< 16	20 (c)	154 (d)	174
Total	68	292	360

Abbreviation: EAT-10, 10-item Eating Assessment Tool.
[a] Values represent number of patients. Sensitivity: a / (a + c) = 48 / (48 + 20) = 71%. Specificity: d / (b + d) = 154 / (138 / 154) = 53%. Positive predictive value: a / (a + b) = 48 / (48 + 138) = 26%. Negative predictive value: d / (c + d) = 154 / (20 + 154) = 89%. Relative risk: [a / (a + b)] / [d / (c + d)] = [48 / (48 + 138)] / [154 / (20 + 154)] = 2.2.

The sensitivity of an EAT-10 greater than 15 in predicting aspiration was 70.6% and the specificity was 52.7%. An EAT-10 score of greater than 15 has a positive predictive value of 26% and a negative predictive value of 89%. The results are summarized in Table 1.

Discussion

The data from this investigation suggest that self-reported dysphagia symptoms as documented on the EAT-10 can predict risk of aspiration. There is a linear correlation between the total EAT-10 and PAS scores ($P < .001$). Although an EAT-10 < 16 does not rule out the possibility of aspiration, individuals with an EAT-10 > 15 were 2.2 times more likely to aspirate (95% CI, 1.3907-3.6245). Previous studies have demonstrated that increased TPT is a risk factor for aspiration.[10] The present study also found a linear correlation between TPT time and total EAT-10 score ($r = 0.14$, $P < .05$), which further supports the clinical utility of the EAT-10 in predicting aspiration risk.

Early screening to identify patients at risk for unsafe swallowing is an important step in the prevention of aspiration pneumonia. Hospitals that adhere to formal dysphagia screening protocols can significantly lower rates of

pneumonia.[11] Numerous objective screening tests have been developed to identify clinical features associated with increased aspiration risk. In a systematic review of dysphagia-screening tools, 5 principal screening categories were identified: demographic information, medical history, global health assessment, oral mechanism examination, and direct assessment of swallowing.[12] Of these categories, direct assessment of swallowing via the Water Swallow Test[13] displayed the best combination of sensitivity and specificity.[12] In a case-control study of 56 acute stroke patients, Daniels and colleagues[14] demonstrated that use of a clinical screening system to identify patients exhibiting at least 2 of 6 clinical features can effectively distinguish patients with moderate to severe dysphagia from those at low risk without use of VFSS. The investigation evaluated abnormal volitional cough, abnormal gag reflex, dysphonia, dysarthria, cough after swallow, and voice change after swallow. Results of this study suggest that patients lacking these clinical predictors of aspiration did not require VFSS evaluation and could be effectively treated without increased risk of dysphagia-related complications.[14]

The VFSS is widely regarded as the gold standard for evaluating swallowing disorders.[15,16] Nevertheless, VFSS is not without its limitations. This diagnostic technique requires special equipment and trained staff, exposes patients to radiation, is expensive, and provides minimal anatomic information.[16,17] Furthermore, various studies have found that VFSS may yield false-negative results, thereby failing to identify certain groups at high risk for aspiration and aspiration pneumonia.[18-20] This problem may arise from the fact that aspiration events are often episodic in nature and may not be triggered by the conditions under which VFSS is performed. Studies have demonstrated that use of VFSS in conjunction with additional diagnostic modalities, such as radionucleotide salivagrams, laryngopharyngeal sensory discrimination testing, and fiberoptic endoscopic evaluation of swallowing, may achieve lower false-negative rates.[18-20] Additional investigation is warranted to elucidate how subjective measures of dysphagia using instruments such as the EAT-10 may be incorporated with objective data to further quantify aspiration risk in vulnerable individuals.

Previous studies suggest that responses from a validated, self-reported dysphagia inventory can reliably predict swallowing difficulty and aspiration events in patients.[21,22] The purpose of the present study was to evaluate the ability of the EAT-10 to screen for swallowing dysfunction and aspiration risk. The findings suggest that individuals with EAT-10 scores > 15 have higher relative risk of an aspiration event on VFSS (PAS) and greater overall risk of aspiration (TPT time). The instrument has a sensitivity of 71% and a negative predictive value of 89%. These values are less than those of other screening tests such as the mammogram for breast cancer (sensitivity of 85%)[23] and prostate specific antigen for prostate cancer (sensitivity of 83.4%).[24] An EAT-10 < 16, therefore, does not preclude the presence of aspiration and a high index of suspicion warrants further instrumental evaluation of swallowing with endoscopy and/or fluoroscopy.

Conclusion

Subjective dysphagia symptoms as documented with the EAT-10 can predict increased risk of aspiration. There is a linear correlation between the EAT-10 and aspiration, as observed on VFSS (PAS), and aspiration risk (TPT time). Persons with an EAT-10 > 15 are 2.2 times more likely to aspirate (95% CI, 1.3907-3.6245). The sensitivity of an EAT-10 > 15 in predicting aspiration is 71%.

Authors' Notes

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Declaration of Conflicting Interests

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