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Original Article

Clinical, Radiological and Procedural Perspectives on Pediatric Foreign Body Aspiration: A Retrospective Analysis from Benghazi Children's Hospital, Libya

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ABSTRACT:

Background: Foreign body aspiration (FBA) is a major cause of morbidity and mortality in preschool-aged children, especially in low-resource areas where diagnosis may be delayed. This study aimed to describe the clinical, radiological, and procedural features of paediatric FBA in a single tertiary centre in Libya. **Material and Methods:** A retrospective review was conducted for all children aged 16 years and younger with suspected FBA at Benghazi Children's Hospital in 2019. The data included demographics, symptoms, imaging results, and bronchoscopy findings. All of the patients in this study underwent rigid bronchoscopy under general anesthesia. **Results:** Sixty-six children (mean age 2.9 years; 62.1% male) were analysed. Cough (90.9%) and observed choking (86.4%) were the most prevalent symptoms. Chest X-rays were normal in 72.7% of cases. Rigid bronchoscopy revealed FBA in 69.7%, mainly vegetative material like peanuts and seeds. The right main bronchus was the most common location (50%). Fever, wheezing, and a history of previous infections were associated with a significant delay in diagnosis ($P < 0.05$). Operative success was greater than 95% and complications were rare. **Conclusion:** In pediatric FBA, normal radiographs are not predictive of non-aspiration. Diagnosis is still established through rigid bronchoscopy, and treatment is also performed through this method. A high degree of clinical suspicion is necessary, in particular in low-resource settings. This study offers critical regional data to inform practice and prevention.

Keywords: foreign body aspiration, pediatric airway, rigid bronchoscopy, diagnostic performance, Libya.

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INTRODUCTION:

Foreign body aspiration (FBA) is a critical pediatric emergency of high morbidity and mortality and remains relevant on an international scale. The Global Burden of Disease Study 2021 reported a 35.3% decrease in the incidence of FBA from 1990 to 2021; however, the number of deaths caused by FBA continued to rise, resulting in a total of 103,915 deaths worldwide in 2021 [1]. Children under 5 years represent almost 98% of all FBA cases, and the highest mortality was demonstrated in infants under 1 year, where it is the leading cause of accidental death [2]. Current epidemiological data indicate a continued prevalence of FBA due to variations in healthcare systems. Reported rates of complications in delayed cases from multi-institutional studies range from 7.2%-37%, with pneumonia, atelectasis, and respiratory failure as the most common sequelae [3]. The issue of early detection remains high, as in up to 40% of cases, the chest X-ray is normal, and the clinical picture is similar to that of several respiratory diseases, such as asthma or pneumonia [5]. The diagnostic workup for FBA is evolving, and an increasing body of evidence is demonstrating the limitations of traditional imaging. More recently, it has been shown that chest X-rays detect fewer than 60% of confirmed cases, particularly when radiolucent organic materials are present [6]. This discrepancy in diagnosis requires a high degree of clinical suspicion, particularly in patients with no witnessed choking, which occurs in 8% of cases [7]. Rigid bronchoscopy remains the gold standard in terms of both diagnostic and therapeutic tools in pediatric FBA. The current series reports success rates of over 95% and complication rates lower than 7%. Recent developments in anesthetic management, such as jet ventilation methods and the use of spontaneous breathing, have significantly enhanced procedural safety and enabled optimal visualization and removal of foreign bodies [10]. Recent comparative studies confirm the superiority of rigid bronchoscopy procedures, and flexible bronchoscopies should be converted to rigid procedures as necessary in less than 5% of cases [11]. It also offers both diagnostic and therapeutic abilities, and with excellent control of the airway and broad instrument versatility, it is the favored modality for definitive treatment. In this context, this study aimed specifically to quantify the sensitivity of pre-bronchoscopic clinical and radiological indicators in children under 16 years with suspected aspiration; detail the technical approaches, instrument profiles, and anesthetic modalities employed during rigid bronchoscopy; and finally evaluate procedural outcomes, including success rates, operative times, hospital stay, and complication spectra. By delineating these parameters in a setting with a high caseload and limited published evidence, the study aims to inform regional practice guidelines and establish benchmark quality metrics for the management of airway foreign bodies.

