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ORIGINAL ARTICLE

Evaluation of respiratory problems in children with esophageal atresia

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ABSTRACT

Objective: Esophageal atresia (EA) is the most common esophageal anomaly associated with respiratory morbidity in childhood. This study aimed to evaluate respiratory problems in children who underwent surgery for esophageal atresia.

Material and Methods: A total of 33 cases with EA were included in the patient group, and 20 cases diagnosed with isolated gastroesophageal reflux disease (GERD) were included in the control group. This case-control study also included observational and analytical evaluations. Respiratory symptoms and findings were recorded. Spirometry was performed to assess lung function, and laboratory tests indicating an allergic condition were examined.

Results: In the patient group with a median age of 4.7 years (IQR: 6.7), 84.8% had recurrent or chronic cough, 51.5% had wheezing, 63.6% had a history of respiratory distress in the past year, 24.2% had recurrent pneumonia, and 63.6% had a history of hospitalization due to respiratory problems at least once. Aspiration pneumonia was present in 27.2% of patients, asthma diagnosed by a physician in 33.3%, and tracheomalacia in 18.1%. Asthma, cough, and wheezing were observed at similar rates in both groups, while aspiration pneumonia and hospitalization due to respiratory problems were more common in the patient group. Pulmonary function test (PFT) abnormalities were significantly more common in the EA group compared with the control group ($p<0.001$).

Conclusion: Respiratory problems in EA are based on structural and functional causes and are quite widespread. We emphasize the importance of conducting research using more detailed respiratory tests in larger patient series to obtain clearer data.

Keywords: Cough, esophageal atresia, pneumonia, pulmonary function tests.

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INTRODUCTION

Esophageal atresia (EA) is the most common congenital structural anomaly of the esophagus. According to the most recent prevalence studies, it is observed in one in every 3500–4500 live births.[1–3] The most common long-term complications include esophageal motility disorder, gastroesophageal reflux disease (GERD), and respiratory system problems.[4–7] The development of neonatal intensive care and surgical conditions has increased survival rates, which in turn has raised the prevalence of long-term complications, especially those related to respiratory problems.[8,9]

According to clinical studies conducted to date, the etiology of respiratory complications is multifactorial.[8,10,11] Prematurity and respiratory system malformations such as tracheomalacia, laryngeal cleft, and lung hypoplasia have been found to pose a risk for respiratory morbidities.[12] Apart from structural disorders in the respiratory tract, the reason for poor respiratory function is not fully understood.[13] It has been stated that long-term respiratory complications may be associated with upper respiratory tract conditions (such as tracheomalacia, aspiration, and difficulty swallowing), the gastrointestinal system, and lower respiratory tract morbidities.[7,13–17]

The goal of this study was to analyze long-term respiratory complications in children who underwent EA repair. The study aimed to determine the frequency of respiratory symptoms, their relationship with identified risk factors, and measurements of spirometric respiratory functions, in addition to assessing supporting factors for asthma, such as total immunoglobulin E (IgE) level, eosinophilia, and house dust mite (*D. farinae*)-specific IgE level.

MATERIAL AND METHODS

This study was conducted in collaboration with the Pediatric Pulmonology, Pediatric Gastroenterology, and Pediatric Surgery clinics at Istanbul Medeniyet University Göztepe Training and Research Hospital. The research process began after parents were provided with detailed information and gave informed consent through the "Informed Consent Form." The study included 33 patients who underwent surgery for EA and were followed up at pediatric pulmonology clinics between September 1, 2018, and April 1, 2019.

A control group of 20 children diagnosed with isolated GERD (according to ESPGHAN/NASPGHAN guidelines), unrelated to EA and other structural abnormalities, was selected to investigate the presence of morbidities that could cause respiratory symptoms and findings in patients diagnosed with EA. The aim was to identify factors other than reflux that could lead to respiratory complications in patients who underwent EA repair.

To evaluate the impact of gastroesophageal reflux (GERD) on respiratory outcomes, the rates of respiratory symptoms and complications were compared between the patient group (EA patients with GER) and the control group (patients with GERD but without EA). The presence of chronic cough, wheezing, episodes of respiratory distress, hospitalization due to respiratory problems, and aspiration pneumonia was recorded and compared between the groups. The baseline variables of the study and control groups, such as age, gender, prematurity, and length of stay in intensive care, are presented in Table 1.

