



STUDY OF CLINICAL PROFILE OF PATIENTS OF FOREIGN BODIES IN THEIR AIRWAY IN RELATION TO ITS LOCATION

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ABSTRACT Foreign body aspiration is a critical emergency in otorhinolaryngology, particularly among pediatric patients, where it remains a major cause of morbidity and mortality. Young children, especially those aged 1–2 years, are most vulnerable due to immature swallowing coordination, incomplete dentition, and exploratory behavior. Common aspirated objects include food items, such as peanuts, and nonorganic objects like pen caps in older children. Diagnosing foreign body aspiration poses challenges, especially in unwitnessed cases, where symptoms like coughing, reduced air entry, and respiratory distress mimic other conditions. Boys are more frequently affected, with a male-to-female ratio of 2:1. This study evaluated the use of the Hopkins rod lens telescope and optical forceps in managing airway foreign bodies. Rigid bronchoscopy under general anesthesia was performed in all cases, with enhanced optical systems improving visualization, precision, and operative efficiency. The right main bronchus was the most common site of impaction due to anatomical factors. While chest X-rays identified radio-opaque foreign bodies or secondary lung changes in some cases, high-resolution computed tomography (HRCT) with virtual bronchoscopy was utilized for inconclusive findings. Complete foreign body removal was achieved in most cases, minimizing complications and repeat procedures. The study underscores the importance of modern bronchoscopic techniques in reducing morbidity and improving outcomes in airway foreign body management.

KEYWORDS : Foreign body aspiration, Respiratory distress, Rigid bronchoscopy, HRCT, Hopkins rod lens telescope, optical forceps etc.

INTRODUCTION

Foreign bodies in the airway represent a common and urgent condition encountered in otorhinolaryngology, often requiring immediate intervention. Aspiration of foreign bodies remains a significant cause of morbidity and mortality, especially in pediatric populations, despite advancements in endoscopic techniques^[1]. Chevalier Jackson described a foreign body as “an object or substance that does not naturally belong in its location”^[2]. A wide range of objects may be aspirated, with vegetative materials being the most frequent in children. Peanuts and other types of nuts are commonly implicated in such cases^[3].

Managing airway foreign bodies continues to pose diagnostic and therapeutic challenges for otolaryngologists. Even with improvements in public health awareness and emergency medical care, foreign body aspiration remains a leading cause of mortality in children^[1]. The condition often mimics other medical disorders, particularly when the aspiration event is unwitnessed, potentially delaying diagnosis and increasing the risk of complications. Most of the patients are seen to be of the pediatric age group in which case accurate history of foreign body aspiration may not be available, hence the diagnosis may not be done on time and complications can arise.^[4,5]

Children, particularly those aged 1–2 years, are most at risk for foreign body aspiration. Factors contributing to this vulnerability include incomplete dentition (lack of molars to grind food properly), immature swallowing coordination, and the tendency to engage in activities like playing or running while eating^[6]. While food items are the most common aspirated foreign bodies in younger children, older children are more likely to aspirate nonorganic objects such as pen caps or pins^[7,8]. Boys are affected more often than girls, with a reported male-to-female ratio of 2:1^[9]. A study of 225 cases by Rothmann and Boeckman found a definitive history of aspiration in 168 cases (74.9%)^[10]. In cases where a clear history is unavailable, persistent coughing, reduced air entry on one side of the lung, and/or signs of respiratory distress in a pediatric patient without other identifiable causes should prompt suspicion of airway foreign body aspiration. McGuirt et al. reported that only 61% of children with tracheobronchial foreign bodies

presented with abnormal physical findings, such as decreased breath sounds or wheezing^[11].

It is essential to investigate any suspected foreign body aspiration thoroughly, regardless of the patient's age or symptom presentation. In rare cases, a foreign body may lodge near the glottis, causing acute airway distress, hoarseness, or stridor. Complications such as pneumonia, atelectasis, or abscess formation in the lung or mediastinum can occur if diagnosis and treatment are delayed^[12]. Radiographic imaging may not reveal significant findings in the early stages but may show characteristic changes over time [2]. The gold standard for management is the prompt removal of the foreign body through rigid bronchoscopy, which remains the safest and most effective approach^[13].