MATERIAL AND METHOD:

Study Design and Clinical Context

This is a retrospective observational study, conducted in response to a local clinical necessity to enhance knowledge and confidence in the diagnosis and management of FBA in the pediatric population. It is based on the accepted knowledge that late diagnosis leads to significantly higher morbidity, which increases from 7.2% in early recognition to 60.4% in delayed diagnosis. To describe the entire clinical spectrum of FBA, this study constitutes a comprehensive review of all cases managed at Benghazi Children's Hospital during 2019.

Patient Population and Inclusion Framework

Patient selection was based on worldwide epidemiological data, which indicate that children under 3 years represent 73–85% of FBA cases [3]. Therefore, we enrolled all patients under 16 years of age admitted to the emergency department during the period from January 1 to December 31, 2019. The inclusion criteria were constructed to represent the diagnostic challenge of FBA, including both typical and atypical presentations. While these criteria have been well established by historical features, including a witnessed foreign body inhalation [4] and evidence of acute onset of respiratory symptoms in previously well children, it is known that up to 36.4% of proven cases will deny a choking episode [5]. We also enrolled patients with recurrent, unexplained pneumonia who had a prior history in which clinical or radiological examination indicated a tracheobronchial foreign body. To adhere to a specific diagnosis, cases with a definite underlying bronchial asthma were excluded, as there is a high degree of clinical similarity between asthma and FBA. Other exclusion criteria included acute laryngotracheobronchitis, bronchiolitis, or bronchiectasis, conditions that might complicate the clinical examination, and congenital malformations of the respiratory tract that misshapen the normal bronchoscopic anatomy.

Data Collection and Clinical Documentation

Due to its retrospective nature of this study, great care has been taken to ensure the completeness and

reliability of clinical documentation. A comprehensive search for hospital information system data and bronchoscopy procedure logs was conducted in accordance with the best principles for retrospective clinical studies. Data extraction was performed according to the standard procedure established for FBA studies. Variables recorded were patient age and sex, and place of origin; the nature and time of onset of the symptoms and, in particular, the typical triad consisting of a sudden onset of cough, wheezing, and hypophonetic lung sounds, which is said to have complete presentation in less than 65% of cases, the delay between suspected aspiration and the presentation of the case; the findings of the physical examination, such as signs of respiratory distress, a difference in the findings of lung auscultation, and pulse oxymetry data; and the radiographic findings, mainly chest radiography.

Bronchoscopy Intervention Protocol

When the inclusion criteria were satisfied, all patients underwent RBV under general anesthesia. This policy is consistent with the current clinical agreement that rigid bronchoscopy is the gold standard for both diagnosing and treating pediatric FBA. The operations were performed by experienced paediatric otolaryngologists who utilized standard institutional protocols. Anesthesia was administered in accordance with pediatric airway evidence-based guidelines, and controlled ventilation was performed as clinically indicated to minimize the risk of foreign body aspiration during retrieval. Bronchoscopy was performed with age-appropriate Karl Storz ventilating bronchoscopes. Attention was given to the supraglottic areas, vocal cords, trachea, carina, and bilateral bronchi. An attempt was made to remove the FBs in a retrieval basket, when possible, with utmost care taken to prevent fragmentation or distal migration of the FBs, as this may lead to serious risks and complications, including life-threatening episodes.

Outcome Assessment and Follow-up Monitoring

The primary endpoints were diagnostic and therapeutic success of bronchoscopy, as well as the incidence and classification of procedural complications. Tailored clinical end-points were chosen from symptom resolution, radiological normalization, and length of stay in the hospital as an estimator for both the complexity of each case and the recovery trend. Secondary analyses assessed the association between time to presentation and clinical outcome, as diagnostic delay is known to be associated with both the procedural success and the long-term pulmonary consequences [14].

Statistical Framework and Analytical Approach

All statistical analyses were performed with SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Descriptions were made using a dataset to characterise the study population. Descriptive statistics were presented in frequencies and percentages for categorical variables, and in means and standard deviations, or medians and interquartile ranges for continuous variables, according to the data distribution. Comparisons of early and delayed presentations were conducted, using chi-square tests for categorical variables and independent t-tests or Mann–Whitney U tests for continuous variables. A p-value of ≤ 0.05 was considered statistically significant.

