

Foreign body aspiration in children

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Abstract

Foreign body lodged in either larynx or bronchi lead to significant morbidity and mortality in children. It can lead to severe asphyxiating choking which if not recognised and intervened immediately can be fatal. The other non-asphyxiating mild type of choking requires proper history and radiological examination for diagnosis. Bronchoscopy is helpful in confirming the diagnosis as well as in extraction of the foreign body. Public awareness can be helpful in preventing this type of injury in children.

Keywords: Foreign body aspiration; Children.

Introduction

Accidental inhalation of both organic and non-organic foreign bodies continues to be a cause of childhood morbidity and mortality, requiring prompt recognition and early treatment to minimize the potentially serious and sometimes fatal consequences. Children, especially toddlers, tend to place objects in their mouths while exploring their environment. They are therefore at increased risk of inhaling foreign bodies, which may become lodged in the tracheobronchial system.

Epidemiology

Worldwide, 55% of children who have inhaled foreign bodies are between 1 and 3 years of age and 7-10% are under 1 year of age[1]. During 2008-9, just over 300 hospital admissions in England were due to foreign body inhalation in children up to 14 years of age [2]. In the United States, foreign body inhalation accounts for 7% of accidental deaths in children under 4 years of age[3]. At a centre in India a review of 165 pediatric cases of suspected foreign body aspiration revealed, children between 1 and 3 years

were found to be very vulnerable for aspiration[4].

Pathophysiology

Children are more prone to aspirate foreign material for several reasons. The lack of molar teeth in children decreases their ability to sufficiently chew food, leaving larger chunks to swallow. The propensity of children to talk, laugh, and run while chewing also increases the chance that a sudden or large inspiration may occur with food in the mouth. Children often examine even non-food substances with their mouth.

The most common entities aspirated are small food items such as nuts, raisins, sunflower seeds, improperly chewed pieces of meat and small, smooth items such as grapes, hot dogs, and sausages. All of these should be avoided until the child is able to adequately chew them. Generally, this occurs around age of 5 years. Small items that are round, smooth, or both (eg, grapes, hot dogs, sausages, balloons) are more likely to cause tracheal obstruction and asphyxiation. Dried foods may cause progressive obstruction as they absorb water.

In a review of 1068 foreign body aspirations in children, 3% was found in the larynx, 13% in the trachea, 52% in the right main bronchus, 6% in the right lower lobe bronchus, fewer than 1% in the right middle lobe bronchus, 18% in the left main bronchus, and 5% in the left lower lobe bronchus; 2% were bilateral [5]. In a child in an upright position, the right-sided airways are direct entries from the trachea. The left main bronchus is smaller than the right main bronchus and is slightly angled. In a child

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in a supine position, material is more likely to enter the right main bronchus.

Diagnosis

Sudden episode of coughing or choking while eating with subsequent wheezing, coughing, or stridor is most common presentation. Hence careful history taking regarding onset of symptoms and its beginning during or just after food ingestion is very important in diagnosis of a foreign body inhalation. However, in numerous cases, the choking episode is not witnessed, and, in many cases, the choking episode is not recalled at the time the history is taken. In these situations, the child may present with persistent or recurrent cough, wheezing, persistent or recurrent pneumonia, lung abscess, focal bronchiectasis, or haemoptysis.

The most tragic cases occur when acute aspiration causes total or near-total occlusion of the airway, resulting in death or hypoxic brain damage. They present with sudden onset of increasing breathing difficulty, unable to make any sound or speech, older children may show universal choking sign by clutching of throat with their hands. The urgent recognition of such condition and obstruction relieving technique like back blows and chest thrusts in infants and Heimlich manoeuvre in older children are required for saving life of the victim.

If the material is in the subglottic space, symptoms may include stridor, recurrent or persistent croup, and voice changes.

In one series, as many as one third of parents were unaware of the aspiration or remembered an event that occurred more than a week before the presentation [6]. In as many as 25% of cases, aspiration occurred more than one month before presentation. Consequently, a high index of suspicion in addition to the history may be necessary to reach the diagnosis. In another series of 280 foreign body aspirations, 47% were detected more than 24 hours after the aspiration[7]. However, 99% had signs or symptoms or abnormal plain radiographs before the bronchoscopy.

Clinicians may fail to consider the diagnosis of an inhaled foreign body if the child has no symptoms at presentation or presents with prolonged or atypical symptoms, especially when physical examination and chest radiograph findings are normal. Inhaled objects that do not cause an intense inflammatory response (plastic toys, for example) or that result in only partial airway occlusion are the most difficult to detect.

Radiology

Most aspirated foreign bodies are food material and are radiolucent. Thus, one has to look indirectly for signs of the foreign body.

A plain radiograph can reveal an area of focal over inflation or an area of atelectasis, depending on the degree of obstruction.

If the material completely occludes the airway, the radiograph may reveal opacification of the distal lung as residual air is absorbed and no air entry is possible.

If the obstruction is partial, progressive ball valve obstruction results in focal over inflation in the area of the lung distal to the affected airway.

