

## Analysis of Outcomes of Early and Late Management of Inhaled Foreign Bodies

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### ABSTRACT

**Background:** There is a high danger of foreign body aspiration (F.B.A.) since children put everything they find in their mouths. Children's tiny airways and undeveloped defensive mechanisms likely contribute to their higher rates of morbidity and deaths.

**Objective:** Improving outcomes of patients with history of inhaled foreign body (F.B.).

**Patients and Methods:** We conducted a prospective cohort study on 90 cases suffered from foreign body inhalation (early or late management) in Cardio-thoracic Surgery Department, Zagazig University Hospitals.

**Results:** We found 76.7 % of cases between age one and three years, 13.3 % of cases with age between three and ten years and 10% of the study sample had age more than ten years. 67.8% of the cases were males and 32.2% of them were females. As regard residence we reported that 65.6 % of cases were living in rural areas and 34.4% of them were living in urban areas

**Conclusion:** The timing of management of inhaled foreign bodies in children, whether early or late, can impact the clinical features and outcomes. Early management of inhaled foreign bodies tend to present acutely with choking and respiratory distress, while late management of inhaled foreign bodies may have more subtle and chronic respiratory symptoms. Prompt diagnosis and management are crucial in both cases to prevent complications and achieve favorable outcomes.

**Keywords:** Inhaled foreign bodies, Foreign body aspiration, Outcomes.

### INTRODUCTION

A foreign body aspiration (F.B.A.) is a medical emergency that can happen to anyone, but is more common in youngsters. Patients may exhibit no symptoms, experience a choking episode or coughing spells accompanied by inspiratory stridor, or exhibit mild or chronic nonspecific symptoms (sputum, dyspnea, wheezes as well as cough) that are easily confused with those of other lung disorders. Foreign body aspiration (F.B.A.) should be evaluated in cases of subacute and chronic respiratory infections, asthmatic form syndrome, hemoptysis, pulmonary abscesses, localized bronchiectasis, and when a lung malignancy is suspected <sup>(1)</sup>.

Chest radiography (CXR) is the first test for foreign body aspiration, despite its low diagnostic value (sensitivity of 28-60%; specificity of 68%). Foreign body aspiration (F.B.A.) might go undiagnosed for months, or even years, increasing the risk of problems if the patient does not recall the aspiration incident. A bronchoscopy is necessary to remove a foreign body when F.B.A. is detected <sup>(2)</sup>.

Foreign body aspiration, choking, pneumonia, dyspnea after trauma, and cardiorespiratory arrest are all situations in which bronchoscopy may be helpful and should be evaluated. CXRs were aberrant in cases where a foreign body (F.B.) was seen, where there was condensation, or where there was atelectasis <sup>(3)</sup>.

Whether a rigid or flexible bronchoscopy is preferable when foreign body aspiration (F.B.A.) is suspected is still up for dispute. Because of its high success rate and low risk of side effects, rigid bronchoscopy is the management of choice <sup>(4)</sup>.

Since the right main bronchus is vertical, it is not surprising that the bulk of foreign bodies (F.B.) were

located in the right bronchial tree. Increased airflow, a bigger internal diameter, and positioning of the carina to the left of the tracheal midline all contribute to the trachea's status as the main airway <sup>(5)</sup>.

We aimed in this study at improving outcomes of patients with history of inhaled foreign body (F.B.).

### SUBJECTS AND METHODS

This study was conducted in Cardio-thoracic Surgery Department, Zagazig University Hospitals. Total cases; (90) cases were included as a comprehensive sample. Patients were complaining of signs and symptoms of inhaled foreign body (F.B.).

#### Patients were divided into 2 groups:

- 1<sup>st</sup> group: included symptomatized patients with history of inhaled foreign body (F.B.) less than week by close relatives.
- 2<sup>nd</sup> group: included symptomatized patients with vague history of inhaled foreign body (F.B.) more than week.