Ethical Considerations and Regulatory Compliance

This study was approved by the Benghazi Children's Hospital ethical committee. All processes were conducted in accordance with national research governance policy and in compliance with the Helsinki Declaration, Principles of Good Clinical Practice, international standards of the ICH, Good Clinical Practice guidelines, as well as local laws and regulations. To protect patient confidentiality, all unique identifiers were erased during data analysis. The study was described according to established criteria for retrospective review, with full recognition of the limitations and strengths of such methodology.

Study Significance and Contextual Importance

This study fills a significant gap in the current Libyan FBA literature. With the real-life data from a principal referral hospital, the results provide useful information that may inform clinical practice and health policy in similar settings with constrained pediatric otorhinolaryngologic services and operational challenges.

RESULT:

For one year, 66 children with suspected FBA were examined in Benghazi Children's Hospital. The mean age was 2.9 years; the median age was 2 years; and the mode was 1 year. In particular, the highest prevalence in terms of the age at aspiration was observed in the age of one year, where 10.6% of the study sample (n = 7) was inserted in domiciliary care services for this age (Figure 1), followed by 5 years of age (n=6, 9.1%). A clear male preponderance was observed: 41 boys (62.1%) and 25 girls (37.9%), resulting in a male-to-female ratio of 1.6:1 (Figure 2). This growing trend reflects a continual epidemiologic pattern observed in childhood FBA, and the fact that boys are apparently more affected. Cough was the most frequent symptom of the clinic (60 of 66 patients,

90.9%). A history of observed choking, most commonly food or small objects, was reported in 57 patients (86.4%). These two signs, often in association, were the clinical mainstay of suspicion of FBA. Other common presenting symptoms were dyspnea (83.3%, n = 55) and a known case of aspiration of a foreign body (77.3%, n 51). Cyanosis (n = 39; 59.1%), wheezing (n = 30; 45.5%), fever (n = 15; 22.7%), stridor (n = 14; 21.2%), recurrent chest infections (n = 11; 16.7%), hoarseness of voice (n = 4; 6.1%) comprised the less common symptoms (Figure 3). In the majority of cases, the clinical diagnosis was supported by physical findings. A total of 71.2% (n=47) experienced respiratory distress, and 65.2% (n=43) were tachypneic. Asymmetrical breath sounds were found in 62.1% on chest auscultation (n = 41), and 31.8% had diminished air entry (n = 21). Symmetrical breath sounds were heard in only a small number of patients (6.1%, n = 4), indicating the importance of auscultatory asymmetry in diagnosis (Table 1). The chest X-ray (CXR) was the primary radiographic workup; however, 72.7% (n = 48) had a normal CXR. Emphysematous changes were observed in 15.2% (n = 10), radio-opaque foreign bodies in 6.1% (n = 4), and lung collapse in 6.1% (n = 4) of cases each (Figure 4). These imaging findings (especially hyperinflation and opacity asymmetry) have been fundamental in the decision-making for bronchoscopy. When patients underwent a subsequent rigid bronchoscopy (all patients under general anaesthesia) for foreign body retrieval, a diagnostic yield of 46 patients (69.7%) was demonstrated. In comparison, twenty patients (30.3%) tested negative on the bronchoscope, although this was still indicated based on clinical or radiological evidence Table 2. Examination of the objects removed revealed a pronounced predominance of vegetative foreign bodies in 62% (n = 41). The most common aspirated objects were peanuts (n = 15, 22.7%), sunflower seeds (n = 13, 19.7%), and orange seeds (n = 11, 16.7%). Non-vegetative foreign bodies were seen in a total of five patients (7.5%) a needle, a plastic earring, and three pieces of metal (Figure 5). These results confirm the association between dietary and environmental factors and the risk of aspiration. Regarding the location of foreign bodies, the right main bronchus was the most common site (50%, n = 33). The left main bronchus was the second most common site of tracheal impaction (n = 8, 12%), with 6.1% (n = 4) involving carinal impaction, and one (1.5%) at the subglottic level (Figure 6). This anatomical fact is consistent with the known anatomical vertical position and larger diameter of the right bronchus in children.

