

Foreign body in children's airways

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ABSTRACT

OBJECTIVE: To determine the clinical characteristics and the results of bronchoscopic treatment of children due to foreign body aspiration in a university hospital.

METHOD: Time series of children who underwent bronchoscopies for foreign bodies aspirated into the airway between March 1993 and July 2002. Each patient was analyzed for age, sex, initial clinical diagnosis, nature and location of the foreign body, duration of symptoms between aspiration and bronchoscopy, radiological findings, results of bronchoscopic removal, complications of bronchoscopy and presence of foreign bodies in the airways.

RESULTS: Thirty-four children, 20 (59%) boys, ages ranging from nine months to nine years (median = 23 months). In 32 (94%) children the foreign body was removed by rigid bronchoscope, and two resulted in thoracotomy. Foreign bodies were more frequent in children under three years of age (66%). A clinical history of foreign body inhalation was obtained in 27 (80%) cases. Most of the foreign bodies removed were organic (65%) and more frequently found in the right bronchial tree (59%). Foreign bodies were removed within 24 hours in 18 (53%) cases. The most frequent radiographic findings were: unilateral air trapping, atelectasis and radiopac foreign body. Major bronchoscopy complications occurred in seven children (22%), and there were no deaths. **CONCLUSIONS:** More attention is necessary to the respiratory symptoms of aspirations, mainly in boys at early ages, with clinical history and compatible radiological findings. Most foreign bodies removed were of organic nature. In this case series, therapeutic rigid bronchoscopy was effective with few complications.

Key words: Bronchoscopy. Pediatric.

Abbreviations used in this study

FBA – Foreign body aspiration

LMB – Left main bronchus

FB – Foreign body

Introduction

Foreign body aspiration (FBA) in the airway is a universal problem, being still an important cause of childhood morbidity and mortality. Socioeconomic-cultural and educational factors are determinants for the frequency and particularities of the foreign body (FB) aspirated ⁽¹⁾.

According to statistics of the *National Safety Council* of the United States, of 1995, mechanical suffocation was responsible for 5% (167) of accidental deaths in children under the age of four ⁽¹⁾. Aspiration is the most important cause of accidental death of children younger than six years of age in American homes ⁽²⁾.

In our environment, available data place FBA as the third cause of accidental deaths in the pediatric age range. Reports on the incidence and deaths from FBA are more frequent in children younger than four years of age ⁽³⁾.

The clinical feature of children with foreign body in the airways depends on the size and location of the material aspirated, and varies from asymptomatic to severe respiratory failure ^(4,5).

FBA history is present in 72 to 85% of the cases confirmed by endoscopy; however, the aspiration episode is often not the main family complaint, being it necessary to get a guided history ⁽⁶⁾.

The most frequently used auxiliary method for causal investigation of pulmonary features is the simple thoracic X-ray, which appears altered in 80% of the children with foreign bodies in the airways. Images of condensation from atelectasis and/or secondary pneumonia can be noticed, whereas partial obstruction can lead to pulmonary hyperinsufflation ⁽⁶⁾.

Rigid bronchoscopy is the procedure of choice for removal of aspirated foreign bodies, and other methods are not encouraged ⁽⁷⁾. Fortunately, most of the aspirated foreign bodies are visualized by endoscopy and removed by one of the several types of capture forceps. This procedure must be accomplished by expert bronchoscopists and anesthesiologists, due to the risks of bronchospasm, pneumomediastinum, and heart arrhythmias ⁽⁶⁾. Several reports mention the need to perform an open thoracotomy, resection of a pulmonary segment or several endoscopical procedures to remove the FB peripherally impacted ⁽⁸⁾.

The purpose of this study was to determine the clinical characteristics and the result of the bronchoscopy approach for foreign body aspiration in children's airways, referred to the University Hospital of Santa Maria in the last nine years.

Method

In this study, we evaluated children who underwent respiratory bronchoscopy for BFA in the period between March 1993 and July 2002 in the Department of Pediatric Pneumology of the University Hospital of the Universidade Federal de Santa Maria, RS, Brazil.

The present study is a time series of cases, with data obtained from specific FBA protocols, with all bronchoscopy exams performed by the same examiner.

The routine of the Pediatric Endoscopy Department for cases of suspected FBA included clinical evaluation and thoracic radiological exams and, if an emergency endoscopy is needed, it is referred to a surgical procedure. In clinically stable cases, the necessary exams are performed, such as, intravenous hydration, antibiotics when necessary, and pre-anesthetic evaluation. All patients undergo rigid bronchoscopy (Lutz) in FBA cases, under general anesthesia with spontaneous respiration maintained whenever possible, and continuous monitoring of electrocardiogram, blood pressure, oxygen saturation by pulse oxymetry and precordial stethoscope auscultation. The foreign bodies were removed with adequate forceps for each case, including reintroducing the bronchoscope for removal of any remaining fragments,

aspiration of secretion, and evaluation of tissue reaction, edema, and other lesions. During the post-operative period, the children were observed in the recovery room or, if necessary, in the intensive care unit.

The following information was obtained from the revised protocols: age, gender, time between aspiration and bronchoscopy finding, previous clinical diagnosis, type of foreign body found, location of the foreign body, radiological finding, complications from the foreign body and bronchoscopical procedure. Bronchoscopy-related complications were divided in major (laryngospasm or larynx bronchospasm with bradycardia; laryngospasm or larynx bronchospasm, with desaturation; desaturation with bradycardia and bilateral pneumothorax) and minor (desaturation).

Data were analyzed by the Epi-Info software version 6.04. The statistical test was the chi-square and the level of significance was set at 5%.

The present study was submitted and approved by the ethics committee of this institution.

Results

Thirty-four children who underwent rigid bronchoscopy for removal of foreign body in the airways were evaluated.

Clinical characteristics of the patients

Their age varied from nine months to nine years. Most cases (66%) occurred within the first three years and, in 74% (25) of the cases, in children younger than five years old. Foreign body impairing the airways occurred in 59% of the cases in boys.

Clinical diagnosis other than FBA were initially determined in 59% of the patients in this study, where the most frequent were: asthma (18%); pneumonia (26%); bronchiolitis (6%) and laryngitis (6%), although in most of the cases (80%) the parents or guardians reported positive history for FBA.

Regarding the time elapsed between the aspiration and the bronchoscopical finding, removal of FB occurred within the first 24 h in 53% of the cases.

[Table 1](#) shows the distribution of patients by age, gender, clinical manifestations, and the time between aspiration and bronchoscopic finding.

TABLE 1
Clinical characteristics of the patients

Characteristics	x	%
Gender		
M/F	20/14	59/41
Age		
Median	1 year and 11 months	
Minimum	9 months	
Maximum	9 years	
Distribution (years)		
= 1	05	15
1-3	17	50
3-5	03	09
= 5	09	26
Time of evolution between onset of symptoms and bronchoscopic findings		
Median	2 days	
Minimum	1 days	
Maximum	1 year	
Initial diagnosis		
Pulmonary disease	16	47
FBA suspicion	14	41
Others*	04	12

* laryngitis; IVAS; recurrent cough; bronchiolitis.

Type of aspirated foreign body

In most cases, the foreign bodies were organic in nature (65%), with peanuts and seeds predominating ([Table 2](#)). Organic foreign bodies are most frequently aspirated by children in their first three years of life ([Table 3](#)).

TABLE 2
Nature of the foreign body

Nature of the foreign body	n	%
Peanuts	8	23
Seeds	7	20
Metal parts	3	9
Chicken bones	2	6
Screws	3	9
Grains	3	9
Pen caps	2	6
Others*	6	18

* Tracheostomy part, nut fragment, limestone left-over, tacks, flashlightbulb, food left-overs.

TABLE 3
Age range and nature of the foreign body

Age	Organic (n = 22)	Inorganic (n = 12)
≤ 3 years	19 (86%)	3 (14%)
> 3 years	03 (25%)	9 (75%)

(?2 p < 0.001)

Radiological study

All children in this study underwent thoracic X-ray, with ins technique and forced expiration in doubtful cases. The most frequent alterations were hyperinsufflation, atelectasis and radiopac foreign body. Only four exams were considered normal ([Table 4](#)).

TABLE 4
Radiological finding

Finding	n	%
Hyperinsufflation	16	47
Atelectasis	7	21
Radiopac FB	7	21
Infiltration/consolidation	5	15
Normal	4	12

Location of foreign body

The predominant location of foreign bodies were the bronchia (85%), with 59% of the cases in the right main bronchus. Foreign body impairing the upper airway occurred in only five cases ([Figure 1](#)).

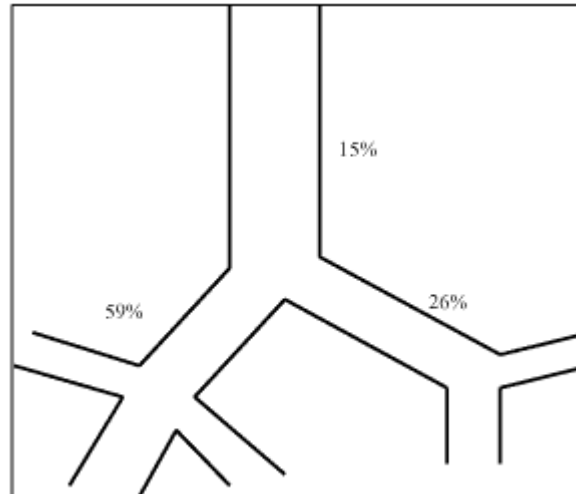


Figure 1 - Location of the FB affecting the airway

Successful bronchoscopic removal

In 32 cases it was possible to remove the foreign body. In two cases of peripheral foreign body, thoracotomy with bronchotomy were decided after several unsuccessful attempts.

Bronchoscopy complications

Bronchoscopy-related complications in our sample were observed in 53% of the cases, being most of them (32%) minor complications, such as desaturation; and only seven (21%) cases were major ones, such as laryngospasm with desaturation, laryngospasm with bradycardia; laryngo- bronchospasm with bradycardia and bilateral pneumothorax, all of which were successfully treated.

FBA-related complications

Two children were submitted to tracheostomy before being admitted to our care; 20 (59%) were being treated for other pathologies, such as asthma, pneumonia, laryngitis and bronchiolitis; two children required thoracotomy with bronchotomy to remove FB peripherally located.

The foreign body complications observed during bronchoscopy were: bronchial stenosis and formation of granulation tissue (one patient); one case of pulmonary sequela in the right lower lobe verified by perfusion scintigraphy; and one case of stenosis in the right main bronchus.

Discussion

Children present a higher risk of foreign body aspiration, which is attributed to several factors: a) tendency to put objects in their mouth; b) absence of molars to chew some types of food; c) to cry, walk and run with objects inside their mouth; d) lack of coordinating mechanism of swallowing, associated to the elevation of the larynx and to the protective reflex, which is immature in small children. Boys are usually more involved in foreign body aspiration, with a ratio boys/girls of two to one, which might be explained by their more adventurous personality and sharper curiosity, compared to girls ^(1,7,9,10).

In our sample, the findings of FB predominated in boys (59%), especially in the first three years of their lives (66%), which is in agreement with literature data ^(3,4,6,7,9,11,12).

The positive history of FBA is present in 72 to 85% of the cases confirmed by endoscopy, with reports of up to 89.2% ^(11,13). Fraga et al. ⁽⁴⁾ referred to FBA clinical history in 77% of the cases. In our sample we obtained 80% of positive history for aspiration, confirmed by bronchoscopic finding, which is in accordance with the above mentioned authors.

The clinical features associated to the permanence of foreign bodies in the airways are the consequence of bronchial reaction and secondary infections. The low level of medical suspicion associated to the absence of FBA clinical history often leads to a mistaken initial diagnosis ^(9,11,13-15). In our sample, 59% of the children submitted to bronchoscopy were given an initial clinical diagnosis other than FBA, being the most frequent: asthma, asthma associated to pneumonia, pneumonia, laryngitis and bronchiolitis. These diagnostics are in agreement with those obtained by Piva et al. ⁽⁷⁾, in which the most frequent were asthma, bronchopneumonia and laryngitis, where only 31.5% were FBA.

In this series, organic materials such as peanuts (23%), seeds (20%) and others corresponded to most of the aspirated foreign bodies (65%), which is in agreement with literature data ^(3,4,7,9,13,16). For Cataneo et al. ⁽¹⁶⁾, their findings are likely due to the fact that a significant part of their patients come from the countryside; in our study, 16 children also came from the countryside, and 75% of them had an organic foreign body. Regarding the age range, we found a predominance of foreign organic bodies (86%) in the first three years of life and inorganic (75%) in children older than three years of age. These data are in agreement with the literature, which emphasizes the higher probability of finding food material in younger children, whereas inorganic objects are more frequently aspirated by older children ^(3,4,7,9,12,17,18).

The foreign material aspirated into the airway must be removed as soon as the diagnosis is suspected or confirmed, and when the children's clinical conditions allow airway manipulation under anesthesia ⁽⁴⁾. The consequence of a delayed diagnosis is the delay in performing the endoscopy procedure ⁽⁷⁾. In our sample, FB was removed within 24 h in 53% of the cases, 20% in seven days, 6% within the first month, and 22% beyond 30 days. These results are similar to those found by Wiseman ⁽⁵⁾, Cotton et al. ⁽¹⁹⁾ and Hugles et al., ⁽²⁰⁾ who obtained an early diagnosis in 46 to 48% of the cases. Regarding the late findings (over 30 days), we obtained a percentage similar to the 16% reported by Wiseman ⁽⁵⁾ and lower than the 26% reported by Lima et al. ⁽³⁾.

The distribution of FB location in our sample showed the predominance on right main bronchus (59%) in relation to other areas, which is in agreement with the literature ^(3,5,17,21-23). However, studies by Piva et al. ⁽⁷⁾ and Fraga et al. ⁽⁴⁾ show the predominance of FB in the left main bronchus (LMB). This finding is explained by Fraga et al. ⁽⁴⁾ as probably occasional because of the small number of patients analyzed, whereas for Piva et al. ⁽⁷⁾ and Campbell et al. ⁽¹²⁾ the explanation would be in the fact that FB in the LBO is hardly expelled spontaneously ^(4,7,12).

The predominance of aspiration of radiotransparent foreign bodies recommends special attention to indirect radiological alterations, among which the most frequent are

hyperinsufflation, atelectasis, infiltration and consolidation. These alterations are usually restricted and depend on time elapsed, on the nature of the foreign body, and on the degree of the airway obstruction ⁽²¹⁾. In our sample, all patients with foreign body aspiration underwent a simple thoracic X-ray. In those with suspected radiotransparent foreign body, the ins technique and forced expiration was used, and the indirect signs found were: hyperinsufflation (47%); atelectasis (21%); infiltration/consolidation (15%). In 21% of the cases the foreign body was radiopac. We found radiological alterations in 88% of the patients, which is in agreement with the literature ^(4,5,6,11,16). The higher frequency of consolidation and atelectasis in the X-ray exams observed by Lima et al ⁽³⁾ was justified by the extended stay of the foreign body in the airway, with a probable inflammatory reaction, determining obstruction and consequent atelectasis. Atelectasis was present in 21% of our patients, being the second most frequent radiological alteration.

In our study, 94% of the foreign bodies were removed with rigid bronchoscope. In two cases, thoracotomy with bronchotomy was necessary to remove the FB. The review of 50 published papers, involving 6,393 patients with FBA, made by Bittencourt and Camargos ⁽²¹⁾ revealed the need of thoracotomy in 2.5% of the cases. In 74 FBA patients, Cataneo et al. ⁽¹⁶⁾ performed thoracotomy to remove FB in 10.8% of the cases. Fraga et al. ⁽⁴⁾ referred that it was not necessary to perform surgical exploration by thoracotomy in any of their 26 children treated for FBA. In both our patients submitted to bronchotomy, the foreign body was peripherally located, causing mucosa edema, making its removal difficult.

Despite the development of bronchoscopic equipment, the report of complications related to foreign body removal in children still occurs ⁽²¹⁾. To Ahmed ⁽²³⁾, bronchoscopy is a delicate procedure and must be performed by an experienced team, due to the risk of bronchospasm and arrhythmias. The removal of foreign bodies in our service is performed by means of rigid bronchoscopy, allowing adequate ventilation for the patient, while the flexible bronchoscopy is a recommended approach to be only used for diagnosis in some cases ^(2,3,6,7,16,21,23,24). We emphasize the difficulty of comparing our results with those of the literature, due to the absence of standardization and the lack of reference to complications by most authors. To Mélon et al. ⁽²⁵⁾, among the complications of the endoscopic procedures that deserve special attention are larynx edema, subglottic epithelial erosion, bronchial edema due to excessive local manipulation, which may lead to atelectasis, pneumothorax, pneumomediastinum and subcutaneous emphysema evolving to cardiac buffering, hemorrhages and septic complications – which were almost non-existent in our sample, except for one case of pneumothorax.

Um et al. ⁽²⁶⁾, consider that the delayed diagnosis has a remarkable effect on the frequency of complications, probably higher than any other factor. In our series of cases, the complications of the FB staying in the airway were: one patient with bronchial stenosis, another patient with granuloma and partial stenosis of the right main bronchus, and a third patient with lung sequela in the right lower lobe verified by perfusion scintigraphy.

Concerning the prevention of foreign body aspiration, we emphasize the importance of parental orientation by doctors and the media about offering peanuts, popcorn, seedy fruits, and such other foods to children younger than five years of age, since these are the most aspirated foods in this age range ^(3,4,7,9,15,20,21), a fact also observed in our study. We highlight the importance of disclosing the statistical information on FBA accidents, thus calling the attention of health professionals about the incidence, risk groups, and presentation of most commonly aspirated objects, because these vary according to the habits of each region.

Therefore, in this series of cases, we noticed a higher risk of organic material aspiration, predominantly in boys during their first three years of life, often with clinical diagnoses other than FBA. A well-conducted anamnesis and more careful observation of indirect FBA radiological signs are surely main factors to increase the rate of correct diagnosis. Clinical manifestations can vary, easily mimicking other diseases and resulting in a diagnosis delay and consequent increase of childhood morbidity. The present study allows us to conclude that rigid bronchoscopy is an efficient and safe therapy.

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