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ORIGINAL ARTICLE

Foreign Body Aspiration in Children is Time-Sensitive: A Retrospective Analysis of 79 Cases

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Abstract

Background: Foreign body aspiration (FBA) is an important cause of morbidity and mortality in children, especially within the 1-3 year age range. Bronchoscopy is the gold standard diagnostic method in patients with a suspected history of FBA and is also the primary treatment.

Methods: We evaluated pediatric patients who presented with suspected FBA between December 2023 and December 2024. Bronchoscopy was recommended for all patients who might have aspiration, and fiberoptic bronchoscopy (FOB) was done under a laryngeal mask on those who agreed to the procedure.

Results: A foreign body was identified in 43 patients (54.4%). Foreign body extraction was performed by FOB in 2 (2.6%), rigid bronchoscopy in 40 (50.6%), and thoracotomy in 1 (1.3%) of the patients. FBA of organic origin was considerably elevated before schooling compared to post-schooling (p=0.004). The median interval between aspiration and interventional procedure was 8 (min: 5 - max: 45) and 2 (min: 0 - max: 61) days in FBA cases with and without granulation tissue development, respectively. The median interval between aspiration and interventional procedure was significantly longer in those who developed granulation tissue (p=0.002).

Conclusion: FBA is an important health issue in childhood and can lead to morbidity and mortality. Foreign body aspirations should be considered time-sensitive due to the development of granulation tissue and potential accompanying complications.

Keywords: Bronchoscopy, childhood, foreign body aspiration

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INTRODUCTION

Foreign body aspiration (FBA) is an important cause of morbidity and mortality in the pediatric age group, particularly in the 1-3 year age group. In this age group, lack of teeth, weak swallowing reflex, involuntary breathing during laughing and crying, and the habit of putting objects in the mouth are considered the main aetiological factors (1).

FBA may occur with or without witnesses. The most important clue in the diagnosis is anamnesis. In the anamnesis, a history of witnessed aspiration is present in most cases (1). Despite the absence of findings on physical examination and radiological imaging, the number of cases in which FBA is found on bronchoscopy is considerable. Therefore, bronchoscopy is the gold standard diagnostic method in patients with a suspected history of FBA and is also the basic treatment (2).

In our study, we aimed to present the results of our patients who were evaluated for suspected FBA in our clinic during a one-year period between December 2023 and December 2024 in light of the literature.

MATERIALS AND METHODS

Pediatric cases consulted at our clinic with suspicion of FBA between December 2023 and December 2024 were included in the study. Local ethics committee approval was obtained before the study (AEŞH-BADEK-2024-1264), and the study was conducted in accordance with the Helsinki Declaration of Human Rights.

Age, gender, symptoms, physical examination findings, procedure (flexible/rigid bronchoscopy, surgery), type of foreign body (organic, non-organic), complications, mortality, length of hospitalization, and follow-up data were retrospectively evaluated. Patients were categorized into two periods, preschool (<7 years) and post-school (>7 years), due to the prolonged separation from parents/caregivers and increased exposure to a variety of materials with the start of school age.

Patient Management

Bronchoscopy was routinely recommended for all patients with suspected aspiration, and all patients who consented to the procedure were admitted to either the pediatric ward or the intensive care unit based on their clinical condition. No premedication was administered to any patient, and all procedures were initiated following standard anesthesia monitoring, including electrocardiography, peripheral oxygen saturation, and noninvasive arterial blood pressure measurement. Anesthesia induction was performed intravenously with propofol (2–3 mg/kg) in the presence of intravenous access; otherwise, inhalational induction was achieved with sevoflurane (4–5%) in 100% oxygen. Rocuronium (0.6–1.2 mg/kg) was administered as a neuromuscular blocking agent. Following induction, a Class 1 laryngeal mask airway (LMA) of appropriate size was inserted, and the patient was connected to the respiratory circuit via a T-tube. Flexible bronchoscopy was performed through the connection between the T-tube and the LMA. If a foreign body was identified and couldn't be removed with FOB, both the FOB and LMA were removed, and rigid bronchoscopy was initiated (Figure 1).