To investigate the timing of diagnosis, two groups were formed: one with early diagnosis of FBA and the other with delayed diagnosis of FBA. Cough was absent in none of the cases with delayed diagnosis and in 85% of those diagnosed early (χ^2 = 4.3, P = 0.04). Comparing these values with those of the control group showed that a persistent cough might contribute to raising awareness of the diagnosis (Table 3). Fever was also much more prevalent in late versus early diagnoses (46.2% and 7.5%, respectively) (χ^2 = 13.4, P < 0.001), possibly due to secondary infection. Wheezing showed a similarly significant difference in prevalence, 65.4 vs 32.5%, respectively (χ^2 = 6.9, P = 0.012). Repeated respiratory tract infections were also significantly more common in delayed cases (38.5% vs 2.5%; χ^2 = 14.7, P < 0.001), highlighting the importance of including FBA in the differential diagnosis of unexplained or refractory pulmonary symptoms. Presenting clinical findings included cyanosis, which was also significantly more common in the children who presented late (76.9% vs 47.5%; χ^2 = 5.6, P = 0.02). Although the antecedent of foreign body aspiration was more frequently identified in early diagnosis (87.5%) compared to delayed diagnosis (61.5%) (χ^2 = 6.05, P = 0.018), this highlights the significance of caregivers' observation and prompt reporting. When we compared the bronchoscopy results with the presenting symptoms, choking was the most significant in predicting positive findings, which were present in 97.8% of the proven aspiration group and 60% of the negative bronchoscopy group (χ^2 = 16.9, P < 0.001) (Table 4). In contrast, fever was significantly more common in patients without bronchoscopy (50%) than those with proven foreign bodies (10.9%) (χ2 = 12.15, P = 0.001), suggesting that fever alone could be a less specific sign. Recurrent chest infections were also more frequent in the subgroup of patients with an inconclusive bronchoscopy (40%) than in the subgroup with proven aspirations (10.9%) (χ^2 = 11.2, P = 0.002). These discriminations are crucial for enhancing the diagnostic role of bronchoscopy in challenging clinical scenarios. Square =11.2, P 0.002).

