

AIRWAY FOREIGN BODIES IN CHILDREN

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Foreign body (FB) aspiration into the airway is one of the dramatic pediatric emergencies. Incoordination of swallowing leads to aspiration. Depending on size, shape and nature, the aspirated FB lodges in the larynx, trachea or bronchial system. It is a completely treatable and to much extent preventable situation. Delay in recognition and removal leads to chronic complications. Prevention, early recognition and extraction of foreign body are the mainstay of treatment. It is interesting to note similarities in epidemiologic and clinical features of FB aspiration in reviews from elsewhere(1-13) and India(15,16).

Incidence

Data on the incidence of FB aspiration is scarce. At our Institute they accounted for 60 cases (0.6%) out of 9300

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admissions at pediatric emergency over a period of 20 months. One study from U.S. estimates the incidence as 0.23% of total admissions(1). United States has a good surveillance system to generate community data on choking and other accidents, e.g., NEISS (National Electronic Injury Surveillance System)(2).

Age. 75-85% of aspirations occur in children between 6 months - 3 years.

Sex. Boys predominate, (the ratio being 2.5:1 for boys and girls). The higher incidence in boys which is attributed to their inquisitive nature.

Pathogenesis and Natural History

Certain anatomical and cognitive constraint predispose the child for aspiration: (a) Oral phase, i.e., tendency to take everything into mouth; (b) Poor mastication; (c) Inadequate control of deglutition; (d) Crying /laughing while eating; (e) Certain parental behavior patterns like thumping or spanking while feeding, feeding a crying child, etc. Loss of co-ordination during swallowing results in aspiration of foreign bodies into the airway. In 90% of such occasions FB are coughed out by strong cough reflex, in only 10% it gets lodged in the airway. Three phases have been recognized in the natural history of FB aspiration: *Phase I:* "Choking" - immediately after aspiration, the child develops violent cough, stridor, respiratory distress and/or wheezing. Later the receptors get adapted and child passes on to *Phase II;* i.e., the asymptomatic phase. It's during this phase that FB aspiration is either forgotten or neglected. This stage may

last from hours to weeks. *Phase III* is the stage of complications in the form of secondary effects of airway obstruction and/or secondary infection. Only 25% of patients present within 24 hours of aspiration(3,4). They are most likely to have foreign body in upper airway, trachea or one of the main bronchi.

Clinical Features

Clinical features depend on site, size, nature and duration since aspiration of foreign body. In 10-20% cases, the FB can lodge in the larynx or trachea(5). These patients usually present with acute life-threatening upper airway obstruction characterized by stridor and suprasternal retractions.

Commonly the FB may lodge in the bronchial tree (80-90%). The right side is

commonly affected(3,14,15). However, some have reported aspirations more on the left side(6). The clinical presentation of bronchial foreign bodies depends on the severity of obstruction and mechanism involved. *Table I* describes the mechanisms with their clinico-radiologic correlation(17).

The common modes of presentation of bronchial FB are: (a) Acute respiratory distress; (b) Recurrent respiratory symptoms; and (c) Chronic respiratory illness. The clinical and radiologic features include obstructive emphysema, pneumonia, non-resolving pneumonia, recurrent wheeze, recurrent hemo-ptysis, lung abscess, or bronchiectasis.

Food items are the commonest (65-85%) FB encountered. The specific na-

TABLE I—Characteristics of Mechanisms of Obstruction Caused by Airway Foreign Body

Mechanism (Frequency)	Effect	Clinical features	Radiology
By-pass valve (15%)	Partial obstruction both during inspiration and expiration	Nil History of choking	Plain X-ray-normal Fluoroscopy-mediastinal shift
Check valve (60%) Refer Fig. 1	Complete obstruction during expiration <i>Obstructive Emphysema</i>	Unilateral decreased air entry and hyper-resonance	Unilateral hyper-inflation and herniation
Ball valve (15%) Refer Fig. 2	Partial obstruction during inspiration <i>Atelectasis</i>	Unilateral decreased air entry and dullness with mediastinal shift	Unilateral collapse with mediastinal shift
Stop valve (10%)	Complete obstruction during inspiration and expiration <i>Atelectasis</i>	-do-	-do-

ture of FB depends on the regional dietary items. In India, peanuts are common while watermelon and pumpkin seeds are common in Greece and Israel, respectively. Generally organic FB produce intense inflammation and hence worsen the obstruction. Certain edible objects like toffee, chocolate and lozenges draw water from mucosa, swell and produce progressive obstruction(15).