If the child cooperates, an anteroposterior expiratory radiograph may reveal trapped air in the affected portion of the lung. In those children who cannot cooperate with the manoeuvre, lateral decubitus radiographs may reveal the trapped air. An anteroposterior film with compression on the abdomen, mimicking a forced exhalation, can be helpful.

Fig. 1: Chest X-ray of foreign body aspiration.



Fluoroscopy

Fluoroscopy of the chest may be helpful in showing focal air trapping, paradoxical diaphragmatic motion, or both.

CT scan

Chest CT scanning may reveal the material in the airway, focal airway edema, or focal over inflation not detected using plain radiography. If the index of suspicion is high, many physicians forgo CT scanning and proceed to the more definitive study,

bronchoscopy. The use of CT scan in managing the child with a foreign body in the airway has recently been questioned.

Even if no foreign body is evident on any of the radiographic studies, a foreign body may still be present, and a bronchoscopy should be performed if the suspicion is high.

Treatment

Acute choking, with respiratory failure associated with tracheal or laryngeal foreign body obstruction, may be successfully treated at the scene with the Heimlich manoeuvre, back blows, and abdominal thrusts. Hence public awareness and learning skill for identifying such type of severe choking and relieving obstruction at scene is very important in saving lives in such conditions.

In nonemergency situations bronchoscopy can be used diagnostically and therapeutically. Most aspirated foreign bodies are radiolucent. Radiologic procedures do not have extreme diagnostic accuracy, and aspiration events are not always detected. Other medical conditions are possible. The presentation may be delayed, and the patient may have been unsuccessfully treated for other conditions.

The presence of a foreign body and its condition, anatomic location (eg, larynx; trachea; main, lobar, or segmental bronchus), shape, composition, position, and extent of entrapment by edema or granulation tissue must be identified prior to extraction attempts. If the foreign body is of a color that might camouflage it within the surrounding mucosa (eg, carrot, rubber pencil eraser) or if the object is completely engulfed by granulation tissue, it may be missed. If it is too distal, the object may not be visualized.

Rigid bronchoscopy

Rigid bronchoscopy usually requires heavy intravenous sedation or general anesthesia. The rigid bronchoscope has important advantages over the flexible bronchoscope. The larger diameter of the rigid bronchoscope facilitates the passage of various grasping devices, including a flexible bronchoscope. A better chance of quick, successful extraction and better capabilities of suctioning clotted blood and thick secretions are offered by the rigid bronchoscope. The pediatric flexible bronchoscope lacks a hollow working channel through which instruments may be inserted or blood and secretions may be aspirated.

Unlike the flexible bronchoscope, the patient can be ventilated through the rigid scope. Rigid

bronchoscopy is the procedure of choice for removing foreign bodies in children and in most adults. Success rates for extracting foreign bodies are reportedly more than 98%. Large solid and semisolid objects are best managed emergently in the operating room with a rigid bronchoscope and appropriate grasping instruments.

Whichever type of bronchoscope is used, practice grasping and manipulating a similar object outside of the body to help reduce the likelihood of shattering the object or of impacting the object to an even less favorable position.

Flexible bronchoscopy

The flexible fiberoptic bronchoscope can be directly inserted into the trachea trans nasally or trans orally. It can also be inserted into the trachea through a rigid bronchoscope or through a large endotracheal tube. Sedatives can be administered if needed. Small forceps, baskets, and Fogarty balloon catheters can be inserted through the narrow working channel. The instrument offers a limited capability to visualize, grasp, and remove certain foreign bodies of appropriate size, shape, and position. As with rigid bronchoscopy, it is imperative to practice grasping an identical object outside of the body before attempting to manipulate the aspirated object.

While passing the flexible bronchoscope through the larynx via the trans nasal route is easier than the trans oral route, the latter is preferable if removal of the foreign body is anticipated. Aspirated foreign bodies are too large or rigid to be withdrawn through the flexible bronchoscope and often also cannot be withdrawn through an endotracheal tube. Withdrawal of an exposed foreign body poses the risks of trauma and impaction in the trachea, larynx, or pharynx. Any attempt to withdraw the bronchoscope from the nose with an exposed foreign body tenuously grasped at its tip poses the additional risk of trauma and impaction in the nasal passage.

Despite its limitations, use of the flexible fiberoptic bronchoscope may be necessary in patients with maxillofacial or cervical trauma in whom rigid bronchoscopy is not feasible.

Flexible bronchoscopy can be performed to confirm, localize, and visualize the foreign body in the tracheobronchial tree. The flexible bronchoscope can provide access to sub segmental bronchi beyond that provided by the rigid bronchoscope. If gas exchange is already compromised or if insertion of

the flexible bronchoscope would result in significant impairment of gas exchange, flexible bronchoscopy is contraindicated. Diagnostic flexible bronchoscopy prior to rigid bronchoscopy has even been advocated for non asphyxiating children in whom the diagnosis of foreign body aspiration cannot be confirmed.

For the same reasons, flexible bronchoscopy also exposes the patient to a greater risk of bleeding, perforation, shattering of the object, and losing the object in the subglottic area or more distal bronchus. With flexible bronchoscopy, the potential exists for a more difficult subsequent extraction, worse airway obstruction, or even asphyxiation.

