

Airway Foreign Bodies

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INTRODUCTION

The presentation of an airway foreign body can range from benign to truly life-threatening. Respiratory tract obstruction from an airway or esophageal foreign body is relatively rare but remains a leading cause of morbidity and mortality among children. Up to half of patients with a confirmed foreign body do not have a history suggestive of aspiration, and 20% of children are misdiagnosed and improperly treated for a month or more before diagnosis. A high index of suspicion and thorough physical examination skills are necessary in the initial evaluation of these patients.

There are limited epidemiological data on the morbidity and mortality of airway foreign bodies. The most recent update from the Centers for Disease Control and Prevention in 2001 cited an estimated 17,537 children aged 0–14 years visited the emergency department for choking; 1,844 of these were hospitalized. A mortality rate of 2.75% has been documented for pediatric patients admitted with the diagnosis of aspirated foreign body. The majority of airway foreign bodies occur in children younger than age 4 years, with a slight male predominance. Foods such as hard candy, seeds, and nuts are the most frequently

retrieved objects from the respiratory tract, followed by nonorganic objects such as small toy parts, beads, and rocks.

Due to a combination of developmental and anatomic factors, children are especially at risk for foreign body aspiration and its complications. Molars are used to crush and grind food prior to swallowing; prior to the eruption of primary molars in children younger than age 3 years, the lack of these teeth may increase the risk of aspiration because it is more difficult to appropriately reduce the size of food boluses by chewing. It is for this reason that hard foods such as carrots and nuts are generally not recommended in this age group. Developmentally, hand–mouth exploration of their environment is a common activity for children, which also increases the risk of aspiration in this age group.

The management of foreign bodies in a pediatric airway should take multiple factors into consideration, including the presence of respiratory distress, the potential location and type of foreign body, the ability to visualize and reach it, and the child's compliance with removal.

NASAL FOREIGN BODY

See Chapter 46 on foreign body removal.

HYPOPHARYNGEAL FOREIGN BODY

The hypopharynx is the short anatomical area extending from the epiglottis to just below where the trachea and esophagus separate into distinct tracts. The larynx is the first part of the trachea. Retained hypopharyngeal foreign bodies are rare but precarious and require immediate recognition to avoid worsening obstruction. The most common retained foreign bodies in this area are bony portions of fish or chicken or a large/partially masticated food bolus.

Other objects such as coins, batteries, and small toys may also be ingested by young children during oral environmental exploration.

Presentation

Children typically will present acutely due to the dysphagia caused by the lodged foreign body. Bloody secretions may be present secondary to removal attempts or associated retching. Frank hematemesis is concerning for potential catastrophe caused by a button battery eroding through the esophageal mucosa or a full-thickness penetration of an object in the esophagus. Prior to arrival, there may have been some attempts at manual removal or drinking water or swallowing other food in the hopes of dislodging the object.

Prior to arrival, parents often encourage drinking water or swallowing food in an attempt to dislodge foreign bodies associated with food. Manual removal attempts may occur with both food and foreign object aspiration. Frequently, foreign object aspiration occurs and is witnessed as choking episodes followed by dysphagia and/or drooling resulting from the child's inability to swallow their own saliva.

Anatomical Considerations

The location of the foreign body may be determined by the location of pain. Anatomically, foreign bodies often get lodged around the tonsillar pillars and aryepiglottic folds. Congenital abnormalities such as vascular rings or a right-sided aortic arch may create a narrowing in the esophagus and lead to potential points of obstruction. The upper aerodigestive tract contains sensory innervation; patients can often localize their pain to the area where the foreign body is located. The lower esophagus below the hypopharynx contains visceral innervation;

thus, discomfort is often reported as vague, nonlocalized chest or throat pain.

Diagnosis

In patients in whom a hypopharynx/upper aerodigestive foreign body is suspected, information regarding the approximate timing of the event and type of foreign body should be obtained.

Direct visualization may be possible using a tongue depressor and otoscope light, or a laryngoscope may be utilized to identify and localize the foreign body if it is located around the area of the tonsils. If unsuccessful and the patient is cooperative, a nasal fiberoptic scope may be utilized to visualize the hypopharynx to the area of the vocal cords for foreign objects. Topical benzocaine spray can make visualization much more comfortable for the patient.

Imaging techniques are varied and depend on the index of suspicion that a foreign body remains in situ. Among patients in whom a large radio-opaque foreign body is suspected, anterior-posterior and lateral radiographs of the neck soft tissues may demonstrate the object in the hypopharynx to thoracic inlet. Note that the orientation of a discoid object may suggest its location; due to the shape of the cartilaginous rings in the upper airway, coins will appear edge-on in anterior-posterior views, whereas they will appear face-on if they are in the esophagus.