Table 1: Comparison and characteristics of the patient group and control group.

	Patient group (n=33)	Control group (n=20)	p
Age (year), median (IQR)	4.7 (6.7)	10.1 (4.7)	0.030
Gender, n (%)			
Male	17 (51.5)	13 (65)	0.114
Female	16 (48.5)	7 (35)	0.396
Length of NICU stay (day) median (IQR)	30 (44)	5.2 (4.5)	0.009
Birth status, n (%)			
Term	19 (57.6)	15 (75)	0.050
Preterm	14 (42.4)	5 (25)	0.002

IQR: Interquartile range; NICU: Newborn intensive care unit.

Patient Selection

Upon reviewing the records of the Pediatric Surgery Clinic for the past 13 years, 107 patient files were identified. Examination of hospital records revealed that 14 patients had died and 50 patients could not be reached due to insufficient contact information or discontinuation of treatment. Ten patients' family members reported that they were unable to participate in the study for various reasons. Thirty-three patients aged 6 months to 18 years were being followed up at the Pediatric Pulmonology outpatient clinic. Patients with intellectual disability and neuromuscular disease were not included in the study; however, no patients meeting these exclusion criteria were identified.

Interview Forms and Data Collection

Based on previous studies, common respiratory complications and associated morbidities in patients with EA were identified, and an interview form was prepared. The interview form was designed to collect the following information: detailed prenatal, natal, and postnatal histories; type of EA, time, and technique of surgery; surgical and other complications; associated anomalies; history of GERD; allergic diseases previously diagnosed by a physician; and respiratory symptoms and findings. The presence of cough and wheezing was asked about separately in detail. Patients were asked whether they had experienced respiratory distress requiring emergency department visits, bronchodilator or inhalation/systemic steroid use, and, if so, how many times per year on average.

A history of tracheomalacia, inspiratory stridor, and associated metallic cough was assessed according to criteria, and bronchoscopic examination reports were reviewed if available. The number of hospitalizations due to respiratory problems and a history of ≥3pneumonia episodes in the past year was determined. Clinical information was obtained from parental interviews, detailed physical examination of the patient, and medical records.

Spirometry and Early Reversibility Test

Spirometry was performed in the patient and control groups aged six years or older using the Spirolab III Color LCD device. Data were recorded using the WinspiroPRO 6.8 program. Respiratory function tests were performed in accordance with the recommendations of the European Respiratory Society (ERS) and the American Thoracic Society (ATS).[18,19] The forced expiratory volume in the first second (FEV_1), forced vital capacity (FVC), and forced expiratory flow ($FEF_{25–75\%}$) were reported. The FEV_1/FVC ratio was documented. Spirometric measurements were evaluated and interpreted according to the guidelines of the aforementioned associations.[20,21]

Regardless of baseline lung function, an early reversibility test with a bronchodilator was performed. A change in FEV_1 of ≥12% was considered a positive result.

Serum Total IgE Level and Eosinophil Percentage

The serum total IgE levels of patients and the control group were analyzed using the *in vitro* immunoturbidimetric method with the Abbott Architect Biochemistry Analyzer. The IgE level determined by the current method was considered high if it exceeded the upper reference limit for the corresponding age group.[22] The eosinophil percentage was considered high if it was >5%.

House Dust Mite (*D. farinae*) Specific IgE Level

The results were obtained by *in vitro* quantitative measurements of serum using a specific IgE kit suitable for IMMULITE 2000 3g Allergy Systems analyzers. A standard classification system was used to interpret quantitative values.[23]

This study was conducted in accordance with the 1964 Helsinki Declaration and subsequent protocols, which set ethical standards for research involving human subjects. Ethical approval for this study was obtained from the Clinical Research Ethics Committee of Istanbul Medeniyet University Göztepe Training and Research Hospital on August 15, 2018 (decision number 2018/0318).

Statistical Analysis

SPSS version 17.0 software was used for statistical analyses. The normality of the variables was examined using histogram graphs and the Shapiro–Wilk test. Descriptive analyses were presented using mean, standard deviation, median, and minimum–maximum values. Pearson Chi-square and Fisher's Exact tests were used for binary parameter comparisons.

