BRONCHOSCOPIC REMOVAL OF INHALED FOREIGN BODIES IN CHILDREN

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SUMMARY

This report analyses the problems of anaesthesia in 63 children, mainly in the age group 1–3 years, having bronchoscopy for removal of inhaled foreign bodies. Most of the inhaled material was vegetable matter (nuts or water-melon seeds) which does not cause gross X-ray changes until after 24 hours, at which time valvular obstruction commonly causes local hyperaeration. All patients underwent bronchoscopy under halothane and oxygen anaesthesia. Ventilation was assisted by oxygen flushing via a side-arm on the bronchoscope.

The inhalation of a foreign body in a child is a life-threatening accident. Early diagnosis and bronchoscopic removal of the foreign body will save the patient from serious complications and even death (Davis, 1966; Slim and Yacoubian, 1966; Harboyan and Nassif, 1970). The purpose of this report is to analyse the problems in 63 children who were undergoing general anaesthesia and bronchoscopy for removal of inhaled tracheobronchial foreign bodies.

MATERIAL AND RESULTS

The majority of the children were in the age range 1–3 years. Most of the inhaled foreign bodies were vegetable (nuts or water-melon seeds) and only three were metal. The symptoms of vegetable inhalation (choking, cough, cyanosis, dyspnoea, stridor) were more severe with nuts than with watermelon seeds. Most of the children who had inhaled nuts came to the hospital within 24 hours following inhalation. This contrasted with the children who inhaled melon seeds who frequently showed an initial latent period with minimal or no symptoms and who came for consultation about 1 week after the inhalation.

Melon seed inhalation was always limited to one site, while choking with nuts resulted in widespread inhalation in about 26% of patients (table I). About 70% of the melon seeds entered the right bronchus, while nuts entered both sides of the bronchial tree.

X-Ray findings.

In children inhaling radiopaque foreign bodies, the chest X-ray confirmed the diagnosis. In children inhaling vegetable (radiolucent) foreign bodies, the chest X-ray findings varied according to the time from aspiration. Within the first 24 hours, 86% of the children had a normal chest X-ray. This contrasted with the X-ray findings after 24 hours which were abnormal in about 90% of the children.

The commonest radiological finding was unilateral hyperaeration of the obstructed lung (fig. 1). This resulted in spontaneous rupture of the lung and a tension pneumothorax in 1 patient (fig. 2). Atelectasis and pneumonia were less common (fig. 3).

Anaesthetic technique during bronchoscopy.

As soon as the inhalation of a foreign body was diagnosed, bronchoscopy was performed under general anaesthesia. Premedication was limited to atropine 0.1 mg per year of age injected i.m. 30 min before induction. The heart was monitored with the aid of a precordial stethoscope and the e.c.g. Anaesthesia was induced with 1–4% halothane in oxygen using a modified T-piece system (Baraka et al., 1969). When an adequate level was achieved, the airway was sprayed with lignocaine 2% and the bronchoscope was inserted by the surgeon.

<table>
<thead>
<tr>
<th>Table I. Distribution of inhaled vegetable foreign bodies in the tracheobronchial tree in 60 children.</th>
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<td>Melon seeds</td>
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<td>Right bronchus</td>
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INHALED FOREIGN BODIES IN CHILDREN

FIG. 1. A chest X-ray following peanut inhalation 1 week previously. The whole left lung is emphysematous with the heart displaced slightly to the right side. The right lung appears to be clear. The left diaphragm is depressed and flattened. The findings are consistent with obstructive emphysema on the left. Arterial blood-gas analysis while breathing air showed \( P_{O_2} \) 65 mm Hg and \( P_{CO_2} \) 35 mm Hg.

FIG. 2. Chest X-ray of a 2-year-old child who had inhaled a peanut 1 month previously. There is evidence of a tension pneumothorax on the right side. In order to maintain anaesthesia, the halothane-oxygen mixture was delivered by high-pressure tubing to the sidearm of a Chevalier Jackson bronchoscope. The diameter of the bronchoscope varied between 3 and 5 mm depending on the age of the child.

FIG. 3. Chest X-ray of a 7-month-old boy showing atelectasis of the right lower lobe following peanut inhalation 10 days previously.

Intermittent flushing of oxygen via the sidearm of the bronchoscope was enough to assist ventilation and to inflate the lung following suction without occluding the head of the bronchoscope. The oxygen flush button was depressed just enough to give the desired flow rate as judged by watching chest expansion, and listening to air entry. Occasionally, the airway pressure during this procedure was measured with a Statham strain-gauge transducer and recorded on a Grass polygraph. The maximum pressure varied between 15 and 50 cm H\(_2\)O according to the flow rate and the duration of the oxygen flush. Bronchoscopy could be performed continuously for 15-60 min.

When the foreign body was removed, the bronchoscope was withdrawn to above the carina and both lungs were inflated fully with 100% oxygen. After suction of the pharynx and tracheobronchial tree, the bronchoscope was removed. During the recovery period bouts of coughing and laryngospasm occurred commonly and the patients breathed oxygen from a face mask.

Complications.

In 62 patients, the foreign body was removed successfully. In 1 child a metallic foreign body which had been present for 2 years could not be removed in spite of repeated bronchoscopy and right lower and middle lobectomy was performed. During the bronchoscopy 1 child developed severe
Hypoxia aggravates vagal responses, and increases the incidence of cardiac arrhythmias (Jacoby et al., 1955; Baraka, 1968; Shim et al., 1969). Excessive suctioning during bronchoscopy can markedly diminish the inspired oxygen concentration. Also it might induce atelectasis (Brandstater and Muallem, 1969; Boutros, 1970). Therefore, suction must be applied for only short periods of time which are followed by lung inflation.

Following bronchoscopy, all children must be carefully observed for the development of subglottic oedema and other respiratory complications. Prolonged bronchoscopy is a potential cause of subglottic oedema. The early use of humidified oxygen and steroids may be a sufficient treatment but, in more severe obstruction a temporary tracheostomy may be necessary.

**DISCUSSION**

Inhalation of foreign bodies should always be suspected in children with any history, however vague, of choking or gagging (Chevalier Jackson, 1925). A normal chest X-ray, though confirming the absence of a radiologically opaque foreign body, does not exclude the presence of material which is radiolucent, particularly during the first 24 hours.

Partial obstruction of the bronchus by the foreign body may produce a unidirectional valve effect which allows the entry of air during inspiration (Kassay, 1960): hyperinflation of the obstructed lung results. If the distended lung is perfused but not ventilated, a reduction of the arterial PO₂ is to be expected. In the presence of valvular bronchial obstruction, the patient may develop severe over-distension of the obstructed lung, either spontaneously or secondary to intermittent positive pressure ventilation. This can embarrass the cardiovascular system, and has been known to cause a rupture of the lung with a tension pneumothorax (Gray and Edwards, 1948).

In the present series intermittent jets of oxygen were used to ventilate the patients undergoing bronchoscopy. This can be achieved with either a venturi system attached to the head of the bronchoscope so that oxygen plus entrained air provides the necessary pressure and volumes for ventilation (Sanders, 1967), or directly by injecting oxygen via the sidearm of the bronchoscope (Carden, Trapp and Oulton, 1970). Oxygen flushing via the sidearm of the bronchoscope is simpler and provides a higher oxygen concentration (Baraka, Muallem and Salibian, 1972).

Severe cardiovascular embarrassment, or even cardiac arrest may follow tracheobronchial manipulation and suction. This has been attributed to a combination of hypoxia and reflex vagal stimulation. Hypoxia aggravates vagal responses, and increases