The development of enhanced optical systems, such as the Hopkins rod lens telescope introduced in the late 1960s^[14] has greatly improved the precision and success rate of this procedure. This study examines the application of the Hopkins rod lens telescope and optical forceps in the removal of airway foreign bodies. It also explores the challenges encountered during the procedure, the clinical presentations associated with various types of foreign bodies, their sites of lodgement within the tracheobronchial tree, and their effects on the respiratory system.

Objectives

- 1) To study the various sites of lodgement and its effect on respiratory tract
- 2) To study different types of foreign bodies and their behaviour.
- 3) To study the clinical presentations.

MATERIALS AND METHODS

Study Design : Observational Descriptive study.

Study Period : June 2019 to November 2020.

Study Duration: 1 year and 6 months.

Study Place : The study was conducted in the Department of ENT and Head and Neck Surgery of our tertiary health care centre.

Sample Size : 40.

Study Population : All patients with airway foreign bodies who reported to the Department of ENT at our centre.

Inclusion Criteria : Patients of all age groups admitted with history, clinical and radiological findings suggestive of foreign body aspiration, where,

Clinical Findings Suggestive Of Foreign Body Aspiration:

1. Respiratory distress
2. Cough
3. Breathlessness
4. Wheeze on auscultation
5. Tracheal 'thud'

Radiological Findings Suggestive Of Foreign Body Aspiration:

1. Visualisation of radio-opaque foreign body.
2. Obstructive emphysema
3. Mediastinal shift
4. Unilateral lung/lobar atelectasis.

Exclusion Criteria : Patients with other causes of respiratory distress/decreased air entry, such as:

1. Lower respiratory tract infection
2. Bronchial asthma
3. Collapsed segment of lung
4. Pleural effusion
5. Pneumothorax
6. Interstitial lung disease

Methodology:

Patients of all ages, including children and adults were included in the study, selected according to the inclusion and exclusion criteria. A detailed history including situation in which the foreign body was aspirated, symptoms and clinical features were elicited by a pre-designed case record form. A thorough examination of vitals, ear, nose and throat, abdomen and respiratory system were done in all cases. X-ray soft tissue neck antero-posterior and lateral views were taken.

Chest x-ray and plain x-ray abdomen were taken for all patients to rule out foreign bodies in the gastrointestinal tract, and computerised tomography of neck and chest were taken if found necessary. Appropriate lab tests were done in view of general anaesthesia. In cases with an unclear history of foreign body aspiration with inconclusive chest X-ray findings, high resolution computed tomography of the chest with virtual bronchoscopy was done (HRCT chest with VB).

Appropriate consent was taken pre-operatively along with consent for tracheostomy if the need arises. One dose of intravenous Dexamethasone was given pre-operatively to reduce oedema and improve forceps space. All patients included in the study were taken under general anaesthesia for foreign body removal. Rigid bronchoscopes were used along with a Hopkins rod lens telescope and special optical forceps through which the telescope could be passed.

The size of the bronchoscope was determined on the basis of patient's age:

Less than six years of age = $\frac{\text{Age} + 3.5}{3}$

Greater than six years of age = $\frac{\text{Age} + 4.5}{4}$

Data Recording:

All data obtained was recorded in a pre-designed case record form.

Data Analysis:

The data obtained from all the case records of patients was entered in a worksheet-based program like MS Excel. Relevant deductions based on the data has been presented using bar charts & diagrams. Continuous variables are summarised using summary statistics. Categorical values were estimated by using frequencies and percentages.

Observations

Chest X-rays are usually normal in the first 24 hours after the aspiration episode but may subsequently show secondary lung changes due to airway obstruction.



Figure 1: Pre-op & post-op X-ray changes

Figure 1 (a)

Figure 1 (b)

Figure 1 (a): Pre-operative chest X-ray of a case of airway foreign body showing a collapsed right apical lobe.