Investigations

Radiography is the main contributing investigation(17,18).

(a) *Plain Chest X-ray(CXR)*. 80% of laryngotracheal FB and 15-28% of bronchial FB can have normal CXR. Nonetheless, plain X-rays in inspiration and expiration are useful. Obstructive emphysema, segmental or lobar collapse and pneumonia are useful diagnostic findings. A radiopaque FB is seen in only 6-17% patients (Fig. 3). The diagnostic accuracy of X-rays compared to bronchoscopy is 67%(18).

(b) *Fluoroscopy*. Fluoroscopy being a dynamic method of evaluation is more sensitive than plain X-ray. It is most useful when radiolucent FB is suspected and plain X-ray is inconclusive. In the above situations, fluoroscopy would show phasic mediastinal shift. Mediastinal shift during inspiration indicates the side of FB. In our experience fluoroscopy is often not required.

In suspected chronic FB aspiration, investigations like CT scan, and contrast study may be required. Ventilation perfusion scans have also been used(7).

Diagnosis

In a patient with a history of choking

with or without clinico-radiologic signs, the diagnosis is straightforward. However, inspite of this history, the diagnosis may be delayed beyond 24 hours because of ignorance by parents or lack of a high index of suspicion by the primary physician(3). The presence of underlying bronchial asthma or pulmonary tuberculosis may also delay the diagnosis.

Any suspicious clinical or X-ray chest findings (Fig. 4) should make one review the history for any unwitnessed choking episode. This may be done by delineating the circumstances in which the child developed respiratory distress. Particularly useful is the kind of activity

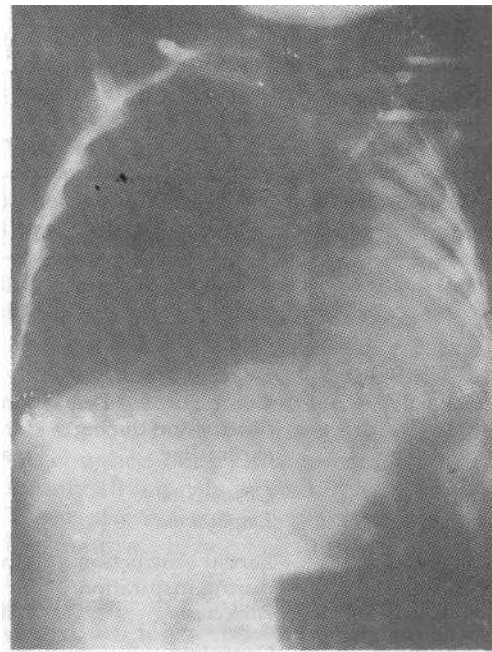


Fig. 1. X-ray chest in a patient with organic foreign body in the right main bronchus leading to right lung obstructive emphysema and mediastinal shift.

