



Flexible bronchoscopy for removal of airway foreign bodies: A single center experience.

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ABSTRACT

Background: Airway foreign bodies are rare in occurrence and challenging to manage. The presentation varies depending upon the size, site, and nature of the aspirated material. Although rigid bronchoscopy is the preferred choice in children; distally lodged foreign bodies in adults have high success rate of extraction with flexible bronchoscope.

Objective: The aim of this study is to evaluate the utility of flexible bronchoscopy for removal of airway foreign bodies in adolescents and adults.

Methods: In a retrospective study conducted between January 2018 to March 2024 at National Academy of Medical Sciences, Bir hospital; medical records of patients undergoing bronchoscopy for airway foreign bodies were extracted.

Methods and Material: Demographic parameters, type and location of foreign body, extraction procedure, accessory equipment used, and the success rates were analyzed. Complications during and after the procedure were also recorded.

Results: During the study period, a total of 3143 bronchoscopies were performed, of which 18 (0.57%) were done for foreign body extraction. Patients were aged between 12 to 89 years; cough was the commonest symptom and lobar collapse was the commonest radiological sign. Organic foreign bodies accounted for 61% cases and inorganic 39%. Right lower lobe was the commonest site. Successful flexible bronchoscopy assisted extraction was achieved in 89%. Of the 18 patients, 12 (67%) were successfully removed with rat toothed forceps and five (28%) with basket device. No major complications were noted.

Conclusions: Flexible bronchoscopy has a high success rate in management of airway foreign bodies and should always be considered as first line in adults.

Key-words: Airway Foreign Body; Adults; Bronchoscopy; Flexible bronchoscopy



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INTRODUCTION:

Foreign body aspiration is more common in children than adults¹. However, adolescents, adults and elderly may also present with foreign body aspiration either as an acute life threatening respiratory failure or new onset dyspnea, wheeze, cough and hemoptysis². The diagnosis is sometimes delayed in the elderly, as they may fail to provide a history of choking episode³. Foreign bodies may either be organic or inorganic. Common radiology findings are visible foreign body, non-resolving pneumonia, collapse, and focal bronchiectasis or hyperinflation⁴. Airway foreign body accounts for approximately 0.16-1.33% of adult bronchoscopy procedures⁵. The location of foreign body is dependent upon the age of the patient and the size and shape of the aspirated material. Historically, rigid bronchoscopy was considered the procedure of choice because

of a larger working channel and better airway control. Flexible bronchoscopy is being increasingly used in adults⁵⁻⁸.

There has been a limited number of publications on airway foreign bodies from Nepal. Majority of them has been on pediatric population with the use of rigid bronchoscope^{9,10}. Flexible bronchoscopy assisted removal has only been reported in a few case-reports¹¹⁻¹². The aim of this study is to evaluate the clinical-radiological features of airway foreign body in

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adolescents and adults and the bronchoscopy methods used to treat them at our center.

METHODS:

We conducted a retrospective study at National Academy of medical Sciences, Bir Hospital between Jan 2018 to March 2024. Medical records of patients undergoing bronchoscopy were reviewed and those with a diagnosis of airway foreign body were extracted and analyzed. The symptoms at presentation, duration of symptoms along with demographic profile were obtained. The radiology findings of x-ray and CT chest were noted. Bronchoscopy findings such as type and location of foreign body, accessory equipment used to extract the foreign body and the procedure outcome were noted. Data regarding sedation and analgesia used during the procedure was extracted along with the complications if any were also noted.

Flexible bronchoscopy was performed in the bronchoscopy suite under mild sedation using fentanyl and/or midazolam ensuring at least two experienced bronchoscopists were available to perform every procedure. Topical lignocaine (10%) spray was used to anesthetize the posterior pharynx and lignocaine (2%) was used as "spray-as-you-go" approach during the procedure. If the diagnostic bronchoscopy was performed via the nasal route, the approach was changed to oral route for extraction. The flexible bronchoscope was inserted and stabilized into the segment where the foreign body was lodged. Accessory equipment was used to firmly grasp the foreign body ensuring that it did not slip during extraction. One of the three accessory equipment were used - Olympus® Rat Tooth Grasping Forceps (FG-26C-1), Olympus® Dormia Basket (FG-55D) and Roth Net® Airway foreign body removal endoscopic basket. The choice of the equipment depended on nature of the foreign body and choice of the operator. Then the bronchoscope along with the grasped foreign body was gently extracted in toto and negotiated through trachea, vocal cords, and the pharynx. If the flexible bronchoscopy failed, general anesthesia with either LMA (Laryngeal Mask Airway) or rigid bronchoscopy was planned. If the patient required general anesthesia or rigid bronchoscopy, the procedure was performed in the operation room. Patient was either provided GA along with placement of Laryngeal mask airway or intubated using a rigid tracheo-bronchoscope to secure the airway. Foreign body was extracted using a flexible bronchoscope if a LMA was used. A non-optical forceps was used to extract foreign body through the rigid barrel if rigid bronchoscopy was performed.

