

Bronchoscopy for foreign body removal: Practical Guidelines

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Introduction

Airway foreign bodies have been a major cause of morbidity and mortality all over the world. It affects children mostly but adults may be also affected under special conditions.

The rigid bronchoscope was used primarily to remove foreign bodies during the first half of the 20th century (in 1897).

Training in rigid bronchoscopy for foreign body removal is gaining more importance especially for otolaryngologists managing pediatric patients. Bronchoscopy in the past was a dangerous procedure with high morbidity and mortality, but recently it is turned into a relatively safe procedure due to the developments in the field of anesthesia and bronchoscopy equipments as optical telescope and solid-rod lens optical systems.

Foreign body aspiration sites

Foreign bodies may be inhaled and cause respiratory obstruction at different levels. Most end up in peripheral bronchi (80-90%) with the right main stem most common as it has less divergent angle and greater diameter. These anatomical differences are apparent only after the age of 15 years (the bronchial angles are symmetric until 15 years of age). Large and irregularly shaped foreign bodies are more likely to become lodged in the laryngeal inlet.

Clinical picture:

Most patients with foreign body aspiration present with an acute onset of choking, respiratory distress, cyanosis, severe coughing and wheezing. On examination, patients may have stridor, wheezing, decreased breath sounds in the affected lung, or normal results on pulmonary physical examination. Stridor may be inspiratory or biphasic stridor in laryngeal or cervical tracheal foreign bodies. If the foreign body is impacted in the intrathoracic trachea, the stridor is prolonged expiratory in nature.

Bronchial foreign bodies manifest with unequal breath sounds with a diagnostic triad present in less than 50% of cases. The triad consists of unilateral wheeze, cough, and ipsilaterally diminished breath sounds. The symptoms and examination can mimic asthma, croup or pneumonia.

Diagnosis of Foreign body aspiration:

The diagnosis of foreign body aspiration depends on three elements:

1. History:

A history of aspiration may be lacking, and patients may present days to weeks after the event. A positive history must never be ignored, while a negative history may be misleading. Persistence of pneumonia or atelectasis symptoms beyond one week must raise the possibility of a retained foreign body.

2. X-ray:

Anteroposterior and lateral projections including anteroposterior neck in full inspiration and expiration are done. Obtaining 2 views of the foreign body helps in determining its location and excludes the presence of superimposed multiple foreign bodies.

Left and right lateral decubitus positions in infants are requested due to difficulty to obtain expiratory and inspiratory films. In decubitus films, dependent lung should collapse but will remain inflated if there is a foreign body.

Radiopaque foreign bodies are easily seen with X-ray. Radiolucent foreign bodies (80%) may cause obliteration of bronchial air column, atelectasis, mediastinal shifts, or air-trapping in the affected lung. It may show signs of a subglottic opacity or swelling from airway inflammation on posteroanterior and lateral neck radiographs.

So, radiographic findings in cases of suspected foreign body aspiration include:

- a) Normal findings (25%).
- b) Signs of air trapping (Figure 1).
- c) Mediastinal shift.
- d) Atelectasis.
- e) Pneumonia (Acute or recurrent).
- f) Lobar collapse.
- g) Radiopaque foreign body.

There are some differences in the radiological findings in adults and children. In adults, lobar or segmental collapse may occur and atelectasis or consolidation is often not appreciated for at least 24 hours. Children commonly present with overaeration of the lung distal to the site of obstruction due to collateral air drift.

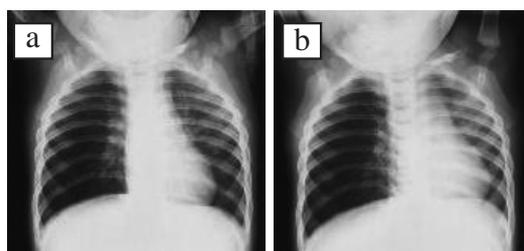


Figure 1: Plain X-ray of the chest showing enhancing air trapping in the expiratory film (b) as compared to the inspiratory film (a).

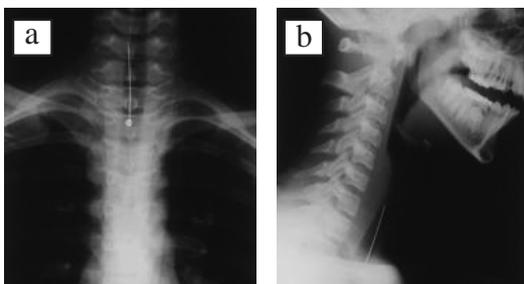


Figure 2: PA (a) and lateral plain X-ray of the chest and neck (b) showing the foreign body in the trachea

If foreign body aspiration is suspected, a normal finding on chest x-ray films does not exclude the diagnosis. It is important to take off the patient's clothes before imaging to exclude external foreign bodies which sometime may be confusing.