Figure 1: Foreign body aspirastion bronchoscopy image

The T-tube was connected at one end to the ventilation port of the rigid bronchoscope and at the other end to the respiratory circuit, allowing manual ventilation with 100% oxygen at a flow rate of 8–10 L/min. Anesthesia was maintained using either inhalational anesthesia (sevoflurane 2–5% in 100% oxygen) or total intravenous anesthesia (TIVA) with propofol (100–150 μg/kg/min) and remifentanil (0.1–0.2 μg/kg/min). At the conclusion of the procedure, anesthetic agents were discontinued, and neuromuscular blockade was reversed in

patients who had received muscle relaxants. Manual ventilation with 100% oxygen was provided until sufficient spontaneous respiration was restored. Patients without respiratory distress at the end of the procedure were transferred to the recovery unit, where they were monitored until an Aldrete score of 9 was achieved before being discharged to the ward.

Statistical analysis

All analyses of the study were performed using the SPSS 24.0 software package. Descriptive statistics were presented as the number of units (n), percentage, and median (minimum-maximum) values for age, time between aspiration and procedure, and length of hospital stay. Pearson chi-squared analysis and Fisher's exact test were used to compare the distribution of categorical variables between groups. The Mann-Whitney U test was used for continuous numerical variables without normal distribution. A p-value less than 0.05 was considered statistically significant.

RESULTS

A total of 125 patients who were evaluated with suspicion of foreign body aspiration (FBA) were retrospectively assessed in our clinic. Diagnostic bronchoscopy was recommended to all patients. Forty-six patients who refused the procedure were excluded from the study. In 79 patients, the median month was 20 months (min: 4 - 180), and the median age was 1 year (min: 0 - max: 15). Forty-eight (60.8%) of the patients were male and 31 (39.2%) were female. Of the patients with suspected foreign body aspiration, 63 (79.7%) were diagnosed. Suspected foreign body aspiration was most common in the 1-2 year age range (44.3%). Symptoms, physical examination, and chest x-ray findings are shown in Table 1. Radiopaque foreign bodies were seen in 7 (8.9%) of the chest radiographs. The median time between suspected foreign body aspiration and interventional procedure was 3 (min: 0 - max: 61) days.

Table 1. Patients' Symptom, Physical Examination, Radiology, Procedure, and Complication Data

Parameters	Suspected Foreign Body Aspiration
	Number n (%)
Symptom	
None	2 (%2,5)
Cough	43 (%54,5)
Shortness of breath	23 (%29)
Wheezing	14 (%17,7)
Cyanosis	12 (%15,2)
Sore throat	1 (%1,3)
Flushing	1 (%1,3)
Chest pain	1 (%1,3)
Physical Examination	
Normal	37 (%46,8)
Decreased breath sounds	16 (%20,3)
Rhonchi	14 (%17,7)
Wheezing	4 (%5,1)
Stridor	3 (%3,8)
Coarse breath sounds	3 (%3,8)
Rales	2 (%2,5)

Chest X-ray	
Normal	38 (%48,1)
Increased aeration	33 (%41,7)
Atelectasis	6 (%7,6)
Foreign body	3 (%3,8)
Opacity	1 (%1,3)
Pneumonia	1 (%1,3)
Procedure	
Fiberoptic bronchoscopy (FOB)	38 (%48,1)
Rigid bronchoscopy	40 (%50,6)
Thoracotomy with exploration	1 (%1,3)
Complication	
None	75 (%95)
Pneumothorax	2 (%2,5)
Bronchospasm	2 (%2,5)
Cardiopulmonary resuscitation	1 (%1,3)
Hypoxic brain injury	1 (%1,3)