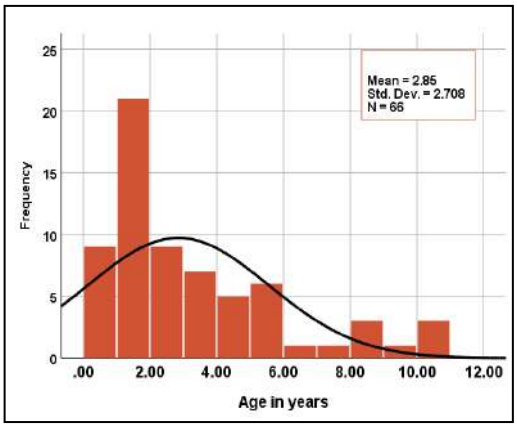


Figure 1: Age distribution of the sample

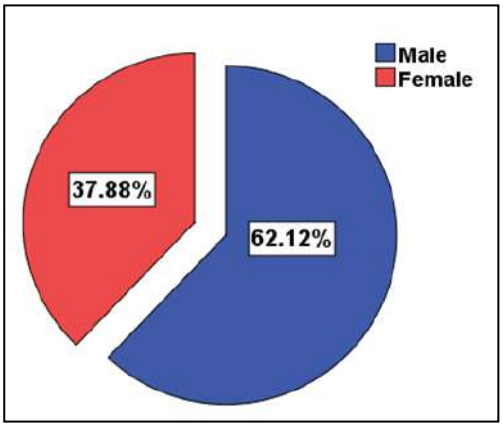


Figure 2: Gender distribution of sample

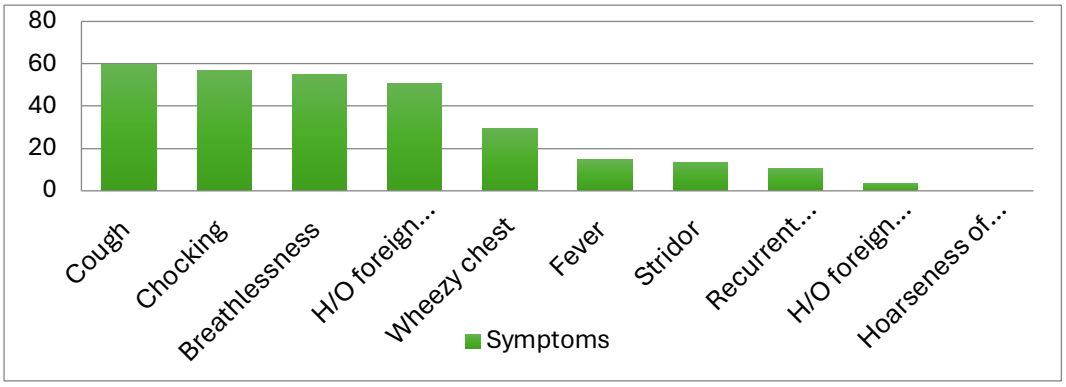


Figure 3 :Presenting symptoms of the studied sample.

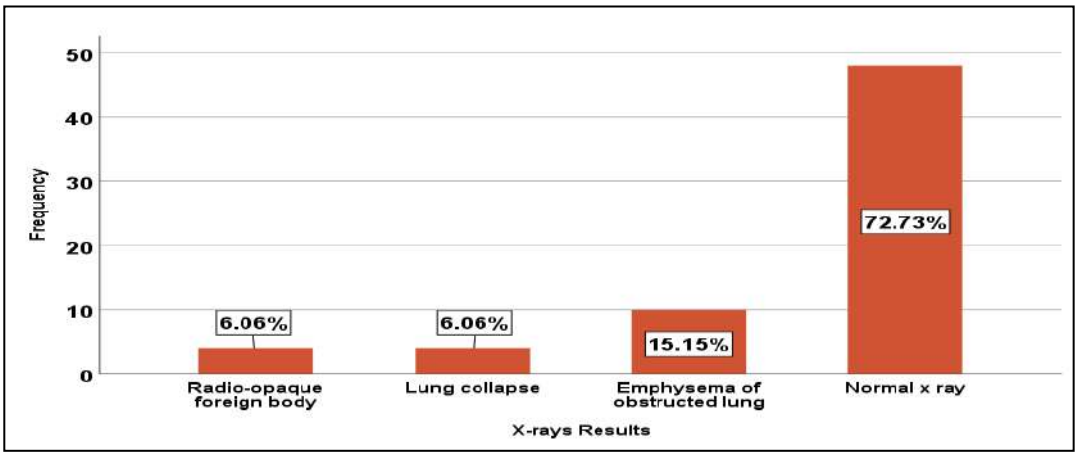
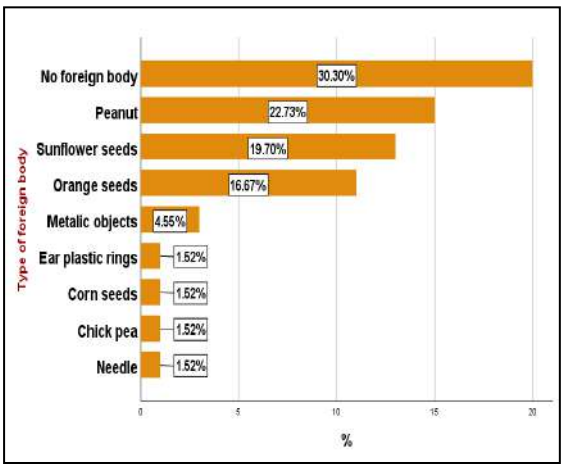


Figure 4: X-ray findings of the studied cases.



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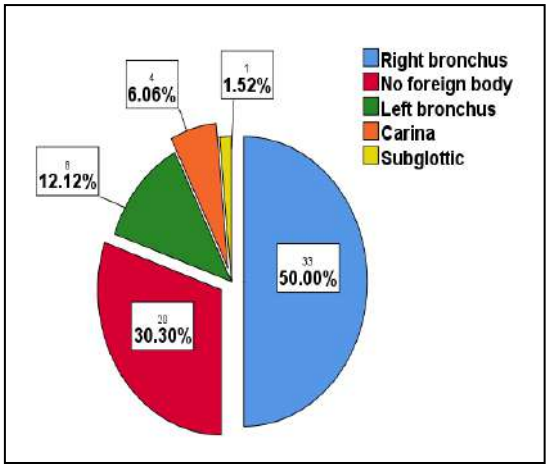

Figure 6: Site of foreign body impaction in the

Table 1:Clinical features of the studied sample.