RESULTS:

Between Jan 2018 and March 2024, a total of 3143 bronchoscopies were performed, of which 18 were for foreign body extraction. The baseline characters of the study population are depicted in Table 1. Patients' age ranged between 12 to 89 years and the majority (72%) were male. Cough was the most common symptom and lobar collapse was the commonest radiological finding. A foreign body was visualized in radiology

in 16 of the 18 (89%) patients. Figure 1 depicts the radiological findings in patients with foreign body aspiration in our study.

Table 1: Baseline characteristics of the study population

Parameter	Value
Age (range)	12-89 years
Males	13 (72%)
Symptoms	18 (100%)
Cough	12 (67%)
Dyspnea	4 (22%)
Hemoptysis	
Radiology	
Foreign body visualized.	16 (89%)
Collapse / atelectasis.	10 (56%)
Consolidation	6 (33%)

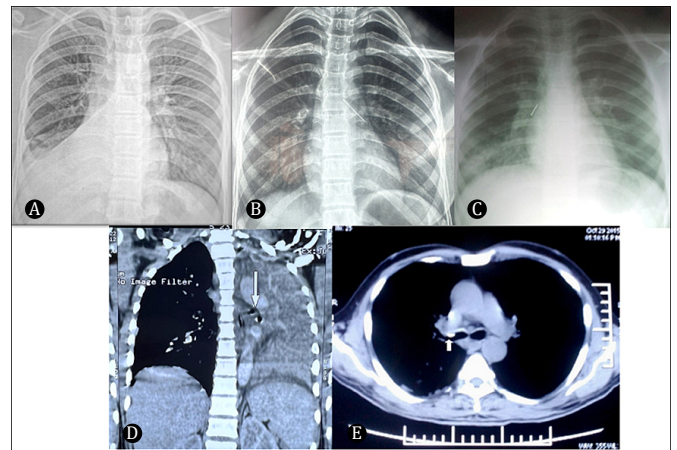


Figure 1: Radiology in foreign body aspiration. A: right lower lobe collapse. B: Pin lodged in the left main bronchus. C: Push pin in right main bronchus. D: Pen cap in left main bronchus causing left lung collapse. E: Fish bone in right lower lobe

The most common site of foreign body lodgment was right lower lobe bronchus followed by bronchus intermedius and left main bronchus. In our study 11 (61%) foreign bodies were organic and 7 (39%) inorganic. Figure 2 shows bronchoscopy findings of airway foreign bodies in selected patients from our study.

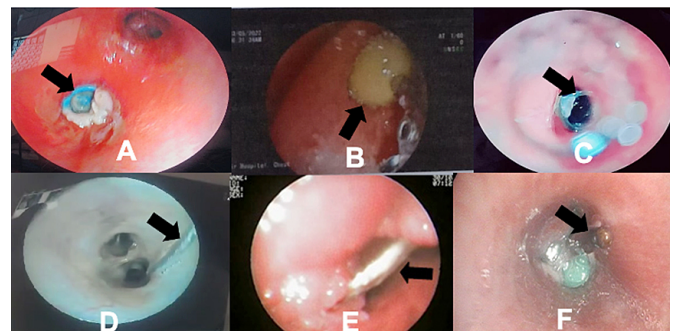


Figure 2: Bronchoscopy findings in patients with airway foreign bodies. A: Pen cap in bronchus intermedius. B: Peanut in RUL bronchus. C: Pen cap in RLL bronchus. D: Pin in RLL bronchus. E: Fish bone in RLL bronchus with granulation tissue. F: Push Pin in RLL bronchus

A total of 19 attempts (flexible bronchoscopy- 18, rigid bronchoscopy – 1) of foreign body extraction in 18 patients were performed during the study period. The incidence of foreign body aspiration was 0.57% of all adult bronchoscopies at our center. Seventeen procedures were performed under mild sedation using Fentanyl and Midazolam in the bronchoscopy suite. Two patients required general anesthesia, one for LMA placement and the other for rigid intubation. Foreign body was successfully extracted by flexible bronchoscope in 17 patients and one patient required rigid bronchoscopy. The success rate of flexible bronchoscopy assisted extraction was 89%. Thirteen (72%) foreign bodies were successfully grasped with a rat toothed forceps and removed successfully. Three (17%) and two (11%) required Dormia basket and Roth fish net basket respectively for removal. Figure 3 shows different accessory equipment used during bronchoscopy to remove the foreign bodies.