FOB was performed as standard at the beginning of the procedure (Figure 2). Foreign bodies were detected in 43 patients (54.4%). Foreign body removal was performed by FOB in 2 patients (2.6%), rigid bronchoscopy in 40 patients (50.6%), and thoracotomy in 1 patient (1.3%) (Table 1). Foreign bodies were of organic origin in 36 of 43 patients (83.7%) and of inorganic origin in 7 patients (16.3%). Complications developed in 4 patients (5.1%) and were as follows: pneumothorax in 2 patients (2.5%), bronchospasm in 1 patient (1.3%), bronchospasm, cardiopulmonary arrest, and subsequent hypoxic brain in 1 patient (1.3%) (Table 1). The median length of hospital stay was 3 (min: 0 - max: 23) days. Patients with suspected foreign body aspiration did not experience any pre- or post-procedural mortality. The type and location of the foreign bodies are shown in Table 2. Figure 1 illustrates the discovery of a localized foreign body in both the right lower lobe and the left upper lobe in one patient. It was found that suspicion of a foreign body was more common in the 1-2 and 2-3 age groups, while the likelihood of no significant findings was higher in the 0-1 age group. Thirty-two (74.4%) of the patients with FBA were aged between 1 and 3 years (Figure 3). Seven patients (16.3%) with foreign body aspiration showed granulation tissue development.

