

# The anaesthetic consideration of tracheobronchial foreign body aspiration in children

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**Abstract:** Cases of tracheobronchial foreign body aspiration are frequently encountered emergency cases of childhood; and, delays in its recognition and treatment do result in serious morbidity and mortality. Diagnosis mainly relies on taking history which should indicate what the foreign body is, when it has been aspirated and where it is located. Belated consultation can cause misdiagnosis with the mixing of the symptoms and data with those of other pathologies common to childhood and further delays in the correct diagnosis. Bronchoscopy is required for the differential diagnosis of suspected tracheobronchial foreign body aspiration in order to eliminate other common pediatric respiratory concerns. Given the shared use of the airways by the surgeon and the anaesthesiologist, bronchoscopy is a challenging procedure requiring experienced teams with an efficient method of intercommunication, and also well planning of the anaesthesia and bronchoscopy ahead of the procedures. Despite the recent popularisation of the fiberoptic bronchoscopes, the rigid bronchoscopy remains to be used commonly and is regarded to provide the gold standard technique. There have been reports in the literature on the uses of inhalation and/or intravenous (IV) anaesthesia and spontaneous or controlled ventilation methods without any demonstration of the superiority of one technique over the other. The most suitable methods of anaesthesia and ventilation would be those that reduce the risks of complications, morbidity and mortality; and, preventive measures should be taken with priority against childhood cases of tracheobronchial foreign body aspiration.

**Keywords:** Tracheobronchial foreign body; anaesthesia; child

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## Introduction

Tracheobronchial foreign body aspiration is an emergency situation with serious life threatening complications frequently met especially in children, such that it probably constitutes one of the most common emergency procedures undertaken in the paediatric population. Early diagnosis and the successful removal of the inhaled foreign material are associated with effective reduction in complications and mortality. Historically, Gustav Killian was the first to use the rigid bronchoscopy method in 1897 to remove a foreign body from the right main bronchus which through the subsequent development of the bronchoscopic techniques lead to the observed reduction

in the rate of mortality (1,2). With advances in the anaesthetic technique, rigid bronchoscopy has come to be performed under general anaesthesia. Use of the flexible bronchoscope was started in the 1970s, especially for the removal of aspirated foreign material localised in the distal airways (3,4).

## Patients

Tracheobronchial foreign body aspiration is seen most frequently in children under the age of 5 years, the peak incidences varying between 6 months and 3 years of age (5). Generally, the loss of concentration during physical activity, such as running or jumping, while eating or when they

explore plastic or metallic objects they play with by putting them in the mouth can result in sudden symptoms of difficulty in breathing. Given the anatomical characteristics of this age group with the relatively high position of the larynx and epiglottis, narrow airways, compounded with incomplete development of airway protective reflexes, immature swallowing coordination and inadequate chewing process, they run a high risk of this traumatic advent. The risk of foreign body aspiration is more frequent among boys due to their propensity to physical overactivity (5-7).

### Clinical presentation and diagnosis

Depending on the type of foreign body, the duration of time after aspiration and the exact location of the object can present with a wide spectrum of clinical symptoms ranging from the asymptomatic to severe respiratory distress (8). Tracheobronchial foreign body aspirations generally present with symptoms of coughing, dyspnea, wheezing, and also very rarely with stridor and cyanosis (9). In cases with delayed diagnosis the unilateral subsidence of breath sounds, audible ronchi, persistent coughing and repetitive pneumonia may be observed. Reported studies have established that the majority of blocking objects are not radiopaque, such that chest radiographs can appear normal, or pulmonary infectious or inflammatory infiltration, mediastinal shift, obstructive emphysema, atelectasis, and air trapping suggestive of foreign body aspiration and very rarely pneumothorax or pneumomediastinum may be observed. The chest X-ray may alter on the basis of object localisation and the aspiration time. Normal X-ray results are usually associated with upper airway obstruction, whereas emphysema and infiltration are seen more in distal airway obstruction. In cases with belated medical consultation, appearance of infection can lead to misdiagnosis and further delays in correct diagnosis. Most of the aspirated objects consist of organic materials, which can vary according to the residential locality of the patient, but often consist of nuts, seeds, and legumes. Materials such as gelatinous snacks that completely obstruct the small cylindrical airways and some types of small toys are exceedingly dangerous (10). In contrast to the inorganic foreign bodies, such as toy parts, pen caps or pins, organic foreign bodies are more inductive to inflammatory reactions and symptoms of fever and pneumonia are observed more frequently (7). Some organic foreign materials may swell due to fluid absorption after aspiration and the partial blockage can become total in time. Also, sharp tipped

