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Inhalation of foreign bodies by children: Review of experience with 74 cases from Dubai

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Abstract
Seventy four out of 94 cases of bronchoscopy carried out over a five year period are reviewed. The clinical history of choking followed by recurrent spasmodic cough were found to be the most important element in making the diagnosis and proceeding to diagnostic and therapeutic bronchoscopy. Radiology was inferior as a diagnostic aid although radioactive scanning may be helpful in difficult cases.

Introduction

Foreign body inhalation is the most common cause of accidental death at home in children under six years of age (National Safety Council of America, 1980). It is estimated that approximately 3,000 deaths per year

TABLE I
BRONCHOSCOPY SURVEY PROFORMA
ENT
Bronchoscopy Survey (Proforma)—Dubai Hospital

NAME:	DATE OF ADMISSION:
AGE:	
NATIONALITY:	
HISTORY:	
Definite/Inhalation Foreign Body	Duration
Choking	
Cyanosis	
Cough	
Stridor	
Dyspnoea	
EXAMINATIONS FINDINGS:	
Positive Findings	
1. Atelectasis	
2. Decreased breathing sound	
3. Compensatory emphysema	
4. Chest infection	
X-ray Findings	
1. Collapsed lung	
2. Emphysema	
3. Chest Infection	
4. Radiolucent Foreign Body	
5. Radionuclide Ventilation/ Perfusion (Pre-Endoscopy)	
Bronchoscopy Findings	
1. Foreign Body (removed)	Type
2. No Foreign Body	
3. Inflammatory Mucosa	
4. Mucous Plug	
5. Abnormality	
Post-operative	
1. Complete relief (Yes/No)	
2. Chest Infection	
3. X-ray Finding	
4. Radionuclide Ventilation/ Perfusion (Post-Endoscopy)	

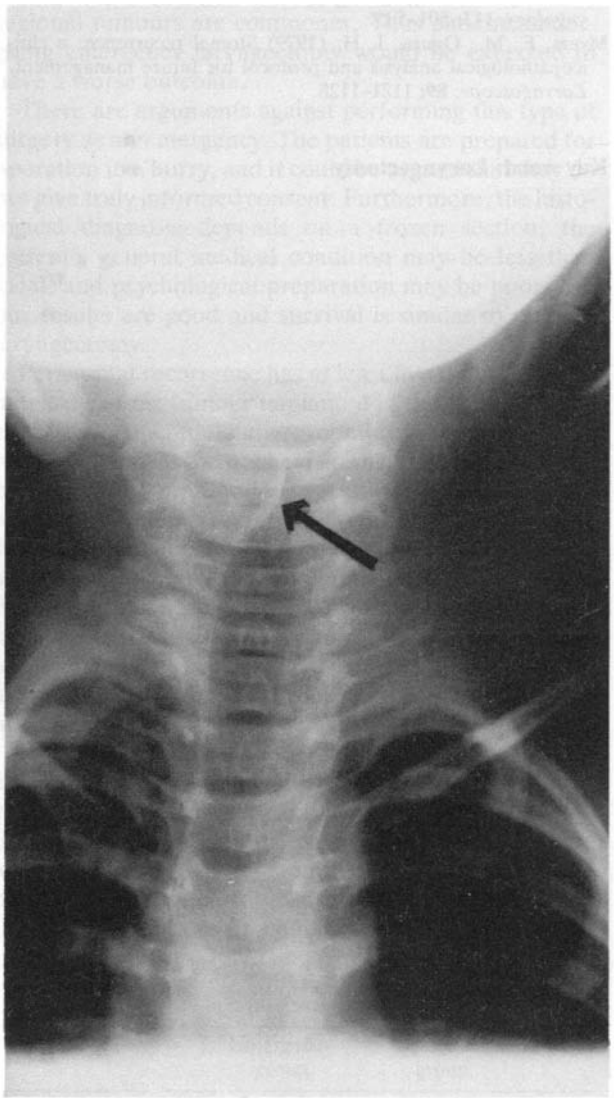

FIG. 1
X-ray neck AP view shows egg shell in the larynx of a five year old girl.

