

MANAGEMENT OF FOREIGN BODY ASPIRATION IN INFANCY AND CHILDHOOD*

A Life – Threatening Problem

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It is well known that young children have tendency to place objects in their mouths, frequently leading to aspiration of foreign bodies (FBs) into the tracheobronchial tree (TBT).

The patient group comprised 596 patients with a history of suspected aspiration of FBs into the TBT who were bronchoscoped for diagnosis and treatment. There were 306 male (51.3%) and 290 female (48.7%) patients, with a mean age of 2.4 years (range 3 months-13 years). Sunflower seeds and hazelnuts were the most common FBs that were extracted using an open-tube rigid bronchoscope (Storz, Germany) and suitable coaxial forceps (Storz, Germany). Patients admitted within 48 hours following the aspiration numbered 341 (57.2%). The distribution of FBs between the right and left lung and trachea was 53, 37 and five percent, respectively. The aspirated material was visible on the chest x-ray in only 10 percent cases, which facilitated in making the diagnosis. Despite a history of aspiration, bronchoscopy was negative in 21 (3.4%) of the cases. Thoracotomy and subsequent bronchotomy was the treatment of choice in seven (1.5%) and lobectomy in two (0.3%) cases. Cardiorespiratory arrest was observed in five (0.8%) cases, three of whom (0.5%) died during bronchoscopy (2 cases) or thoracotomy (1 case).

In conclusion, patients with FB aspiration are rapidly recognized from their histories and easily treated by bronchoscopy and extraction of the aspirated foreign body. A high index of suspicion is crucial for early diagnosis. However, education is the best preventive measure for decreasing the incidence of this problem. *Key words: foreign body, aspiration, bronchoscopy, childhood.*

Foreign bodies in the tracheobronchial tree (TBT) are commonly encountered in infants and young children and occasionally in adults. Although it is rare, suffocation and subsequent death may be seen in some patients. If the foreign body (FB) is not removed, complications may include various lung disease such as acute respiratory distress, atelectasis, chronic pulmonary infections, abscess,

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bronchiectasis or asthma¹. In most children, aspiration usually produces acute respiratory symptoms such as choking, coughing, wheezing and dyspnea. Using current techniques, FBs may be removed without significant morbidity and mortality. In addition, improved instruments play an important role in the diagnosis and management of this catastrophe. Bronchoscopy is the technique of choice for diagnosis and treatment. In experienced hands, FB extraction can be simple and almost free of complications. The presentation may occasionally be more subtle and the FB may be left undetected, usually leading to chronic or recurrent lung infections. We presented 10 years of experience with 596 patients diagnosed and treated at this center.

Material and Methods

The study involved a retrospective review of 596 patients who were admitted and underwent bronchoscopic examination of the TBT owing to suspected FB aspiration between January 1985 and December 1995 at the University of Uludağ, Department of Cardiothoracic and Vascular Surgery. Only the children less than 13 years of age were included in the study.

A history of sudden choking or coughing, often followed by wheezing, stridor and respiratory distress, prompted further evaluation. Acute signs of aspiration included cyanosis and chest wall retractions. Most children were initially evaluated by chest x-ray taken on inspiration in cases sent by the emergency department, and taken on inspiration and expiration in elective cases sent by the Department of Pediatrics. If the child was in acute respiratory distress, the procedure was performed on an urgent basis without chest x-ray. Computerized tomography was also used in chronic cases. Bronchoscopies were performed under general anesthesia induced by intravenous thiopental sodium administration and inhalation of a mixture of oxygen, nitrous oxide as well and halothane. An intravenous (IV) route was kept open in order to administer the medication. In addition, succinylcholine chloride was used to facilitate muscle relaxation. Heart rate, blood pressure, oxygen saturation and electrocardiogram were monitored in all patients. The appropriate-sized pediatric ventilating rigid bronchoscope (Storz, Germany) was inserted under direct vision, and FB extraction was attempted using coaxial forceps (Storz, Germany) in all cases. If the procedure was unsuccessful, other techniques were also used, such as insertion of a Fogarty balloon catheter (Baxter, USA), thoracotomy and bronchotomy.

In most cases, particularly following the removal of a nutty substance, the TBT was washed with 0.9 percent saline solution and aspirated. During bronchoscopy, prednisolone at a dose of 2 mg/kg was administered via the IV route in order to prevent post-bronchoscopy edema. Nebulization of sterile water with a bronchodilator (salbutamol) was used routinely in almost all cases for 6-12 hours

after bronchoscopy. A routine chest x-ray was taken in all cases following the procedure, and the patients were discharged 24 hours following an uneventful recovery. All patients who died during transport and were resuscitated unsuccessfully were excluded from the study.

