Pediatric Eating Assessment Tool-10 as an indicator to predict aspiration in children with esophageal atresia ☆

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ABSTRACT

Aim: Airway aspiration is a common problem in children with esophageal atresia (EA). Pediatric Eating Assessment Tool-10 (pEAT-10) is a self-administered questionnaire to evaluate dysphagia symptoms in children. A prospective study was performed to evaluate the validity of pEAT-10 to predict aspiration in children with EA.
Methods: Patients with EA were evaluated for age, sex, type of atresia, presence of associated anomalies, type of esophageal repair, time of definitive treatment, and the beginning of oral feeding. Penetration-aspiration score (PAS) was evaluated with videofluoroscopy (VFS) and parents were surveyed for pEAT-10, dysphagia score (DS) and functional oral intake scale (FOIS). PAS scores greater than 7 were considered as risk of aspiration. EAT-10 values greater than 3 were assessed as abnormal. Higher DS scores shows dysphagia whereas higher FOIS shows better feeding abilities.
Results: Forty patients were included. Children with PAS greater than 7 were assessed as PAS + group, and scores less than 7 were constituted as PAS − group. Demographic features and results of surgical treatments showed no difference between groups (p > 0.05). The median values of PAS, pEAT-10 and DS scores were significantly higher in PAS + group when compared to PAS- group (p < 0.05). The sensitivity and specificity of pEAT-10 to predict aspiration were 88% and 77%, and the positive and negative predictive values were 22% and 11%, respectively. Type-C cases had better pEAT-10 and FOIS scores with respect to type-A cases, and both scores were statistically more reliable in primary repair than delayed repair (p < 0.05). Among the postoperative complications, only leakage had impact on DS, pEAT-10, PAS and FOIS scores (p < 0.05).
Conclusions: The pEAT-10 is a valid, simple and reliable tool to predict aspiration in children. Patients with higher pEAT-10 scores should undergo detailed evaluation of deglutitive functions and assessment of risks of aspiration to improve safer feeding strategies.
Level of evidence: Level II (Development of diagnostic criteria in a consecutive series of patients and a universally applied "gold standard").

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Respiratory problems are common in patients with repaired esophageal atresia (EA). Nearly half of the patients have respiratory complications [1]. In one study, it was reported that 19% of patients had recurrent pneumonia, 10% had aspiration and 13% had chocking, gagging or cyanosis during feeding [1]. These complications are due to the gastroesophageal reflux disease (GERD) in 74% of cases, tracheomalacia in 13%, recurrent tracheoesophageal fistula (TEF) in 13%, and esophageal stricture in 10% of the cases [1]. The incidence of airway aspiration was 37% in patients with EA in videofleuroscopic (VFS) evaluation [2]. It is suggested that dyscoordination of upper esophageal sphincter relaxation and pharyngeal contraction may result in airway aspiration

and most of the respiratory problems are related to aspiration. We previously reported that patients with oropharyngeal dysphagia had higher incidence of airway aspiration and showed severe respiratory problems [3]. Barium swallowing studies and VFS can be used to evaluate the aspiration during deglutition. In addition, manometry and bronchoscopy are commonly used to evaluate aspiration in children with respiratory complications after the repair of EA [3]. However, there is no simple method to assess the risk of aspiration in children with EA.

The Eating Assessment Tool-10 (EAT-10) is a validated, self-administered, commonly used tool in clinical practice, which serves for the assessment of symptom-specific outcomes [4]. Serial application of the EAT-10 was shown to be effective in documenting the severity of initial symptoms, monitoring of the treatment efficacy and in prediction of aspiration and the risk of aspiration in patients with dysphagia. Patients with EAT-10 scores higher than 10 had 2.2 times more risk of aspiration and the scores higher than 3 were predictive for airway aspiration [4,5].

Therefore, in this study, we aimed to assess the validity of PEDI-EAT-10 for the prediction of aspiration in children with EA.

1. Patients and methods

Patients operated for EA were evaluated for age, sex, weight (percentiles validated for Turkish children), type of atresia, presence of associated anomalies, type of esophageal repair, time to definitive treatment and the beginning of oral feeding. The study was carried out in collaboration with Department of Pediatric Surgery and Center for Swallowing Disorders of Hacettepe University. Patients who admitted to our center for the last year were included. Children younger than one- year of age, without oral feeding and with esophageal replacement were excluded from the study. Patients who had primary anastomosis before 1 month of age were assessed as early repair, whereas patient operated after 1 month of age considered as delayed repair. Also, children were grouped according to beginning of oral feeding as before 1 week, one week to 1 month and 1 month after primary anastomosis.

Videofluoroscopy (VFS) is known to be the basic method for the investigation of the deglutitive functions and of aspiration. The oral, pharyngeal and esophageal phases of deglutition were evaluated with different consistencies of food in this procedure [3]. Liquid (1–3–5–10–20 ml of barium), pudding (3–5–10 ml of barium with pudding) and solid (5–10 ml of barium with biscuit) barium tests were performed with 5 ml volume of bolus. Pediatric and aspiration score (PAS) was also used for the full evaluation of VFS findings, and the score of 1–2 was defined as 'no penetration and aspiration', of 3–6 as 'penetration', and of 7–8 as 'aspiration' (Table 1) [3]. Patients with PAS scores higher than 7 were assessed as the PAS + group and with scores less than 7 were assessed as the PAS- group.