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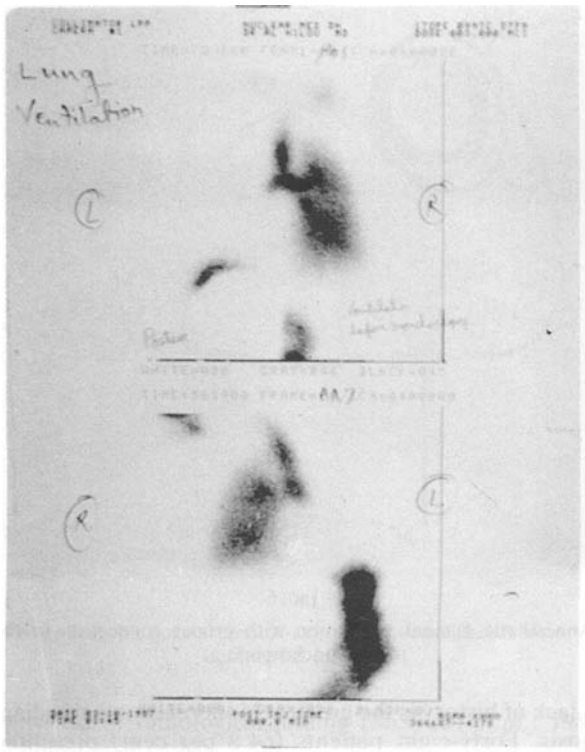

FIG. 2

Pre-endoscopy lung ventilation scan indicate obstruction of the left lung (anterior and posterior view)

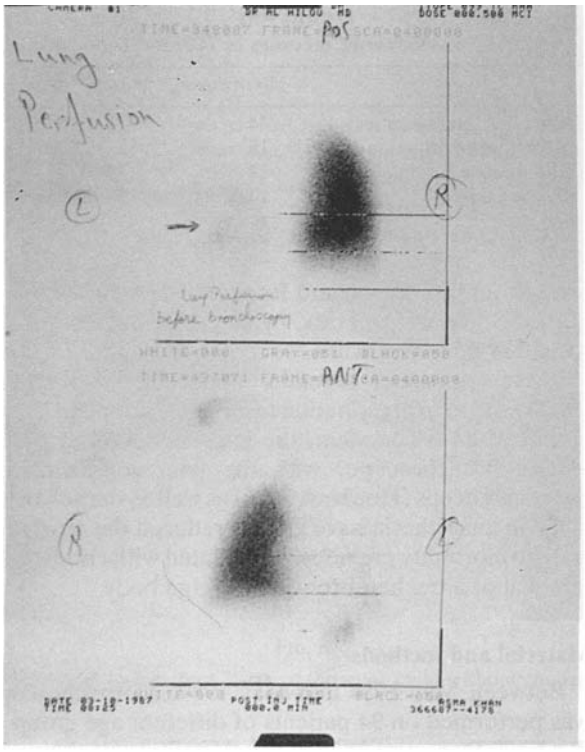

FIG. 3

Pre-endoscopy lung perfusion scan of the same patient indicate decrease perfusion of the left lung (anterior and posterior view)

occur in United States from this cause (Mofenson and Greensher, 1985). Early diagnosis and removal of the tracheo-bronchial foreign body is imperative to prevent serious complications.

