

Tracheobronchial Foreign Bodies

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Abstract. Objective : Foreign body inhalation is an extremely serious problem in children and sometimes result in sudden death. The current mortality rate from foreign body inhalation is between 0% and 1.8% according to various studies. In spite of this, undiagnosed and unsuspected foreign bodies still occur in the airway. **Methods :** Pediatric patients with documented foreign body inhalation, treated in the Department of Pediatrics, Bapuji Hospital, JJM Medical College during 1997-2000 are included in the analysis. Children with or without positive history of aspiration were examined and the diagnosis was made on the basis of history, clinical findings, radiologic evaluation and strong index of suspicion in those children where reasonable appropriate treatment failed to resolve the respiratory symptoms. Bronchoscopy was performed for a suspected foreign body on 165 children. **Result :** A review of 165 pediatric cases of suspected foreign body aspiration revealed, children between 1 and 3 years were found to be very vulnerable for aspiration. Majority of children were boys. Over 70% of the patients had positive history of inhalation. Only 60% of the patients presented immediately, that is within 24 hours after aspiration. Common symptoms were cough and respiratory distress. Physical examination showed abnormal finding in 91% of cases. Decreased air entry was the significant clinical sign. Obstructive emphysema was found in majority of the cases (49.5%). Rigid bronchoscopy under general anaesthesia was the preferred method for removal of aspirated foreign body. In 65 (61.9%) cases foreign body was lodged in the right main bronchus and majority of these were organic in nature, that is 96(91.43%). **Conclusion :** Tracheobronchial foreign bodies should be strongly suspected in pediatric age group who present with a suggestive history, even when physical and radiographic evidence is absent. The modalities of diagnosis, management and outcome are discussed. [Indian J Pediatr 2003; 70 (10) : 793-797] E-mail : amshivak@yahoo.co.in

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Inhalation of foreign bodies into the tracheobronchial tree is an extremely serious problem in childhood, sometimes resulting in sudden death. It is the leading cause of sudden death in children under 6 years of age.¹ Early diagnosis and removal of the foreign body is imperative to prevent serious complications, as well as to prevent the lesser, but still significant complications of recurrent acute respiratory distress, chronic and recurrent pneumonia and pulmonary abscess.

Foreign body inhalation is usually accompanied by severe coughing, wheezing, dyspnoea or stridor. This acute episode may escape the notice of the parents, and the cause may be obscured for a long period. Radiology is the primary means of confirming the diagnosis. However, it is seen that, most foreign bodies are radiolucent. Chest roentgenograms are frequently normal and findings of obstructive emphysema and atelectasis are not always present.

Attempts to remove foreign bodies by physiotherapeutic clapping, or postural drainage have had rather poor results. However, for removal of the aspirated foreign body, the open tube bronchoscope with Hopkins telescopes is undoubtedly the instrument of choice. The first successful removal of tracheobronchial

foreign body was performed by Gustav Killian on March 30th, 1887.² Earlier mortality rate was high for the procedure, but currently it is 0-18%.^{2,3,4} Great advances in endoscopic and anaesthetic techniques have greatly reduced the trauma and complications previously associated with endoscopic removal of tracheobronchial foreign bodies.

We share our experience with tracheobronchial foreign bodies in 105 children who presented to Bapuji Hospital, Davangere, Karnataka, India, during a 3-year-period. We report the retrospective analysis of this experience.

MATERIALS AND METHODS

All pediatric patients with documented foreign body inhalation, treated in our hospital during 1997 to 2000 are included in this analysis. Children with or without positive history of aspiration were examined and the diagnosis was made on the basis of history, clinical findings, radiologic evaluation and strong index of suspicion in those children where reasonable appropriate treatment failed to resolve the respiratory symptoms.

Inclusion criteria for suspecting foreign body aspiration

- (1) Positive history of aspiration while eating given by the parents.

