

Research Paper

Investigating the Location and Types of Aspirated Foreign Bodies in the Airway of Hospitalized Patients



Reza Samareei^{1*}, Ali Mohammadpour¹

1. Department of Otorhinolaryngology and Head Neck Surgery, School of Medicine, Urmia University of Medical Sciences, Urmia, Iran.

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ABSTRACT

Objectives: Foreign body aspirations (FBAs) comprise the majority of accidental childhood deaths. The present study aimed to investigate the location and types of aspirated foreign bodies in hospitalized patients' airways.

Methods: In this cross-sectional study, the medical records of all consecutive patients with a primary diagnosis of FBA were reviewed retrospectively from 2019 to 2022. We extracted demographic profile (age and gender), type of aspirated foreign body, clinical manifestation at the time of presentation, clinical signs according to physical examination, and the time duration between presentation to hospital and removal of aspirated foreign body.

Results: Of 101 patients, 65 were male, and most were under 4 years old. Nuts (53.5%) and organic bits (30.7%) were the most common aspirated foreign bodies. The bronchus (69.4%) was the most common location of aspirated foreign bodies. Most of the organic pieces (96.8%) and nuts (87%) were seen in the age group below 4 years old and also most of the cases of plastic pieces were related to children aged 4 to 18 years ($P<0.001$). Cough and shortness of breath (68.3%) were the most common clinical complaints. Most patients with FBA in the trachea (65%) and bronchus (74%) had a normal clinical examination and a significant difference was observed between the clinical signs and location of the foreign body ($P<0.001$). Fifty-four patients (53.5%) underwent foreign body intervention and removal less than 24 hours after aspiration.

Discussion: A high frequency of FBA in children, especially in infants and toddlers, is due to starting feeding. It is very important to consider the differences in the types and locations of the aspirated object. Therefore, early rigid bronchoscopy is effective for inhaled foreign body removal with fewer complications.

* Corresponding Author:
Reza Samareei, Professor.
Address: Department of Otorhinolaryngology and Head Neck Surgery, School of Medicine, Urmia University of Medical Sciences, Urmia, Iran.
Tel: +98 (912) 1481868
E-mail: samareireza@gmail.com

Introduction

Foreign body aspiration (FBA) is a relatively rare yet potentially life-threatening occurrence, constituting 0.16-0.33% of adult bronchoscopy procedures [1]. While accidental aspiration is higher among children, adults account for as much as 25% of reported cases [2]. Adults with FBA typically experience a sudden choking episode followed by persistent coughing. However, in some cases, the initial incident may go unnoticed, leading to the misdiagnosis of chronic ailments such as chronic obstructive pulmonary disease, asthma, or obstructive pneumonia, particularly among older patients exhibiting altered mental status [3]. According to the [National Safety Council](#), the fatality rate due to choking among children under five years old within the general population was 0.43 per 100000 in 2016 [4]. Nonetheless, a separate study examining non-fatal choking incidents in children below the age of 14 revealed a notably higher rate of 20.4 per 100000 individuals [5]. Among these nonfatal cases, 55.2% involved ingesting candy, while hot dogs and nuts were more likely to necessitate hospitalization [6].

Delayed identification of retained FBAs can result in recurring pneumonia, bronchiectasis, recurrent hemoptysis, pneumothorax, lung abscesses, pneumomediastinum, and other complications [7]. It is crucial to promptly remove aspirated FBAs to alleviate acute symptoms and prevent long-term complications. These aspirated objects are typically small, round items like nuts, candy, popcorn, beans, and even small toy parts [8]. The act of swallowing FBAs may exhibit no symptoms or be accompanied by choking, difficulty swallowing, vomiting, and dark stool [9]. The immediate aftermath of solid or semisolid objects entering the airway involves intense coughing, choking and retching; furthermore, larger FBAs can cause total airway obstruction, asphyxiation, and swift fatality [10].

The patient's medical history is valuable in assessing individuals suspected of FBA [11]. In children, there is a higher occurrence of the well-known "penetration syndrome," characterized by a choking incident followed by an uncontrollable cough, compared to adults [12]. However, adult patients have varied recollections of FBA across multiple studies, with an unexpectedly low average of approximately 50% [1, 13]. Specifically, patients aged 65 years or older are even less likely to remember the aspiration event, with only 30% providing a consistent history of aspiration before bronchoscopy [3]. Consequently, all children with a history of FBA should

undergo radiographic examinations of the neck, chest, and abdomen [9]. Radiolucent objects necessitate direct visualization or contrast radiographs. If imaging studies yield negative results but there is a high suspicion of aspiration, bronchoscopy should be promptly performed [14].