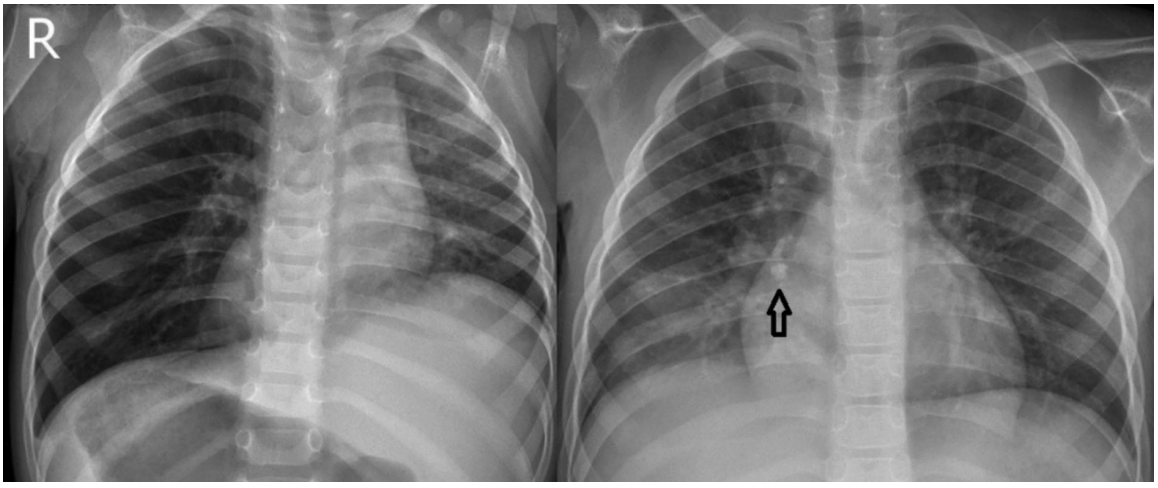

Figure 2: Chest X-ray of foreign body aspiration

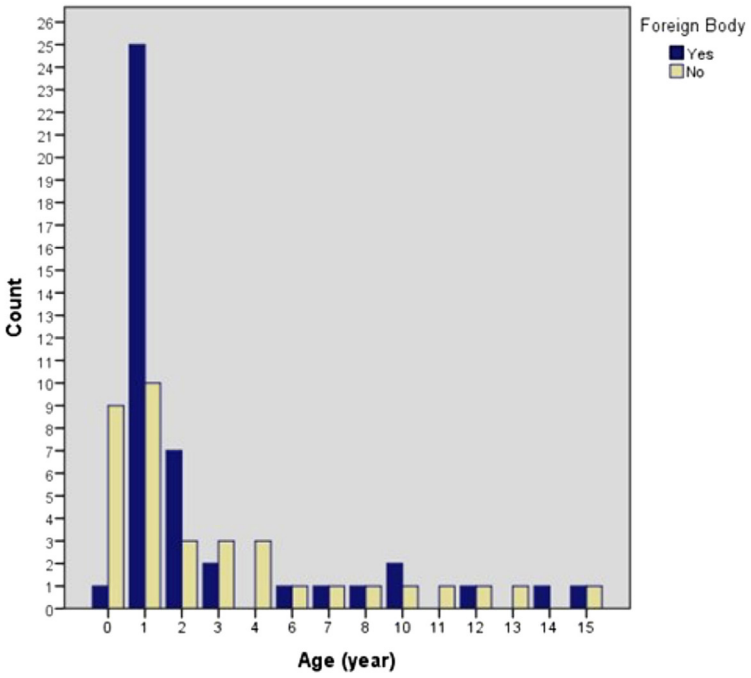

Figure 3: Age distribution graph of foreign body aspirations

We found that FBA of organic origin was significantly higher in preschool age compared to post-school age (p=0.004). The median time between aspiration and interventional procedure was 8 (min: 5 - max: 45) and 2 (min: 0 - max: 61) days in FBA cases with and without granulation tissue development, respectively. We found that those with granulation tissue development had a significantly longer median time (p=0.002).

Table 2. Characteristics of the Foreign Body

Parameters	Suspected Foreign Body Aspiration
	Number n (%)
Type of Foreign Body	
Nut	25 (%58,1)
Food	10 (%16,3)
Tooth	2 (%4,7)
Apple	1 (%2,3)
Plastic piece	1 (%2,3)
Screw	1 (%2,3)
Thumbtack	1 (%2,3)
Stone	1 (%2,3)
Pen cap	1 (%2,3)
Location	
Trachea	3 (%7)
Right	16 (%37,2)
Left	21 (%48,8)
Bilateral	3 (%7)

DISCUSSION

Anamnesis and bronchoscopy are the most important tools in FBA. FBA may cause a wide range of respiratory symptoms, from coughs to severe respiratory distress, and it may be completely asymptomatic. In addition, no radiological findings may be observed. Therefore, bronchoscopy is recommended in patients with suspected FBA even if physical examination and radiology are completely normal (2, 3, 4). In our clinical approach, we recommend bronchoscopy in all patients regardless of physical examination and radiological findings in case of suspicion in the anamnesis. FOB is performed under a laryngeal mask and low-dose anesthesia in order to confirm the diagnosis, and the procedure is terminated in cases in which no foreign body is detected within a few minutes. In our clinic, we found that 2.5% of the patients with foreign bodies were asymptomatic; 2.5% were both asymptomatic and had no physical examination or radiological findings.

Some studies have focused on scoring studies to avoid bronchoscopy in all patients, and negative findings on bronchoscopy have been shown in the literature to be 14-47% (3, 5). In our study, this rate was 45.6%. However, similar to the literature, in our study we did not observe any complications in patients in whom no foreign body was observed and in whom only rapid FOB was performed; therefore, we adopted the principle of bronchoscopy as an approach in cases of clinical suspicion.

In patients with suspected FBA, granulation tissue development due to inflammation within 48 hours and delayed procedures (>3 days) increase the risk of complications. Therefore, delaying the procedure is not recommended in patients with suspected FBA (3, 6-9). In our study, when evaluating the development of granulation tissue among patients, it was found that patients with granulation tissue developed had significantly later procedures. Although the results are similar to the literature, in our clinical approach, if the patients are stable at the time of admission, we choose to perform the procedure on the first day of the next working shift and under conditions where the anesthesia, pediatric intensive care unit, and the whole experienced team of our clinic are present in the hospital in order to minimize complications.