Smaller foreign bodies such as fish bones may not be easily identified using a simple radiograph. Among children with a high suspicion of a small, retained foreign body, ultrasound, noncontrast computed tomography, or magnetic resonance imaging of the neck may be useful in identifying the type and location of the object. Complicating diagnostic certainly, an abrasion to the mucosa can cause a persistent foreign body sensation even if the offending object has been swallowed or spit up.

Management

For children with uncontrolled hematemesis with high suspicion of esophageal perforation from a sharp foreign body or erosion from button battery, immediately secure the airway and consult the ear, nose, and throat and/or thoracic surgery department. Similarly, patients with stridor, drooling, tripodding, or other

signs of respiratory distress should be kept calm, and surgical consultations should be obtained and the child taken to an operating room for foreign body removal. It is important to note that large objects that are lodged in the esophagus may compress the airway and cause obstruction.

If the foreign body is visualized and graspable, attempts may be made at removal using alligator forceps or similar instruments. In the absence of airway compromise, children may be provided pain control with nonsteroidal anti-inflammatory drugs, benzocaine spray, or viscous lidocaine. If nonvisualized, there is a moderate or low suspicion of a retained foreign body, and the patient is tolerating adequate PO, a plain radiograph may be obtained and, if negative, the patient sent home with pain control and instructed to return for more advanced imaging if symptoms persist.

Disposition

Patients presenting with airway symptoms, in which there is a history or concern for significant bleeding, or with deep neck space infections arising from retained foreign bodies should be admitted for further observation and management. Complications of hypopharyngeal and upper aerodigestive tract foreign bodies include perforation, associated bleeding, and deep neck space infections, which may lead to mediastinitis.

Key Points

- The hypopharynx is the anatomic area directly superior to the division of the trachea and the esophagus. Foreign bodies lodged in this area have a high risk of aspiration and upper airway obstruction.
- Fiberoptic scope or other advanced imaging, such as computed tomography, may be needed for diagnosis.
- Subspecialty consultation is needed for removal, and any signs of respiratory distress constitute an emergent intervention.

Pitfall

- A child with a retained hypopharyngeal foreign body who is maintaining an open airway should be left until appropriate difficult airway escalation setup can be obtained (including

subspecialty consultation and potential operative intervention as indicated).

UPPER AIRWAY FOREIGN BODY

Upper airway foreign bodies are among the immediate life-threatening conditions. Foreign body aspiration strikes abruptly, afflicts mostly previously healthy children, and, if unsuccessfully treated, imparts a 45% mortality rate, leaving another 30% of children with permanent disabilities resulting from hypoxic ischemic encephalopathy. Younger children with oral exploration activity are most at risk for upper airway aspiration. The provision of developmentally inappropriate foods, lack of molars to crush hard foods, or the disorganized oromotor process in children with neurodevelopmental delay can increase the chances of aspiration.

Presentation

The initial presentation will depend on the location and whether the obstruction is partial or complete. Patients may begin with coughing in an attempt to dislodge the object, develop stridor, or rapidly progress to respiratory failure.

Following dislodgement of foreign bodies, children may rarely present with a postobstructive pulmonary edema (POPE), which is a form of acute interstitial pulmonary edema resulting from negative inspiratory pressure against an obstructed airway.

Anatomical Considerations

Children aged 2–4 years are far more likely to have foreign bodies removed from the larynx and trachea, whereas children aged 5 or 6 years are more likely to have foreign bodies in the bronchus or lower airways.

Diagnosis

Diagnostic evaluation can be challenging, particularly if the choking event is unwitnessed or if it is unclear if an object was involved in the choking episode. Choking or coughing episodes have a reported sensitivity of 80–82% and a specificity of 34% for foreign body aspiration. The type of object causing the obstruction, the duration of the choking episode, attempts at removal, and patient status are important points of information to gather. The diagnosis of foreign body aspiration should always be considered, particularly in children with out-of-hospital cardiac arrest

or those with difficult ventilation—especially due to oromotor neurodevelopmental delay or tracheostomy tubes.

Management

Awake, alert children often expel an acute foreign body through coughing. Among children, post-tussive emesis can occur as a result. Parents may still seek care as a result of the episode or if there is suspicion that the entire foreign body was not expelled. During a coughing episode following a suspected foreign body aspiration, closely monitor the child and prepare for back blows or a Heimlich maneuver if the coughing ceases or respiratory distress worsens. Objects may move within the airway due to coughing and cause varying levels of obstruction.

