Inhaled Foreign Bodies in Children

An analysis of 40 cases

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Early diagnosis and removal of an inhaled foreign body may save a patient from chronic ill health or possibly death. The purpose of this paper is to discuss the radiological findings in 40 children who attended hospital with respiratory symptoms caused by the presence of an inhaled solid object lodged in the trachea or a major bronchus. 2 of these objects were coughed up while the patients were in hospital, 37 were removed at bronchoscopy, and in one child bronchotomy was necessary. All attended since the beginning of 1956 over a period of almost 10 years.

Just over half the children were under 3 years of age (Fig. 1). Of the 11 children aged under 2 years, 10 were accompanied by responsible adults who had witnessed the acute choking episode when 'something went the wrong way', and realized its significance in relation to the subsequent onset of symptoms. Of the 9 children aged more than 8 years, 8 volunteered such information for themselves; the ninth was a boy who had undergone dental extractions under general anaesthesia, and a few days later developed pneumonia caused by an inhaled tooth. Of the 20 patients aged between 2 and 8 years a relevant history was given by only 8, while 12 attended with respiratory symptoms without any indication of their cause. In this age range children are not constantly under adult supervision and an acute choking episode may pass unobserved. Moreover, they may not have sufficient experience to understand the significance of such an episode or, in the case of the younger ones, language to describe it.

The distribution of the foreign bodies is demonstrated in the Fig. 2, the site in each case being judged by the bronchoscopy findings or, in a few cases in which the foreign body was opaque to x-rays, by the position demonstrated on the radiograph. 2 were in the trachea, 28 were on the right side, and 10 on the left, a proportion similar to that found by Le Roux (1964) in his series of 25 cases, of

FIG. 1.—The age distribution of the patients, with an indication of the number in each group in whom the probable diagnosis was suggested by the clinical history.

FIG. 2.—The distribution of the 40 foreign bodies in the bronchial tree, the outline of which is traced from a normal bronchogram.

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TABLE I
Nature of the Foreign Bodies

Foreign Body	No.	Radiopacity
Nail	2	Dense shadow on film
Screw	2	
Gun pellet ..	1	
Bead	1	
Tooth	1	
Concrete fragment ..	1	Faint shadow on film
Gravel	1	
Stone	1	
Aluminium foil ..	1	
Peanut	23	Not visible on film
Unspecified nut ..	1	
Piece of carrot ..	1	
Plastic fragment ..	3	
Silver paper	1	Not x-rayed before bronchoscopy

which 9 were children. As he points out, the right main bronchus is a little wider than the left and lies in a more direct line with the trachea, and this is demonstrated in the diagram in which the outline of the bronchial tree is a tracing from a normal bronchogram. 22 objects were located in a main bronchus and 15 in a major lower bronchus. It was not possible to subdivide the 13 foreign bodies in the right lower bronchus, as it was often difficult to be certain whether they were lodged in the intermediate bronchus or its continuation, the lower lobe bronchus. Only one foreign body, a tooth extracted under general anaesthesia, was removed from an upper lobe.

The 40 foreign bodies are classified in Table I with an indication of their visibility on the radiograph. In 7 cases the object was densely opaque and clearly visible (Fig. 3), in 4 it was faintly opaque and could be seen only on careful scrutiny of the film (Fig. 4), and in 28 it was non-opaque. The history and clinical condition warranted urgent bronchoscopy in the only patient who was not x-rayed before bronchoscopy. The vast majority of the foreign bodies were peanuts which were not visible on the radiograph. These are particularly harmful as they cause a severe inflammatory reaction (*Brit. med. J.*, 1965), and because, with the passage of time, vegetable matter decomposes and may become friable and difficult to remove. It is very probable that other fragments of food are inhaled more frequently than peanuts but are rapidly expelled by a violent fit of coughing. The shape and consistency of a peanut are such that it may easily occlude a child's bronchus. Then the initial sharp inspiration of a cough could cause firm impaction and prevent the inspiration of sufficient air into the lung beyond the nut to enable the force of expiration necessary to dislodge it.

FIG. 3.—Boy, aged 2 years and 9 months, who attended with a cough of a few days' duration. An unsuspected metallic foreign body is shown in the right lower bronchus. There is slight lucency of the right lung, which might have escaped notice if the foreign body had been non-opaque.

The commonest radiological finding in the lung fields (Table II) was unilateral basal collapse or consolidation (Fig. 4 and 5). In 14 of the 17 cases with changes in the right lower lobe, similar changes

FIG. 4.—Boy, aged 8 years and 10 months, with cough and pyrexia following a choking attack when he had a 'milk-bottle top' in his mouth. The postero-anterior view (a) shows consolidation at the right base and a faint opacity (arrows) at the right hilum. The lateral view demonstrated that this faint opacity lay within the right main bronchus. Prior to an arranged bronchoscopy, the boy coughed up a crumpled piece of aluminium foil.