Oriented Examination		Frequency	%
Distressed		47	71.2
Tachypnea		43	65.2
Breathing sound	Symmetrical	4	6.1
	Asymmetric	41	62.1
	Decrease of breath sound	21	31.8

Table 2: Time of foreign body diagnosis and bronchoscopy results.

Criteria and sub criteria		Frequency	%
Time of diagnosis	Early	40	60.6
	Late	26	39.4
Bronchoscopy result	Positive	46	69.7
	Negative	20	30.3

Table 3: Time of diagnosis and presenting complaint of the sample.

Presenting complaint		Diagnosis		Significance of difference
		Early (n=40)	Late (n=26)	
Cough	Yes	34 (85%)	26 (100%)	Chi Square =4.3 P= 0.04*
	No	6 (15%)	0 (0%)	
Fever	Yes	3 (7.5%)	12 (46.2%)	Chi Square =13.4 P= 0.00**
	No	37 (92.5%)	14 (53.8%)	

Wheezy chest	Yes	13 (32.5%)	17 (65.4%)	Chi Square =6.9 P= 0.012*
	No	27 (67.5%)	9 (34.4%)	
Recurrent chest infection	Yes	1 (2.5%)	10 (38.5%)	Chi Square =14.7 P= 0.00**
	No	39 (97.5%)	16 (61.5%)	
Cyanosis	Yes	19 (47.5%)	20 (76.9%)	Chi Square =5.6 P= 0.02*
	No	21 (52.5%)	6 (23.1%)	
H/O FB aspiration	Yes	35 (87.5%)	16 (61.5%)	Chi Square =6.05 P= 0.018**
	No	5 (12.5%)	10 (38.5%)	

*: Statistically significant at $p \leq 0.05$
**: high significance difference $p = 0.001$
***: very high significance difference $p < 0.001$

Table 4: Bronchoscopy result and presenting complaint of the sample.

Presenting complaint		Bronchoscopy result		Significance of difference
		Positive (n=46)	Negative (n=20)	
Choking	Yes	45 (97.8%)	12 (60%)	Chi Square =16.9 P= 0.00**
	No	1 (2.2%)	8 (40%)	
Fever	Yes	5 (10.9%)	10 (50%)	Chi Square =12.15 P= 0.001**
	No	41 (2.2%)	10 (50%)	
Recurrent infection	Yes	5 (10.9%)	8 (40%)	Chi Square =11.2 P= 0.002**
	No	43 (93.5%)	12 (60%)	

*: Statistically significant at $p \leq 0.05$
**: high significance difference $p = 0.001$
***: very high significance difference $p < 0.001$

DISCUSSION:

This single-center retrospective study, conducted at Benghazi Children's Hospital, provides detailed information regarding pediatric FBA and has contributed to the international literature in numerous aspects. The 66 children in the study had a typical age distribution, with a mean age of 2 years, and there was a male predominance (1.6:1). Rigid bronchoscopy was diagnostic in 69.7% (46/66) of these patients. Notably, regular chest X-rays were observed in 72.7% of patients, which is a significant finding for clinical decision-making. This highlights the need for a high clinical suspicion, irrespective of radiographic features, and especially in a resource-constrained environment where advanced imaging may not be readily available. The preponderance of vegetative foreign bodies (62%) and the prevalence of right main bronchus impaction (50%) correspond to known trends. However, the distinct profile of organic materials, especially peanuts (22.7%), sunflower seeds (19.7%), and orange seeds (16.7%), reflects local dietary habits, which may impact the methods of prevention and clinical investigative awareness.The demographics of our cohort closely align with international patterns in pediatric foreign body aspiration (FBA). Specifically, children aged 1–2 years were most commonly affected, consistent with a retrospective study of 200 children in Shanghai, which reported that 92% were under three years old and 69% were aged 1–2 years, reflecting the developmental propensity for mouthing objects combined with immature swallowing coordination [12]. Our observed male predominance (62.1%) aligns with reports citing gender ratios between 1.4:1 and 2.6:1, reinforcing the hypothesis that boys' more impulsive exploratory behavior increases aspiration risk [13,14].Clinically, the prominence of cough (90.9%) and witnessed choking events (86.4%) in our series aligns with findings from Chinese and global cohorts, which have identified these as hallmark symptoms [12,15]. However, the exceptionally high rate of normal chest X-rays in our population (72.7%) stands in contrast to the 35%–54% range typically reported elsewhere [16,17]. This discrepancy may be attributed to differences in radiograph interpretation practices, a higher prevalence of radiolucent organic foreign bodies like seeds, or variations in the timing of imaging relative to aspiration.Our bronchoscopy retrieval success rate of 69.7% aligns with the 49%–87% diagnostic yield reported in meta-analyses and is consistent with findings from high-volume tertiary centers, even when using rigid bronchoscopy [15,18,19]. When comparing early versus delayed presentation groups, we observed several notable trends: persistent cough was reported universally in delayed cases compared to 85% of early presentations ($p = 0.04$), highlighting the clinical significance of chronic cough—especially without a witnessed choking episode—as a red flag for FBA [15]. Additionally, fever (46.2% vs. 7.5%, $p < 0.001$) and recurrent chest infections (38.5% vs. 2.5%, $p < 0.001$) were significantly more common in delayed presenters, indicative of progression towards inflammation, bronchiectasis, or abscess formation, as described in earlier studies [17,20]. Witnessed choking was highly predictive of positive bronchoscopy (97.8% vs. 60%, $p < 0.001$), reaffirming its importance in clinical decision-making. In contrast, fever and recurrent infections were more frequent in children with negative bronchoscopy results, suggesting these findings may reflect alternative diagnoses or resolution of foreign bodies prior to intervention [17]. Our findings have important implications in resource-limited settings lacking access to advanced imaging techniques such as CT. They underscore that normal chest radiographs should not preclude further evaluation when clinical suspicion for FBA remains high [17]. The predominance of organic foreign bodies, especially seeds and nuts typical of local diets, emphasizes the need for culturally tailored prevention strategies. Despite a negative bronchoscopy rate of 30.3%, which is within acceptable bounds [15], there remains scope for refining patient selection criteria. Several clinical models, including recently proposed scoring systems that combine history, physical examination, and chest radiography, show potential for improving triage accuracy, though they require external validation in diverse settings [19,21].This study has limitations inherent to its retrospective design, including potential documentation bias and the inability to capture unrecorded variables. The single-center nature and limited sample size may restrict generalizability and statistical power in subgroup analyses. Additionally, our results are influenced by the specific institutional protocols and procedural expertise of our bronchoscopy team.Future efforts should prioritize prospective, multicenter validation of clinical prediction tools adapted to different resource settings, particularly in regions with high rates of organic FBA. Community-based preventive interventions—especially those targeting dietary habits and caregiver education—also hold promise in reducing the incidence of pediatric FBA. If successfully implemented and validated, such

approaches could substantially enhance airway safety for children in similar healthcare environments.

CONCLUSION:

Pediatric aspirated foreign body continues to be a significant clinical issue, especially in resource-poor regions. The present study reinforces that radiographic imaging is often falsely reassuring (>70% cases having normal CXR) and emphasizes the importance of clinical assessment. Rigid bronchoscopy proved to be very effective and safe, confirming its value as the gold standard for diagnosis and management. The large proportion of organic foreign bodies associated with local dietary practices highlights the importance of culturally relevant prevention strategies. Time to diagnosis correlated significantly with higher rates of complications, highlighting the need for early identification. These findings are crucial for informing local clinical practice protocols and public health interventions aimed at reducing FBA-associated morbidities in children.

Limitations

- This study is retrospective in nature, making it dependent on the accuracy and completeness of previously documented medical records, which may introduce reporting and documentation bias.
- The research was conducted in a single tertiary center, limiting the generalizability of the findings to other regions with different healthcare systems, demographic characteristics, or clinical practices.
- The sample size was relatively small, reducing the statistical power for subgroup comparisons and limiting the robustness of some analytical conclusions.
- Variability in clinician expertise, radiographic interpretation, and decision-making regarding bronchoscopy may have influenced diagnostic and therapeutic outcomes.
- The lack of advanced imaging modalities, like CT scans, limited the ability to compare the diagnostic performance of chest X-rays with more sensitive techniques.
- Long-term follow-up data were not available, preventing assessment of delayed complications or long-term pulmonary sequelae.

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