Figure 1 (b): Post-operative X-ray showing correction of the atelectatic lobe.

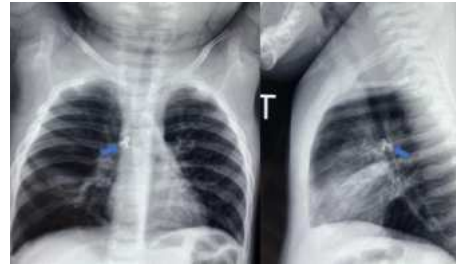


Figure 2: Chest X-ray PA and lateral views showing radio-opaque foreign body (screw) in the right main bronchus.



Figure 3: Chest X-ray PA view showing a radio-opaque foreign body seen at carina (denture).



Figure 4 (a)

Figure 4 (b)

Figure 4: Migrating foreign body (metallic pin), seen in (a) in the right main bronchus, with repeat x-ray (b) showing the foreign body seen in the left main bronchus.

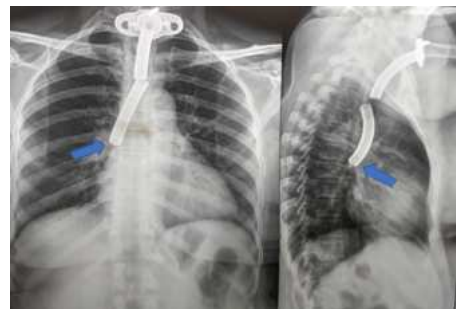


Figure 5: Broken distal end of a metallic tracheostomy tube lodged in the trachea, with another metallic tracheostomy tube in its normal position.



Figure 6: Chest X-ray PA and lateral views showing foreign body seen in right main bronchus (LED bulb).



Figure 7 (a, b): Chest X-ray and 3D reconstructed CT images of the same patient, which shows a relatively unremarkable X-ray (a), but on CT (b) shows a foreign body lodged in the trachea.



Figure 8 (a) Chest X-ray findings suggestive of right sided hyperinflated lung fields, but not detecting any foreign body. Figure 16 (b) HRCT chest showing a foreign body lodged in the right main bronchus.

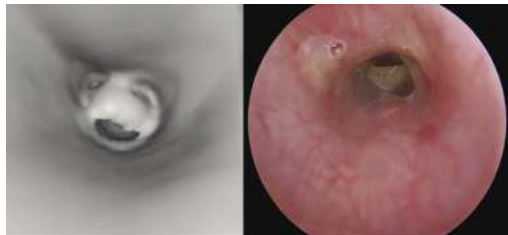


Figure 9 (a): Virtual bronchoscopy image of showing the foreign body in the trachea, confirmed by direct visualization of the same using a Hopkins rod lens telescope (b).

RESULTS & STATISTICAL ANALYSIS

Our study included 40 cases of airway foreign bodies. Consents were taken in the format approved by ethics committee from the institution. Observations of all patients were noted in the case sheet typed for study.

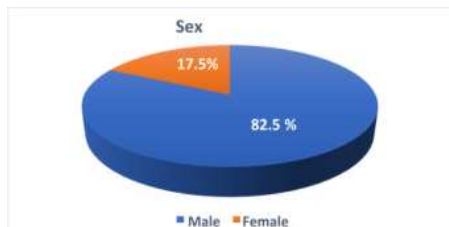


Chart 1: Sex Distribution Of Airway Foreign Bodies.

Table 1: Sex Distribution Of Airway Foreign Bodies.

	Male	Female
N=40	33	7

Hence, it is apparent that the patients of foreign body aspiration in our study were predominantly male (82.5%).

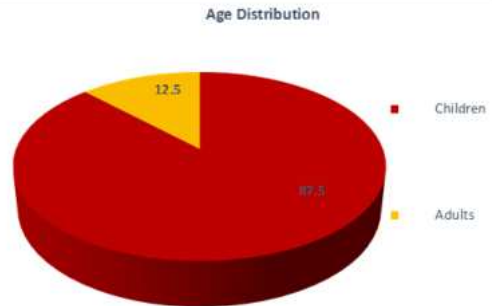


Chart 2: Age of distribution of airway foreign bodies

Majority of the patients in our study were of the paediatric age group (<12 years). Out of the 40 patients included in our study, 35 were children under the age of 12 years (87.5%).