The first bronchoscopic removal of a foreign body from the lower air passages is attributed to Gustav Killian in 1897 (Clerf, 1952). The basic diagnostic and therapeutic principles for the management of these patients

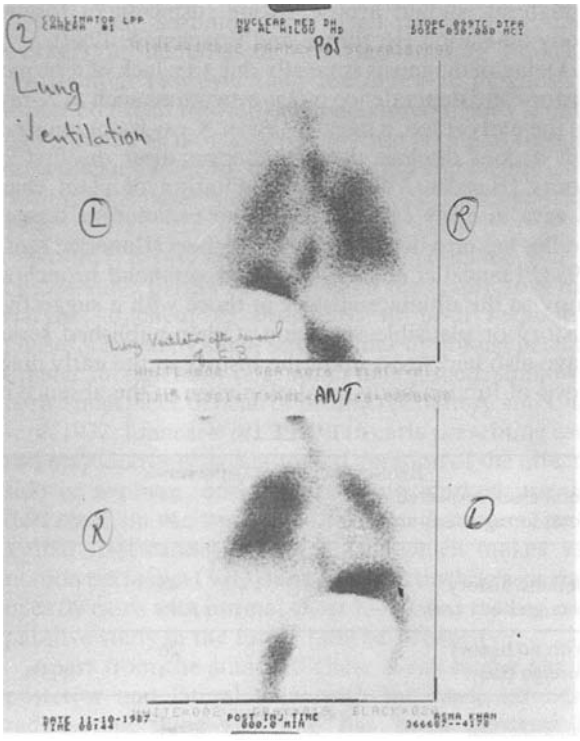

FIG. 4

Post-endoscopic ventilation scan shows improved lung ventilation after removal of the FB of the same patient (anterior and posterior view)

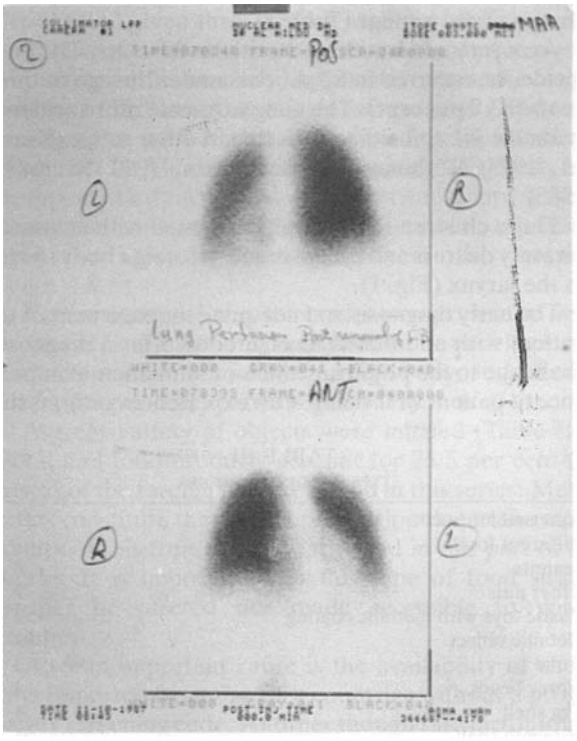

FIG. 5

Post-endoscopic perfusion scan indicate improved perfusion of left lung after removal of the FB of the same patient (anterior and posterior view)

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TABLE II
RADIOGRAPHIC CHANGES IN 74 PATIENTS

	No of cases	%
Chest infection (opacities)	34 cases	43%
Obstructive emphysema	18 cases	22.7%
Radio-opaque foreign body	14 cases	17.7%
Collapsed lung	13 cases	16.4%

(Some cases have more than one X-ray changes)

was set out by Jackson and Jackson (1936, 1950), in the United States of America, by Negus in Britain and by Killian in West Germany.

These principles remain applicable today but improvement in illumination techniques provided by the Hopkins rod lens system, the introduction of the ventilating bronchoscope, with the finer self-contained grasping forceps (Hopkins, 1976) as well as the advances made in anaesthesia have greatly reduced the mortality and the morbidity previously associated with endoscopic removal of a tracheo-bronchial foreign body.

Material and methods

Between May 1984 and May 1989, a bronchoscopy was performed on 94 patients of different age group in the ENT Department at Dubai Hospital. Of these, 74 case records have been examined for the purpose of this review. The 20 other case records could not be traced due to a change in the filing system.

