

Practical Imaging Evaluation of Foreign Bodies in Children: An Update



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KEYWORDS

- Foreign bodies in children • Foreign body aspiration • Foreign body ingestion
- Foreign body insertion • Foreign body complications

KEY POINTS

- Foreign bodies in children can be inhaled, ingested, or inserted in natural body cavities or tissues.
- Most ingested foreign bodies pass the pylorus without sequelae.
- Foreign bodies can cause severe and even life-threatening complications.
- Radiologic imaging helps in detection, characterization, localization, and assessment of complications of foreign bodies in children.
- Not all foreign bodies are visible on radiographs.

INTRODUCTION

The typical mechanisms of entry for a foreign body (FB) include aspiration, ingestion, insertion, penetrating trauma, or even iatrogenic. When the event is witnessed, diagnosis and management are usually expedited and less problematic in the pediatric population. However, unrecognized FB may present long after the initiating incident, and the symptoms may even mimic other conditions.¹ The Susy Safe database, a large database describing all pediatric FB-related injuries in children, showed that 74% of objects were inorganic and were mostly represented by pearls and balls, followed by coins.² FB injuries may be asymptomatic and, if symptoms are present, they may be nonspecific. FB injuries can be misinterpreted as a gastrointestinal or respiratory infection or other

conditions, contributing to delayed diagnosis and increased risk of complications.³ Therefore, history with documentation of the possible object is of utmost importance when witnessed.

Accidental aspiration of FBs into the respiratory system is commonly encountered in children younger than 3 years old and is an important cause of morbidity and mortality in children. A diagnosis of FB aspiration is often missed or delayed because the causative event is usually unobserved and the symptoms are often nonspecific in children.⁴ FB can also be ingested and many pass naturally through the gastrointestinal tract without complications. However, severe potential complications, including obstruction, mucosal injury, or perforation can occur. These complications depend on the characteristics of the FB, its

Disclosure Statement: The authors have nothing to disclose.

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Radiol Clin N Am 55 (2017) 845–867

<http://dx.doi.org/10.1016/j.rcl.2017.02.012>

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anatomic location, the child's age, and delay in diagnosis.³ Insertion of FBs in various natural body cavities also occurs in children. Aural FB placement can be a response to irritation or could be a child's way of exploring the ear cavity. Although accidental and traumatic insertion of FB in the vaginal and urethrovaginal cavity can occur, intentional insertion is the more common cause, believed to be due to body exploration or for sexual gratification. In either case, sexual abuse or psychiatric disorder has to be excluded.

Various medical imaging modalities have been used in the evaluation of FBs. Radiographs can be helpful in localizing radiopaque FBs such as coins, buttons, pins, and batteries. However, radiographic visibility of a foreign object depends on its inherent composition and its location in the human body. FBs might be radiographically visible in 1 body part but not visible if located in another, much thicker, body part. The same FB might be visible in a superficial extremity soft-tissue but invisible in the abdomen. This also means that not all radiopaque objects are detected by radiography.⁵ Fluoroscopy with oral administration of contrast can be a useful tool, particularly in outlining nonradiopaque FB ingestions. Ultrasound (US) is also used to evaluate FBs in the gastrointestinal tract, as well as vagina and the urinary bladder. Computed tomography (CT) has become more valuable by virtue of its wide availability; high resolution; and the multiplanar, 3-dimensional (3D), and other image reconstruction capabilities. CT can establish the diagnosis of FB, indicate its exact location, and detect associated complications. Because of its great soft tissue differentiation capability, MR imaging has been used for FB evaluation in the genitourinary tract.

It is often that radiologists are the first to raise the possibility or report presence of FB, particularly in the pediatric population. Thus, it is important for a radiologist to confirm its presence, as well as to describe associated secondary findings or complications related to longstanding FBs.

AIRWAY FOREIGN BODIES

Overview and Etiologic Factors

Inhalation of FBs in children is a frequent complaint in the pediatric emergency department. Most FB inhalations occur in children less than 3 years old, with a peak incidence between 10 to 24 months of age.^{6,7} Serious complications can occur, such as severe airway obstruction and death, especially in younger children and infants because of the small caliber of their airways. FB

aspiration is ranked sixth most common cause of accidental deaths in children.⁸

Younger children are predisposed to FB inhalation for 3 main reasons. First, they have a tendency to explore by placing objects into their mouths; second, they are unable to adequately chew certain foods due to lack of molars that can grind food into smaller, smoother particles; and third, they have immature or poorly coordinated swallowing mechanisms.^{9–11} Additionally, there may be less adult supervision as children increase ambulation and thus the likelihood of aspiration is higher.¹¹ Most aspirated FBs are organic or food objects, including peanuts and sunflower seeds, which together account for almost 80% of aspirated FBs. Organic FBs cause more tissue reaction and tend to produce more complications.¹² Nonorganic or nonfood objects, such as whistles, soil, and plastic objects, including musical mouth pieces, pen tops, and LEGO toy pieces, have also been retrieved and are more likely culprits in older children.^{6,11–13} Inert FBs are more likely to remain in 1 place for a longer period of time and are less likely to cause complications.¹²

Location and Symptoms

Upper airway

Aspirated FB can lodge anywhere along the upper airway that lies above the thoracic inlet. Nasal FBs tend to be located on the floor of the nasal passage, just below the inferior turbinate, or in the upper nasal fossa anterior to the middle turbinate (**Fig. 1**). Affected pediatric patients often present with unilateral, foul-smelling nasal discharge.¹⁴ Approximately 3% of aspirated FBs lodge in the larynx, and are usually bulky, irregularly shaped, or sharp (even penetrating) objects (**Figs. 2 and 3**).^{13,15} They produce symptoms that are abrupt and severe, with an acute event noted in 90% of cases.¹ Signs and symptoms of FB lodged in the supraglottic region are cough, dyspnea, salivation, and voice changes. When in the larynx, there is stridor, cough, voice changes, and severe breathing difficulty. When in the extrathoracic trachea, inspiratory stridor and expiratory rhonchi are observed.^{16,17}

Lower airway

Most aspirated FBs (75%) in the lower airway are lodged below the thoracic inlet, most frequently in the bronchi,^{1,15} especially in the right main bronchus, which is larger than the left main bronchus and directly aligned with the trachea in upright patients (**Fig. 4**).^{9,10} Recent studies state that the difference in occurrence of FB lodged in the right and the left bronchus is less pronounced because the airway in children is immature and that the

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