Table 2: Age of distribution of airway foreign bodies

Age group (years)	Number N=40	%
0 – 5	21	52.5
6 – 10	12	30
11 – 15	2	5
16 – 20	0	0
21 – 30	0	0
31 – 40	2	5
41 – 50	1	2.5
51 – 60	2	5

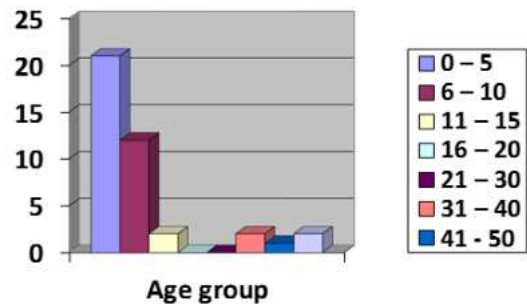


Chart 3: Age of distribution of airway foreign bodies

Our data suggests that more than half (52.5%) of the patients were 5 years of age and below. This was followed by the age group of 6-10 years, with 30% of our study population being in that age group. History of aspiration of foreign body was elicited in most (85%) of cases.

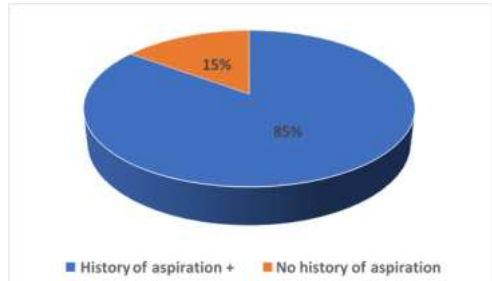


Chart 4: History of foreign body aspiration.

Table 3: Frequency Of Various Symptoms.

	Cough	Respiratory distress	Fever	Stridor	Cyanosis	Change in voice
Number	37	14	5	11	2	3
Percentage	92.5	35	12.5	27.5	5	7.5

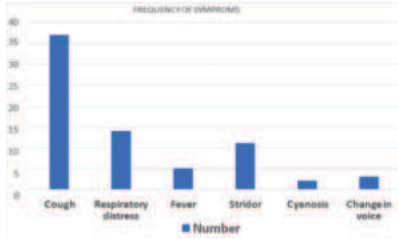


Chart 5: Frequency of various symptoms.

Cough was the most common symptom elicited, seen in 92.5% of cases, followed by respiratory distress (35%).

Stridor, or noisy breathing was seen in 27.5% of cases, the other common symptoms being fever, cyanosis and change in voice.

On examination, decreased air entry on auscultation of the chest was the most common finding, seen in 47.5% of cases.

Second most common examination finding was chest retractions, seen either as intercostal or substernal retractions, seen in 32.5% of our cases.

“Tracheal thud” which has been described in literature, was an uncommon finding in our study, seen in only 10% cases.

Table 4: Frequency Of Various Examination Findings.

	Fall in SpO ₂	Chest retractions	Wheeze	Decreased air entry	Tracheal thud
Number	3	13	4	19	4
%	7.5	32.5	10	47.5	10

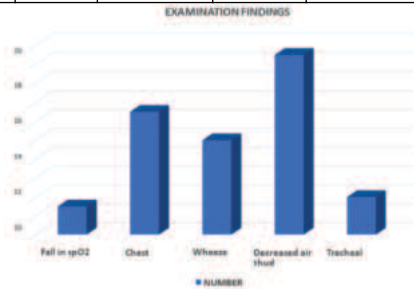


Chart 6: Frequency of various examination findings

On chest auscultation, 19 out of 40 cases (47.5%) showed a decreased air entry, while the rest (52.5%) had B/L equal air entry.

Out of those 19 cases, 6 (15%) had decreased air entry on the left side, 8 (20%) on the right side, while 5 cases (12.5%) showed B/L decreased air entry on chest auscultation.