Most of the cases were referred either from the Paediatric Department of the same hospital or from peripheral hospitals where facilities for endoscopy were not available. The clinical data for each patient has been recorded on a special bronchoscopy survey proforma for the whole event from the time of admission until discharge of the patient (Table I).

Ages ranged from three months to 23 years. The peak incidence occurred in 62 patients under the age of three years (83.7 per cent). The male to female ratio incidence is almost 2:1 coinciding with that in other series (Kim *et al.*, 1973; Rothman and Boeckman, 1980; Svensson, 1985).

Three children (4 per cent) presented with acute respiratory distress and cyanosis due to foreign body lodged in the larynx (Fig. 1).

The early diagnosis and adequate management of the patient with an inhaled foreign body offer a diagnostic challenge to the physician and is of fundamental importance to patient well-being. Our experience confirms that

TABLE III
TYPE OF FOREIGN BODIES

Water-melon seed	11
Different foods	8
Peanuts	8
Other nuts	7
Plastic toys with metallic coating	4
Metallic object	3
Stone	3
Worry beads	1
Egg shell	1
Pistachio shell	1
Vertebral fish bone	1
Whistle	1
Total foreign bodies	49

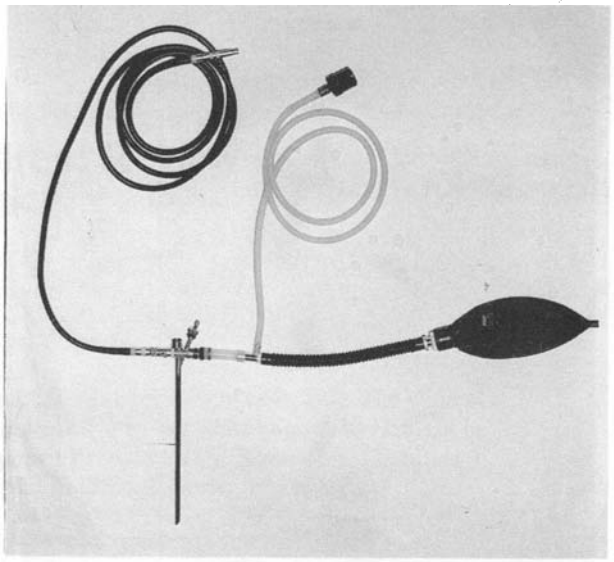

FIG. 6
Anaesthetic manual ventilation with proper connection to the bronchoscope

a lack of history is the greatest hinderence to early diagnosis. Forty-eight patients (64.8 per cent) presented with a history of a definite event of aspiration, namely choking followed by prolonged paroxysms of coughing. This event had often been ignored by medical staff when the initial assessment was made, although it was often recalled later either by the patient or the parent. It is therefore important that questions to this effect are specifically asked.

Also the appearance of a sudden wheeze in a child without a previous history of asthma, especially if it is unilateral, should arouse strong suspicion of foreign body inhalation (Rothman and Boeckman, 1980).

Delay in diagnosis is mostly due to a lack of a proper history and dependence on investigations such as X-ray. In the early stage, a negative chest X-ray is not unusual, but it does disclose definite changes after the first 24 hours (Baraka, 1974). This limitation of plain chest X-rays in early cases of aspirated radiolucent foreign bodies has also been reported by others (Banerjee *et al.*, 1988; Liancai *et al.*, 1990) who recommend bronchoscopy as the ultimate answer in those with a suggestive history or plausible suspicion. Other published series have also laid stress upon the history in the early diagnosis of foreign body inhalation even in the absence of

TABLE IV

BRONCHOSCOPIC EXAMINATION		
Total cases suspected	74	
Total foreign body seen	49	66.2%
PATIENT'S HISTORY		
Definite history	48	
Foreign body seen	45	93.7%
With no history	26	
Foreign body	4	15.3%
X-RAY FINDINGS		
Changes seen	57	
Foreign body seen	36	63.1%
No changes seen	17	
Foreign body seen	11	64.7%