When comparing variables that did not follow a normal distribution (non-parametric variables), the Mann–Whitney U test was used for two groups, and the Kruskal–Wallis test was used for more than two groups. The Spearman correlation test was used to analyze the measured data with each other. Results with a $p<0.05$ were considered statistically significant.

RESULTS

Thirty-three patients who underwent EA repair participated in the study. The median age was 4.7 years (IQR:6.7). The male-to-female ratio was 17:16. According to the Gross classification,[24] 66.6% (22/33) of patients were type C, 21.2% (7/33) were type A, 9% (3/33) were type B, and 3% (1/33) were type E. A total of 66.6% of patients (22/33) underwent early primary repair, 12.2% (4/33) underwent delayed primary repair, and 21.1% (7/33) underwent esophageal replacement surgery. Surgical complications included stricture in 54.5% (18/33) of patients, anastomotic leak in 6% (2/33), and recurrence of fistula in 3% (1/33).

Table 2: Respiratory complications, concomitant respiratory comorbidities

	EA patient group	
	n	%
Cough	28/33	84.8
Chronic cough (>4 weeks)	7/28	25
Recurrent cough	21/28	75
Wheezing	17/33	51.5
Respiratory distress episode	21/33	63.6
Hospitalization due to respiratory problems	21/33	63.6
Recurrent pneumonia	8/33	24.2
Doctor-diagnosed		
Asthma	11/33	33.3
Allergic rhinitis	4/33	12.1
Atopic dermatitis	1/33	3
Aspiration pneumonia	9/33	27.2
Tracheomalacia	6/33	18.1
Chest deformity	7/33	21.2

EA: Esophageal atresia.

GERD was diagnosed in 72.7% (24/33) of patients, and 29.1% (7/24) of these patients underwent anti-reflux surgery. Stricture development was observed in 66.6% (16/24) of patients with GERD.

During the postoperative follow-up period, esophagogastroscopy was performed in 75.7% (25/33) of patients, and esophagitis was detected in 20% (5/25) of these patients.

The median number of hospital admissions due to respiratory problems was 1 (IQR:3). The median number of respiratory distress episodes in the past year was 1 (IQR:3). The most common clinical findings in our patients were cough (84.8%), respiratory distress attacks and hospital admissions (63.6%), and wheezing (51.5%) (Table 2).

Table 3 presents the rates of respiratory symptoms and signs by age groups ($p>0.05$).

Fiberoptic bronchoscopic examination was performed in 33.3% (11/33) of patients due to recurrent wheezing and respiratory tract infections. Tracheomalacia was detected in six of the 11 EA patients, and refistulation was detected in one patient.

No significant correlation was found between gestational age, birth weight, postoperative invasive mechanical ventilation (MV)

Table 3: Rates of respiratory symptoms and signs by age groups

	Aged ≤5 Total n=18 n (%)	Aged >5 Total n=15 n (%)	p
Cough	14 (77.7)	14 (93.3)	0.215
Wheezing	10 (58.8)	7 (46.6)	0.492
Recurrent pneumonia	4 (22.2)	4 (26.6)	0.767
Respiratory distress episode (Mean±SD)	2.9±2.3	4.8±5.9	0.515
Hospitalization due to respiratory problems (Mean±SD)	3.36±2.5	4.2±3.3	0.747

SD: Standard deviation.

requirement, and EA type with cough, wheezing, recurrent pneumonia, number of respiratory distress episodes in the past year, or number of hospitalizations due to respiratory problems. Similarly, no significant correlation was found between the length of stay in the neonatal intensive care unit (NICU) and coughing, wheezing, or recurrent pneumonia (Table 4).

Dysphagia was present in 24 patients (72.7%). Among these patients, 87.5% (21/24) had coughing, 54.1% (13/24) had wheezing, 25% (6/24) had recurrent pneumonia, 70.8% (17/24) had a history of respiratory distress, and 62.5% (15/24) had a history of hospitalization due to respiratory problems. Eighteen patients (54.5%) had a history of esophageal stricture. Among these patients, 55.5% (10/18) had a history of cough, 61.1% (11/18) had wheezing, 22.2% (4/18) had recurrent pneumonia, 72.2% (13/18) had a history of respiratory distress, and 55.5% (10/18) had a history of hospitalization due to respiratory problems. When comparing patients with and without dysphagia or stricture, no significant difference was found in the frequency of respiratory symptoms and findings (Table 5).

