

# Inhaled Foreign Bodies

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*Inalazione di corpi estranei*  
CMI 2015; 9(1): 3-5  
<http://dx.doi.org/10.7175/cmi.v9i1.1159>

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The inhalation of a foreign body (FB) is a potentially life-threatening event demanding timely recognition and prompt intervention as, even in cases without acute respiratory failure, delayed diagnosis and treatment can result in serious complications [1].

The vast majority of FB inhalation occurs in infancy and early children (80% of cases in children younger than 3 years of age) [2], with the peak incidence in children between one and two years. Reasons for this include their:

- habit to putting anything in the mouth, especially when they play/laugh/cry;
- lack of molar teeth and poorer mastication; and
- less mature protective laryngeal reflexes [3].

Loss of consciousness from trauma, drug or alcohol intoxication, aging-associated pathological status, and medication use are risk factors for FB inhalation in the adults [4].

The majority of inhaled FBs are organic materials, such as nuts and seeds in children and food and bones in adults [5]. Organic FBs can expand from bronchial secretions and worsen obstruction; moreover, materials with a high oil content (such as peanuts) can also cause severe mucosal inflammation and accumulation of bulky granulation tissue resulting in airway stenosis. Inorganic FBs can result in direct airway injury if they are sharp.

The most common type of inorganic FBs in children are beads, coins, and small parts of toys; whereas in adults are dental debris, dental prostheses, and appliances [5]. However, with globalization, civilization and growing populations new types and more reports of FB inhalation are published. For example, there is a distinct group recently being recognized as at risk: women wearing headscarves who inappropriately place the pin in their mouth prior to securing the veil, leading to accidental aspiration.

FBs are lodged preferentially in the right bronchial tree (60% of cases); this is due to its more vertical disposition and to the position of the carina to the left of the mid-trachea that increase the “catchment area” of the right main bronchus [6]. The position of the carina to the right of the mid-trachea in one third of children could account for the prevalence of inhaled FBs in the left bronchial tree reported in some pediatrics series.

The clinical course and outcome of FB inhalation depend on the size and localization of the FB, as well as the length of time that the FB has been in the airway. Airway involvement varies from complete obstruction with hypoxia and cardiorespiratory impairment (more frequent in case of large FB or laryngeal/tracheal FB) to partial obstruction with coughing, wheezing, and respiratory distress (more common when FB is inhaled in the lower lobes).

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**Disclosure**  
L'autrice dichiara di non avere conflitti di interesse di natura finanziaria in merito agli argomenti trattati nel presente articolo

In children even a small reduction of the size of airway can cause a significant increase in airway resistance; therefore the consequences of FB inhalation could be dramatic (**the FB inhalation is one of the leading cause of accidental death in children**). The most frequent symptoms associated with FB inhalation are sudden onset of choking and intractable cough with or without vomiting ("penetration syndrome") [7]. Other presenting symptoms may be cyanosis and breathing difficulties. These symptoms can subside spontaneously and quickly even when the FB remains. In other cases, children continue to have respiratory symptoms due to complications related to the presence of the FB, such as obstructive pneumonitis, atelectasis, bronchiectasis, lung abscess, pneumomediastinum or pneumothorax.

Compared to children, in adults, the clinical presentation of FB inhalation is often subtle or silent [8]. The most common symptom is chronic cough that may mimic other respiratory diseases such as asthma not responding to therapy, or recurrent/nonresolving pneumonia. The nonspecificity of clinical presentation and the absence of inhalation history are the probable reasons for the frequent misdiagnosis in these patients. In adults, a FB may be discovered incidentally during bronchoscopy performed for symptoms related to complications caused by the FB often ignored or forgotten.

Of all signs and symptoms, **the most predictive indicator of FB inhalation is the history of choking** (sensitivity of 76 to 92%) [9]. At clinical examination, the most frequent sign of the presence of an inhaled FB is the decrease in the breathing sound on the same side as the FB; however, **physical examination may be normal** (up to 56% of cases).

Likewise, as the majority of FBs are radiolucent, the **chest radiograph may be normal** (up to 80% of cases) unless aspiration is accompanied by airway obstruction or other complications [9,10]. In these cases, an expiratory chest radiograph or fluoroscopy may be helpful to demonstrate the air trapping distal to the FB or a mediastinal shift contralateral to lung containing the FB [11].

As the clinical presentation of FB inhalation may be silent, the most important factor in diagnosis is **consider the possibility**. In this regard, **when bronchopulmonary symptoms develop in an otherwise healthy child**, one should always ask whether the child may have eaten nuts or

seeds, or whether the child may have been playing with small objects that could have been inhaled.

Once FB inhalation is suspected, rapid FB identification and localization are required. Flexible bronchoscopy is the gold standard for definitive diagnosis. Because of complications that can result from the presence of a FB in the airway, if there is any doubt about the existence of a FB in the lung, **it is better to perform a bronchoscopy to conclude that there is no a FB rather than risk to leave a FB in the bronchial tree** [12].

Rigid bronchoscopy is the procedure of choice to remove the FB, especially in children; whereas in adults most of inhaled FBs can be removed with the flexible bronchoscope [13]. Rigid bronchoscopy permits control of airways (ventilation), manipulation of the FB with a wide variety of extraction instruments, and management of mucosal bleeding that can occur in the case of FB embedded in granulation tissue.

A strong coordination among interventional pulmonologist, anesthesiologist, and instrumentation nurse in addition to relevant skill and experience is essential in making the removal procedure safe and efficacious. During the endoscopic removal the FB may slip out of the grip of the forces and dislodge in previously healthy mainstem bronchus: this event may be lethal if the originally involved lung is atelectatic or the originally involved bronchus remains obstructed by inflammation or residual FB. This potentially dangerous accident is most likely to happen when the FB is too large to be withdrawn through the bronchoscope and usually occurs as it is being withdrawn through the cords. Another complication during FB extraction may be distal dislodgement and fragmentation of the FB.

Because FB inhalation is a relatively rare phenomenon, opportunities for acquiring skill in removal procedures are inherently scarce. This problem is made more complex because the rigid bronchoscopy in children is quite a different matter from flexible bronchoscopy in adults; and it is not just a matter of **size of the airways and size of the instruments** (which is still a big problem). There is, also, in children, a **tendency to spasm** which can be increased by the prolonged intubation necessary to the removal of the FB. Therefore, **if an immediate emergency procedure is not indicated**, I recommend the **transfer of the patient to a center with experience in airway endoscopy in children**. This also

applies to the “simple” diagnostic flexible bronchoscopy as accidental dislodgement of the FB may occur during this procedure so that interventional pulmonologist should have a rigid bronchoscopy immediately available in the event of a more serious airway obstruction.

There is no agreement about the urgency for removal of inhaled FBs. Laryngeal and subglottic/tracheal FBs need urgent intervention, whereas more commonly the clinical situation is relatively stable. However, even in stable patients with distal obstruc-

tions, the possibility of increased morbidity due to prolonged distal obstruction as well as the potential for a FB to dislodgement, should be taken into consideration when planning the timing of removal [14,15].

Finally, it is important to emphasize preventive measures in order to make parents able to avoid risk situations. In particular, **the offering of nuts or seeds of any kind to young children should be avoided.** It is also strongly recommended that **younger children should not be allowed to play with small plastic or metallic objects.**

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