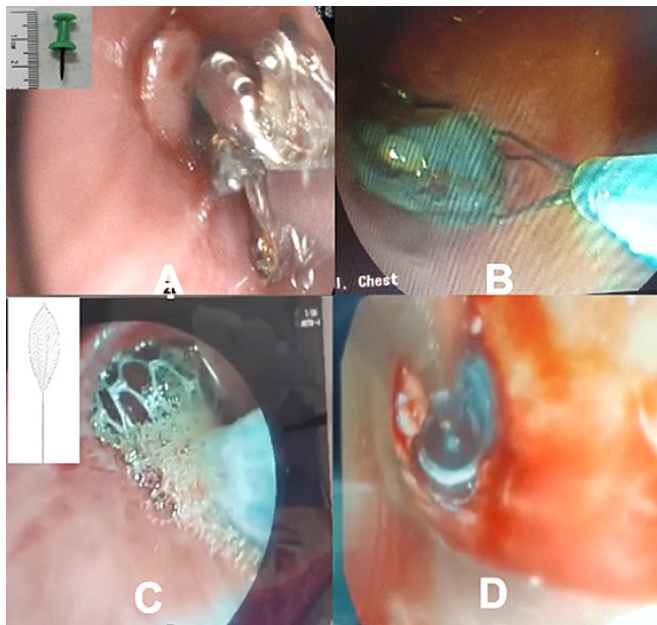


Figure 3: Accessory equipment used during bronchoscopic removal of foreign bodies. A: Rat toothed forceps, B: Dormia Basket, C: Roth Net basket, D: Non optical forceps within the barrel of rigid bronchoscope

Of the 18 patients, 11 had organic foreign bodies which included betelnut, chicken bone, fish bone, peanut, black gram seed, gooseberry (Amala) seed and Acorus calamus (Bojho). Seven had inorganic foreign bodies which included ball pen cap, pin, push pin and tooth. Selected foreign bodies removed via bronchoscopy during the study period is depicted in figure 4. Two attempts of flexible bronchoscopy failed one of which was successfully removed by rigid bronchoscopy. In the other patient with brainstem stroke and tracheostomy, who had aspirated a tooth during endotracheal intubation surgical removal was planned after stabilization. However, the patient succumbed to his primary illness before surgery could be done. One patient complained of mild hemoptysis lasting for 16 hours post procedure which was managed conservatively. No other major complications were noted during or after the procedure and all patients were discharged stable within 24

hours of procedure. Table 2 shows the details of the procedures, locations and accessory equipment used for foreign body removal in our series.

Table 2: Details of the foreign body extraction procedures in the study population.

Parameter	Value
Total Number of Procedures	19
Flexible Bronchoscopy	18 (95%)
Rigid Bronchoscopy	1 (5%)
Laryngeal mask airway + Flexible bronchoscopy	1 (5%)
Anesthesia / Analgesia	
Local Anesthesia	17 (89%)
General Anesthesia	2 (11%)
Location of Foreign body	
Right Lower lobe bronchus	8 (44%)
Bronchus Intermedius	5 (28%)
Left main bronchus	3 (17%)
Upper lobe bronchus	1 (5%)
Segmental bronchus	1 (5%)
Type of foreign body	
Organic	11 (61%)
Betel Nut	4
Peanut	2
Chicken Bone	1
Fish Bone	1
Black gram	1
Gooseberry seed	1
Black gram seed	1
Inorganic	7 (39%)
Pen-cap	4
Pin	1
Push pin	1
Tooth	1
Accessory equipment	
Forceps (Rat-toothed)	12 (67%)
Basket (Dormia)	3 (17%)
Basket (Roth's Net)	2 (11%)
Rigid non-optical forceps	1 (5%)
Success of procedure	
Overall success	17 (94%)
Flexible bronchoscopy	16 (89%)
Rigid Bronchoscopy	1 (100%)
Complications	
Hemoptysis	1 (5%)



Figure 4: Airway foreign bodies after removal from the airways

DISCUSSION:

Airway foreign body are rare in adults and adolescents. We hereby report an incidence of 0.57% of airway foreign bodies and an 89% success rate of flexible bronchoscopy guided extraction, which is comparable to those reported in previous studies^{5,13}. Foreign bodies are more common on the right side owing to a wider diameter and a lesser angle of convergence of the right main bronchus with carina and tend to be lodged more distally in adults⁸. Right lower lobe and bronchus intermedius were the commonest site of lodgment in our series. The distal lodgment is also associated with absence of features of acute respiratory obstruction. Cough is the most common symptom; majority of the foreign bodies were radio-opaque, and collapse was the commonest radiological sign. Diagnosis of foreign body aspiration may be delayed in a few cases, especially in the elderly as they may fail to provide a history of choking episode¹¹. These patients may present with collapse, recurrent pneumonia, or bronchiectasis. Flexible bronchoscopy clinches the diagnosis in such cases.