Despite advances in radiologic techniques, the diagnosis of foreign body aspiration can be difficult, and endoscopy may be required.

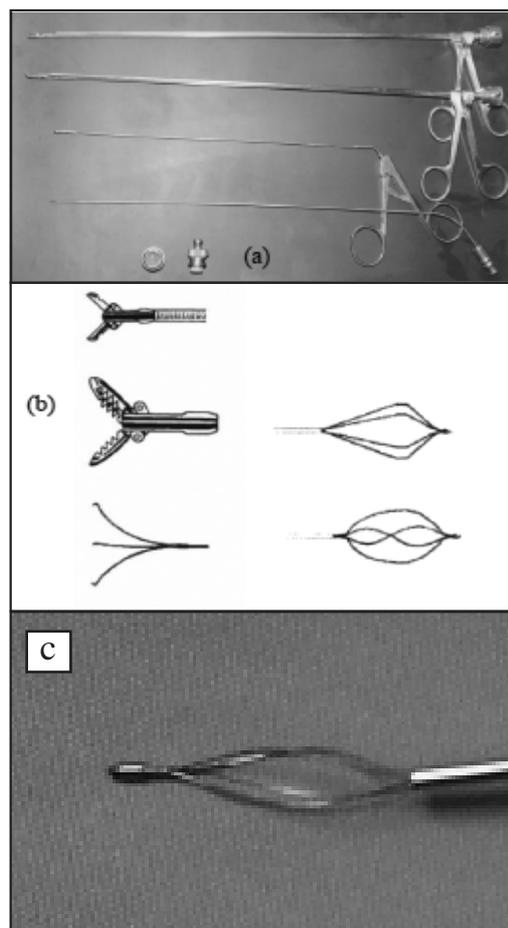


Figure 3: The forceps and suction set (a). The set should include forceps suitable for the type of foreign body expected (b). Also, special instruments as basket coil and basket hexagonal should be available (c).

3. Rigid Bronchoscopy:

The Procedure

Rigid bronchoscopy is not a direct emergency unless there is total airway obstruction at any level. Usually this occurs if obstruction is at high level but may also occur with the rare situation of having double bronchial foreign bodies.

Another emergency situation is the inhalation of a small alkaline battery which may cause severe tissue reaction and it has to be removed as early as possible. In non-emergency cases, it is advisable to take time for the arrival of trained personnel, to assemble and check instruments and to wait for emptying of stomach of the patient. It is of value to find duplicate foreign body (for uncommon types) to test the instruments.

The technique:

For training and educational purposes, the technique is done according to the following steps:

- A. Preparation
- B. Positioning of the patient.
- C. Anesthesia.
- D. Introduction of the bronchoscope.
- E. Identification of the anatomy.
- F. Removal of the foreign body
- G. Re-checking.
- H. Withdrawal of the bronchoscope.
- I. Emergence from the operating room and postoperative care.

A. Preparation

- * Dentures should be removed.
- * Check your instruments: Equipments needed are those for general anesthesia, spontaneous ventilation & bronchoscopy:
- * Laryngoscopes
- * Bronchoscopes: Age matched appropriate bronchoscopes and a size smaller are needed in case edema or stenosis is encountered.
- * Check the length of the suction tube and the forceps in relation to the bronchoscope (Figure 3,4).
- * Suction
- * Forceps: Optical Forceps and/or a magnifying piece (Figure 4). It is also advisable to have ordinary forceps to be used in simple cases
- * Rod-lens telescopes

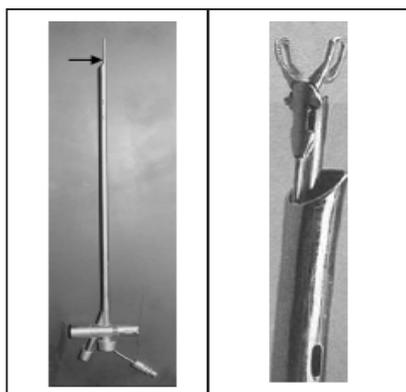


Figure 4: Check the length of the suction tube and the forceps in relation to the bronchoscope.