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- (2) Spasmodic cough without fever not responding to medical line of treatment.
- (3) Unresolved bronchopneumonia
- (4) Respiratory distress not responding to bronchodilators
- (5) Decreased air entry on one particular site while auscultating the chest.

Bronchoscopy was performed for a suspected or verified foreign body on 165 children. It was performed as an emergency procedure for those children who had acute respiratory symptoms. In remaining cases, immediate treatment was given in the form of antibiotics, steroids and other supportive measures and bronchoscopy were performed as an elective procedure. Foreign body removal was done using open tube bronchoscope, under general anaesthesia using jet ventilator. The children were monitored post operatively in the intensive care unit for 12 to 24 hours.

Statistical Analysis

Categorical data was analysed by chi-square test. Diagnostic validity tests were performed for calculating sensitivity and specificity for various signs and symptoms.

RESULTS AND ANALYSIS

Bronchoscopy was performed on 165 children with radiologically suspected foreign body. There were 96 boys (58.1%) and 69 girls (41.8%) and foreign body was extracted in 105 cases (63.5%). Foreign body was found more frequently among boys, 69 cases (65.7%) when compared to girls, 36 cases (34.2%). The male to female ratio was 1.9:1. Children between 1 and 3 years were found to be very vulnerable for aspiration and the mean age determined was 2.8 years (± 2.7).

A definite history of foreign body aspiration was obtained in 74 cases (70.40%). Cough was the most common symptom seen in 92% of cases, followed by wheeze and dyspnoea in 64% and 61% respectively (Table 1) in cases where foreign body aspiration was confirmed after bronchoscopy. Whereas fever was the most common symptom seen in 96% of cases followed by cough and wheeze in 91% and 66% of cases respectively in cases where foreign body aspiration was ruled out after bronchoscopy.

Decreased air entry and unilateral wheeze were the common respiratory signs (Table 1), in cases where foreign body aspiration was confirmed after

TABLE 1. Symptoms and Signs

| | Where foreign body was confirmed after bronchoscopy | | Where foreign body aspiration was ruled out after bronchoscopy | | Significance* |
|---------------------|---|------------|--|------------|---------------|
| | Total | Percentage | Total | Percentage | |
| Symptoms | | | | | |
| Cough | 97 | 92.34 | 55 | 91 | NS |
| Wheeze | 68 | 64.74 | 40 | 66 | NS |
| Dyspnoea | 65 | 61.90 | 20 | 33 | Sig. |
| Cyanosis | 13 | 12.38 | - | - | Sig. |
| Fever | 10 | 9.52 | 58 | 96 | Sig. |
| Stridor | 5 | 4.76 | - | - | NS |
| Signs | | | | | |
| Decreased air entry | 83 | 79.02 | 10 | 16 | Sig. |
| Wheeze | 66 | 62.83 | 50 | 83 | Sig. |
| Rales | 10 | 9.52 | 48 | 80 | Sig. |
| Tracheal flutter | 3 | 2.86 | - | - | NS |

*Chi-square test Significant $P < .05$; Sig : Significant; NS : Not significant

TABLE 2. Radiological Evaluation Before Bronchoscopy

| | Where foreign body was confirmed after bronchoscopy | | Where foreign body aspiration was ruled out after bronchoscopy | | Significance* |
|-----------------------|---|------------|--|------------|---------------|
| | No. of patients | Percentage | No. of patients | Percentage | |
| Obstructive emphysema | 52 | 49.50 | 12 | 20 | Sig. |
| Atelectasis | 24 | 22.85 | 10 | 16 | NS |
| Surgical emphysema | 3 | 2.86 | - | - | - |
| Visible foreign body | 4 | 3.81 | - | - | - |
| Consolidation | 4 | 3.81 | 35 | 58 | Sig. |
| Normal | 18 | 17.14 | 3 | 5 | Sig. |

* Chi-square test Significant $P < .05$; Sig. : Significant; NS : Not significant