Overall, 72.7% (24/33) of patients had symptoms and findings consistent with GERD, and 29.1% (7/24) of these patients underwent anti-reflux surgery. Among patients with GERD, 87.5% (21/24) had cough, 54.1% (13/24) had wheezing, 20.8% (5/24) had recurrent pneumonia, 70.8% (17/24) had a history of respiratory distress, and 62.5% (15/24) had a history of hospitalization due to respiratory problems. There was no significant difference in the frequency of respiratory symptoms and findings between patients with and without GERD (Table 5).

The frequency of respiratory symptoms and findings was evaluated between the 24 EA patients diagnosed with GERD and the control group. There was no significant difference in the rates of chronic cough and wheezing complaints between the patient and control groups. However, the hospitalization rate due to respiratory problems was higher in the patient group (62.5%) compared to the control group (25%) (p=0.013). The rate of aspiration pneumonia history was also higher in the patient group (27.2%) than in the control group (5%) (p=0.045) (Table 6).

The rate of asthma diagnosis was 37.5% (9/24) in the patient group and 40% (8/20) in the control group. PFT data were obtained from 15 EA patients and 18 control patients who underwent the test. According to spirometry, the mean FVC (62.3%±17.8 of predicted, mean±SD), FEV_1 (66.5%±19.2 of predicted, mean±SD), and $FEF_{25–75\%}$ value (75.1%±28.3 of predicted, mean±SD) were lower than those in the control group (p<0.001) (Fig. 1). The early reversal test was positive in nine of 15 patients (60%) and six of 17 controls (35%) ($\Delta FEV_1 \geq 12\%$). There was no statistically significant difference between the groups (p=0.065).

When ventilation patterns were compared between the groups, a mixed type was detected in eight (53.3%) patients, a restrictive type in four (26.6%) patients, and an obstructive type in one (6.6%) patient. The number of normal ventilation patterns was significantly higher in the control group (p=0.001) (Fig. 2).

The median total IgE level was higher in the control group than in the patient group (control group median 32.8 IU/L [IQR:43.3], patient group median 5.5 IU/L [IQR:16.7]) (p=0.004). The median eosinophil percentage was also higher in the control group (control group median 3.1% [IQR:2.3], patient group median 2.2% [IQR:2]) (p=0.023).

House dust mite (*D. farinae*)-specific IgE measurements were higher in the control group (control group median 0.35 [IQR:2.76], patient group median 0.1 [IQR:0]) (p=0.030). No significant correlation was found between house dust mite-specific IgE measurements and cough, wheezing, or annual respiratory distress attacks (p=0.946, p=0.763, p=0.083).

Table 4: The relationship between the respiratory symptoms and findings of the patients and gestational age, birth weight, neonatal NICU length of stay, post-operative invasive MV requirement, and EA type

p	Cough	Wheezing	Recurrent pneumonia	The number of episode*	The number of hospitalization**
Gestational age	0.905	0.946	0.746	0.930	0.493
Birth weight	0.698	0.704	0.810	0.841	0.409
Length of stay at NICU	0.546	0.664	0.333	0.621	0.303
Post-operative invasive MV	0.508	0.809	0.212	0.655	0.201
EA type	0.072	0.078	0.242	0.156	0.495

*: The number of respiratory distress episodes in the past year; **: The number of hospitalizations due to respiratory problems; NICU: Newborn intensive care unit; MV: Mechanical ventilation; EA: esophageal atresia.

Table 5: The relationship between the respiratory symptoms and signs and the presence of surgical complications, tracheomalacia, and chest deformity

p	Cough	Wheezing	Recurrent pneumonia	The number of episodes	The number of hospitalizations
Stricture	0.478	0.162	0.767	0.399	0.099
Dysphagia	0.488	0.538	0.868	0.712	0.154
GERD	0.778	0.380	0.456	0.492	0.263
Tracheomalacia	0.943	0.100	0.793	0.283	0.452
Chest deformity	0.208	0.810	0.763	0.270	0.387

GERD: Gastroesophageal reflux disease.

Table 6: The rates of respiratory symptoms and signs between the EA patients with GERD and control groups

	EA patients with GERD (n=24) n (%)	Control group (n=20) n (%)	p
Chronic cough	7 (29.1)	4 (20)	0.669
Wheezing	13 (54.1)	10 (50)	0.532
Respiratory distress episode	17 (70.8)	10 (50)	
Hospitalization due to respiratory problems	15 (62.5)	5 (25)	**0.013**
Aspiration pneumonia	9 (27.2)	1 (5)	0.045

EA: Esophageal atresia; GERD: Gastroesophageal reflux disease.

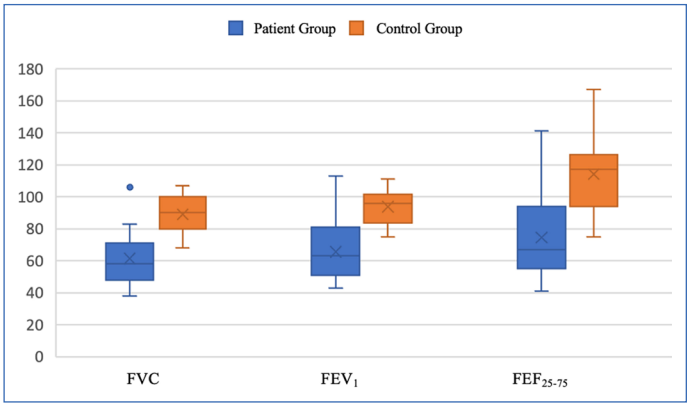

Figure 1: PFT/spirometry results in the graphic of patient and control group (p<0,001).

FVC predicted % patient group 62.3±17.84-control group 89.0±12.39; FEV_1 predicted % patient group 66.57±19.23-control group 93.82±10.88; FEF_{25-75} predicted % patient group 75.1±28.3-control group 114.1±25.7.

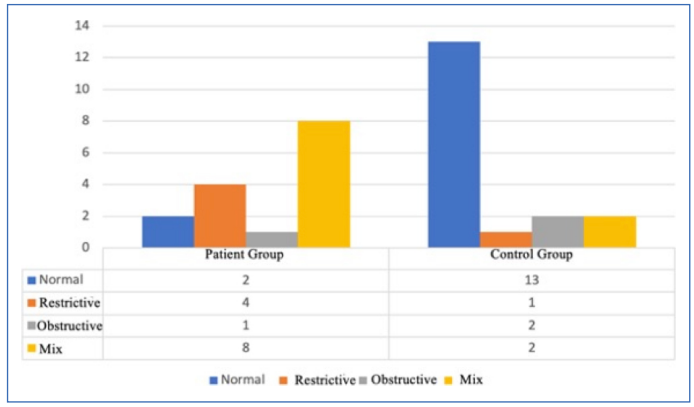

Figure 2: Pulmonary function disorders in the patient and control groups.

DISCUSSION

Respiratory problems in children with EA are structural and functional in nature and are quite widespread. However, we did not observe an increase in respiratory problems among those with esophageal stricture or dysphagia. Children with EA experienced more aspiration pneumonia and were hospitalized more often than the control group. In children with EA and asthma symptoms, we observed that an allergic etiology was not predominant.

In our study, 84.8% of patients had a history of at least one emergency department visit due to recurrent cough, 21.2% due to chronic cough, 51.5% due to wheezing, and 63.6% due to respiratory distress. The median number of emergency department visits per year for respiratory issues was 1 (IQR: 3). Similarly, 24.2% of patients had experienced ≥3 episodes of pneumonia in the past year, 63.6% had a history of hospitalization due to respiratory problems at least once in their lives, and the median number of hospitalizations was 1 (IQR: 3) per year.

Respiratory symptoms and findings were observed at similar rates in patients under and over 5 years of age. No significant correlation was found between gestational age, birth weight, length of stay in the

NICU, postoperative mechanical ventilation requirement, type of EA, presence of surgical complications, tracheomalacia, chest deformity, and respiratory symptoms or findings. Similar results have been reported in most previous studies.[2,8,12,13]

Although the etiology of respiratory complications in EA is not fully understood, it is believed to be multifactorial.[6,7,14,24–28] Surgery-related pathologies and associated structural and functional abnormalities are thought to contribute to the development of short- and long-term respiratory complications.[25,27] Therefore, respiratory complications have been associated with upper airway anomalies, gastrointestinal issues (such as GERD, esophageal motility disorder, and esophageal stricture), dysphagia, aspiration, and lower airway pathologies.[6,7,10,14]

In a meta-analysis, the overall prevalence of chronic cough and wheezing was reported as 14.6% and 34.7%, respectively, based on data from six different studies.[9] In a study conducted by Cartabuke et al.[29] on 43 patients with an average age of 8 years, the prevalence of cough and wheezing was reported as 72.1% and 53.5%, respectively. In our study, 84.8% of patients had recurrent cough, 51.5% had wheezing, and 21.2% had chronic cough. In a study conducted by Chetcuti et al.[17] on 334 patients aged 1–37 years who underwent EA repair, it was found that chronic cough decreased with age, but the frequency of wheezing remained similar. In a retrospective study conducted by Little et al.[25] on 69 patients, it was observed that the frequency of respiratory tract infections decreased with age. In our study, the similarity in respiratory findings such as cough and the number of respiratory tract infections between age groups can be attributed to the fact that the median age of our patient group was lower than that of other studies. Additionally, we did not find any association between respiratory symptoms such as coughing, wheezing, and recurrent pneumonia and conditions like esophageal stricture, dysmotility, GERD, tracheomalacia, and chest deformity.

Asthma diagnosis and respiratory distress attacks are quite common during the follow-up of patients with EA. In a systematic review on respiratory complications conducted by Sistonen et al.,[28] the prevalence of asthma diagnosed by a physician during childhood and adolescence was reported to be between 12% and 29%. In a study by Malmström et al.[30] (mean age 13.8 years), the prevalence of patients diagnosed with asthma by a physician and experiencing wheezing episodes was reported as 22%. However, histopathological features in biopsy samples obtained through bronchoscopic examination were not consistent with asthma, and findings indicative of chronic bronchial inflammation were identified. In our study, we also did not find a relationship between an allergic background and the etiology of asthma in EA cases. This finding supports the notion that asthma-like clinical findings in EA patients do not reflect the histopathological features of asthma, do not develop on an allergic background, and may be related to chronic bronchial inflammation.

Recurrent pneumonia is among the other common respiratory complications in EA patients. According to a meta-analysis conducted by Connor et al.,[9] the prevalence of recurrent pneumonia ranged from 9.5% to 51.5% (with an estimated average prevalence of 24.1%) across different age groups. In two different studies, the incidence of pneumonia decreased with age.[17,25] In a case-control study by Pedersen et al.[13] (mean age 10.2 years), the proportion of patients with a history of three or more episodes of pneumonia was 54.2%. The median age of our patients was also low, similar to the sample in the latter study, indicating that the incidence of pneumonia and wheezing is currently high but may decrease with age.

Hospital admissions due to respiratory problems, like other respiratory symptoms, are also on the rise. In a multicenter study conducted by Sulkowski et al.[31] on 2,887 patients, the rate of hospital admission with a diagnosis of pneumonia within the first two years after surgery was 12.7%. Additionally, 25.7% of these patients were hospitalized three or more times during follow-up. In a study by Chetcuti et al.,[17] the hospitalization rate due to respiratory problems was 73% in children under five years of age and approximately 28% in those over five years of age. In our study, the rates of recurrent pneumonia and hospitalizations were similar in both the under-five and over-five age groups. We did not observe a decrease as seen in other studies.

Perhaps we should take a moment to reflect and emphasize that infection control is a priority issue for patients with EA and that vaccination and awareness are important. In a study by Malmström et al.,[30] 54% of patients had a positive skin prick test; however, this was not significantly associated with bronchial reactivity.