Should this occur, the next approach is to promote a forceful exhalation from the lungs in an attempt to eject the foreign body and relieve the obstruction. In children younger than age 1 year, this is achieved through back blows and chest thrusts; for children older than age 1 year, the Heimlich maneuver is utilized. For infants, in a seated position, lay the child prone along the length of the forearm, supporting the head and neck with the hand. With the head placed lower than the chest, deliver five forceful back blows to the area between the infant's shoulder blades. Immediately following, transfer the infant to the other forearm, turning the infant supine. Using two fingers from the initially supporting hand, provide five chest thrusts to the area of the breastbone at the nipple line, again with the infant's head placed lower than the chest. Continue to repeat the maneuvers until the obstruction is relieved or the patient loses consciousness.

Among unconscious patients suspected of having a foreign body obstructing the upper airway, the initial approach is for direct laryngoscopy and, if the object is visualized, removal using McGill forceps.

If mechanical removal attempts are unsuccessful, or if the object is not visualized and there remains a high suspicion for an upper airway obstruction from a foreign body, the next step is to convert a laryngeal or tracheal obstruction into a unilateral pulmonary main stem obstruction in order to ventilate one lung. This temporizing method will then allow mobilization of operating room resources to definitively alleviate the obstruction. Use a bag

valve mask to provide positive pressure, intubate with the appropriately sized endotracheal tube and ventilate, or employ a bougie stylet to force the object distally to relieve the midline obstruction.

If the patient remains difficult to oxygenate and ventilate, a surgical cricothyroidotomy is indicated in children aged 8 years or older, and a needle cricothyroidotomy and jet insufflation are indicated for children younger than age 8 years. Rapid initiation of extracorporeal membrane oxygenation should be considered for children who fail all of the previously discussed approaches.

Disposition

In minor choking episodes in which the object is expelled by initial cough, discharge may occur if the assessment is normal. Most significant choking episodes involving the upper airway and trachea require admission and monitoring for signs of POPE. For all children suspected of upper airway obstruction, soft tissue neck and chest radiographs should be obtained to evaluate for signs of lower airway obstruction as well as POPE. Initial radiographs demonstrating new infiltrates may indicate developing interstitial alveolar edema. If children develop signs of respiratory distress during their period of observation, repeat chest radiographs should be obtained. Positive pressure respiratory support, judicious intravenous hydration, and, in some cases, antidiuretics are utilized to treat POPE.

Anticipatory guidance should be provided to all families presenting with children following choking episodes. Avoidance of age-inappropriate foods, use of toys meeting Consumer Product Safety Commission standards, and education regarding supervision and first aid should be provided.

Complications

Significantly high mortality and morbidity rates are associated with upper airway foreign bodies. Children surviving severe episodes often develop the sequelae of hypoxic-ischemic static encephalopathy.

Airway, thoracic, and abdominal trauma may result from attempts at removal of the foreign object. Laryngotracheal injury, pneumothorax and pneumomediastinum, POPE, rib fractures, and solid and hollow organ injury have been reported in children.

Key Points

- Upper airway obstruction is associated with extremely high morbidity and mortality.
- Allow a choking person to cough in an attempt to dislodge a foreign body.
- Rapidly progress through back blows/Heimlich maneuver, direct visualization and removal, or distal displacement with bag valve mask, intubation, or bougie in patients with a complete upper airway obstruction.
- Following the resolution of a significant upper airway obstruction, monitor children for signs of POPE.

Pitfall

- Failure to consider postobstructive sequelae after successful foreign body dislodgement

LOWER AIRWAY FOREIGN BODY

Aspiration of foreign bodies may have a wide range of presentations and present insidiously or acutely and dramatically. Aspirated foreign bodies lodge in the trachea in 5–15% of cases and are managed in a similar manner as upper airway foreign bodies. Up to 95% of aspirated foreign bodies lodge distal to the carina. Thirty to forty percent lodge in the main stem bronchi, where there is an equal prevalence in laterality among otherwise healthy children. Literature suggesting that aspiration occurs more frequently on the right side predominantly examined children with neuromuscular disorders that were baseline recumbent. Foreign bodies come to rest in the lobar bronchi in 5–15% of cases.

Presentation

The majority of aspiration episodes are witnessed because children at highest risk are often in the age range requiring continuous supervision. There should be a high index of suspicion for an aspirated foreign body when a history is elicited of acute onset of cough paroxysm with persistent respiratory symptoms that began while eating or during exploratory activities. Children aged 12–36 months, as well as children with neurodevelopmental delays and persistent oromotor behaviors, are most commonly affected.