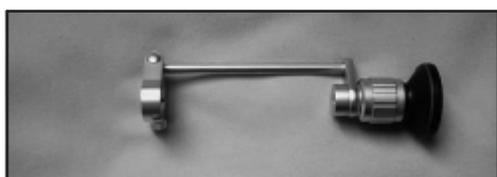


Figure 5: Magnification piece can be used with non-optical forceps in straight forward cases.

B. Position:

Patient should be positioned supine with the head even with the end of the operating room table equipped with a moveable headpiece. The head is fully extended after keeping a pillow or a ring beneath it so that the chin points vertically upwards: *shaving chin position* (Figure 6).

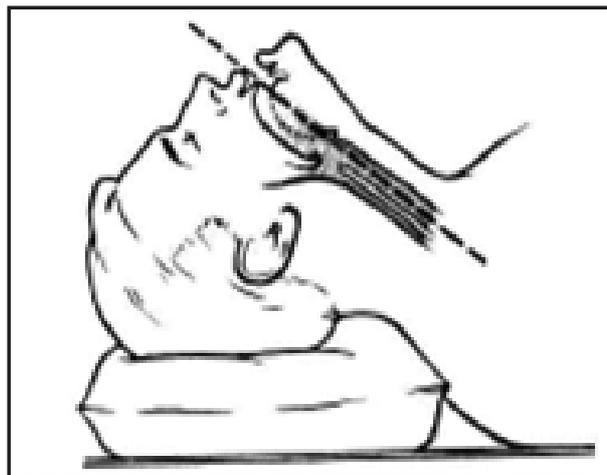


Figure 6: The shaving chin position

C. Anaesthesia :

Anesthesia is induced with inhalation (sevoflurane or halothane) agents with oxygen. Spontaneous ventilation is needed via inhaled rather than fixed agents. Nitrous oxide is contraindicated in patients with air trapping because of the risk of lung overinflation. Pulse oximetry monitoring is mandatory. *No muscle relaxant is given at induction: Never paralyze a foreign body patient. Also, no endotracheal intubation is done before evaluating the location of the foreign body.* Check the light of the laryngoscope (Figure 7), remove any artificial denture, and use the teeth protector (Figure 8).



Figure 7: Check the laryngoscope light

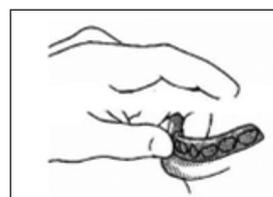


Figure 8: Protect the upper teeth after removal of any removable artificial teeth.

Once the patient can tolerate laryngoscopy, the airway can be sprayed with 4% lidocaine (4mg/kg of 4% lidocaine, or 0.1 ml of the 4% solution per kg) before the surgeon inserts the bronchoscope. *Lidocaine doses up to 7 mg/kg have been proven safe if administered over 15 minutes.*

It is important to handle the laryngoscope gently and under no circumstances should the upper teeth or gum be used as a fulcrum to lever the laryngoscope or the bronchoscope into position (Figure 9).



Figure 9: The upper teeth or gum should not be used as a fulcrum to lever the laryngoscope or the bronchoscope into position.

If the 2.5-, 3.0-, and 3.5-mm internal-diameter bronchoscopes are used, there will be increased resistance to breathing. In combination with anesthetic agents that depress respiration, this increased resistance may result in compromised ventilation and oxygenation during spontaneous breathing.

D. Introduction of the bronchoscope

The bronchoscope is introduced while the anesthetic gases are delivered to the patient, who is **spontaneously breathing**. The patient should be on 100% oxygen for at least 2 minutes.

The forefinger and thumb of the left hand form a supportive guide for the bronchoscope and protect the teeth or gums from trauma (Figure 8). Again, under no circumstances should the upper teeth or gum be used as a fulcrum to lever the bronchoscope into position.

The telescope is introduced after visualization of the laryngeal inlet by the laryngoscope (Figure 10).

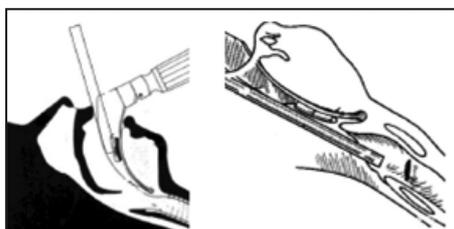


Figure 10: Introduction of the bronchoscope guided by the laryngoscope after exposure of the laryngeal inlet

The orientation of the bronchoscope is modified during its introduction between the vocal folds as illustrated in figure 11. Thus it is important to minimize trauma of the vocal folds or the arytenoids.

