BRONCHOSCOPY FOR A FOREIGN BODY IN A CHILD

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Introduction

Inhalation of a foreign body (FB) is a potentially life threatening event, with boys in the age range 1 to 3 years most at risk. Resistance to gas flow is related to the fourth power of the radius, so a small reduction in airway radius in a child will result in a large increase in resistance to airflow. Inhalation of an organic FB may result in airway hyperreactivity and mucosal oedema. The occurrence of oedema in addition to the physical presence of the FB results in a rapid increase in airway resistance. Coupled with the high oxygen consumption of infants and small children, hypoxia may rapidly occur.

Presentation

The presentation may be acute, with symptoms and signs of laryngeal or tracheal obstruction (cough, choking, respiratory distress, cyanosis, stridor, tachypnoea), or with signs of obstruction of a main bronchus (respiratory distress, tachypnoea, wheeze or absent breath sounds on the affected side). There may be no clinical findings, even following a clear history of FB inhalation. The presentation may be more insidious, with chronic cough, chest infection, signs of mixed upper and lower airway collapse and consolidation affecting one or more lobes. Air trapping might be seen radiographically on expiratory films, due to a "ball valve effect". Initially an air bronchogram may be seen, with later evidence of atelectasis distal to the obstruction.

The history may help in the diagnosis, for example sudden onset of respiratory distress while playing with small objects, but FB aspiration should be considered in every child presenting with cough or stridor, in the absence of clear symptoms and signs pointing to another aetiology. It should also be remembered that an oesophageal FB, usually hypopharyngeal, may present with respiratory distress due to external compression of the trachea.

Preparation, investigation and examination of the child

To a large extent this will be dictated by the clinical condition of the child. If time allows the usual preoperative assessment of the child should be made, with particular attention to examination of the airway and chest. The presence of an inspiratory wheeze (glottic or supraglottic) or expiratory wheeze (infraglottic) may help to localise the site of a FB. If the child is stable a chest radiograph may be helpful in localising the FB, although the majority of FBs will not be radio-opaque. In the acute situation few other investigations are indicated. The child should be starved according to the recommended guidelines, but this will clearly not be possible in a child with acute respiratory distress. Sedative premedication should not be used.

Anaesthesia

General anaesthesia will be required to perform bronchoscopy. The anaesthetic machine and other equipment should be checked, especially suction equipment. A range of sizes of endotracheal tubes should be available, in case intubation is urgently required, bearing in mind that the presence of airway oedema reduces the tracheal diameter.

Monitoring including pulse oximetry, ECG, non-invasive blood pressure, and capnography should be applied. Intravenous access should be secured prior to induction, but if the child is distressed this can be performed immediately after induction.

A senior anaesthetist and ENT surgeon should be present at induction, along with the most skilled assistant available. Inhalational induction is recommended using either sevoflurane or halothane in 100% oxygen. There is much debate about the relative advantages of halothane and sevoflurane. Sevoflurane causes less airway irritation and is more cardiovascularly stable than halothane. Halothane has a longer lasting anaesthetic effect, allowing more time for airway manipulation without fear of the child becoming too lightly anaesthetised. In many locations halothane is more readily available than sevoflurane. Halothane is associated with more cardiovascular instability than sevoflurane, especially arrythmias, which are worsened in the presence of hypercapnia and high circulating levels of catecholamines. The choice will be dictated by personal experience and preference, and also local availability. Ether is still used in some centres.

Spontaneous ventilation is recommended, although occasionally it might be necessary to assist ventilation with gentle mask ventilation. Spontaneous ventilation reduces the risk of hyperinflation of the lung and pneumothorax, and is also less likely to dislodge the FB distally. After induction , a cannula should be sited, if it has not been sited prior to induction, and nitrous oxide should be discontinued. When the child is deeply anaesthetised, which can take a long time due to the reduced airflow, laryngoscopy should be performed, and the larynx and trachea sprayed with 4% lignocaine (maximum dose 4mg/kg). After a few minutes, the ENT surgeon can perform rigid bronchoscopy.

During bronchoscopy, anaesthesia should be maintained by connecting a T-piece to the sidearm of the Stortz bronchoscope. Intubation should not be performed prior to rigid bronchoscopy, due to the risk of dislodging or fragmenting the FB, with a risk of complete airway obstruction. If desaturation during bronchoscopy of one lung occurs, the bronchoscope can be withdrawn into the trachea to allow re-oxygenation of both lungs, before a further attempt at bronchoscopy is made. The telescope might also need to be removed from the bronchoscope to allow adequate gas flow. During bronchoscopy careful observation of chest movements should be made.

After removal of the FB the airway can be maintained using a face mask, endotracheal tube or laryngeal mask. The anaesthetic is discontinued, 100% oxygen is administered, and the child observed carefully until awake and extubated.

Postoperatively, the child must be monitored for signs of stridor and airway obstruction due to oedema. Humidified oxygen is recommended for 24 hours, and if worsening stridor occurs, nebulised adrenaline 1:1000 may be useful (0.5ml/kg, maximum 5ml). Dexamethasone 250mcg/kg i.v. at induction, followed by 100mcg/kg 6 hourly for 24 hours has also been recommended.