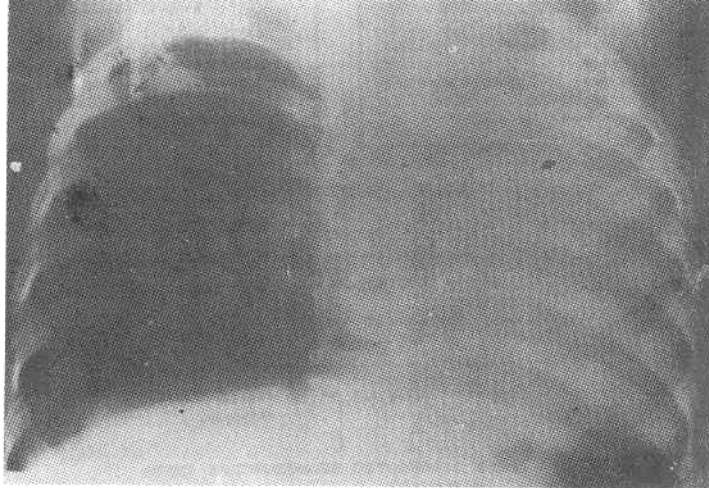


Fig. 2. X-ray chest in a patient with organic foreign body in left main bronchus leading to left lung collapse and compensatory emphysema of the right lung.

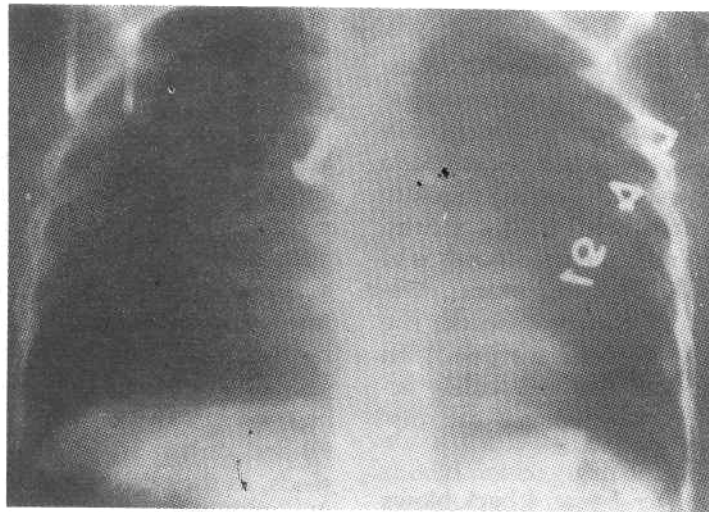


Fig. 3. X-ray chest showing a metallic screw in the right main bronchus.

the child was involved prior to onset of respiratory distress, *e.g.*, eating or playing, missing parts of a toy, light going off when child was eating, *etc.*

With improvements in broncho-

scopes and enhanced safety of bronchoscopy, early diagnostic bronchoscopy is recommended in all cases suspected to have FB aspiration(3,7,15). We follow a simple algorithm for early diagnosis (*Fig. 4*).

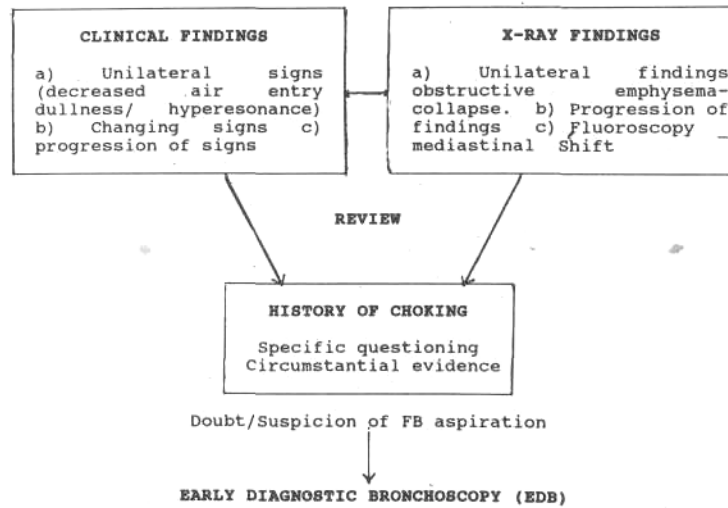


Fig. 4. Algorithm for early diagnosis of foreign body aspiration.