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TABLE 3. Diagnostic Validity of Different Variables (Signs And Symptoms)

| Diagnostic validity | Decreased air entry | Obstructive emphysema | Atelectasis | Decreased air entry + obstructive emphysema | Decreased air entry + atelectasis |
|----------------------|---------------------|-----------------------|-------------|---|-----------------------------------|
| Sensitivity | 79% | 50% | 23% | 73% | 67% |
| Specificity | 83% | 80% | 83% | 58% | 70% |
| +ve predictive value | 89% | 81% | 71% | 88% | 84% |
| -ve predictive value | 69% | 48% | 38% | 33% | 47% |
| Efficiency | 81% | 61% | 45% | 70% | 68% |

bronchoscopy, whereas wheeze and rales were the common respiratory signs in cases where foreign body aspiration was ruled out after bronchoscopy.

Radiological examination before bronchoscopy revealed radioopaque foreign body in 4 cases. Obstructive emphysema was seen in 49.50% and atelectasis in 22.85% of cases where foreign body aspiration was confirmed after bronchoscopy (Table 2), whereas consolidation 58% and obstructive emphysema 20% were seen in patients in whom foreign body aspiration was ruled out after bronchoscopy.

65 foreign bodies were found in the right bronchial tree and 36 were in left bronchial tree. In only 4 cases foreign bodies were lodged in the trachea.

Groundnut was the most common foreign body as seen in 35 cases (33.32%). Organic foreign bodies constituted 91.4%. Eleven foreign bodies were non-organic in nature. Endoscopic removal was successful in 101 cases at first attempt. In 4 cases foreign body was removed in the second attempt. There was one death in our series due to hypoxia and cardiac arrest.

Sensitivity, specificity and predictive values for variables in Table 1 and 2 were calculated (Table 3). Decreased air entry has high specificity, sensitivity and positive predictive value. Combination of decreased air entry with obstructive emphysema, has good positive predictive value.

DISCUSSION

Highest incidence of foreign body aspiration occurs in children below the age of 3 years.^{3,5,6,7} The probable reasons are lack of molar teeth in children which leads to improper chewing and makes them vulnerable to aspiration and inadequate control of deglutition. Physical activity like playing, running, together with talking and crying while eating are definite risk factors.^{8,9} The tendency of the parents to thump or spank children for acts of pranks or mischief during eating seem to be contributory.³ The male predominance in this series is in agreement with published reports.⁴

Most of the foreign bodies in the present study were organic in nature (91.4%) and it is in agreement with those presented by previous authors (66.4% - 98.4%)¹⁰ Majority of foreign bodies were groundnut seeds accounting for 33.3% followed by arecanut in 26.6% and coconut pieces

in 12.4%. The other foreign bodies found were, mucus plugs, tamarind seed, red gram, metallic foreign body, plastic, charcoal, pebble, bengalgram, meat piece, clay, vegetable. This cannot be consistent since the differences in the nature of foreign bodies reflect eating habits in people around the world. Peanuts in China, dry pumpkin seeds in Greece, watermelon seeds in Egypt are the most common foreign bodies reported.^{6,9,11} So this coupled with high frequency in children below the age of 3 years makes it advisable not to offer nuts and seeds to them.

A positive history of foreign body aspiration can be obtained in 73% to 98% of cases according to various literatures.^{3,4,6} In our series a definite history of aspiration was present in 70.4% of the cases, after close enquiry. The remaining 29.6% denied history of such episode. So, pediatrician must keep in mind the diagnosis of foreign body when dealing with respiratory diseases, if other symptoms and signs of foreign body are present. Cough, wheeze and dyspnoea were most common symptoms in our series of 165 patients. But statistical analysis revealed, that most consistent clues to presence of foreign body in tracheobronchial tree was combination of symptoms of cough and dyspnoea. Cyanosis and fever were present in 13 and 10 patients respectively but they are not of much significance. Stridor was present in 5 cases but foreign body was found in trachea in all of them. So one must consider tracheal foreign body when stridor is present with other associated symptoms of foreign body.