#### Inclusion criteria:

Patients with sure history of foreign body aspiration, vague history of foreign body aspiration but with repeated chest infection, vague history of foreign body aspiration but representing with pneumonia not responding to medical treatment according to culture and sensitivity, radiological abnormalities linked with foreign body aspiration, which are most commonly radiolucent foreign bodies, unilateral emphysema (hyperinflation), or atelectasis, and patients with unclear history of foreign body aspiration.

**Exclusion criteria:** Unstable patients as hypoxic, arrested or ventilated.

**All patients were subjected to:**

**1. Complete history taking:**

- Name, age, sex, occupation, residence.

**2. General and local examination:**

- Vital signs, general look and especially local chest examination.
- Inspection of any chest wall motion abnormalities.
- Palpitation if there was any doubt of motion abnormalities.
- Percussion of all lung zones.
- Auscultation, which was very important.

**3. Radiographic assessment:**

- A non-varying lung capacity throughout the breathing cycle is diagnostic of an inhaled foreign body.
- Plain radiograph (X-ray).
- Unilateral emphysema or atelectasis, characterised by overinflation and hyperlucency, flaring of the ipsilateral rib cage, and depression of the ipsilateral hemidiaphragm (interrupted bronchus sign) were the most prevalent findings; radiopaque foreign bodies were extremely rare.

**4. Laboratory studies:**

- CBC, inflammatory markers, KFT, LFT, as preparation for surgery.

**Post-operative and Meticulous follow up (3 months):**

*Both study groups were then followed up in early and late post-bronchoscope course. Data were collected concerning:*

- Complications of foreign body aspiration.
- Complications of early or late bronchoscope.
- Symptoms and signs improved or not.
- Post procedure stay in hospital.

**Ethical approval:**

**This experiment was ethically approved by the Faculty of Medicine, Zagazig University. After being fully informed, all the caregivers of the participants provided written consent. The study was conducted out in line with the Helsinki Declaration.**

**Statistical analysis**

Statistics were calculated by IBM SPSS, Windows Edition, Version 23.0. IBM Corp., Armonk, New Qualitative data were presented as frequency and percentage and were compared by Chi-square test. A p-value less than 0.05 was considered significant.

**RESULTS**

We found most of the patients were males, between one and three years old, and were living in rural areas (Table 1).

**Table (1): Demographics of studied cases**

Study population	N=90	100%
<b>Age</b>	<b>N</b>	<b>%</b>
1–3 years	69	76.7
3–10 years	12	13.3
> 10 years	9	10
<b>Gender</b>		
Male	61	67.8
Female	29	32.2
<b>Residence</b>		
Rural	59	65.6
Urban	31	34.4

Among the study cases we found that the most common inhaled foreign bodies were vegetables and metal coins (Table 2).

**Table (2): Type of foreign bodies distribution among the study population**

Type of foreign bodies	n = 90	%
vegetable	38	42.2
peanut	11	12.2
Metal coin	20	22.2
needle	10	11.2
Grape seed	11	12.2

After respiratory examination by bronchoscopy, the most common finding was diminished air entry on right side (Table 3).

**Table (3): Respiratory examination of the study population**

Location on the basis of bronchoscopy	Respiratory examination	n = 90	%
<b>Left bronchus</b>			
Decreased left sided chest movements		23	26%
Diminished air entry on left side		42	47%
Diminished air entry on right side		4	5%
	Rhonchi	32	36%
	Crepitus	28	31%
<b>Right bronchus</b>			
Decreased right sided chest movements		4	5%
Diminished air entry on right side		58	64%
Diminished air entry on left side		4	5%
	Rhonchi	42	47%
	Crepitus	15	17%

After radiological findings by X-ray, we found that 42% of cases' X-ray showed left sided FB and 41% of cases' X-ray showed right sided FB (Table 4).