objects may perforate the airways they enter (8,11). Taking history leads to correct diagnosis (5). Hence, an aspirated foreign body should be eliminated by procedures of differential diagnosis when there is suspected aspiration or suspicious chest X-ray results, a history of choking crisis, persistent wheezing, and auscultation of unilateral abnormal breathing sounds. Bronchoscopy is demanded when considering the elimination of a possible tracheobronchial foreign body aspiration from other common paediatric pathologies such as asthma, pneumonia, bronchiolitis, upper respiratory tract infections. In cases with clinical emphasis on the presence of an inhaled tracheobronchial foreign body not observable by bronchoscopy, such as with dissolved pills or inhaled talcum powder, histological demonstration of bronchial inflammation on a bronchial biopsy sample could be elected (6).

### Management

Most fatalities associated with foreign body aspiration occur during aspiration. Therefore, if an aspiration incident has been witnessed or suspected, basic life support maneuvers based on the guidelines of the European Resuscitation Council and the American Heart Association should be commenced while the local ambulance services are called (6,11). It is imperative that the requisite preparations be completed before bronchoscopy, to be undertaken as early as possible. Bronchoscopy becomes an urgent intervention in severe respiratory distress. If the patient is in a stable condition, it has been recommended that bronchoscopy be performed in day time operating hours with experienced anaesthesiologists and surgeons under optimal conditions (8,11-13). Despite recent preference in some centers for using the fiber-optic bronchoscope, use of the rigid bronchoscope remains the gold standard (7,11,14,15). Although the fiber-optic bronchoscopy has the disadvantages of limited suction and instrumentation, and the lack of ventilatory capability and airway control, it has advantages in being less invasive, and in not requiring general anaesthesia. The flexible bronchoscope is also preferred for the removal of the foreign materials in distal airways of the upper lobe bronchi (8,16-18). It appears more useful with the paediatric patient as a diagnostic device to detect the foreign body, when there is insufficient historical, clinical, or radiologic findings for foreign body aspiration; whereas the rigid bronchoscope is used for its retrieval only (19,20). Presence of an optical forceps on the rigid ventilating bronchoscope simplifies the procedure

as well as rendering it less hazardous. Skill is required for using the rigid bronchoscope in children who have small airways. An appropriately sized bronchoscope has to be selected to avoid the high incidence of bronchospasm in this age group of patients, as well as to prevent laryngeal oedema by not extending the time of the intervention (5). If tracheal blockage and asphyxia are caused during the attempt to remove the foreign body, the rescue technique consists of pushing the object into a bronchus and to ventilate the other lung (7). Care should be taken not to fragment the foreign bodies during its removal as the small pieces may fall into the distal airways creating difficulty of retrieval. After the removal of the main obstructive agent, the trachea, bronchi, the vicinity of the vocal cords and the epiglottis as well as the whole mouth should be checked against the presence of or the remnants of a foreign body. If bronchoscopy is not urgent, the patients should be fasted for at least 6 hours for solids and 2 hours for clear fluids to decrease the risk of aspiration during the procedure; the pre-anaesthetic fasting being important for airway protection against the risk of aspiration, which is difficult to achieve with full stomach (21). If the intervention is urgently required, a large-bore gastric tube can be used to aspirate the stomach contents before induction of anaesthesia (8).

As the airways are used jointly by the surgeon and the anaesthesiologist, a good intercommunication has to be established between them to meet the requirements of the procedure itself and the pre-planning of the anaesthesia and bronchoscopy.