Decreased air entry was seen in 79.2% cases of foreign body, so one must consider this as an important diagnostic sign of foreign body. Wheeze was present in 62.83% cases of positive foreign bodies but this sign was also present in 83% of the other group where foreign body was not found, so one can not consider this as specific sign of foreign body.

So, in cases where cough and dyspnoea with decreased air entry on one side were present, one must strongly suspect foreign body. But in some cases, physical examination may be completely normal. Radiological examination was carried out whenever there is a history of foreign body aspiration or clinically a high index of suspicion for the presence of foreign body. This study suggests that chest roentgenograms are not confirmatory, but definitely contributory in cases where foreign body is suspected on clinical grounds.

In 4 (3.8%) patients the foreign bodies were radio

opaque and the radiographic diagnosis is straight forward and precise location was possible. There were interesting radio-opaque foreign bodies like a 3.5 inch long metal nail which was lodged in the right main bronchus of a 2 year old child (Fig. 1), a metal nut also lodged in right main bronchus and the flange of Fuller's tracheostomy tube in the left lower lobe bronchus (Fig. 2). The metallic foreign bodies are dangerous because of the risk of corrosion and subsequent chemical pneumonitis, which further complicates the problem. Difficulties are encountered when the foreign body is radiolucent and the interval between inhalation and radiologic reactive changes are not yet evident on chest roentgenograms.¹⁰ Unilateral obstructive emphysema was the commonest finding on chest X-ray, seen in 52 patients (49.50%). This is in confirmity with other reports⁴, atelectasis was seen in 24 patients (22.85%). Chest roentgenograms were normal in 18 patients (17.14%) of tracheobronchial foreign bodies which may be due to early presentation of cases after aspiration or in cases of tracheal foreign body. This would suggest normal X-ray does not negate diagnosis of a foreign body in respiratory tract.

It is usually believed that foreign bodies are lodged in right bronchial tree because of its more vertical position.^{5,6} This was confirmed in this series i.e. 65 in right side and 36 in left side. 4 children (3.8%) had a foreign body situated in the subglottis or trachea, but no complications

occurred during their removal. Extraction of groundnut and peanut may be difficult because of fragmentation or spillage, and residual foreign body may occur in upto 10% of cases and this usually results in recurrent pneumonia before the second extraction is attempted.¹⁰

In 60% of our children, the symptoms started suddenly and they presented to hospital within 24 hours. If the child is not in acute respiratory distress, removal of the foreign body is not urgent and should be performed as an elective procedure with proper preparations.^{10,12} Bronchoscopy is also performed as an emergency procedure since dislodgement of foreign body from bronchial tree to trachea is always life threatening. Preferably a rigid rather than a flexible endoscope is used for removing foreign bodies. Rigid bronchoscopy provides adequate ventilation during the procedure. Hypoxia and reflex vagal stimulation can lead to bradycardia and cardiac arrest during the procedure. So careful monitoring of oxygen level is mandatory using a pulse oxymeter. Throughout the procedure proper oxygenation can be maintained by jet ventilator. Once foreign body is removed, it is mandatory to examine carefully the airway on both sides for the presence of residual or fragmented foreign body. In this series there was one death due to post procedural hypoxia, probably due to subglottic edema and thick secretions in tracheobronchial tree.