After meticulously evaluating the obtainable evidence about clinical observations, anatomical placement, and composition of aspirated substances across diverse geographical regions, along with the absence of a similar investigation within the province, we decided to undertake the current inquiry. The primary objective of our study is to examine the precise locations and foreign body types that have been aspirated into the respiratory tracts of patients receiving inpatient care at [Urmia Imam Khomeini Hospital](#), Urmia City, Iran.

Materials and Methods

In this cross-sectional study, the medical records of all consecutive patients with a primary diagnosis of FBA in [Imam Khomeini Hospital](#) in Urmia, Iran, were reviewed retrospectively from 2019 to 2022. We extracted and analyzed the following information from the medical records: Demographic profile (age and gender), type of aspirated foreign body, clinical manifestation at the time of presentation, clinical signs according to physical examination, the time duration between presentation to hospital, and removal of aspirated foreign body. Physical examination and radiological findings were noted during the presentation. Bronchoscopy findings were also tabulated. The final result and complications were documented. Cases with incomplete records were excluded from the study. All patients underwent elective or emergent rigid bronchoscopy for aspiration, foreign body imaging, and chronic cough. After removing the aspirated material, patients were monitored for adverse events.

Statistical analysis

Data were analyzed using SPSS software, version 21. Quantitative variables were analyzed using Mean $\pm$ SD, and frequency and percentage were calculated for qualitative variables. Also, statistical tables and graphs were used as needed to display the data. To investigate the relationship between different qualitative parameters, the chi-square test was used at a significance level of $P < 0.05$.

Results

According to the primary statistics from the archives of Imam Khomeini Hospital in Urmia, 125 patients were hospitalized with the initial diagnosis of FBA for 4 years from 2019 to 2022. During the initial examination, 24 patients were excluded due to their foreign bodies in the esophagus and underwent endoscopy. Finally, 101 patients were examined.

As Table 1 shows, nuts (54 cases, 53.5%) were the most common aspirated foreign bodies, followed by organic pieces (31 cases, 30.7%). The right and left bronchus were also the most common locations of aspirated foreign bodies, with a frequency of 45 cases (44.6%) and 25(24.8%), respectively, followed by the trachea (20, 19.8%). Also, all the cases with unspecified aspiration sites (spread in the airways) were of nut types. All bone and metal items were also located in the chip.

Of 101 investigated patients, 65(64.3%) were male, and 36 cases (35.6%) were female. Also, 83(82.1%) were under 4 years old (infants and toddlers), 10 cases (9.9%) were between 4 and 18 years old, and 8 cases (7.9%) were adults, ranging from 36 days to 35 years. As Table 2 shows, there is no significant relationship between the gender (P=0.088) and age (P=0.168) of the patient with the location of FBA.

According to Table 3, there was no significant relationship between gender and the type of aspirated foreign body types (P=0.303). Most of the organic parts (96.8%) and nuts (87%) were seen in the age group >4 years old, and also most of the plastic pieces in children between 4 and 18 years old. According to the chi-square test results, the aspirated foreign body types have a significant relationship with the age group of the patients (P<0.001).

The most common clinical complaints of patients with FBA at the time of presentation were cough and shortness of breath in 69 cases (68.3%); most of them (52

Table 1. Frequency and type of aspirated foreign bodies based on their locations

Foreign Body	No. (%)	No.				
		Trachea	Right Bronchus	Left Bronchus	Bronchioles	Not Specified
Nuts*	54(53.5)	7	27	15	0	5
Bone fragments	1(0.9)	1	0	0	0	0
Organic pieces**	31(30.7)	4	13	8	6	0
Metal pieces	5(4.9)	3	0	2	0	0
Plastic pieces	10(9.9)	5	5	0	0	0
Total (No. [%])	101(100)	20(19.8)	45(44.6)	25(24.8)	6(5.8)	5(4.9)

*Sunflower seeds, walnuts, almonds and pistachios, **Pieces of vegetables, carrots, fruit peel and bread.

Table 2. Patients' demographic features and frequency of the foreign body locations according to gender and age groups

Variables		No. (%)					P*
		Total	Trachea	Bronchus	Bronchioles	Not Specified	
Gender	Male	65(64.3)	17(85)	43(61.4)	2(33.3)	3(60)	0.088
	Female	36(35.6)	3(15)	27(38.6)	4(66.7)	2(40)	
Age (y)	<4	83(82.1)	13(65)	61(87.2)	5(83.3)	4(80)	0.168
	4-18	10(9.9)	5(25)	4(5.7)	1(12.7)	0	
	>18	8(7.9)	2(10)	5(7.1)	0	1(20)	

*Chi-square test.