**Table (4): Radiological examination of the study population**

Location on the basis of bronchoscopy	Radiological findings (x ray)	n = 90	%
<b>Left bronchus</b>	X ray performed	90	100%
<b>Left sided FB on X-Ray</b>		38	42%
<b>Left lung collapse</b>		19	21%
<b>Mediastinal shift to left</b>		4	5%
<b>Mediastinal shift to right</b>		4	5%
<b>Right bronchus</b>	X ray performed	90	100%
<b>Right sided FB on X-Ray</b>		37	41%
<b>Right lung collapse</b>		15	17%
<b>Mediastinal shift to right</b>		5	6%
<b>Mediastinal shift to left</b>		10	11%
<b>Pericardial pneumonitis</b>		10	11%

Among the study population, 49% of them reported fever and 48% of them reported tachycardia (Table 5).

**Table (5): Clinical features of the study population**

Clinical features	n = 90	%
<b>Fever</b>	44	49
<b>Tachycardia</b>	43	48
<b>Wheeze</b>	40	44
<b>Wet cough</b>	33	37
<b>Dry cough</b>	30	33
<b>Dyspnea</b>	26	29
<b>Choking</b>	5	6
<b>Post tussive vomiting</b>	25	28
<b>Chest indrawing</b>	13	14

In our study population, the majority of the patients reported symptoms after one week (Table 6).

**Table (6): How long it takes for a patient to go from experiencing a symptom to checking into a hospital**

	n = 90	%
<b>Within 24 h.</b>	22	24
<b>1 day to 1 week</b>	20	22
<b>1 week to 1 month</b>	24	27
<b>&gt; 1 month</b>	24	27

There was significant difference between early and late management of inhaled foreign bodies regarding clinical features (Table 7).

**Table (7): Comparison between early and late management of inhaled foreign bodies regarding clinical features**

Clinical features	Early (41)	Late (49)	X <sup>2</sup>	P value
<b>Fever</b>	39	10	60.874	<0.001
<b>Tachycardia</b>	40	8		
<b>Wheeze</b>	30	14		
<b>Wet cough</b>	23	14		
<b>Dry cough</b>	4	29		
<b>Dyspnea</b>	14	15		
<b>Choking</b>	4	2		
<b>Post tussive vomiting</b>	13	15		
<b>Chest indrawing</b>	4	10		

**DISCUSSION**

Inhaling a foreign body can cause a variety of unpleasant symptoms, including coughing, choking, severe dyspnea, and the quick beginning of wheezing. It may be obvious clinically, but even if a foreign body is still there, the symptoms may go away on their own or within a short period of time. The radiographic manifestations of a foreign body are conditional on its size, location, duration, and character. Several other results, including air trapping, atelectasis, consolidation, and bilateral overaeration can be seen on a chest X-ray (6).

Recurrent pulmonary infections, atelectasis, and bronchiectasis are all major complications that can develop after a foreign body is aspirated into the lungs. These consequences can be avoided with timely foreign body diagnosis and removal. Bronchoscopy is frequently performed for both definitive diagnosis and therapy due to the risks of undetected foreign body aspiration, even when there is a minor suspicion or uncertain history. Despite the common belief that bronchoscopy on children is straightforward and risk-free, even in skilled practitioners' hands, major complications can arise (7).

We aimed to assess the more suitable and beneficial solution of early intervention in patients with history of inhaled foreign body (F.B.).

We conducted a prospective cohort study on 90 cases suffered from foreign body inhalation (early or late management) in Cardio-thoracic Surgery Department, Zagazig University Hospitals. We found 76.7 % of cases between age one to three years, 13.3 % of cases with age between thee to ten years and 10% of the study sample with age more than ten years. 67.8% of the cases were males and 32.2% of them were females. As regard residence we reported that 65.6 % of cases were living in rural areas and 34.4% of them were living in urban areas.

**Korlacki et al.** (8) hoped-for evaluation of bronchoscopy's diagnostic and therapeutic value in children with possible foreign body aspiration. 19

(67.85%) of the children with aspiration of a foreign body were between the ages of 1 and 5, 6 (21.42%) were between the ages of 6 and 12, and 3 were older than 12 years old (10.71%). Also, in terms of demographic data, studies have shown that inhaled foreign bodies can occur in a wide age range, but are more commonly seen in children, especially in those aged 1-3 years, due to their exploratory behavior and tendency to put objects in their mouths <sup>(9)</sup>.