Up to 20–30% of patients with lower airway foreign body aspiration present more than

1 week after the event. The smaller and more commonly organic objects implicated may elicit a less dramatic cough paroxysm or are completely unwitnessed.

Among children with aspirated foreign bodies, the most common physical examination finding is tachypnea, followed by unilateral wheezing or crackles on focal lung examination. Children with recurrent pneumonias localizing to the same area without interval clearing of the chest radiograph should be evaluated for an aspirated foreign body.

Diagnosis

As with every potential airway foreign body, the history plays a significant role in the diagnostic workup. A concerning history and physical examination demonstrating focal wheezing or change in oxygenation should trigger definitive treatment. However, many aspirated foreign bodies may have an equivocal history, physical examination, or both. If aspiration is suspected, various diagnostic techniques are available with variable sensitivity. Choice of modality will depend on the acuity of the presentation and the level of suspicion following history and physical examination.

Chest radiographs can be obtained rapidly and relatively easily. They can be obtained in a portable manner in children who are too unstable to leave the emergency department. In addition, it is an initial diagnostic tool for children with low to moderate suspicion. A four-view series may be obtained to further evaluate for an aspirated foreign body, including anterior–posterior, lateral, and inspiratory–expiratory or bilateral decubitus views. Because younger children suspected of foreign body aspiration cannot follow instructions for inspiratory–expiratory views, decubitus views imitate forced expiration of the dependent lung and may uncover air trapping if present. However, the presence of air trapping is neither sensitive nor specific for foreign body aspiration.

Approximately 26% of foreign bodies are radiolucent. Obstruction is often inferred from signs of air trapping, which manifests as unilateral hyperinflation or atelectasis. Atelectasis is often assumed to be an infectious infiltrate, and children are treated with antibiotics. The lack of resolution of these focal findings on a radiograph in 4–6 weeks following antibiotic course should prompt the suspicion of a

potential foreign body. Organic foreign bodies can serve as a nidus for infection, making the patient's initial presentation indistinguishable from a bacterial pneumonia. Overall, the sensitivity radiographs in detecting aspirated foreign bodies is 63%, and the specificity is 79%.

New low-dose computed tomography protocols are also available and have the advantage of identifying the exact location of airway obstructions. Their disadvantage is the still relatively high dose of ionizing radiation compared to that used with other methods, but their use may avoid the need to undergo general anesthesia and bronchoscopy.

Bronchoscopy is a simultaneously diagnostic and therapeutic intervention for aspirated foreign bodies. General anesthesia and skilled personnel are required to perform bronchoscopy.

Management and Disposition

The management and disposition of children suspected of foreign body aspiration depend on the severity of symptoms and the level of suspicion elicited from the history and physical examination.

Those considered high risk include children presenting with a concerning history and those who are noted to be symptomatic by parents or providers, have a suggestive physical examination, have a strongly suggestive radiography, and/or are in extremis. These patients should have emergent consultation for bronchoscopy and admission.

Those with moderate risk may present with a questionable history or no witnessed episode suggestive of aspiration, are asymptomatic and have no focal findings on physical examination, and have negative radiographs. These patients may be discharged with specific return instructions and have follow-up with the primary care provider or pulmonologist. Should further symptoms develop, they can be subsequently scheduled for advanced radiographic studies or a bronchoscopy.

For children who present with a history providing low suspicion for aspiration, are asymptomatic with a normal physical examination, and have a negative radiograph, discharge home with anticipatory guidance and routine pediatric follow-up are indicated. Parents should be informed that should the child develop respiratory symptoms or illnesses in the coming weeks, they should inform their physician of the significant history because it

may prompt evaluation that otherwise would not occur without a suspicion for aspiration.

Complications

The most severe complication of foreign bodies is respiratory failure, which may occur in tracheal or main stem obstructions. Pneumonitis and other local reactions may occur around aspirated objects, typically organic material, and lead to recurrent pneumonia.

Key Points

- Suspect foreign body aspiration in children with recurrent lobar pneumonias and in those in whom infiltrates on chest radiographs do not resolve 4–6 weeks after treatment.
- Bilateral decubitus films may demonstrate hyperinflation in the setting of foreign body aspiration but are incompletely sensitive.
- A majority of children present immediately after a witnessed choking episode, but many may present more than 1 week after the event.

PITFALLS

- Failure to consider the possibility of an aspirated foreign body in a patient with remote history of a choking episode
- Failure to consider the possibility of an aspirated foreign body in a patient with known choking episode but normal imaging and physical examination

Further Reading

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