### Anaesthetic considerations

Patients should be quiet during induction of anaesthesia to avoid displacement of the inhaled foreign body that may result in complications of further airway obstruction. However, sedative premedication is not warranted in order not to suppress the respiratory drive. Steroids (dexamethasone 0.4–1 mg/kg i.v.) can be used to treat the inflammation and to prevent the likelihood of airway oedema incurred by bronchoscopy (11,22,23). Resorting to the multiple anaesthetic methods during the removal of the foreign body has been reported in the literature. As has been pointed out, positive pressure ventilation during induction can convert the proximal partial obstruction to complete obstruction. Therefore, the common approach with foreign bodies localised proximally is to use smooth mask inhaled induction or cautious IV induction with spontaneous ventilation (8,15). After inserting the bronchoscope through

the glottic opening, spontaneous ventilation may be supported for the cases with proximally located obstructions that seem to require a short procedure of removal. If, however, the procedure is expected to last long with deeper insertion of the bronchoscope, the mobility and reflexes of the patient may have to be suppressed by neuromuscular blocking agents to prevent airway traumas resulting from coughing and resistance as well as to enable the surgeon to work more comfortably (8). With this approach, positive pressure ventilation can be applied to reverse of atelectasis, to correct oxygenation and to overcome the airway resistance. Some anaesthesiologists prefer spraying the epiglottis, larynx and the cords with 1% topical lidocaine before the procedure to reduce the haemodynamic and airway reactions to the introduction of the bronchoscope into the airways, reducing the need for general anaesthetic use and the risks of laryngospasm (11,24). Use of manual jet ventilation during bronchoscopy in nonobstructed lung prevents the hypoxaemia that can arise despite spontaneous or controlled ventilation. Given the tendency in children to fast desaturation, manual jet ventilation reduces the risk of intraoperative hypoxemia (25,26).

Anaesthesia can be maintained by the use of inhaled agents. Sevoflurane is the generally preferred inhalational anaesthetic for fast induction and the least irritant to the airways (8,27). Possible gas escapes from the bronchoscope during the procedure necessitate requirement for high gas flows to maintain the depth of anaesthesia, but this may pollute the atmosphere of the operation theatre. Nevertheless, rapidity of induction and recovery and relaxation of the bronchial muscle are distinct advantages (26,27). Constant level of anaesthesia can be achieved with propofol-remifentanyl infusion. There are reports of body movement, cough, desaturation and delayed recovery while using different doses of IV propofol-remifentanyl with spontaneous ventilation (27,28). Remifentanyl infusion can be used together with inhalation anaesthetics. The chosen anaesthesia method can be inhalation or IV based as there is no evidence for the superiority of one approach relative to the other (11). The anaesthetic use and ventilation method (spontaneous or controlled) should ensure the least risks of mortality and complications for the patient (29).

After the removal of the inhaled foreign body, if the patient has not developed any complication relative to his/her general condition before bronchoscopy and also with respect to airway oedema and pulmonary gas exchange, mask ventilation can be applied until adequate spontaneous ventilation is reached. If, on the other hand, a complication has arisen, or the procedure has been prolonged, or there

is residual neuromuscular blockade, the patient is indicated for continued intubation and positive pressure ventilation for re-expansion of any atelectasis, and until completely awake and stabilised with adequate protective reflexes (24).

### Postoperative care

Postoperative hospitalisation depends on the clinical state of the patient. Close observation is necessary on the patients who have developed complications before or during the procedure, and treatment should be given on time. For example, if pneumonia has developed due to delayed diagnosis, antibiotic treatment should be started immediately. If the patients are stable and have been through uncomplicated procedures, they can be discharged on the same day after a short period of observation.

### Complications

Complications may develop due to the tracheobronchial foreign body itself as well as the bronchoscopic procedure. Pneumonia, atelectasis and emphysema are the most frequently observed complications, but laryngeal oedema, complete airway obstruction secondary to dislodged foreign body during coughing or removal, failure to remove the object, hypoxia, hypercarbia, bronchospasm, bradycardia, regurgitation and aspiration of gastric contents, pneumothorax, pneumomediastinum, lung abscess, tracheal laceration, cardiac dysrhythmias and cardiac arrest may also be observed (6,7,24). In delayed diagnosis cases bronchiectasis and irreversible pulmonary changes may develop (10,30). Therefore, early diagnosis and early intervention are highly important.

### Conclusions

Tracheobronchial foreign bodies are frequently observed in young children with serious life threatening effects. There is need for preventive measures including parental education and awareness. If not witnessed, treatment for inhaling foreign materials can be delayed as the symptoms are often nonspecific. Suspicious history and symptoms should be taken seriously and bronchoscopy should be performed in order to ensure early treatment and to reduce the development of probable complications including mortality. Bronchoscopy should be performed under optimal conditions after planning by experienced and well cooperating surgical and anaesthetic teams.

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### Footnote

*Conflicts of Interest:* The author has no conflicts of interest to declare.

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