Among the study cases we found the most common inhaled foreign bodies were vegetables (42.2%), metal coin was found in 22.2% of cases, grape seed and peanut were revealed in 12.2%, but 11.2% of the cases inhaled needles.

**Korlacki et al.** <sup>(8)</sup> aimed at assessment of bronchoscopy usefulness for diagnosis and treatment in children suspected of foreign body aspiration. They reported that among the aspirated foreign bodies, 75% (21 cases) of them were organic, while the remaining 25% (seven cases) were inorganic.

One study conducted by **Baharloo et al.** <sup>(10)</sup> examined 1,000 cases of inhaled foreign bodies in children and found that the most common types of foreign bodies were organic materials, such as peanuts, followed by plastic objects, including beads and toy parts <sup>(10)</sup>. The outcomes of these cases varied depending on the type of foreign body. Organic materials, being biodegradable, were found to cause less severe complications, such as localized inflammation and infection, as they tended to disintegrate over time. On the other hand, plastic objects were associated with a higher risk of complications, including airway obstruction, pneumonia, and lung abscess, due to their non-biodegradable nature and potential for migration to distant airways or lung tissue <sup>(10)</sup>.

Another study conducted by **Bandyopadhyay et al.** <sup>(3)</sup> also found similar results, with organic materials, particularly peanuts, being the most common foreign bodies inhaled by children. The study reported that peanuts were associated with a higher risk of complications, such as respiratory distress, pneumonia, and bronchiectasis, due to their tendency to swell and obstruct the airways

After respiratory examination by bronchoscopy, in left bronchus we found 26% of cases had decreased left sided chest movements, 47% reported decreased air entry on left side, 5% revealed decreased air entry on right side, 36% reported respiratory rhonchi and 31% revealed respiratory crepitus. In right bronchus we found 5% of cases had decreased left sided chest movements, 64% reported decreased air entry on left side, 5% revealed decreased air entry on right side, 42% reported respiratory rhonchi and 15% revealed respiratory crepitus.

After radiological findings by X-ray, in left bronchus we found 42% of cases' X-ray showed left sided FB, 21% reported left lung collapse, 5% revealed mediastinal shift to left, and 5% reported mediastinal shift to right. In right bronchus we found 41% of cases'

X-ray showed right sided FB, 21% reported right lung collapse, 6% revealed mediastinal shift to right, 11% reported mediastinal shift to left and 11% reported pericardial pneumonitis.

A retrospective study conducted by **Smith et al.** <sup>(11)</sup> evaluated the radiological findings of inhaled foreign bodies in children using X-ray imaging of the left and right bronchial tree. The study included 150 pediatric patients who presented with suspected foreign body aspiration and underwent X-ray imaging of the chest. The radiological findings were analyzed and correlated with the final diagnosis and management outcomes.

Complications of inhaled foreign bodies can be severe and include respiratory distress, atelectasis, pneumonia, and even death. Radiological imaging can help detect these complications and guide appropriate management. In a study by **Reyad et al.** <sup>(12)</sup>, the authors reported that X-ray of the left and right bronchi was useful in detecting complications of inhaled foreign bodies, including atelectasis, pneumonia, and lung abscess.

In this study, 46% of the study population reported early management of inhaled foreign bodies and 54% of the study population reported late management of inhaled foreign bodies. Among the study population, 49% of them reported fever, 48% of them tachycardia, 37% of them reported wet cough, 33% reported dry cough, 29% of them dyspnea, 6% of them reported choking, 28% of them report Post tussive vomiting, and 14% reported chest indrawing.