Pedersen and colleagues found no significant association between obstructive dysfunction and sensitivity in their patient group.[13] In our study, the median total IgE level and eosinophil percentage were quite low in the patient group, and no sensitivity to house dust mites (*D. farinae*) was detected. There was no significant correlation between respiratory complications and total IgE levels, eosinophil counts, or sensitivity to house dust mites. Based on this finding, we can reemphasize that non-allergic factors also play a role in the etiopathology of asthma in these patients.

In a case-control study conducted by Pedersen and colleagues, the control group consisted of children diagnosed with GERD. A history of recurrent pneumonia and respiratory symptoms were significantly more common in the control group.[13] The findings of this study were not in accordance with those of Pedersen et al.[32] A higher number of hospital admissions and a greater incidence of aspiration pneumonia were observed in the EA patient group in comparison with the control group. Therefore, we can conclude that it is essential to investigate the presence of comorbid conditions, other than reflux, that may trigger respiratory symptoms and aspiration pneumonia. We believe that studies evaluating swallowing dysfunction may shed light on this issue.

In situations where multiple respiratory events are intertwined, it is natural to expect impaired respiratory function tests.[28,30] In a study by Sistonen and colleagues, obstructive and restrictive disorders were observed equally in 21% of patients, while both ventilation patterns were present in 36%.[28] In a study by Legrand and colleagues, PFTs were performed on 36 children, and obstructive disorders were detected in 50% of cases, while restrictive disorders were detected in 11%. However, no significant association was found between respiratory disorders and accompanying anomalies or esophageal pathologies.[5] In our study, restrictive, obstructive, and mixed respiratory disorders were detected in 26%, 6.67%, and 53.3% of patients, respectively. Although obstructive disorders were predominant in the study by Legrand and colleagues, no association was detected between these disorders and accompanying anomalies

or esophageal pathologies. However, both in Sistonen's study and in ours, restrictive and mixed patterns of dysfunction were predominant. These findings suggest that restrictive issues are not negligible and that factors such as chronic lung parenchymal damage and chest wall deformities may also play a role. This is because the disorder cannot be explained solely by airway narrowing or obstruction by secretions accompanied by asthma. In our study, the respiratory function of EA patients diagnosed with GERD was found to be lower than that of the control group diagnosed with GERD. This suggests that other clinical pathologies related to the primary disease, aside from GERD, may contribute to the etiology of long-term respiratory problems.

More accurate and reliable results can be obtained by including a larger number of patients and utilizing tests such as respiratory muscle strength measurement, IOS (impulse oscillometry system), and Lung Clear Index (LCI) to clarify this issue.

This study has several limitations, including a small sample size, missing data, and variability in the reporting of results. The limitations are attributed to the collection of retrospective data from a single institution and the potential for changes in surgical techniques and perioperative approaches over time. Since our clinic did not have a device such as IOS that could successfully measure lung function in patients under the age of five, PFT could only be performed in patients over the age of six. Finally, it was thought that patients with respiratory complaints were more willing to participate in the study, while those without respiratory complaints were reluctant (families expressed this during telephone interviews). This may have created a bias in the study population.

An important aspect of our study is that it highlights the importance of a multidisciplinary approach and follow-up for many respiratory problems.

CONCLUSION

Respiratory problems in children with EA are structural and functional in nature and are quite widespread. We would like to emphasize the importance of conducting research using more detailed respiratory tests, such as IOS, LCI, and functional assessment of swallowing, in larger patient series to obtain clearer data on this subject.

Statement

Ethics Committee Approval: The Istanbul Medeniyet University Goztepe Training and Research Hospital Ethics Committee granted approval for this study (date: 15.08.2018, number: 2018/0318).

Informed Consent: The research process began after parents were provided with detailed information and gave informed consent via the "Informed Consent Form."

Conflict of Interest: The authors have no conflict of interest to declare.

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Use of AI for Writing Assistance: We acknowledge that we employed ChatGPT 3.5 and 4 to assist us in refining the clarity of our writing while developing the draft of this case report. We always maintained continuous human oversight(editing and revising) and verified the artificial intelligence-generated output. We never used AI to find, locate, or review the literature or resources, summarize the articles, analyze the selected articles, or synthesize the findings. The authors completed all analyses with higher-level efforts.

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