Results

The patient group consisted of 596 patients, 85 percent of whom were less than six years of age (Table I). Only 20 patients were between 10 and 13 years of age. There were 306 male (51.3%) and 290 female (48.7%) patients, with a mean age of 2.4 years (range 3 months-13 years). FBs were detected in 575 patients, whereas in 21 cases bronchoscopy were carried out for suspected aspiration but no FB was found (Table II). Owing to the regression of symptoms, bronchoscopy was not repeated in such cases. Three hundred and forty-one cases (57.2%) were admitted within 48 hours of the aspiration, the main symptom being respiratory distress. The other group of 152 patients (25.5%) having mild respiratory distress and signs of pulmonary infection were admitted to the hospital three to seven days following aspiration. Sixty-nine patients (11.5%) who had chronic pulmonary or tracheobronchial infections were admitted to the hospital eight days to one month following FB aspiration. The clinical presentation generally resembled chronic bronchitis or bronchiectasis in the 28 children (4.8%) admitted more than one month following aspiration (Table III).

On chest x-ray, hyperaeration was seen in 190 (32%) and atelectasis in 96 cases (16%, Fig. 1). The aspirated object was visible in only 10 percent of the children (Fig. 2). Chest x-rays were evaluated as normal in 250 (42%) cases.

Bronchoscopy was the first treatment of choice and was performed under general anesthesia in all cases. Coaxial forceps were used successfully for the removal of all but 13 cases (2.2%). Fogarty balloon catheter was successfully used in four (0.7%) patients with firmly lodged objects, and thoracotomy as well as bronchotomy was performed (6 cases) in nine (1.5%) cases in whom all other procedures failed to remove the FB or the bronchoscopy was complicated by a ruptured bronchus (3 cases). A right lower lobectomy had to be performed due to obstructive bronchiectasis in only two (0.3%). cases. Bronchoscopy was

Table I: Age Distribution of Children with
Suspected Foreign Body Aspiration

	Age groups (years)				
	0<1	1-3	4-5	6-9	10-13
No. of cases	134	346	51	45	20
%	22.5	58	8.5	7.5	3.5

Table II: Localization of the Foreign Body in the Tracheobronchial Tree

	n	%
Right side	303	51.0
main bronchus	193	32.5
lower lobe bronchus	88	14.7
upper lobe bronchus	12	2.2
middle lobe bronchus	10	1.6
Left side	212	35.6
main bronchus	138	23.2
lower lobe bronchus	72	12.2
upper lobe bronchus	2	0.2
Trachea	30	5.0
Bilateral	30	5.0
Absent	21	3.4
Total	596	100.0

Table II: Time Interval Between Aspiration of Suspected Foreign Body and Endoscopy

Time Interval	No.	%	Manifestation
0-48 Hours	341	57.2	Coughing, choking, respiratory distress
3-7 days	152	25.5	Respiratory distress, infection
8-29 days	69	11.5	Bronchitis, pneumonia
1 month-5 years	28	4.8	Chronic bronchitis bronchiectasis
6 years and longer	6	1.0	Chronic bronchitis, bronchiectasis, abscess
Total	596	100.0	

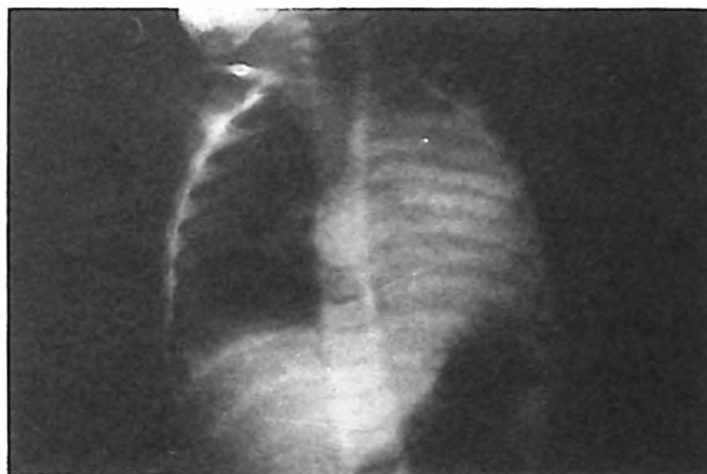


Fig. 1: Atelectasia on the chest x-ray of a case with sunflower seed aspiration.