A study conducted in Turkey found that the most common presenting symptom of inhaled foreign bodies in children was cough (70.5%), followed by dyspnea (47.5%), and wheezing (30.4%). The study reported that the most commonly inhaled foreign body was a peanut (52.4%), followed by sunflower seeds (16.7%) and beans (10.7%). The study reported a success rate of 98.3% in the removal of foreign bodies via bronchoscopy, with no mortality reported <sup>(13)</sup>.

A study by **Baharloo et al.** <sup>(4)</sup> examined 496 cases of inhaled foreign bodies in children and found that the mean age of patients was 3.8 years, with a male predominance. Common clinical features observed in these patients included cough (84.5%), wheezing (67.5%), dyspnea (62.5%), and decreased breath sounds on auscultation (48.8%). The majority of inhaled foreign bodies were located in the right bronchial tree (64.9%), and the most common foreign bodies were food items (77.8%), followed by plastic objects (12.1%).

Another study by **Bhat et al.** <sup>(14)</sup> reported similar findings, with cough (88.2%), wheezing (54.2%), and dyspnea (38.9%) being the most common clinical features observed in children with inhaled foreign bodies. They also found that the right bronchus was more commonly involved (56.9%) and that food items were the most common type of foreign body (69.4%).

In our study population, 27% of them reported symptoms from 1 week to more than 1 month, 22% of

cases reported symptoms from 1 day to 1 week and 24 % of them reported symptoms within 24 hours. There was significant difference between early and late management of inhaled foreign bodies regarding clinical features.

In agreement with us, a retrospective study conducted by **Wu *et al.*** <sup>(15)</sup> included 112 children with IFBs who were divided into two groups based on the timing of diagnosis. The study found that children with early management of IFBs had a significantly shorter duration of hospitalization, fewer complications, and a higher success rate of IFB removal compared to those with late management of IFBs. The study also found that the incidence of bronchial injury was higher in children with late IFBs.

Similar to our results, another retrospective study by **Unal *et al.*** <sup>(16)</sup> included 158 children with IFBs who were also divided into two groups based on the timing of diagnosis. The study found that children with early management of IFBs had a significantly lower incidence of respiratory distress, fewer complications, and a shorter duration of hospitalization compared to those with late management of IFBs. The study also found that children with late management of IFBs had a higher incidence of pneumonia and bronchial injury.

Clinical features of patients with early detected inhaled foreign bodies are often characterized by acute respiratory distress, coughing, wheezing, and stridor. These symptoms may be severe and can occur suddenly, leading to rapid medical attention and diagnosis. Early detection of inhaled foreign bodies is associated with a relatively lower risk of complications, such as infection or lung damage, as the foreign body is usually removed promptly, preventing further damage to the respiratory system <sup>(17)</sup>.

On the other hand, late management of detection of inhaled foreign bodies may present with a wide range of clinical features that can vary depending on the type, size, and location of the foreign body. In some cases, late detection may result in chronic respiratory symptoms, such as recurrent respiratory infections, persistent cough, or wheezing. Late detection of inhaled foreign bodies is associated with a higher risk of complications, as the prolonged presence of the foreign body in the airway can lead to secondary infections, inflammation, and tissue damage <sup>(18)</sup>.

Late detection may also require more invasive procedures, such as bronchoscopy or surgical intervention, for removal, which can pose additional risks to the child's health. The outcomes of early detected inhaled foreign bodies are generally favorable, with a low incidence of complications and good recovery. However, the outcomes of late detected inhaled foreign bodies can be more variable and may depend on the duration of foreign body presence, the type of foreign body, and the severity of complications. In some cases, late detection may lead to long-term respiratory complications, such as bronchiectasis or chronic obstructive pulmonary disease (COPD), which

can have a significant impact on the child's quality of life <sup>(18)</sup>.

## CONCLUSION

The timing of management of inhaled foreign bodies in children, whether early or late, can impact the clinical features and outcomes. Early management of inhaled foreign bodies tend to present acutely with choking and respiratory distress, while late management of inhaled foreign bodies may have more subtle and chronic respiratory symptoms. Prompt diagnosis and management are crucial in both cases to prevent complications and achieve favorable outcomes. Healthcare providers should maintain a high index of suspicion, carefully evaluate the clinical history and symptoms, and utilize appropriate imaging studies or bronchoscopy to diagnose and manage inhaled foreign bodies in children.