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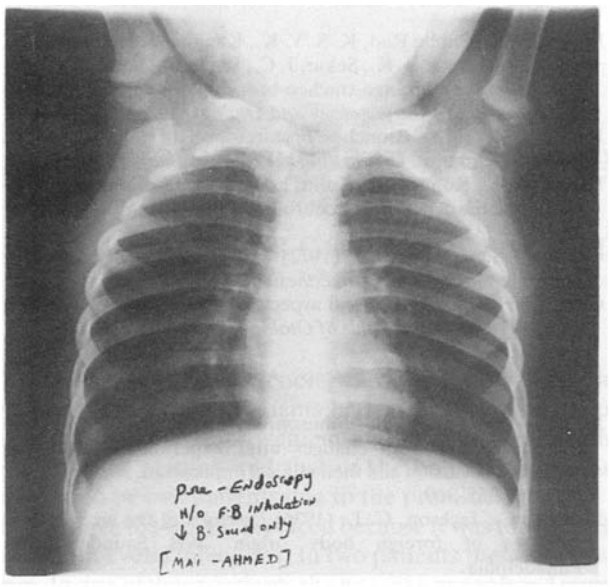

FIG. 7
Pre-endoscopic normal chest X-ray of child with 12 hours history of definite FB inhalation

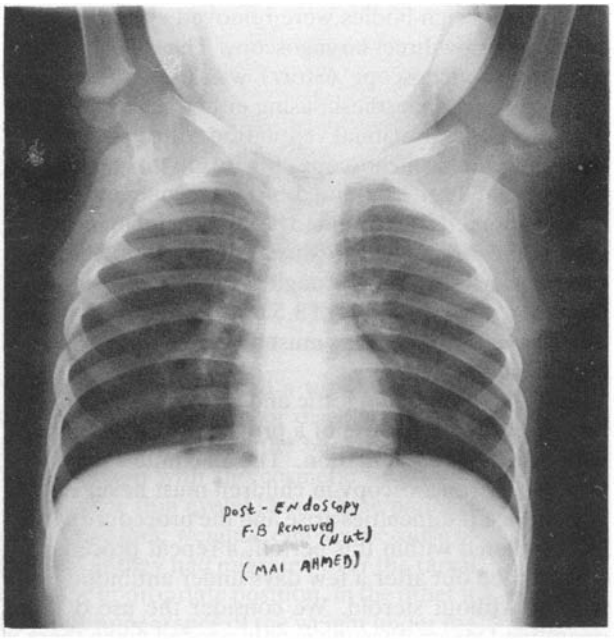

FIG. 8
Post-endoscopic chest X-ray of the same child without change

physical or radiological finding (McGuirt *et al.*, 1988; Liancai *et al.*, 1990).

The positive X-ray findings are related to many factors, namely, the size, type and the shape of foreign body, the site of its lodgement, the pattern of bronchial obstruction and the length of its presence in the airway as well as the technique of radiographic evaluation used (Liancai *et al.*, 1990).

Different modalities of imaging diagnostic techniques such as xeroradiography, stereoscopic fluoroscopy, bronchography, ordinary and computed tomography as well as lung scanning have been reported by many workers to be efficient in demonstrating bronchial obstruction. However their usefulness in diagnosis of aspirated occult tracheo-bronchial foreign body seem to be restricted as most patients are too young to co-operate sufficiently during the examination and the radiation dosimetry is high (Rudavasky *et al.*, 1973; Berger *et al.*, 1980).

Normal X-ray finding has been explained due to bypass-valve partial obstruction of the respiratory tract (larynx, trachea, or bronchus) in both respiratory phases, caused by small size and flat or oblong in shape organic foreign body (*e.g.* water melon seed, sunflower, corn, small piece of bean or peanut) (Chatterji and Chatterji, 1972; Liancai *et al.*, 1990). In early presenting cases this may lead only to diminished aeration of the affected side or segment, and if there is no marked pressure difference on the two sides of the mediastinum, mediastinal shift cannot occur. A fact which makes ventilation perfusion (V/Q) lung scan worthwhile especially in early cases with normal chest X-ray, but further comparative study in the future may be necessary.