Fig. 2: The chest x-ray of a case with delayed (37 days) presentation of radiopaque screw aspiration.

repeated in 22 (3.7%) cases owing to persistent symptoms. These cases were delayed due to an infection in the TBT. In one case, bronchoscopy was performed twice with an interval of four months due to two separate aspirations. Two children were admitted with cardiorespiratory arrest due to total occlusion of the trachea caused by a dried bean; thus, they were excluded from the study.

Sunflower seeds and hazelnuts were the most common FBs, observed in 33.5 percent of the children (Table IV). The location was the right lung in 303 cases (53%), the left lung in 212 (37%) and the trachea in 30 (5%) cases. Furthermore, bilateral aspiration was observed in 30 (5%) cases (Table III).

Three cases died (0.5%) during the hospital stay. The cause of death was sudden cardiorespiratory arrest during bronchoscopy in two (0.3%) cases and thoracotomy in one (0.2%) case.

Table IV: Nature of the Aspirated Foreign Bodies

	No	%
Sunflower seeds	138	23.0
Hazelnuts	63	10.5
Watermelon seeds	52	8.8
Roasted chick peas	55	9.2
Peanuts	40	6.7
Pumpkin seeds	36	6.1
Beans	23	4.0
Plastic objects	26	4.5
Maize	28	4.8
Metal pins and wires	16	2.5
None found	21	3.4
Miscellaneous	98	16.5
Total	596	100

Discussion

Aspiration of foreign bodies is common in children less than five years of age^{3,4}; we treated only 20 cases greater than ten years old. Boys are affected much more than girls⁵ because they are more active than girls during childhood and they are more likely to play with toys containing small parts.

More than half of the children (57.2%) were admitted to the hospital in the first 48 hours following aspiration. The presentation was respiratory distress with symptoms of bronchial irritation such as severe cough. In these patients, cyanosis and respiratory distress may be more prominent and require urgent bronchoscopic removal of the FB in order to relieve respiratory failure. Such symptoms are usually due to blockage of the trachea or main bronchi caused by large tracheal or multiple bilateral FBs. Dried beans cause a special airway obstruction as they, in almost all cases, settle in the lower trachea or the orifice of the main bronchi. Within a few hours, dried beans are swollen rapidly with bronchial secretions and may cause total blockage as observed by Hoeve et al.⁶, as well as in our study. Therefore, if the history of dried bean aspiration is given, immediate bronchoscopy must be carried out even if the symptoms are mild. Unfortunately, two of our patients were admitted with cardiorespiratory arrest due to aspiration of such material.

It was shown by Wolach et al.³ and Hoeve et al.⁶ that three to seven days following aspiration of material such as sunflower seeds, peanuts or hazelnuts, symptoms of respiratory distress may be significant due to persistent pulmonary infection. This was also observed in our study. The most commonly aspirated material in our series was the sunflower seed. Although most children are immediately admitted to the hospital, some cases are seen 24 hours or more following aspiration. If the diagnosis is delayed more than seven days following aspiration, the clinical picture may resemble pulmonary infection such as bronchitis, pneumonia or bronchiectasis⁷. Plastic or metallic materials may remain for many years in some cases⁷.

As shown by Kain et al.⁸, the diagnosis may in some cases be easily confirmed by chest x-ray, radiopaque material is aspirated. Hyperaeration and/or atelectasis with a history of aspiration observed on chest x-ray is also diagnostic in such cases. However, even utilizing special techniques such as inspiration-expiration films, bilateral decubitus films and fluoroscopy, the diagnosis can only be confirmed in a limited number of cases by means of chest x-ray^{3,6,9}; thus prolonged radiographic diagnostic efforts are not worthwhile. Prebronchoscopic chest x-ray was diagnostic in 10 percent of the children in our series.

Our policy requires only a high index of suspicion together with a positive history of suspected FB aspiration for investigation and subsequent bronchoscopy. We have decided to perform bronchoscopy so readily because of the potential complications of FBs. Our criteria for performing bronchoscopy are:

1. History of suspected aspiration of FB,
2. Physical findings suggesting the possibility of FB aspiration, or
3. Recurrent unexplained pulmonary infection, atelectasis or hemoptysis in a child.