Table 3. Frequency of the foreign body types according to gender and age groups

Variables		No. (%)					P [#]
		Nuts*	Bone Fragments	Organic Parts**	Metal Pieces	Plastic Pieces	
Gender	Male	38(70.4)	0	20(64.5)	2(40)	5(50)	0.303
	Female	16(29.6)	1(100)	11(35.5)	3(60)	5(50)	
Age (y)	<4	47(87)	1(100)	30(96.8)	3(60)	2(20)	0.001
	4–18	2(3.7)	0	1(3.2)	0	7(70)	
	>18	5(9.3)	0	0	2(40)	1(10)	

[#]Chi-squared test, *Sunflower seeds, walnuts, almonds and pistachios, **Pieces of vegetables, carrots, fruit peel and bread.

cases) had FBA in the bronchus, and nausea and vomiting in 11 cases (10.9%). According to Table 3, there was no significant difference between the clinical symptoms and the location of FBA (P=0.25) (Table 4).

According to physical examination (Table 5), 74.3% of the patients had no clinical findings, 18.8% reported wheezing and 9.8% stridor. As Table 5 reports, there was a significant difference between the clinical signs and the location of the foreign body (P<0.001). Most patients with FBA in the trachea (65%) and bronchus (74%) had a normal clinical examination. At the same time, the cases related to the bronchiole region were often accompanied by one clinical sign.

Fifty-four patients (53.5%) received prompt medical attention for foreign body intervention and subsequent removal within less than 24 hours following aspiration. Twelve cases (11.9%) sought medical intervention within 24-48 hours, and 35 cases (34.7%) beyond 48 hours after presentation. As outlined in Table 6, 70% of plastic cases were successfully treated within the initial 24-hour window. Similar results were observed for nuts and organic fragments, whereby treatment was successfully administered within the first 24 hours. However, it is essential to note that the difference between foreign body types was statistically significant (P=0.258).

Discussion

Delayed or missed diagnosis of FBA can result in significant morbidity. Children, particularly those between the ages of 12 months and 3 years, are at risk for mortality from this condition [15]. A recent study of 101 children found that the highest incidence of foreign-body aspiration occurred in those under 4 years old, which aligns with findings in the existing literature [16-18]. Previous studies have indicated that the first three years of life pose the greatest risk for foreign-body aspiration [19, 20]. In our study, boys had a higher incidence of foreign-body aspiration than girls; however, this gender difference was not statistically significant. Other researchers have reported similar results [21, 22], suggesting that boys in Iran may exhibit more adventurous and playful behaviors than girls.

Based on the findings of the current investigation, the most frequently encountered foreign bodies that are accidentally inhaled are nuts and organic material, specifically fruit skin. These results corroborate a previous study, which found that organic pieces and nuts were the most commonly aspirated objects, while bone fragments had a lower occurrence [23]. However, another study conducted by Budhiraja et al. observed a higher frequency of bone fragments compared to other aspirated objects [24].

Table 4. Clinical manifestations at time of presentation and their associations with FBA location

Variables	No. (%)	Trachea	Bronchus	Bronchioles	Not Specified	P*
Cough and shortness of breath	69(68.3)	10	52	4	3	0.25
Nausea and vomiting	11(10.9)	4	4	1	2	
Pain	10(9.9)	2	2	0	0	
Voice change	4	1	3	1	0	

*Chi-squared test.

Table 5. The clinical signs of patients with FBA based on their locations according to physical examination

Aspirated Foreign Body Location	No. (%)				P*
	Clinical Signs According to Physical Examination				
	Normal Findings	Wheezing	Stridor	Decreased Breathing Sound	
Trachea	13(65)	2(10)	5(25)	0	<0.001
Bronchus	52(74.3)	15(21.4)	3(4.3)	0	
Bronchioles	1(16.7)	2(3.3)	1(16.7)	2(3.3)	
Not specified	5(100)	0	0	0	

*Chi-squared test.

In developed nations, plastic toy parts and metal pieces are the most frequently inhaled objects [25]. Following the findings of this study, it was observed that the nature of the foreign object is significantly associated with the age group of the patients. Specifically, most organic pieces and nuts were found in patients under the age of 4, whereas plastic pieces like whistles or fragments of toys were more prevalent. This observation is consistent with the study conducted by Na'ara et al. where they also observed a higher incidence of aspirated cases involving organic pieces and nuts in children [26]. Corroborating these findings, multiple other studies have underscored the significance of aspiration of small organic objects such as sunflower seeds, walnuts, almonds, bread pieces, and fruit skins in children aged between 2 and 4 years [27-29]. It is worth noting that this age range is crucial as children begin to eat solid food. Simultaneously, the child can manipulate and engage with the food in their vicinity, increasing the risk of FBA.