Management

The first thing to be assessed in a case of suspected FB aspiration is "airway patency". Signs of upper airway obstruction including aponia or apnea need to be urgently managed. The technique to be adopted is debatable(19,20). The principle involved in all the procedures is to generate a positive intrathoracic pressure so that the FB may be expelled. The most recent AAP statement (1993) on these techniques is the one Widely accepted(19). These techniques are discussed below(21).

(a) *Infants under 1 year.* 4 back blows with head held low followed by 4 chest compressions. Visualize the pharynx with jaw lift, if FB is seen, extract (avoid blind finger sweeps). If above measures fail, give rescue breathing, then repeat the above procedure.

(b) *Children above 1 year* (Heimlich maneuver). 6-10 abdominal thrusts,

visualize pharynx, if FB is seen, extract. If failed, give rescue breathing, then repeat the above procedure.

However, these measures should not be instituted in a child who is able to speak or cry or is breathing. If above measures fail, urgent cricothyrotomy should be done with an 18G needle with a simultaneous call being sent for tracheostomy. In hospital setting endotracheal intubation can be tried with smaller size tube. Intubation should not be tried in cases of large FB, subglottic FB and certain seeds such as tamarind seeds, as they can slip down and straddle across the carina, worsening the condition. Similarly postural drainage should not be attempted.

Bronchoscopy

Once stabilized the child is kept nil orally. Oxygen should be administered in cases with respiratory distress. Dehydration, dyselectrolytemia and acid-base

disturbances should be corrected before bronchoscopy. Secondary infection should be managed with appropriate antibiotics. There is no role of prophylactic antibiotics. If obstruction is significant or in case of long standing FB aspiration, perioperative steroids should be used to reduce airway edema. Bronchoscopy and general anesthesia in FB aspiration should be viewed as an "unstable ventilating system" (22). Therefore special attention should be paid to oxygenation. The procedure time should not usually exceed 20 minutes. A good preparation is the key for successful extraction of foreign body. Rigid bronchoscopes (*e.g.*, Karl Storz) are the best. Flexible bronchoscopes are generally not preferred(23). Proper size bronchoscope should be selected for the age as larger bronchoscopes can cause trauma and post-operative edema. It is not uncommon to confuse the pink integument of the peanuts for bronchial mucosa. At times larger bronchial foreign bodies cannot be extracted through bronchoscope and have to be pulled along with the bronchoscope. A second bronchoscopy may be needed in 5-15% of cases because of incomplete removal of the FB. Details of bronchoscopy and its complications may be found elsewhere^{^^}). Chronic bronchial FB may require thoracotomy or lobectomy(8,25).

Prevention

With the increase in nuclear families and employment of both parents, children are often unattended and at risk of FB aspiration(26). Hence there is an urgent need for dissemination of information regarding preventive measures.

Environment. Community data from

US (NEISS) states that 75% of choking episodes occurred in home and 60% occurred during feeding(2). However, with the present situation of both parents being employed, location of aspiration would probably shift to creches and working places. Same is the case with labour class who often carry their child to their work-place and leave them unattended. Our experience and that from China(3) reveals that majority of parents are unaware of the dangers of aspiration. The parents and caretakers should be made aware of the dangers of aspiration, proper feeding habits and burping, and avoiding hurried feeding. Common sense and anticipation would prevent FB aspiration. The parents should be taught about first aid techniques and their indications.

Agent. 60-80% of FB are organic. Pulses, nuts, vegetables should be thoroughly boiled and mashed before feeding. Coins, marbles, whistles, balloons, tablets, and unsafe toys should be kept out of reach from the child.

Host. Eighty per cent of affected children are between 6 months to 3 years. Because of their cognitive constraints vigilance is essential in prevention. Most children about 4 years can be taught about the dangers of aspiration. Coins should not be given as a token of appreciation. Table manners should be taught. Child should be told not to suck at whistle or balloon and avoid games like putting a bead in the nose. Special care is required in patients with cerebral palsy or mental retardation.

The above information should be disseminated by the family physician, pediatrician, health workers and affected

parents. Mass media can be utilized in this respect. The Government and the industry must avoid manufacture of unsafe toys.

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