Rigid bronchoscopy remains the procedure of choice for centrally located foreign bodies especially in children as there is a good airway control and it has a larger working channel^{1,9,10}. It is also preferred if the foreign body has sharp edges and has a lots of granulation reaction as the risk of bleeding is high. Hemostatic control is better if rigid bronchoscope is used as larger forceps and accessories can be used during the procedure. The risk of migration is also reduced. However, rigid bronchoscopy requires general anesthesia and may not be available at all centers. Flexible bronchoscopy is the preferred modality now in adults especially if the foreign body is distal in location. The advantages are that it requires less sedation, it is readily available at many centers and is easy to perform. The success rate of flexible bronchoscopy in adults is high⁵. Flexible bronchoscopy failed to successfully grasp and remove the foreign body in two cases in this study. We performed rigid bronchoscopy guided extraction in one, whereas in the other patient with brainstem stroke and tracheostomy, patient succumbed to his primary illness prior to planned surgery.

In adults, given the high success rate of flexible bronchoscopy, it should be performed in all cases unless contraindicated as in respiratory failure, stridor and cyanosis requiring urgent maintenance of the airway. An initial assessment bronchoscopy helps to confirm the diagnosis, localize the foreign body, and plan the removal procedure. The choice of accessory equipment depends upon the type and location of foreign body and the bronchoscopist's preference. Forceps are by far the commonest ancillary equipment used^{5,8}. Two-third (67%) of the foreign bodies in our series could be successfully grasped with a rat-toothed forceps and removed. Forceps are more suitable for inorganic foreign bodies with thick edges, and hard organic foreign bodies like bones. In foreign bodies with sharp edges such as pins, the prongs of the forceps should hold the sharp tip of the foreign body to avoid airway injury during extraction. We removed two pins using the forceps in our study. Organic foreign bodies such as nuts or meatballs are soft and friable and should not be attempted to remove using a forceps. Larger foreign bodies with a round surface such as betel nuts or seeds are difficult to grasp firmly with a forceps and have a chance of slippage. Baskets (wire baskets and fish net baskets) are the second most common devices used for foreign body retrieval from the airway^{5,8}. We used the Dormia and the Roth net basket in nearly a third of our cases. Large and friable foreign bodies and those with smooth surfaces can be firmly grasped and secured by a basket for removal. These devices are passed distal to the foreign body and deployed while gently withdrawing to engage the foreign body into them. Organic foreign bodies that are cryo-sensitive can also be removed using a cryoprobe. Similarly metallic foreign body can be removed using a magnetic probe. Fogarty balloon catheter may sometimes be useful in mobilizing distally wedged foreign bodies during extraction. We did not use cryoprobe, magnetic probe or Fogarty balloon catheter for foreign body removal in our study.

In our country only a few centers provide services for advanced bronchoscopic procedures. Two prospective studies have reported the rigid bronchoscopy to extract airway foreign bodies in the pediatric population.^{9,10} We have previously reported two cases of successful flexible bronchoscopy guided removal in an elderly patient with fish bone and an adolescent with push pin.^{11,12} The current study indicates a wider use of flexible bronchoscope in foreign bodies in adult population and referrals for the same in Nepal. As bronchoscopy services are expanding throughout the country, pulmonologists need to be well versed with the techniques of foreign body management for a better patient care. Airway foreign body extractions are challenging and require a thorough planning, precise choice of technique and most importantly a teamwork. It is always preferable to have at least two experienced bronchoscopist and a trained nurse to assist the procedure. Continuous reassessment and change of approach, if one approach fails, ensures the success of the procedure. Our study also has some limitations. The study has a relatively small sample size; hence the high success rate of flexible bronchoscopy needs to be replicated in a larger cohort. Pediatric population is excluded

from the study as our center only sees adolescent and adult patients with respiratory symptoms. Our center is a tertiary level government referral hospital, hence there might also have been a referral bias as rigid bronchoscopy services have started only recently in our department.

CONCLUSION:

Flexible bronchoscopy has a high success rate in management of airway foreign bodies in adults. Initial bronchoscopy assessment for feasibility of removal under light sedation should always be considered as first line. Careful planning, appropriate use of accessory equipment and a team approach is the key to success.

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