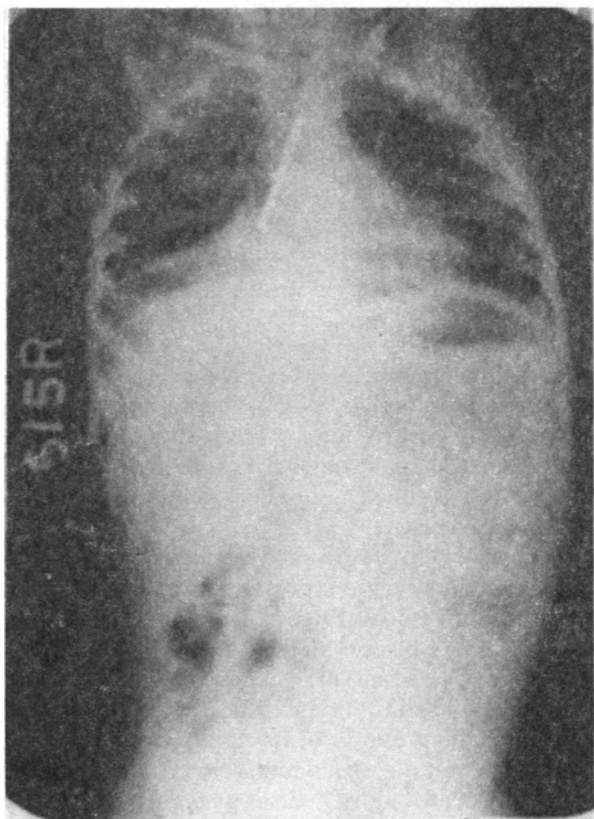


Fig. 1. Showing Metallic Nail in the Right Main Bronchus

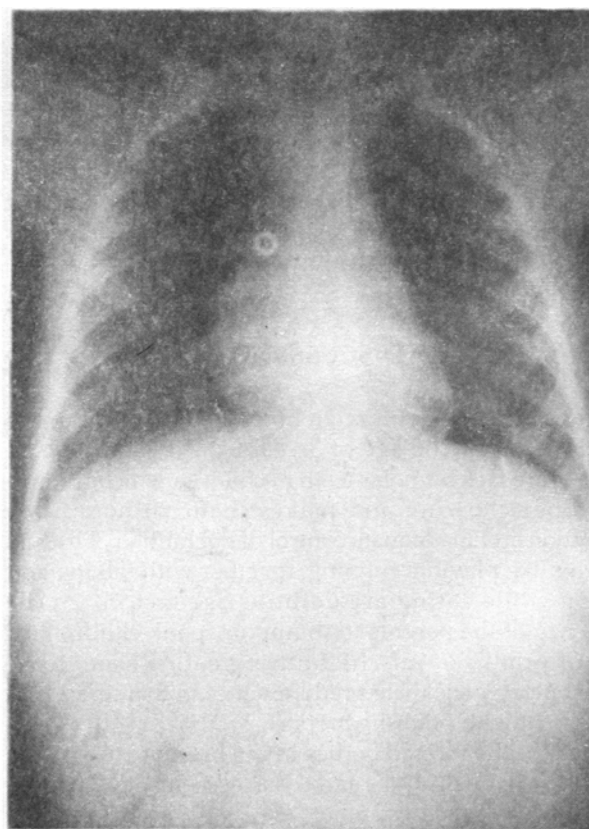


Fig. 2. Showing Metallic Nut in the Right Main Bronchus

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CONCLUSION

Tracheobronchial foreign body should be suspected in children presenting with history of cough, wheezing, choking episodes or in cases of non-responding pulmonary infections. Decreased air entry should be considered as a positive sign of foreign body. Bronchoscopy is always done whenever definitive diagnosis of foreign body is made. But, should also be done in suspected cases, so that morbidity and mortality due to foreign body can be reduced. In cases where the diagnosis is delayed, the resulting infection makes it very difficult to visualize and extract the foreign body, especially a distally located one. In such cases, antibiotic treatment and a repeat endoscopy after a few days should lead to removal of the foreign body.

A complete range of pediatric bronchoscopes, together with different types of foreign body forceps and other accessories greatly influence the outcome of the procedure and a good set up is mandatory to ensure comfortable and confident endoscopy and optimal safety for the patients. Bronchoscopy done under general anaesthesia and patient ventilated using a jet ventilator is a very safe and effective technique. A second look into the airway, soon after removal of the foreign body is emphasized.

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