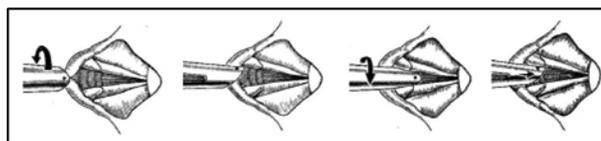


Figure 11: Modification of the bronchoscope orientation during its introduction.

After stabilizing the bronchoscope in the trachea, connect the ventilation arm of the bronchoscope to the anesthesia system. Use a light connection tube in order to facilitate handling of the bronchoscope. Short connection (Figure 12) will limit the bronchoscope manipulation.



Figure 12: Short connection between the bronchoscope ventilation port and the anesthesia system is to be avoided as it hinders free handling of the bronchoscope and the instruments.

E. Anatomy identification:

Observe the tracheal rings. The posterior membranous portion will bulge normally during expiration and cough. You have to familiarize yourself with the segmental anatomy and a three dimensional feel for the tracheobronchial tree.

F. Foreign body manipulation:

Muscle relaxant is requested after identifying the nature and location of the FB and before any manipulation. A muscle relaxant facilitates foreign body removal by keeping the vocal folds perfectly immobile decreasing cough and bronchospasm. The airway is secured by the bronchoscope and the attached ventilation arm. Adequate relaxation of the upper airway and glottis reduces the risk that the foreign body will be lost when it is pulled out of the airway with the grasping forceps and the bronchoscope. Suction to remove any secretions is done sparingly and intermittently to avoid damage to the mucous membrane and bleeding. The sub segments will also collapse with excessive suction.

Always enter the side opposite to the known abnormal lung as the preoccupation with the abnormal lung may

preclude the operator from spending sufficient time for evaluation of the normal side and the anesthesia will stay current. Suction opposite bronchus to improve oxygenation. After suctioning the opposite bronchus, advance to foreign body and atraumatically grasp it. Smaller objects can be pulled through the bronchoscope, larger objects are to be pulled snugly against bronchoscope and removed as one unit.

In some cases you may need to remove granulation tissue or to apply topical vasoconstrictors for bleeding. Trial of FB removal is done until the oximeter readings start to drop. When this occurs, typically after 2-3 minutes, the glass shield is repositioned and the patient is well ventilated with 100% oxygen, and the cycle is repeated as many times as necessary.

G. Re-check.

It is important to repeat bronchoscopy after suctioning of the bronchus as multiple foreign bodies may be found in 5-19%.

J. Withdrawal of the bronchoscope.

When the examination is complete, the bronchoscope is removed and bag-and-mask ventilation with 100% oxygen is instituted. Withdrawal of bronchoscope also requires care. This should be done visually until the tip reaches the tongue. An endotracheal tube may be inserted if the patient is apneic; if blood, secretions, or difficult anatomy make the airway tenuous; or if the patient has a full stomach. If not, the patient may be awakened without an endotracheal tube, as long he or she is closely observed by qualified personnel until airway reflexes have returned.

K. Emergence from the operating room.

During emergence, leave the child unstimulated and mechanically ventilated until spontaneous movement occurs. Do not stimulate with a suction catheter, jaw thrust, etc. It is very important that the child is very awake prior to extubation, not just aroused by inappropriate stimulation.

Be prepared to wait -- a deep inhalation anesthetic of the type described may require 10+ minutes for recovery. It is desirable to extubate these patients in the operating room (not in the recovery room) since it is far easier to regain airway access, if necessary, in the operating room environment.

L. Postoperative Care:

Prevention/treatment of post-op croup: For children with stridor preoperatively or children who have subglottic

involvement, consider giving Decadron (4-10 mg IV) before the airway is instrumented. For post-operative stridor, consider nebulized racemic epinephrine (0.5 ml in 2.5 ml) in the recovery room. Chest physiotherapy may be needed for retained secretions. Antibiotics and steroids are not routinely used.

Problems encountered during bronchoscopy for foreign body removal:

a. Slipped foreign body in the trachea causing complete airway obstruction:

Push the foreign body back into a bronchus, preferably same one, stabilize, attempt removal again.

b. Sharp foreign body as in figure 13, advance the bronchoscope over the foreign body to protect the mucosa during removal.