Dysphagia score (DS) was evaluated by the scoring system introduced by Dakkak et al. (Table 2) [6]. The total sum of DS was obtained by multiplying the dysphagia frequency (presence of dysphagia, often = 1, occasionally = 1/2 and never = 0) with the row number [6]. The patients with DS score of 0 were considered as the group with no dysphagia, between 1 and 44 as the group with mild dysphagia, and patients with DS scores greater than 44 were categorized as the group with severe dysphagia.

The pediatric version of the EAT-10 (PEDI-EAT-10) is a reliable and valid symptom specific outcome tool as a questionnaire including ten questions and is validated for Turkish children [7,8] (Table 3). EAT-10 scores higher than 3 were assessed as risk of aspiration [4].

The pediatric functional oral intake scale (FOIS) adopted from an existing adult tool by Crary et al. [9]. It is a 7-point ordinal scale that documents the functional intake of food and liquid in patients (Table 4).

Both scores were evaluated at the time of VFS for all patients and the results of scores were compared between PAS + and PAS- patients. Each

parameter was also correlated with PAS positivity to define the risk of aspiration.

This study was approved by the Local Ethical Committee (GO-16/410) and non-parametric tests were performed for statistical analysis of our findings (SPSS 15.0). The sensitivity and specificity of PEDI-EAT-10 to predict airway aspiration was evaluated. The results of groups were statically analyzed with non-parametric tests (Mann–Whitney *U*) with SPSS 15.0. The correlation of demographic parameters with PAS scores was analyzed with Spearman correlation test and the sensitivity and specificity were determined by using 2×2 contingency tables. The p values less than 0.05 were considered as significant.

2. Results

Forty patients were included in this study. Children with penetration-aspiration in VFS (PAS > 7) were assessed as the PAS + group (n = 9), and patients with PAS < 7 were included in the PAS- group (n = 31). Demographic features and results of surgical treatment showed no difference between PAS + and PAS- groups (p > 0.05) (Table 5). Fourteen patients had associated anomalies (33% of PAS + and 35% of PAS- patients). Ten patients had cardiac anomalies, three of them had genitourinary anomalies, and one patient had VATER association. Gross A patients (n = 5) and three of Gross C patients underwent delayed repair (after one months of age) for long gap atresia. The rest of the Gross C patients underwent early (before one months of age) repair. All of the patients underwent open surgical repair. The mean age of surgical repair was 1.93 days (1–4 days) in early repair group. In delayed repair group; the mean age of operation was

Table 1
The Penetration and Aspiration Scale.

Score	Definition	VFS findings
1	No penetration	No contrast material in the airway
2	and aspiration	Contrast material passes to airway, **above** the vocal cords, no contrast remnants
3	Penetration	Contrast material passes to airway, above the vocal cords, visible contrast remnants
4		Contrast material passes to airway, **at the level of** vocal cords, no contrast remnants
5		Contrast material passes to airway, at the level of vocal cords, visible contrast remnants
6		Contrast material passes to airway, **below** the vocal cords, no contrast remnants
7	Aspiration	Contrast material passes to airway, below the vocal cords, in addition to response to aspiration visible contrast remnants
8		Contrast material passes to airway, below the vocal cords, no response to aspiration

Table 2
The Dysphagia Scoring System defined by Dakak et al. [6]. The total sum of DS was obtained by multiplying the dysphagia frequency (presence of dysphagia, often = 1, occasionally = 1/2 and never = 0) with the row number. The patients with DS score of 0 were considered as the group with no dysphagia, between 1 and 44 as the group with mild dysphagia, and patients with DS scores greater than 44 were categorized as the group with severe dysphagia.

Type of Nutrition	Often (1 points)	Occasionally (1/2 points)	Never (0 points)	Total
1. Water				1 x
2. Milk/soup				2 x
3. Yogurt/Fruit puree				3 x
4. Jelly/jam				4 x
5. Mashed potatoes or scrambled eggs				5 x
6. Boiled vegetables or fish				6 x
7. Bread				7 x
8. Fresh fruits				8 x
9. Meat				9 x

Table 3
The Pediatric Version of Eating Assessment Tool (PEDI-EAT-10).

PEDI-EAT-10	0 = no problem 4 = severe problem				
1. My child does not gain weight due to his/her swallowing problem.	0	1	2	3	4
2. Swallowing problem of my child interferes with our ability to go out for meals.	0	1	2	3	4
3. Swallowing liquids takes extra effort for my child.	0	1	2	3	4
4. Swallowing solids takes extra effort for my child.	0	1	2	3	4
5. My child gags during swallowing.	0	1	2	3	4
6. My child acts like he/she is in pain while swallowing.	0	1	2	3	4
7. My child does not want to eat.	0	1	2	3	4
8. Food sticks in my child's throat and my child chokes while eating.	0	1	2	3	4
9. My child coughs while eating.	0	1	2	3	4
10. Swallowing is stressful for my child.	0	1	2	3	4
Total score					