Whichever technique is used, it is essential to determine that all of the foreign body has been extracted. Objects not successfully removed may fragment and become impacted in bronchi that are more distal. Carefully examine the extracted object for integrity. Inspect the tracheobronchial tree for fragments or other unsuspected foreign bodies.

Heimlich manoeuvre

If the child has respiratory distress and is unable to speak or cry, complete airway obstruction is probable, and the likelihood of morbidity or mortality is high. In those cases, a Heimlich manoeuvre may be performed. If the child is able to speak, the Heimlich manoeuvre is contraindicated because it might dislodge the material to an area where it could cause complete airway obstruction.

Medication

Bronchodilators and corticosteroids should not be used to remove the foreign body, and chest physical therapy with postural drainage may dislodge the material to an area where it may cause more harm, such as at the level of the vocal cords. Medications are not necessary before removal, although the endoscopist may observe enough focal swelling after the material is removed to recommend a short course of steroid. Unless the airway secretions are infected with organisms present, antibiotics are not necessary.

Table 1: Immediate assessment and action guidelines for choking in infant, child and adult as per IAP- BLS guidelines[8].

signs	The block is	Rescuer actions
1. Good air exchange	Mild	1. Stand by and encourage the victim to continue spontaneous breathing efforts and coughing
2. Can make sounds		2. Do not interfere with the victims' own attempt to expel the foreign body, but stay with victim and monitor condition.
3. Can cough loudly May wheeze between coughs.		1. Ask the victim (older child / adult) if he/she is choking. If the victim nods "yes"
1. Cannot breath or increased severe respiratory difficulty		2. And cannot talk, severe airway obstruction is present and you must try to relieve the obstruction #.
2. Has a cough that has no sound or		
3. Cannot make a sound or high pitched noise		
4. Possible cyanosis		
5. Older child / adult make the choking sign.		

#relieving obstruction in responsive infant with severe choking

5 back blows and 5 chest thrusts are given alternatively keeping the head down, till foreign body is expelled or victim becomes unresponsive.

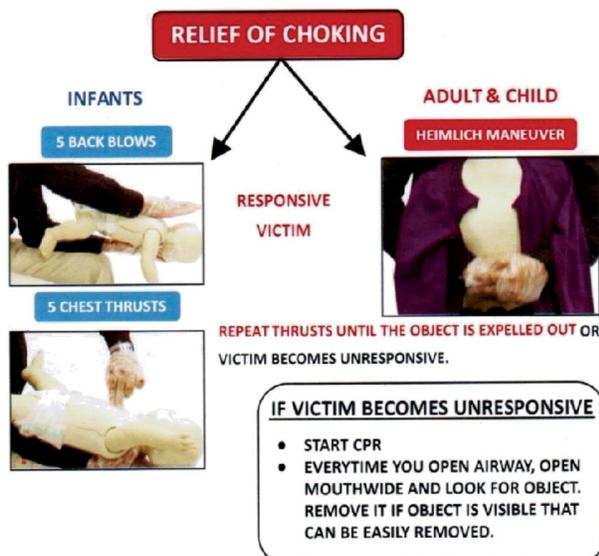
Relieving obstruction in responsive child (> 1 Yr. age) /adult with severe choking

Heimlich maneuver is done till foreign body is expelled or victim becomes unresponsive.

Choking and unresponsive victim

if the victim of choking has become unresponsive (could be due to failed attempt of back blow and chest thrust / Heimlich in severe choking) CPR is started and before giving breath every time mouth is wide opened to look for any foreign body in oral cavity. If seen, it is scooped out.

Fig. 2: Maneuvers in severe choking



Prevention

FBs are a life-threatening event in children that require early diagnosis and prompt successful management. Prevention is the most critical element in reducing morbidity. Since prevention is the key for dealing with these types of injuries [9], more effort in the caregivers' education is warranted. Prevention of aspiration of FBs is better than the cure. Public awareness through the mass media should draw attention and help prevent FB inhalation [10]. Shlizerman et al. found that well-defined public education programmes could achieve prevention.

Various strategies have been used to decrease choking risks and prevent adverse outcomes, such

as changes in product design and public education campaigns. Primary care physicians play a critical role in increasing education efforts during each child's office visit by helping parents through anticipatory guidance of choking risks [11]. Small spherically shaped food items, such as nuts and seeds, are those most likely to cause tracheal obstruction and asphyxia. All these foods should be avoided until the child is able to chew them adequately while sitting. Generally, chewing and swallowing become more co-ordinated around the age of 5 years. Therefore, caregivers should be informed that children under the age of 4 should never eat nuts or other round, crunchy foods, making prevention the most effective treatment of FB injuries[12].

Summary

Foreign body inhalation could be a life threatening event in any child. Prompt recognition of the asphyxiating condition of severe choking and appropriate action of back blows, chest thrust and Heimlich manoeuvre can be life saving. Nonasphyxiating condition is recognised by typical history of sudden onset of symptoms along with eating something. Bronchoscopy is useful in confirming diagnosis as well as in extracting impacted foreign body. This condition can be prevented with appropriate measures like community education.

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