The use of flexible fibreoptic bronchoscopy is described for the retrieval of bronchial FB. In general this is not recommended, as rigid bronchoscopy has several clear advantages - complete airway control, a better view of the bronchial tree, and larger channels through which to pass instruments and withdraw FBs. However, in older children, the rigid bronchoscope only allows limited access to the upper lobes and more distal airways.

Types of bronchoscope

Two types of rigid bronchoscope are available. The older Negus bronchoscope is the original rigid bronchoscope, and has a tapered shape. It is no longer used in most UK centres.

The Stortz ventilating bronchoscope is the most commonly used rigid bronchoscope in most centres. Bronchoscopes are available in a variety of sizes and lengths from 2.5mm internal diameter. This allows safe examination of all children, including neonates. The Hopkins rod lens telescope is inserted through the lumen, allowing a clear view of the endobronchial tree. A wide range of instruments are available to enable retrieval of a FB, as well as other therapeutic procedures.

A T-piece circuit is attached to the sidearm of the bronchoscope to allow delivery of oxygen and anaesthetic gases during the procedure. The presence of the telescope, with the viewing end occluded, results in a closed system, through which spontaneous or controlled ventilation may occur. The system is open when the telescope is removed, allowing only spontaneous ventilation. The telescope occupies a significant proportion of the bronchoscope, through which expiration must occur. It may be necessary to remove the telescope periodically to allow adequate breathing through the lumen of the bronchoscope, especially when using smaller diameter bronchoscopes.

A Sanders injector can be attached to the sidearm to enable controlled ventilation, when the telescope is not being used. It uses the Venturi principle to entrain oxygen-enriched air. The entrainment of air means that it is not possible to deliver high oxygen concentrations, which may not maintain adequate patient oxygenation. Anaesthesia is maintained using intravenous anaesthetic agents. In smaller children barotrauma can easily occur, so this may not be the technique of choice.

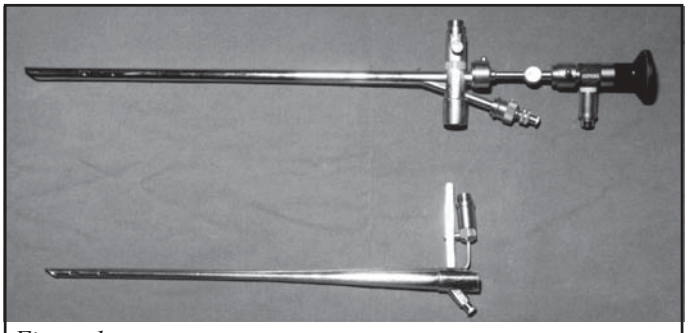

Figure 1:

Case history

A 4 year old boy presented to the emergency department with a history of coughing and choking while he was lying on his back playing with some coins. He had a short spell of cyanosis which lasted a few seconds. He reported "swallowing" a coin.

On examination he was upset, but well. He was apyrexial, and had a respiratory rate of 20/minute with no recession. Chest auscultation revealed reduced breath sounds in the right lower lobe. A chest Xray showed a radio-opaque sphere in the area of the right main stem bronchus. Ametop local anaesthetic cream was applied to both hands.

The child was transferred to the operating theatre. The anaesthetic machine, suction equipment, and laryngoscopes were checked. The consultant ENT surgeon was present. A pulse oximeter and ECG leads were applied, and a 22G cannula was sited. Atropine 10mcg/kg and dexamethasone 250 mcg/kg were given i.v. Anaesthesia was then induced using 3% halothane in oxygen breathed spontaneously via a face mask and Ayres T-piece circuit. After several minutes, when deep anaesthesia had been achieved, laryngoscopy was performed and the cords sprayed with 2mls of 4% lignocaine. A 3.5 rigid bronchoscope was introduced into the trachea. The coin was retrieved uneventfully from the right main bronchus, and the bronchoscope was withdrawn from the airway. The halothane was discontinued, and the airway maintained with a face mask until the child was fully awake.

Humidified oxygen was given overnight on the ward, and the child was monitored with pulse oximetry. The child was discharged the next day.

Learning points

1. Airway obstruction by a foreign body reduces tracheal gas flow, and prolongs the time taken to induce anaesthesia using an inhalational induction.

2. Organic foreign bodies can cause airway oedema and hyperreactivity, which may be worsened by anaesthetic gases.

3. A foreign body may be dislodged at any time, resulting in complete airway obstruction. For this reason, spontaneous ventilation must be maintained, and rigid bronchoscopy performed prior to intubation.

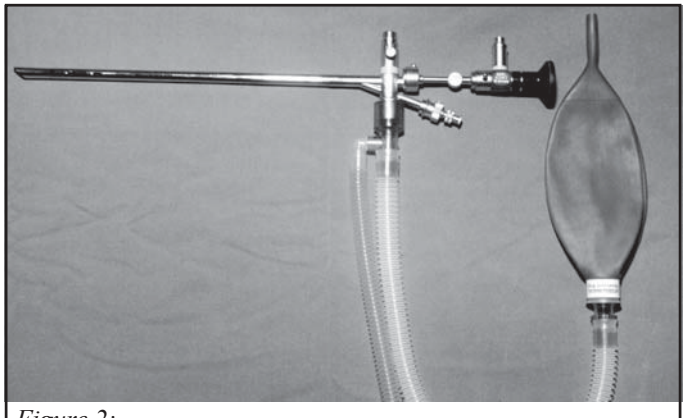

Figure 2: