

The role of rigid bronchoscopy in pediatric foreign body aspiration

Mohamed Zahran, Ahmed Youssef

Alexandria University School of Medicine,
Alexandria, Egypt

Correspondence to Mohamed Zahran, MD,
PhD, Department of Otolaryngology, Alexandria
Faculty of Medicine, Champillion Street,
El-Azareeta, Alexandria, 21563, Egypt
Tel: +20 122 820 0928;
e-mail: abdelnaby00@hotmail.com

Received 25 July 2018

Accepted 20 December 2018

The Egyptian Journal of Otolaryngology
2019, 35:213–218

Introduction

Foreign bodies (FBs) in the airway continue to be a diagnostic and therapeutic challenge. In the present study, we present our experience in the evaluation and management of children with suspected FB aspiration.

Aim

The aim was to study children with suspected FB aspiration regarding clinical presentation, evaluation, and management.

Patients and methods

Fifty patients were included in the study during the period from January 2016 to April 2017. Our study was a retrospective analytical study including analysis of the preoperative, operative, postoperative, and follow-up patients' data.

Results

Most of the studied patients (66%) were between one and less than 3 years. FB was found in right (RT) bronchus in 25 patients (50%). Seeds were found in most of the studied patients (62.5%).

Conclusions

History and clinical suspicion are crucial for the diagnosis of pediatric FB aspiration.

Keywords:

bronchoscopy, FB aspiration, pediatric airway

Egypt J Otolaryngol 35:213–218

© 2019 The Egyptian Journal of Otolaryngology
1012-5574

Introduction

Foreign bodies (FBs) in the airway continue to be a diagnostic and therapeutic challenge. Despite improvement in public awareness and surgical techniques, FBs still result in many fatalities per year in the pediatric age group [1]. Before the 20th century, bronchotomy was the technique of choice for airway FB removal. However, this invasive approach led to much morbidity and mortality. Killian in 1895 was the first to use a hollow tube to examine the tracheobronchial airway. Two years later, he removed a bone from the right main bronchus, becoming the first to perform endoscopic removal of an airway FB [2].

Most FB aspirations occur in children younger than 15 years of age, with the peak incidence occurring between 1 and 3 years of age [3,4].

There are many reasons to explain why children are more susceptible to FB aspirations. First, they lack molars necessary for proper grinding of food. Second, the coordination of swallowing, laryngeal elevation, and glottic closure is still immature. Lastly, children have a tendency to explore the environment by placing objects in the mouth [5].

FB aspiration is suspected when the child presents with acute choking or severe coughing with respiratory

distress. The diagnosis sometimes is difficult if the event is not witnessed in a young child. In addition, symptoms of FB aspiration can mimic conditions such as asthma, croup, and pneumonia [6].

Chest radiography generally is an adjunctive tool because the history and physical examination are sufficient to suspect FB aspiration. Children with FB aspiration can be radiologically normal or may show obstructive emphysema, atelectasis, or consolidation (late findings) [7].

In the present study, we present our experience in the evaluation and management of children with suspected FB aspiration.

Patients and methods

This study was conducted at the Otolaryngology – Head and Neck Surgery Department, Alexandria University Hospitals, Egypt.

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

Fifty patients were included in the study during the period from January 2016 to April 2017. Our study was a retrospective analytical study including analysis of the preoperative, operative, postoperative, and follow-up patients' data. Prior to conduction of the study, informed detailed consent was taken from the parents.

The ethics committee of Alexandria Faculty of Medicine has cleared this study following detailed assessment of the topic.

Inclusion criteria

- (1) Age less than 14 years.
- (2) Suspected or witnessed FB aspiration.

Exclusion criteria

- (1) Age more than 14 years.
- (2) Children with congenital anomalies in the upper airway, for example cleft lip and cleft palate.

Preoperative details

All children included in the study were subjected to full history taking including age, sex, witnessed or suspected FB aspiration, nature of FB, time of aspiration, and presence of other medical conditions especially bronchial asthma or cardiac problems. Physical examination was done focusing on chest auscultation, for example air entry, wheezes, and other adventitious sounds. Standard plain radiography of the chest, both posterioranterior and lateral views were done. Rigid bronchoscopy under general anesthesia was done to examine the larynx, trachea, and bronchial tree.

Bronchoscopy technique

Preoperative evaluation

All patients underwent blood investigation which included hemoglobin, bleeding time, and clotting time. Both the patients and their clinical and laboratory data were assessed by the anesthesia staff.

Preparation of the patient

The patient was kept nil orally for a minimum period of 4 h in elective cases. High-risk consent was taken for the parents. Oxygen mask was given through a face mask. Intravenous steroid (hydrocortisone 10 mg/kg body weight) was given to the patient.

Instruments

The following instruments were used during the procedure (Figs 1 and 2):

- (1) Ventilating pediatric bronchoscope (Karl Storz).

Figure 1



Rigid bronchoscopy.

- (2) Macintosh laryngoscope.
- (3) Rigid suction cannula.
- (4) Forceps:
 - (a) Universal grasping forceps.
 - (b) Peanut grasping forceps.
- (5) Cold light source with cable.
- (6) Tracheostomy set as standby.

Anesthesia

General anesthesia was used in all patients. The plan for induction and maintenance of anesthesia, and the method of evaluation and removal of the FB were communicated preoperatively between the anesthesiologist and the surgeon. Preoxygenation with 100% oxygen for a period of 5 min was given. All patients were monitored using electrocardiogram, a blood pressure cuff, and pulse oximetry throughout the procedure. Positive pressure ventilation was avoided, since this tends to drive the FB further distally. Boyce's position (neck is flexed on the thorax and the head is extended on the atlanto-occipital joint) is utilized.

Age-appropriate equipment for endoscopic FB removal was carefully selected before the patient was brought to the operating room.

Equipment was checked before the procedure in order to confirm the working state. Spontaneous respiration

Figure 2



Different types of forceps and suction for bronchoscopy.

Table 1 Age distribution of the patients in the study

Age	n (%)
6 to <12 months	4 (8)
1 to ≤3 years	33 (66)
>3 to ≤6 years	10 (20)
> 6 years	3 (6)
Total	50 (100)

Table 2 Distribution of cases with witnessed aspiration (40 patients) according to the duration of enlodgmet of F.B.

Duration	n (%)
0–24 h	20 (50)
1–3 days	16 (40)
3–7 days	2 (5)
>7 days	2 (5)
Total	40 (100)

was maintained. The larynx was topically anesthetized with 1–4% lidocaine to inhibit laryngeal reflexes and to reduce the incidence of laryngospasm.

The laryngoscope tip was placed in the vallecula to expose the larynx for passage of the bronchoscope. The patient breathed through the bronchoscope until the conclusion of the procedure. The healthy bronchus was examined first. The bronchoscope was positioned above the FB, and secretions were gently suctioned to expose the object fully. The forceps were placed through the bronchoscope, and the FB was engaged. The bronchoscope, forceps, and FB were removed as a unit, and the bronchoscope was returned immediately to the airway for ventilation and assessment for other FBs.

Postoperative management

The patient was monitored to ensure smooth and adequate recovery. The patients were given bronchodilators, mucolytics, and steroids. Most children were discharged within 24 h.

Results

Most of the studied patients (66%) were between one and less than 3 years, 20% between 3 and 6 years, 8% less than 1 year, and 6% more than 6 years (Table 1). In this study, 30 (60%) of the studied patients were men and 20 (40%) were women. Relying on the history taken from the parents, FB aspiration was witnessed in 40 (80%), and it was suspected but not witnessed in 10 (20%) of the studied patients.

Distribution of cases with witnessed aspiration (40 patients) according to the duration of enlodgmet of FB in the airways – before presenting to the physician – is presented in Table 2.

Clinical symptoms of all cases included in the study are illustrated in Table 3. Table 4 summarizes the physical signs found in the patients on examination. In 10 patients, FB aspiration was not witnessed but suspected in the light of specific symptoms as illustrated in Table 5.

Table 3 Clinical symptoms of all cases included in the study

Symptoms ^a	n (%)
Cough	42 (84)
Chocking	40 (80)
Wheezing	9 (18)
Cyanosis	8 (16)
Fever	3 (6)

^aPatients had more than one symptom.**Table 4 Physical findings**

Signs ^a	n (%)
Unilateral decreased air entry	16 (32)
Stridor	10 (20)
Tachypnea	11 (22)
Signs of consolidation	8 (16)
Unilateral wheezy chest	9 (18)

^aPatients had more than one sign.**Table 5 Cause of suspicion of FB**

Cause of suspicion	n (%)
Persistent wheezes	5 (50)
Persistent cough	3 (30)
Recurrent LRTI	2 (20)
Total	10 (100)

Table 6 Radiologic findings

Radiological findings	n (%)
Normal radiography	25 (50)
Consolidation	11 (22)
Unilateral hyperinflation	9 (18)
Atelectasis	3 (6)
FB shadow	2 (4)
Total	50 (100.0)

FB, foreign body.

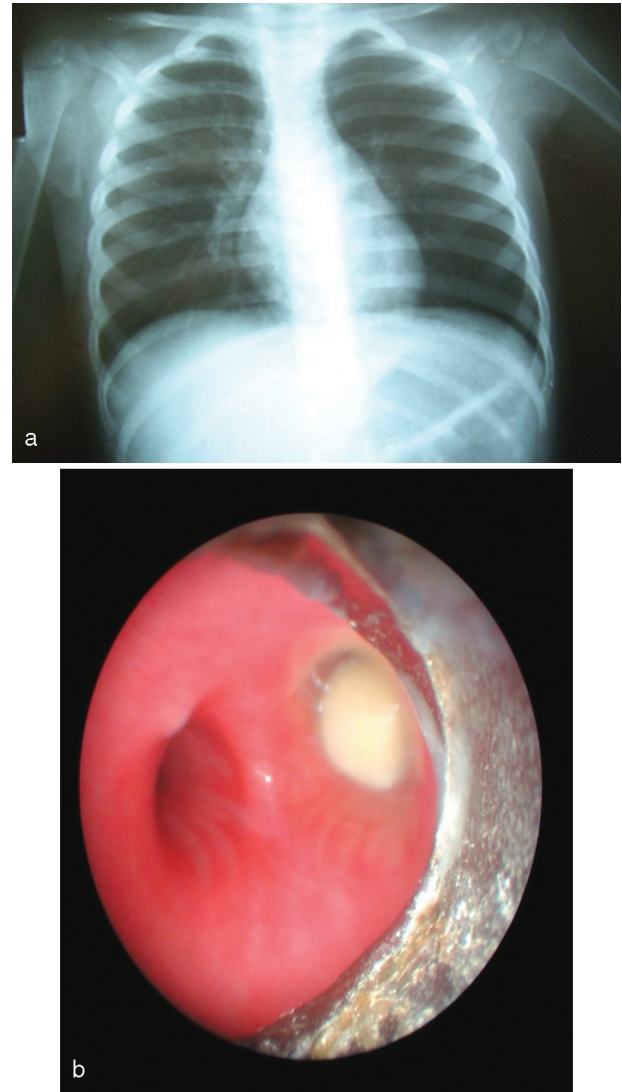
Table 7 Site of FB after bronchoscopy

Site	n (%)
RT bronchus	25 (50)
LT bronchus	11 (22)
Trachea	10 (20)
Larynx	2 (4)
No FB found	2 (4)
Total	50 (100)

FB, foreign body.

Table 8 Type of FB

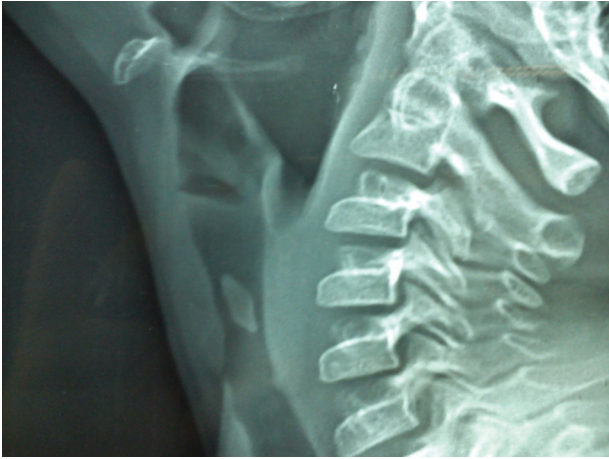
Nature of FB	n (%)
Seeds	30 (62.5)
Peanut	11 (22.9)
Food material	3 (6.25)
Metallic object	1 (2.1)
Plastic object	2 (4.2)
Fish bone	1 (2.1)
Total	48 (100) ^a

FB, foreign body. ^aNo FB found in two patients.**Figure 3**

(a) Radiography of a child showing hyperinflation of the left lung. (b) Bronchoscopic view showing peanut in the right main bronchus.

Normal radiography was found in 50% of cases. Other radiography findings seen in cases are illustrated in Table 6. Distribution of cases according to the site of FB on bronchoscopy is presented in Table 7. It showed that FB was found in right (RT) bronchus in 25 (50%). Seeds were found in most of the studied patients (62.5%). Other FBs are illustrated in Table 8.

Rigid bronchoscopy was done for all cases. Examples of the cases are illustrated in Figs 3a, b, and 4. Most patients had smooth operative and postoperative courses. Bronchospasm occurred in two (4%) cases and most of the studied patients (48 patients 96%) had no complications. Children with persistent wheezing or recurrent pneumonia due to the effect of FB improved dramatically after the removal of FB by bronchoscopy.

Figure 4

Lateral radiography of neck showing foreign body shadow in upper trachea.

Discussion

Aspiration of FBs by children is a common problem around the world. Rigid bronchoscopy is the recommended procedure in children with suspected FBs. The aim of this work was to study children with suspected (FB) aspiration regarding clinical presentation, evaluation, and management [8].

In this study, most of the studied patients (66%) were between one and less than 3 years. In agreement with our study, Christina *et al.* [9] found that most patients with aspirated FBs are children younger than 3 years. The possible reasons may be as follows. First, children of this age group like running and jumping and have a tendency to put things in their mouth. Second, parents like to feed their children with melon seeds or peanuts and amuse them. Third, their larynx is at a relatively high position, and the epiglottis is attached to the root of the tongue [10,11].

In our study, witnessed FB aspiration was found in 40 (80%), and bronchoscopy done for these cases showed FB in all cases. This highlights the importance of history in cases of FB aspiration. In 10 patients, FB aspiration was not witnessed but suspected in the light of specific symptoms. The cause of suspicion in these cases was persistent wheezing in five (50%) cases, persistent cough in three (30%), and recurrent LRTI in two (20%). Rigid bronchoscopy done for these cases was positive in 8 out of 10 cases (80%).

Different studies explained why cases of FB aspiration in children may be misdiagnosed or presented to the specialist too late. First, the history may be unclear, for

the FB aspiration mostly occurs in children less than 3 years old, who cannot express themselves. Second, some doctors who make the initial assessment of the child lack experience or awareness; many parents describe the condition as swallowing of rather than aspiration of FBs, and some mistakenly think that the FBs can be digested and absorbed. Third, there are no typical symptoms [12,13]. Before a definite diagnosis can be established, patients are often mistreated as having upper respiratory tract infection, pneumonia, laryngitis, and asthma, resulting in prolonged or recurring symptoms and causing delay in diagnosis and more complications [12,13].

Different authors proposed the following as the criteria for the diagnosis of FB aspiration. First, there is a history of clear or suspected FB aspiration. In the current study, 80% of the children had a clear history of FB aspiration. Second, paroxysmal cough, choking, unilateral or bilateral reduced breath sounds upon auscultation, stridor, or wheezing are present [7]. As demonstrated in our study, cough was found in most of the studied patients (42 patients, 82%), choking was found in 40 patients (80%), and wheezing was found in nine (18%) of the studied patients. Physical findings of our study showed that stridor was found in 10 (20%), wheezy chest was found in nine (18%), and unilateral decreased air entry was found in 16 (32%).

Chest radiograph was taken to all of our patients prior to bronchoscopy and this is mandatory to assess the nature of the FB, its position, and any associated pulmonary pathology. Normal chest radiography was seen in 25 (50%) patients and this in agreement with others studies [14,15]. This may be explained by early referral by the parents in witnessed cases. Other radiological findings demonstrated that unilateral hyperinflation was found in nine (18%), consolidation was found in 11 (22%), atelectasis was found in three (6%), and FB shadow was found in two (4%) of the studied patients.

In our study, the nature of FB found on bronchoscopy showed that more than 90% of aspirated FBs are organic materials; metallic objects were found in one (2.1%); plastic objects were found in two (4.2%); and fish bone was found in one (2.1%) of the studied cases. In agreement with our study, other investigators demonstrated that most (81%) of the aspirated FBs are organic materials. Nuts (especially peanuts) and seeds (mainly sunflower and watermelon) are the most commonly aspirated FBs reported in almost all studies [8,10].

Distribution of cases according to the site of FB on bronchoscopy showed that FB was found in RT bronchus in 25 (50%), in LT bronchus in 11 (22%), and in trachea in 10 (20%) of the studied patients. As was reported in different studies, the majority of FBs, 88% lodge in the bronchial tree, with the remainder catching in the larynx or trachea. A higher incidence of right-sided FBs (52%) in comparison with left-sided FBs (33%) was reported in all of these studies. The possible explanation may be that in a child in an upright position, the right-sided airways are direct entries from the trachea while the left main bronchus is smaller than the right main bronchus and is slightly angled [8,11,16,17].

While rigid bronchoscopy was used solely for the removal of FBs in our study, both flexible and rigid bronchoscopies were used in other series [18–20]. A minority of FBs were removed by flexible bronchoscopy in three of these studies [18–20], whereas Tang *et al.* [21] reported successful removal by flexible bronchoscopy in 91.3% of children with FB aspiration.

No mortality caused by FB aspiration or their management was encountered in our study. Hui *et al.* [16] reported three deaths among 1428 children (0.21%) undergoing rigid bronchoscopy over a 22-year period in China. Two died after FB displacement during bronchoscopy, and one died of asphyxia during a delay before bronchoscopy. Tang *et al.* [21] reported no deaths among 1027 children in China undergoing bronchoscopy for FB removal. This may be explained by the large number of their studied cases. Another study demonstrated that a decrease in morbidity rates was observed in patients who presented at a hospital within the first 24 h [22].

Conclusion

- (1) Tracheobronchial FB aspiration is a serious and potentially fatal condition, especially when occurring in a small child.
- (2) FB aspiration should be strongly suspected in children presenting with a history of choking episode or with persistent or recurrent pulmonary infection or refractory asthma.
- (3) Rigid bronchoscopy is the gold standard tool for the management of FB aspiration.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

- 1 Albirmawy OA, Elsheikh MN. Foreign body aspiration, a continuously growing challenge: Tanta University experience in Egypt. *Auris Nasus Larynx* 2011; 38:88–94.
- 2 Clerf LH. Historical aspects of foreign bodies in the air and food passages. *South Med J* 1995; 68:1449–1454.
- 3 Crysedale WS. Esophageal foreign bodies in children: 15 year review of 484 cases. *Ann Otol Rhinol Laryngol* 2004; 100:320–324.
- 4 Wood RE. The emerging role of flexible bronchoscopy in pediatrics. *Clin Chest Med* 2001; 22:311–317.
- 5 McGuirt WF, Holmes KD, Feehs R, Browne JD. Tracheobronchial foreign bodies. *Laryngoscope* 2003; 98:615–618.
- 6 Darrow DH, Holinger LD. Foreign bodies of the larynx, trachea and bronchi. In: Bluestone C, Stool S, editors. *Pediatric otolaryngology*. Philadelphia: Saunders 1996. 338–352.
- 7 Chatterji S, Chatterji P. The management of foreign bodies in air passages. *Anesthesia* 2000; 27:390–395.
- 8 Bittencourt PF, Camargos PA, Scheinmann P, de Blic J. Foreign body aspiration: clinical, radiological findings and factors associated with its late removal. *J Pediatr Otorhinolaryngol* 2006; 70:879–884.
- 9 Fidkowski CW, Zheng H, Firth PG. The anesthetic considerations of tracheobronchial foreign bodies in children: experience with 230 patients. *Anesth Analg* 2010; 111:1016–1025.
- 10 Ciftci AO, Bingol-Kologlu M, Senocak ME, Tanyel FC, Buyukpamukcu N. Bronchoscopy for evaluation of foreign body aspiration in children. *J Pediatr Surg* 2003; 38:1170–1176.
- 11 Girardi G, Contador AM, Castro-Rodríguez JA. Two new radiological findings to improve the diagnosis of bronchial foreign-body aspiration in children. *Pediatr Pulmonol* 2004; 38:261–264.
- 12 Torres de Amorim Silva CJ, Fink AM. Pneumonia and bronchiectasis secondary to unrecognized peanut impaction. *Radiology* 2008; 248:1080–1082.
- 13 Jacob SS, Jacob JJ, Paul TV. Foreign body aspiration in a boy with Prader-Willi Syndrome. *Singapore Med J* 2008; 49:12–14.
- 14 Elhassani NB. Tracheobronchial foreign bodies in the Middle East: a Baghdad study. *J Thorac Cardiac Surg* 1998; 96:621–625.
- 15 Hussein WM. Tracheobronchial foreign bodies in pediatric age group. *J fac Med Baghdad* 2001; 26:431–435.
- 16 Hui H, Na L, Zhijun CJ, Fugao ZG, Yan S, Niankai ZK, *et al.* Therapeutic experience from 1428 patients with pediatric tracheobronchial foreign body. *J Pediatr Surg* 2008; 43:718–721.
- 17 Mahafza T, Khader Y. Aspirated tracheobronchial foreign bodies: a Jordanian experience. *Ear Nose Throat J* 2007; 86:107–110.
- 18 Cohen S, Avital A, Godfrey S, Gross M, Kerem E, Springer C. Suspected foreign body inhalation in children: what are the indications for bronchoscopy? *J Pediatr* 2009; 155:276–280.
- 19 Divisi D, di Tommaso S, Garrazone M, di Francescantonio W, Crisci RM, Costa AM, *et al.* Foreign bodies aspirated in children: role of bronchoscopy. *Thorac Cardiovasc Surg* 2007; 55:249–252.
- 20 Heyer CM, Bollmeier ME, Rossler L, Nuesslein TG, Stephan V, Bauer TT, *et al.* Evaluation of clinical, radiologic, and laboratory prebronchoscopy findings in children with suspected foreign body aspiration. *J Pediatr Surg* 2006; 41:1882–1888.
- 21 Tang LF, Xu YC, Wang YS, Wang CF, Zhu GH, Bao XE, *et al.* Airway foreign body removal by flexible bronchoscopy: experience with 1027 children during 2000–2008. *World J Pediatr* 2009; 5:191–195.
- 22 Bakal Ü, Keleş E, Saraç M, Karlıdag T, Kaygusuz İ, Kazez A. A study of foreign body aspiration in children. *J Craniofac Surg* 2016; 27:358–363.