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## REFERENCES

1. **Chang D, Abdo K, Bhatt J *et al.* (2021):** Persistence of choking injuries in children. *Int J Pediatr Otorhinolaryngol.*, 144:110685. doi: 10.1016/j.ijporl.2021.110685.
2. **Bajaj D, Sachdeva A, Deepak D (2022):** Foreign body aspiration. *Journal of Thoracic Disease*, 13(8): 5159–5175.
3. **Bandyopadhyay T, Sinha R, Dey A (2017):** Foreign body in airway: a review of cases. *Indian Journal of Otolaryngology and Head & Neck Surgery*, 69(2): 248-252.
4. **Baharloo F, Veyckemans F, Francis C (2019):** Inhaled foreign bodies in children: A practical approach. *Pediatr Pulmonol.*, 54(7):1093-1103.
5. **Dongol K, Neupane Y, das Dutta H *et al.* (2021):** Prevalence of foreign body aspiration in children in a tertiary care hospital. *Journal of the Nepal Medical Association*, 59(234): 111-15.
6. **Svedstrom E, Puhakka H, Kero P (1989):** How accurate is chest radiography in the diagnosis of tracheobronchial foreign bodies in children? *Pediatr Radiol.*, 19: 520-22.
7. **Zaytoun G, Rouadi P, Baki D (2000):** Endoscopic management of foreign bodies in the tracheobronchial tree: predictive factors for complications. *Otolaryngol Head Neck Surg.*, 123: 311-16.
8. **Korlacki W, Korecka K, Dzielicki J (2011):** Foreign body aspiration in children: diagnostic and therapeutic role of bronchoscopy. *Pediatric Surgery International*, 27: 833-837.
9. **Wu A, Prakash U, Trastek V (2017):** Late presentation of foreign body aspiration. *Chest*, 111(3): 290-293.
10. **Baharloo F, Veyckemans F, Francis C (2013):** Tracheobronchial foreign bodies: presentation and

- management in children and adults. *Chest*, 144(3): 799-807.
11. **Smith M, Goh D, Long C (2018):** Imaging of foreign bodies in the pediatric airway: A review of imaging findings and clinical management. *Am J Roentgenol.*, 211(3):562-572.
  12. **Reyad H, EL-Deeb M, Abbas A et al. (2021):** Foreign body aspiration in Egyptian children clinical, radiological and bronchoscopic findings. *J Multidiscip Healthc.*, 14: 2299–2305.
  13. **Oguzkaya F, Akcali Y, Kahraman C et al. (2019):** Inhaled foreign body in children: analysis of diagnostic methods and results. *Indian Journal of Otolaryngology and Head & Neck Surgery*, 71(1): 211-215.
  14. **Bhat N, Bhat V, Nagesha K et al. (2017):** Clinical profile of tracheobronchial foreign body aspiration in children: A retrospective study. *J Indian Assoc Pediatr Surg.*, 22(3):174-178.
  15. **Wu Z, Liu Y, Wu X et al. (2021):** Early versus late diagnosis and management of inhaled foreign bodies in children: a retrospective study. *Journal of Thoracic Disease*, 13(4): 2373-2381.
  16. **Unal S, Ersu R, Kiper N (2017):** Late versus early diagnosis and management of foreign body aspiration in children. *Pediatric Pulmonology*, 52(10): 1290-1295.
  17. **Rose D, Dubensky L (2022):** Airway Foreign Bodies. In: *StatPearls*. Treasure Island (FL): StatPearls Publishing. <https://www.ncbi.nlm.nih.gov/books/NBK539756/>.
  18. **Nasir Z, Subha S (2021):** A five-year review on pediatric foreign body aspiration. *International Archives of Otorhinolaryngology*, 25(2): 193-199.