Based on the findings of the current investigation, it is determined that patients commonly experience coughing

and pain as clinical symptoms. Substantial evidence indicates a correlation between the age group and the type and location of the aspirated foreign body, influencing the symptoms and clinical observations. This finding aligns with a study conducted by Na'ara et al. [26], where coughing was also reported as the prevalent clinical complaint in children who aspirated organic fragments and nuts predominantly in the distal regions.

The current study revealed that the bronchi and trachea were the primary sites where foreign bodies were aspirated. The findings of this study demonstrate a significant correlation between age groups, the type of aspirated object, and its location. This observation aligns with the study conducted by Safari et al., which identified the bronchi and bronchioles as the primary sites of FBA in children [29]. Additionally, some studies suggest that the pharynx and piriform sinus area should also be considered potential aspiration sites. Lin et al.'s study focused on FBA in adults. It showed that bone fragments, the pharyngeal region, the root of the tongue, and the piriform sinus were commonly involved [30]. The varia-

Table 6. Time duration between presentation to hospital and removal of aspirated foreign body

Variables	No. (%)			P*
	Time Duration			
	<24 h	24-48 h	>48 h	
Nuts	27(50)	5(9.3)	22(40.7)	0.258
Bone fragments	1(100)	0	0	
Organic pieces	16(51.6)	3(9.7)	12(38.7)	
Metal pieces	3(60)	4(40)	0	
Plastic pieces	7(70)	2(20)	1(10)	

*Chi-squared test.

tion in aspirated substances and their locations among different age groups requires distinct approaches. Adult patients suspected of FBA would primarily benefit from laryngoscopy, while bronchoscopy is generally recommended for children with FBA [31].

This research study reveals that 70% of plastic cases were treated within less than 24 hours, while nuts and organic pieces were also treated within the same duration after presentation. However, it is worth noting that this difference was not statistically significant. To some extent, the rate of delayed diagnosis in our local area was relatively low compared to the rates reported in other Asian studies, which stood at 17% to 23% [32, 33]. One potential explanation for this delayed diagnosis is that parents lacked awareness regarding the importance of identifying signs and symptoms, such as coughing and choking. Since children typically do not exhibit severe symptoms immediately following a choking incident, parents may fail to seek medical assistance until persistent symptoms like coughing and fever manifest.

In the current investigation, the physical examination of 70.3% of children with FBA exhibited no anomalies. The prevalence of normal physical findings in cases of FBA was remarkably high, which could be attributed to insufficient documentation by the attending physician. Wheezing and stridor were the primary observations detected during the physical examination of patients with FBA, which aligns with the scientific literature [34]. In situations where the likelihood of FBA cannot be ruled out based on the patient's history, physical examination, and radiological assessment, bronchoscopy should be employed as both a diagnostic tool and a treatment method [35]. Within our study, bronchoscopy was conducted on 102 suspected cases of FBA, resulting in no deaths or requirement for thoracotomy. Physicians must consider performing bronchoscopy when uncertain about the presence or absence of an aspirated FB in the tracheobronchial tract, as it ensures a definitive diagnosis [36].

There were some limitations to this study. The first is its retrospective design and inadequate sample size. Childhood aspiration of foreign bodies is preventable, and there is a need for greater focus on prevention strategies through community education and raising awareness. It has been reported that FBA incidence can be reduced by 35% with public health education programs [37].

Conclusion

The increased occurrence of foreign body inhalation in children, particularly in infants and toddlers, can be attributed to the introduction of feeding. Furthermore, the findings of this study indicate variations in the types and locations of the aspirated objects, as well as the initial clinical symptoms, depending on the age group of the patients. Consequently, it is crucial to consider the patients' age during initial management. Therefore, the early utilization of rigid bronchoscopy proves to be a highly effective procedure for removing inhaled foreign bodies with fewer complications. Although the mortality rate from FBA is low, collaboration among pediatricians, radiologists, and ENT specialists is necessary for prompt diagnosis and treatment.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Ethics Committee of [Urmia University of Medical Sciences](#) (Code: IR.UMSU.REC.1401.006). This study followed the principles of the Declaration of Helsinki.

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Authors' contributions

Conceptualization: Reza Samarei and Ali Mohammadpour; Investigation, data analysis and writing: Reza Samarei; Supervision and project administration: Ali Mohammadpour.

Conflict of interest

The authors declared no conflict of interest.

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