In the literature, complications range from incomplete removal of the foreign body and subsequent repeat bronchoscopy to laryngospasm and associated mortality or hypoxic brain damage (6). The complication rate varies between clinics with rates ranging from 2-15% (2, 3, 10). In our study, no mortality was observed. Laryngospasm was observed in two patients, one of whom had a completely normal follow-up after intubation, while one patient had respiratory and cardiac arrest on the operating table and was resuscitated. Ischemic foci were observed on cranial imaging during ICU follow-up, and the patient was discharged clinically normal after follow-up. At the 3-month follow-up after discharge, the patient continued to be monitored with age-appropriate developmental characteristics and no neurological findings were observed. In one patient, the aspirated foreign body was wrapped with granulation tissue in the distal bronchus and was not removed to avoid complications; surgery was decided. Preoperative chest X-ray of this patient revealed pneumothorax. However, no additional intervention was performed as surgery was planned. In the other patient, a tube thoracostomy was performed, and the lungs were subsequently observed to be fully expanded. No further interventions were required.

Radiological findings in FBA can generally be parallel to physical examination findings. However, particularly in non-occlusive lesions, radiological findings may be absent in 10-50% of cases, while physical examination findings such as wheezing and rhonchi may be present. The rate of radiological findings is high with radiopaque foreign bodies. In the pediatric age group, the foreign body type is predominantly organic. In FBA consisting of organic bodies, the rate of radiological findings directly related to the foreign body is quite low, and parenchymal findings secondary to the foreign body are observed. The literature describes air trapping, atelectasis, infiltration, and pneumonia as the most common radiological findings, particularly in delayed cases (3, 11-18). In our study, 83.7% of foreign bodies were organic, and the most common radiological finding was air trapping (Figure 2). In addition, radiological findings were completely normal in 48.1% of cases.

Although FBA is observed in all pediatric age groups, the literature has shown that FBA is particularly common in the 1-3 year age group and in males. In the literature, the higher incidence in males is thought to be due to both the greater activity levels of boys and the faster developmental growth of girls during early childhood. (1, 11, 13, 19, 20). In our study, a wide range of pediatric patients aged between 4 months and 15 years were eval-

uated, and 74% of these patients were children aged 1-3 years. Similar to the literature, the majority of patients were male.

When the foreign body localization is examined, it is observed that foreign bodies are predominantly localized on the right in the adult age group due to the anatomical structure. However, there are also left-main bronchus-dominant FBA studies in the literature, especially in children because the anatomical angulation difference is not yet fully established (2, 11, 18, 21). However, especially FBAs localized in the trachea are more important in terms of mortality and have a higher life-threatening risk (18). In our study, when FBAs were evaluated in terms of location, it was observed that the location was left dominant. Furthermore, we observed the foreign body at the level of the trachea in 7% of cases.

The value of our study is that the data from an experienced and frequently performed FBA intervention center in the province and throughout the country shows that this procedure can be performed with a very low complication rate in competent hands.

The limitation of our study is that variables such as the time of FBA aspiration may introduce a margin of error due to its retrospective design. In addition, although most of the children were asymptomatic at the time of evaluation, the rate of symptomatic patients is likely to be high because the symptom reported at the first suspicion of aspiration was accepted, as the records were evaluated retrospectively.

In conclusion, FBAs are time-sensitive cases due to the formation of granulation tissue over time and the presence of associated complications. FBA is an important health problem in childhood and can cause morbidity and mortality. However, there is a perception that FBA is underestimated in clinical practice, although it is not uncommon. There is a perceived need to diversify the centers performing procedures for FBA and to perform procedures in multiple centers to prevent complications. Increasing the number of centers performing procedures and using them as a basis for specialist training will be beneficial in preventing one of the health problems.

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Abbreviations list

FBA: Foreign body aspiration
LMA: laryngeal mask airway
TIVA: total intravenous anesthesia

Ethics approval and consent to participate

Local ethical committee approval (AEŞH-BADEK-2024-1264) was taken from Ankara Etlik City Hospital Ethical Commitee and the study was conducted in accordance with the Helsinki Declaration of Human Rights before the study.

Consent for publication

Informed consent was obtained from the legal guardians of patients under the age of 18 for the anonymous use of their data.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

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