Figure 13: Plain PA chest radiograph showing a sharp foreign body (a needle) in the trachea and the right main bronchus.

c. Large solid and semisolid objects: you have to be equipped with appropriate grasping instruments.

d. In patients with maxillofacial or cervical trauma: use flexible fiberoptic bronchoscope.

e. Rigid Bronchoscopic procedure-related adverse events:

Most complications of rigid bronchoscopy are due to poor insertion techniques, prolonged trauma of the larynx and vocal cords, or failure to avoid or correct hypercapnia, hypoxemia, or hemodynamic instability. Bronchoscopists should not forget that the airway is shared with the anesthesiologist. A team approach to each procedure is therefore necessary. Oxygenation and ventilation always take priority over any rigid bronchoscopic manipulations. Any attempt of removal of the foreign body should be stopped to regain safe oxygenation of the patient. Other complications can be avoided by a careful handling and inspection of the mouth, teeth and gums. Patients with a history of laryngo- or bronchospasm should receive inhaled bronchodilators and IV corticosteroids before and after the procedure. Bronchospasm results from instrumentation of an inadequately anesthetized airway, particularly if the bronchoscope is in contact with the carina.

Patients with cervical spine disease and severe osteoporosis should be evaluated carefully before deciding their fitness for the procedure of rigid bronchoscopy.

Airway wall perforation may occur at the posterior wall of the trachea, subglottis, and median walls of the left and right main bronchi just below the carina. Perforation can be caused by inadvertent rigid bronchoscopic manipulations.

Luxation or laceration of the vocal cords and arytenoids results from faulty intubation technique, but can also occur if intubation is attempted before a patient is fully anesthetized.

References

1. Baharloo F, Veyckemans F, Francis C, et al: Tracheobronchial foreign bodies: presentation and management in children and adults. *Chest* 1999 May; 115(5): 1357-62.
2. Darrow DH, Holinger LD: Foreign bodies of the larynx, trachea, and bronchi. *Pediatr Otolaryngol* 1996; 2: 1390-401.
3. Esclamado RM, Richardson MA: Laryngotracheal foreign bodies in children. A comparison with bronchial foreign bodies. *Am J Dis Child* 1987 Mar; 141(3): 259-62.
4. Franquet T, Gimenez A, Roson N, et al: Aspiration diseases: findings, pitfalls, and differential diagnosis. *Radiographics* 2000 May-Jun; 20(3): 673-85.
5. Hoeve LJ, Rombout J, Pot DJ: Foreign body aspiration in children. The diagnostic value of signs, symptoms and pre-operative examination. *Clin Otolaryngol* 1993 Feb; 18(1): 55- 57.
6. Hunter TB and Taljanovic MS: Foreign bodies. *Radiographics*. 2003; 23:731-757 (©RSNA, 2003).
7. Ikeda M, Himi K, Yamauchi Y, et al: Use of digital subtraction fluoroscopy to diagnose radiolucent aspirated foreign bodies in infants and children. *Int J Pediatr Otorhinolaryngol* 2001 Dec 1; 61(3): 233-42.
8. McGuirt WF, Holmes KD, Feehs R, Browne JD: Tracheobronchial foreign bodies. *Laryngoscope* 1988 Jun; 98(6 Pt 1): 615-8.
9. Merchant SN, Kirtane MV, Shah KL, Karnik PP. Foreign bodies in the bronchi (a 10 year review of 132 cases). *J Postgrad Med* 1984; 30:219-23.
10. Mittleman RE, Wetli CV: The fatal cafe coronary. Foreign-body airway obstruction. *JAMA* 1982 Mar 5; 247(9): 1285-8.
11. Perrin G, Colt HG, Martin C. Safety of interventional rigid bronchoscopy using intravenous assisted ventilation. *Chest* 1992; 102:1526-1530.
12. Prakash UB, Cortese DA: Tracheobronchial foreign bodies. In: *Bronchoscopy: A Text Atlas*. Lippincott-Raven; 1997:253-277.
13. Prakash UB, Cortese DA: Tracheobronchial foreign bodies. In: *Bronchoscopy: A Text Atlas*. Lippincott-Raven; 1997:253-277.
14. Silva AB, Muntz HR, Clary R: Utility of conventional radiography in the diagnosis and management of pediatric airway foreign bodies. *Ann Otol Rhinol Laryngol* 1998 Oct; 107(10 Pt 1): 834-8.
15. Tan HK, Brown K, McGill T, et al: Airway foreign bodies (FB): a 10-year review. *Int J Pediatr Otorhinolaryngol* 2000 Dec 1; 56(2): 91-9.
16. Warshawsky M: Foreign body aspiration. Available at: <http://www.emedicine.com/foreignbody-aspiartion.htm>
17. Weissberg D, Schwartz I: Foreign bodies in the tracheobronchial tree. *Chest* 1987 May; 91(5): 730-3.