TABLE II
Radiological Appearance of Lung Fields

Radiological Appearances	No. of Cases	Site
Unilateral basal collapse or consolidation	22	Right middle and lower lobe 14 Right lower lobe only 3 Left lower lobe 5
Unilateral upper lobe consolidation	1	Left upper lobe 1
Obstructive emphysema	6	Left lung 3 Right lung 2 Bilateral 1
Minimal difference in lucency of right and left lungs	5	Slight opacity on side of foreign body (right) 1 Slight lucency on side of foreign body (3 on right side, 1 on the left side) 4
Clear	5	
Not x-rayed before bronchoscopy	1	

were present in the right middle lobe, but in most cases the apical segment of the right lower lobe did not appear to be involved. Basal changes did not always signify that the foreign body was in a lower bronchus. In one child it was in the trachea and in 7 others in a main bronchus, the changes at the lung base probably resulting from the presence of mucus or pus in a lower bronchus (Fig. 4). Basal collapse and consolidation are non-specific and the presence of a foreign body may not be suspected unless there is a relevant clinical history or the foreign body is radio-opaque and clearly visible on the film.

Obstructive emphysema of one lung was present in 5 patients, and of both lungs in one with a foreign body in the trachea. Obstructive emphysema occurs when the obstruction is incomplete during inspiration but is complete when the lumen of the bronchus narrows during expiration. Under these circumstances, the affected lung remains fully inflated in all phases of respiration. At the peak of inspiration both lungs are inflated and lucent and the mediastinum may be central in position. On expiration the affected lung remains inflated and lucent but the normal lung deflates, becomes more opaque, and draws the mediastinal structures away from the affected side. The condition can be recognized on fluoroscopy or if radiographs are taken in both phases of respiration. Even marked obstructive emphysema may be overlooked if it is bilateral or if a single radiograph is taken at the peak of deep inspiration (Fig. 6).

In 5 cases there was a very slight difference in the lucency of the right and left lungs: in 4 of these the foreign body was found on the side of the greatest lucency, which was probably due to a minimal degree of obstructive emphysema (Fig. 3), and in one on the side which was a little more opaque, probably due to

slight de-aeration. Such minimal changes could easily be overlooked or considered insignificant if the observer were unaware of the possible diagnosis.

In 5 patients the lungs were clear: in 4 of them an opaque foreign body was demonstrated on the film (Fig. 7), otherwise the diagnosis would certainly have been delayed or overlooked. Bronchoscopy was performed in the fifth patient because of the clinical history and symptoms. Consolidation of the left upper lobe was shown on the radiograph of the patient who had inhaled a tooth. The only other case with changes in an upper lobe was one whose first film showed collapse of the right upper lobe which rapidly re-expanded, the patient developing obstructive emphysema of the right lung.

Discussion

Removal of an inhaled foreign body from the bronchial tree leads to rapid improvement in the patient's symptoms and may be a life-saving measure. As indicated by Powell (1965), the most important factor in making the diagnosis is awareness of the possibility. In a series presented by Linton (1957), only 5 out of 16 patients gave a relevant history before bronchoscopy, but he was discussing foreign bodies of long standing. In this series 26 gave a history of inhaling a foreign body: 25 of these were x-rayed, and in all but one there was radiological confirmation of the diagnosis, but in some cases the abnormal findings were slight and might have escaped notice without careful inspection or if the films had been of poor quality.

There were 14 patients who presented with respiratory symptoms without any relevant history. A diagnosis could be made radiologically in 8 by demonstration of a densely opaque foreign body (5)

FIG. 5.—Boy, aged 3 years and 6 months, who was admitted with a diagnosis of pneumonia. The radiograph shows extensive consolidation involving the right middle and lower lobes. For a while his condition improved with medical treatment, but later relapsed and then deteriorated. Finally bronchial obstruction was suspected and, at bronchoscopy, a peanut was found in the right lower bronchus, but it was so firmly impacted that bronchotomy was necessary for its removal.

FIG. 7.—Girl, aged 7 years and 3 months, who 'went blue' after inhaling a bead. She recovered from the acute attack but had a slight cough. The opaque bead is shown in the right main bronchus, but the lung fields are clear and if the foreign body had been non-opaque the diagnosis would have been missed.

(a)

(b)

FIG. 6.—Girl, aged 2 years and 8 months, with a history of a cough and wheezy breathing since a choking attack while eating peanuts a few days previously. Films of the chest taken on inspiration (a) and expiration (b) demonstrate obstructive emphysema of the left lung. Note that the left lung remains inflated in both phases of respiration and that the condition is less obvious on the film taken on inspiration. At bronchoscopy a peanut was removed from the left main bronchus.

or obvious obstructive emphysema (3). In the remaining 6, bronchoscopy was considerably delayed and was eventually performed because persistent or recurrent, unilateral basal collapse or consolidation led to a suspicion of bronchial obstruction. It is, of course, impossible to tell the number or ultimate fate of children in whom the diagnosis of an inhaled foreign body has been entirely missed over the period of time during which these 40 cases were diagnosed and treated.

When an inhaled foreign body is suspected careful inspection of a good postero-anterior film may be all that is necessary for confirmation of the diagnosis. In some cases, further films or fluoroscopy may be indicated. Without awareness of the possibility of an inhaled foreign body the diagnosis may be overlooked when the x-ray changes are minimal or the film is of poor quality, or if the only changes are those of unilateral basal collapse or consolidation.

Summary

The radiological findings in 40 children with an inhaled foreign body lodged in the bronchial tree are analysed, and the value of the principal findings is discussed.

If the radiologist is aware of the possibility, a chest radiograph shows confirmatory evidence in nearly every case where a foreign body is present, but the diagnosis may be missed in some patients attending with respiratory symptoms without any indication of their underlying cause in the clinical history.

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