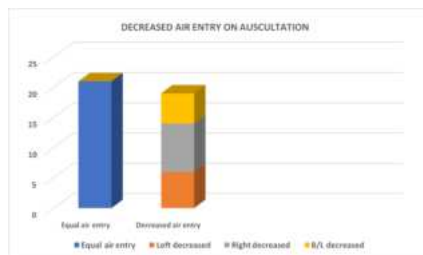


Chart 7: Distribution of air entry on chest auscultation.

A chest X-ray was routinely done for all patients suspected to have foreign body aspiration. Out of the 40 cases included in this study, 11 cases (27.5%) had normal chest X-ray findings.

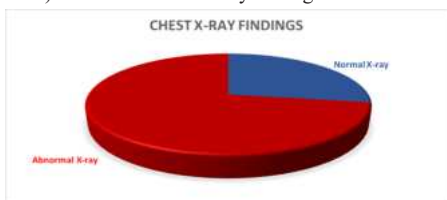


Chart 8: Chest X-ray findings.

The foreign body was seen in the chest X-ray in 50% of total cases, while there was hyperinflated lung fields seen in 15% cases, and 12.5% cases showing a collapsed segment of the affected lung.

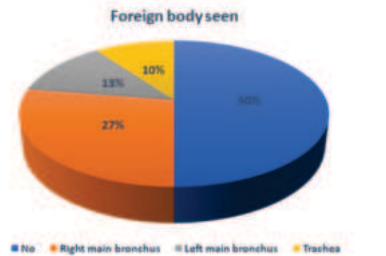


Chart 9: Distribution of foreign bodies seen on chest X-ray.

In cases where we were doubtful about the presence and/or site foreign body (dubious history +/- inconclusive examination and X-ray findings), an HRCT chest with virtual bronchoscopy was done to ascertain the diagnosis. CT was done in 15 out of the total 40 cases in this study (37.5%). Out of the 40 foreign bodies removed, 17 (42.5%) were organic in nature, whereas the rest were inorganic.

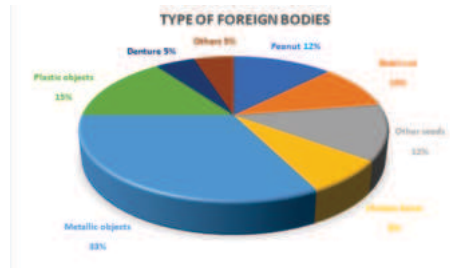


Chart 10: Distribution of various types of foreign bodies.

13 objects (33%) were metallic in nature (safety pins, beads, coins, etc). 6 objects (15%) were of plastic (pen caps, whistles, etc)

Out of all the organic foreign bodies, peanuts, betel nuts, and chicken bones made up the majority, comprising nearly 30% of all foreign bodies found in this study.

Table 5: Condition Of Airway Mucosa On Bronchoscopy

	Normal	Oedematous	Abrasions
Number	28	10	2
%	70	25	5

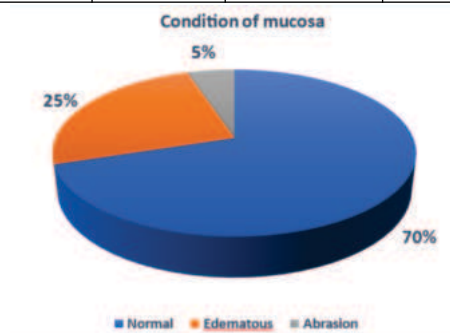


Chart 11: Condition of airway mucosa on bronchoscopy.

Only 30% of the cases showed abnormal condition of the airway mucosa, either abrasions as a result of direct trauma from the foreign body (5%), or oedema (30%) which was the result of the presence of a long standing organic foreign body.

Out of the 40 cases in our study, the foreign body was most commonly found in the right main bronchus, in 17 (42.5%) cases, while the second most common site was the left main bronchus (25%).

There was one case of a migrating foreign body, where the pre-operative chest X-ray showed a radio-opaque foreign body lodged in the right main bronchus, but on bronchoscopy, the object (metallic pin)

was found in the left main bronchus.

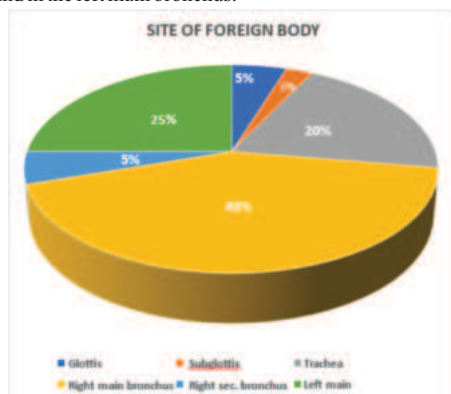


Chart 12: Distribution of foreign bodies based on location.

Forceps space while using telescope with optical forceps was adequate in most cases (75%), whereas it was decreased in 22.5% cases, either because of surrounding mucosal oedema, or due to the shape/nature of the foreign body, in which case we had to abandon the use of the optical forceps and switch to a rigid bronchoscope with standard grasping forceps for better maneuverability.

There was inadequate forceps space encountered in one case, where the procedure had to be staged in order to remove the foreign body completely.

Complications

There were complications in 4 cases (10%), namely:

- Tracheostomy had to be performed in one patient to facilitate removal of the foreign body.
- A staged removal of the foreign body had to be performed in 1 case due to inadequate forceps space.
- The foreign body was inadvertently displaced distally in the tracheobronchial tree in 1 case, such that a flexible bronchoscope had to be used to remove the foreign body.
- A repeat bronchoscopy had to be performed in 1 case, as complete removal of the foreign body could not be ascertained during the first procedure.

DISCUSSION

Foreign body aspiration into the airway is a significant cause of morbidity and mortality in children and remains a diagnostic and therapeutic challenge for otolaryngologists. In this study, the majority of patients were from the pediatric age group, with 52.5% being under five years old, consistent with findings from previous research^[17,18]. This prevalence is attributed to the lack of molar teeth in young children, leading to incomplete chewing of food, their tendency to explore objects orally, and an underdeveloped swallowing reflex^[18].

Male patients accounted for the majority of cases (82.5%), aligning with other studies.^[19,20] This could be explained by boys generally being more active and adventurous than girls.^[21]

Obtaining a detailed history is critical in diagnosing airway foreign bodies. Witnessed foreign body aspiration is a definitive indication for bronchoscopy. Since young children cannot reliably describe their symptoms, caregivers' accounts are crucial.

In this study, a positive history of foreign body aspiration was reported in 85% of cases, similar to findings by Sinha et al.^[22]. The most commonly reported symptom was coughing, seen in 92.5% of cases, followed by respiratory distress in 35% of patients, findings that correspond to Pinzoni et al.^[23]

A typical history includes an episode of coughing followed by choking, as the cough reflex serves to prevent the foreign body from moving further down the tracheobronchial tree. Respiratory distress or stridor occurs primarily with obstructions in the central airway, such as the larynx or trachea, and can present as a medical emergency.

On clinical examination, the most frequent finding was decreased air entry, observed in 47.5% of cases, particularly in bronchial foreign bodies, which obstruct ventilation to distal bronchopulmonary segments. This was consistent with similar studies^[17,24]. Chest

retractions, seen in 32.5% of cases (intercostal or substernal), were also commonly reported in other research. However, the classical triad of cough, wheezing, and decreased air entry, as noted by Mehta et al.^[25] and Denny et al.^[26], was uncommon in this study, seen in only 10% of cases. The phenomenon of "tracheal thud," indicating the movement of a mobile foreign body against the tracheal wall, was also rare, noted in only 10% of cases, consistent with earlier reports^[27,28]. Wheezing, often associated with distal airway foreign bodies, was similarly uncommon, found in 10% of cases. A sudden drop in oxygen saturation, particularly in cases of laryngeal or tracheal obstructions, signals an acute airway emergency. Airway blockage can result from the size or shape of the foreign body or secondary mucosal edema, particularly with organic foreign bodies that have been present for extended periods. Emergency bronchoscopy was required in 7.5% of cases due to respiratory distress and declining oxygen levels.

Chest X-rays were performed for all patients, though 27.5% showed normal findings, contrasting with McGuire's study, which reported 11% normal results^[11]. This highlights that a normal chest X-ray cannot rule out foreign body aspiration, and bronchoscopy should still be considered when clinical suspicion is high.

Radiopaque foreign bodies were detected in 50% of cases, which is higher than the rates reported by Cantaneo et al.^[29] and Swensson^[30], who found rates of 16% and 19%, respectively.

Hyperinflated lung fields were observed in 15% of cases, while atelectasis was noted in 12.5%, findings that were lower than those reported by Gaafar et al.^[31]. Hence, it may be best to use X-rays only as a guiding tool in diagnosing airway foreign bodies, and not as a diagnostic tool. High-resolution computed tomography (HRCT) with virtual bronchoscopy was used in 15% of cases with unclear histories or inconclusive X-ray findings and successfully identified foreign bodies in all cases, consistent with the 100% sensitivity reported by Hong et al.^[32] and Jung et al.^[33].

Rigid bronchoscopy under general anesthesia was performed for all patients, using appropriately sized bronchoscopes, a Hopkins rod lens telescope, and specialized optical forceps. Organic foreign bodies constituted 42.5% of cases, compared to 63% reported by Swensson^[30]. Peanuts were the most common organic foreign body, making up 12.5% of cases, in line with similar studies^[30,34,35].

The right main bronchus was the most frequent site of foreign body lodgment, seen in 42.5% of cases, aligning with findings from Hughes et al.^[18], Swensson^[30] and Zerrella et al.^[18]. This is likely due to the right bronchus being wider, shorter, and more vertical than the left. The left main bronchus was the second most common site, seen in 25% of cases, which is comparable to 20% reported by Swensson^[30], and 33% as reported by Inglis and Wagner^[14].

Complete foreign body removal was achieved in all cases using telebronchoscopes, consistent with findings by Mathur and Pradhan^[35]. Distal displacement of the foreign body occurred in 2.5% of cases, lower than the 10% reported in other studies^[35]. Repeat bronchoscopy was required in 2.5% of cases due to uncertainty about complete removal, compared to 10.3% in another study^[36]. Tracheostomy was necessary in 2.5% of cases, significantly lower than the 10.4% reported by Ouoba et al.^[37].

CONCLUSION

Airway foreign bodies are a common emergency in otorhinolaryngology, particularly in pediatric male patients, as observed in our study. A positive history of foreign body aspiration was noted in the majority of cases, and rigid bronchoscopy was performed for all patients, following a thorough history and clinical examination to confirm the diagnosis. The most common symptom reported was a history of coughing, although many patients became asymptomatic afterward. In contrast, foreign bodies lodged in the larynx or trachea typically presented with respiratory distress and/or stridor.

On physical examination, reduced air entry on the affected side was the most frequently observed finding during chest auscultation. Chest X-rays were not always diagnostic, as they primarily identified radiopaque foreign bodies or secondary lung changes such as hyperinflation or atelectasis caused by obstruction. For cases with inconclusive histories and chest X-ray findings, high-resolution computed tomography (HRCT) combined with virtual bronchoscopy was utilized to confirm the presence and precise location of the foreign body.

Organic foreign bodies, particularly peanuts, accounted for the majority of cases in our study. The right main bronchus was the most common site of impaction due to its wider diameter and more vertical alignment compared to the left.

The use of telescopes with optical forceps significantly enhanced image resolution and magnification, surpassing traditional rigid bronchoscopy without compromising the space required for the forceps. Additionally, the telescopic system allowed simultaneous ventilation, effectively reducing operative time. Telebronchoscopes facilitated complete removal of foreign bodies in most cases, minimizing the need for repeat procedures. They also provided visual documentation of the foreign bodies and their extraction, which served as an invaluable educational tool for training residents.

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