Apart from the standard chest X-ray in the antero-posterior and lateral view with the neck extended, radioisotope lung scanning has been adopted for selected cases in this department. Numerous clinical and experimental studies have shown that a poorly areated lung segment will cause a decrease in pulmonary arterial blood flow to that segment (Mishkin and Wagner, 1967; Isawa *et al.*, 1971). Regional hypoxia seems to be the critical factor causing localized vaso-constriction and elevation of local resistance to blood flow (Isawa *et al.*, 1971; Potchen and Evens, 1971).

A ventilation and perfusion radionuclide lung scan, performed in selected patients when there is no acute respiratory emergency, is found to be very useful and adds further information in addition to the clinical signs.

In a lung ventilation scan, the procedure involves making the child inhale Technetium^{99} aerosol (Tc-DTPA) given through face mask for three minutes with lung scintigraphy both anteriorly and posteriorly. For a lung perfusion study, the patient receives (1–2 millicurie) of Tc^{99} macroaggregate intravenously and lung scintigraphy with both anterior and posterior views (Figs. 2 & 3). This ventilation perfusion (V/Q) study can be repeated within the first week after endoscopy if there is any suspicion of a foreign body remnant, especially food particles, left undetected in the bronchi (Figs. 4 & 5).

The majority of the referred cases presented with recurrent lung infections, presumably due to delay in the early diagnosis of an inhaled foreign body, and account for 34 (43 per cent) patients (Table II).

A great variety of objects were inhaled (Table III). Food and food products account for 75.5 per cent (37 cases) of the foreign body removed in this series. Melon seeds constitute the highest proportion due to the availability of this fruit all the year round in this part of the world. It is important that this type of food should neither be offered nor made accessible to young children.

Also an important cause is the availability of cheap toys imported from Far East countries without a proper safety screening code. Another though rare factor found in young babies less than one year old was that foreign bodies were put deliberately in their mouths by their elder brothers or sisters children in the family as an act of play.

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All the foreign bodies were removed either by bronchoscopy or by direct laryngoscopy. The rigid Hopkin's rod lens bronchoscope (Storz) was used in all cases under general anaesthesia using either a Venturi injection technique or manual ventilation with a proper connection to the bronchoscope (Fig. 6). In our experience the combined self-contained bronchoscope and optical grasping forceps was found to be very useful in removing most of the foreign bodies (Storz). Its limitation lies in its size. It can only pass through a bronchoscope with a minimum inner diameter of 3.5 mm. In infants therefore other types of fine forceps must be used with a swing eye adjustable magnifier.

Post-endoscopy subglottic and laryngeal oedema can be prevented by the use of a proper size bronchoscope with minimal manipulation. The maximum allowable time for a bronchoscopy in children must never exceed 20 minutes. If difficulties arise and the procedure cannot be completed within this period, a repeat procedure is only carried out after a few days under antibiotic cover with or without steroid. We consider the use of post-operative Dexamethasone is only needed when there is fear of subglottic oedema after unusually prolonged bronchoscopy. As a routine and following the extraction of foreign body from the bronchi, the bronchoscope is then reinserted into both lungs and careful examination is carried out to assure that no foreign material remains undetected. The mortality rate was nil in this series.

In our series (Table IV) the history was predictive of a foreign body in 93.7 per cent of cases as confirmed by bronchoscopy whereas positive findings on a routine chest X-ray only did so in 63.1 per cent of cases (Figs. 7 & 8).

Conclusion

1. Susceptible young children presenting with a definite history of sudden choking followed by prolonged coughing episode, with or without cyanosis, even in the absence of physical or radiographic change are likely to have inhaled foreign body and an early decision for bronchoscopy should be taken.
2. X-ray findings cannot be fully relied upon in early cases with a suspected foreign body in the bronchus.

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Key words: Foreign body; Radiography; Bronchoscopy

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