In our opinion, any of the above three findings is sufficient to warrant the performance of bronchoscopy. A history of playing with small objects, ingestion of nuts, seeds or other foods causing cough, choking, wheezing, dyspnea and cyanosis are very important guides for such aspiration. Physical examination may produce a finding such as wheezing, diminished breath sounds or unilateral rhonchi. In such conditions, early bronchoscopy is the only safe way to diagnose and treat, as reported by Abdulmajid et al.¹⁰ and Black et al.¹¹.

If the patient is admitted with respiratory distress or cardiorespiratory arrest, emergency bronchoscopy must be performed even without anesthesia. We carried out urgent bronchoscopy in two cases in whom cardiorespiratory arrest had occurred on the way to the operating room. Open-tube ventilating bronchoscopes have been used in many centers for FB extraction¹²⁻¹⁴. Cunanon¹⁵ suggests that a flexible fiberoptic bronchoscope has advantages in only mentally retarded and physically handicapped patients with skeletal deformities, particularly of the cervical spine or pharynx. We used an open-tube ventilating bronchoscope and coaxial forceps in our patients.

Extraction of nutty substances with forceps may be difficult because of fragmentation or slippage, even with improved instruments and bronchoscopic techniques. Kosloske¹⁶ suggested that the use of the Fogarty balloon technique is useful for the removal of nuts and other spherical substances. We performed this technique in only four cases. Extraction of nutty substances was a major problem in our department because of fragmentation and melting. However, the removal of seeds, the most commonly aspirated substance in our series, was easy with the use of coaxial forceps. Likewise, the Dormier basket (Stortz, foreign body basket) is excellent for the removal of stones and pointed objects from the tracheobronchial tree, as suggested by Kosloske¹⁶; we used it in only two cases.

Whenever a FB is removed, examination of the entire TBT must be carried out to ensure that all bronchial orifices are patent. An unusual presentation of the aspirated material is encountered rarely, most likely due to severe cough following aspiration. Black et al.¹¹ suggested that when the bronchoscope and FB are removed together, a second look with the bronchoscope must be performed in order to check for a FB fragment, to aspirate retained secretions for culture as well as to evaluate the severity of bronchitis. In most of our patients, the entire TBT was washed out with 0.9 percent isotonic saline solution and aspirated after extraction of the FB, especially for nutty substances.

Some authors^{17,18} have suggested that physiotherapy and postural drainage may be effective for expectoration of the aspirated material, although we believe these to be ineffective, and expensive method associated with complications time-consuming in the treatment of such conditions. In a series by Kosloske¹³, the success rate with postural drainage was only 25 percent; however, the efficacy of the bronchoscopic removal exceeded 98 percent. In our series, bronchoscopy was successful in all but nine cases (98.4%) in whom foreign bodies were endoscopically visualized. The complication rate was only 1.3 percent, which was similar to that of other series^{2,7,10}. Five cardiac arrests and three bronchial ruptures occurred during bronchoscopy, requiring thoracotomy.

Dudgeon et al.¹⁴ suggested that simple removal of the FB may be sufficient to reverse chronic pulmonary changes so that resection may not be necessary. Surgical resection should be applied if obvious irreversible changes have occurred. In our series, only two patients required pulmonary resection due to delayed presentation. Irritative effects of nutty substances were more frequent than from metallic or plastic substances. Mu et al.¹ showed that, in chronic cases, bronchial edema, pus and granulation tissue may obscure the FB, as we also observed in delayed cases. Bronchoscopy may be repeated in such cases due to persistent symptoms, as experienced by 29 (4.9%) cases in this series.

In 12 patients, despite a history and signs of aspiration, no material was detected in the TBT. This finding was thought to be the result of either a liquified FB or mucous crusts. In these children, removal of such material, washing out of the TBT with 0.9 percent isotonic saline solution, nebulization, antibiotics and physiotherapy cured the disease, as described by Dudgeon et al¹⁴.

Cardiopulmonary arrest may occur before or during bronchoscopic removal in one to two percent of cases². In two series, mortality was reported at zero¹⁹ and 1.8 percent². In our series five cardiac arrests occurred during bronchoscopy (0.8%). Cardiopulmonary resuscitation was successful in two cases; this, three patients died during bronchoscopy (0.5%).

In conclusion, bronchoscopy is the treatment of choice for the removal of all tracheobronchial FBs. Preventive measures, however, continue to remain the best means of protection of these children. Parents should be educated as to the potential dangers of allowing infants to handle small objects and food material that they are not able to chew properly, such as seeds and peanuts. With improved education the incidence of this potentially fatal condition will decrease.

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