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ADVANCES IN PEDIATRIC RESEARCH

Foreign body inhalation in Tunisian children: Experience of a pediatric respiratory diseases department

Anissa Berraies [1*], Houda Snen [1], Besma Hamdi [1], Jamel Ammar [1], Tahar Mestiri [2], Tarek Kilani [3], Agnès Hamzaoui [1]

1 Department of Pediatric Respiratory Diseases, B. Abderrahmen Mami Hospital, Ariana, Tunisia **2** Department of Anesthesiology, Abderrahmen Mami Hospital, Ariana, Tunisia **3** Department of Thoracic Surgery, Abderrahmen Mami Hospital, Ariana, Tunisia

Abstract

Background: The aim of the present study was to analyze the epidemiological, clinical, radiological and endoscopic characteristics of pediatric foreign body aspiration in Tunisian children.

Methods: This was a retrospective study of 76 children with foreign body aspiration who were admitted to our department for flexible and/or rigid bronchoscopy between January 2002 and January 2013.

Results: The median age of the children was 2.8 years (range: 1.58-6 years). Of these, 61.6% were aged between one and three years. The aspirated foreign bodies were nuts and seeds in 44.64 % of cases, with sunflower seeds representing 19.64% of these cases. Scarf pins were the most frequent metallic foreign body in 7.9% of cases. Almost half of cases were presented within 72 hours of inhalation. Diagnosis of an inhaled foreign body was delayed by more than 30 days in 23.8% of cases. In 79.6% of subjects, a typical penetration syndrome was found on interviewing the parents. Chest X-ray was normal in 18.5% of cases. All children underwent flexible bronchoscopy first, or after rigid bronchoscopy. In 73 (96%) children, the foreign body was seen during flexible bronchoscopy. Eleven foreign bodies (15.2%) were removed safely in our department, via the flexible bronchoscope under general anesthesia. Surgery for foreign body extraction, or for treatment of complications, was necessary in 21.05% of children.

Conclusions: Inhalation of seeds and nuts by children is a serious problem. Education by physicians, and especially parents, is the main guarantor to significantly reduce morbidity and mortality in this pathology.

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* Email: anissa-berraies@hotmail.com

Introduction

Foreign body aspiration (FBA) is a life-threatening situation that can be fatal. Penetration syndrome, however, may be overlooked by parents, and is often followed by an asymptomatic phase that delays diagnosis.

The spectrum of inhaled foreign bodies (FB) may be explained by socio-cultural habits in different countries of the world. In Tunisia, sunflower seeds are a common cause of FBA. Inhaled FB in the tracheobronchial tree can be removed by bronchoscopy, both by rigid as well as flexible bronchoscopes. Delay in diagnosis, and hence in treatment, may have serious acute and chronic consequences, yet can be prevented by both parental and physician-led education. In this study we aimed to describe the epidemiologic and therapeutic data, and to stress the efficiency and safety of flexible bronchoscopy in bronchial foreign body removal in children.

Methods

This retrospective study examined the medical files of 102 patients, aged up to the age of 18 years, who were admitted to the pediatric respiratory diseases department between January 2002 and December 2013 for flexible and/or rigid bronchoscopy for a suspected FBA. Among them, 76 children were diagnosed with FBA.

Parents of all children enrolled into the study gave their oral informed consent for physicians to give anesthesia and perform bronchoscopy.

The bronchoscopes available in our department were the Olympus Flexible video-bronchoscope (3.6/1.2 mm), and the rigid Storz bronchoscope (3.5 mm/30 cm).

Flexible bronchoscopy was performed in the department's endoscopy room after patients had fasted for 6 hours, and under sedation with intranasal midazolam (0.3 mg/kg) and topical anesthesia. Rigid bronchoscopy, and some flexible bronchoscopies, were performed under general anesthesia in the department's operating room. All bronchoscopies were performed by a qualified pediatric pulmonologist, in close cooperation with an experienced anesthetist.

Alligator or peanut-type forceps were used to grasp the FB when using the rigid bronchoscope, and basket or alligator forceps in the case of flexible bronchoscopy. After the removal of the FB, a flexible bronchoscopy was immediately carried out to detect other fragments of FB, or to look for iatrogenic injury.

Statistical analysis was performed using the statistical software SPSS (SPSS Inc, Chicago, IL, USA). The comparison between groups was evaluated by the $\chi 2$ test. The level of statistical significance was set at $p<0.05$.

Results

The average age of the children included in the study was 2.8 years (range: 1.6-6 years); 61.1% were younger than 3 years. The sex ratio was 1.67 with 47% being males. The length of time the FB had been *in situ* ranged from 4 hours to more than 4 years (median 4 days). There was a significant delay in diagnosis since 23.8% of children were diagnosed with FBA after one month. Only 47% of children were diagnosed within the first 72 hours (Fig 1). One of the causes of diagnosis delay was misdiagnosis by doctors (Table 1). Pneumonia was the first suspected clinical diagnosis in 53.7% of cases, whereas FB was initially suspected in only 37% of cases. The most frequently presented symptom was coughing in 64.8% of cases (Table 2), and a typical choking syndrome was found after interviewing the parents in 79.6% of cases. Normal physical examination was found in 51.85% of children. Bilateral ronchi was the most frequent sign (27.8%), followed by a unilateral decrease in breath sounds (20.4%). Data from chest radiography was available for 60 patients (Fig 2). In 18.5% of these cases, chest X-ray was normal, showed ipsilateral air trapping in 7.4% of children, and ipsilateral atelectasia in 33.3% of cases. Ten of the retrieved FB were radioopaque (six scarf pins, one needle, and one metal spring) (Fig 3).

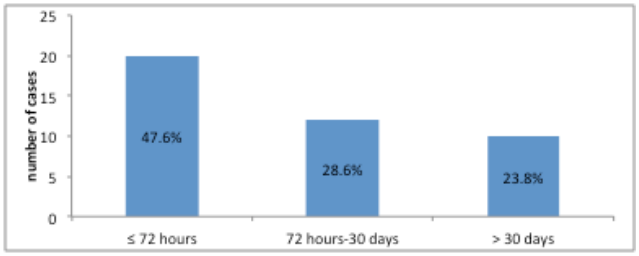

Figure 1. Time from aspiration of foreign object to diagnosis

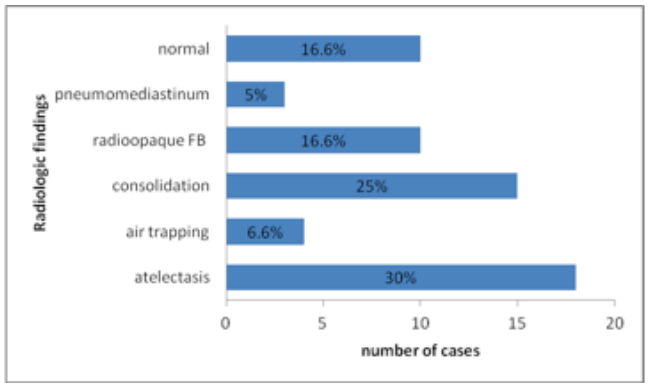

Figure 2. Radiologic findings in patients with foreign body aspiration

Table 1. Different diagnoses made by doctors before referral to our department

Doctors' diagnosis	Frequency
Pneumonia	53.7%
Foreign body	37.1%
Asthma	3.7%
Tuberculosis	5.5%

Table 2. Symptoms of foreign body aspiration

Clinical signs	Frequency
Cough	64.8%
Dyspnea	22.2%
Hemoptysis	9.3%
Chest pain	7.4%
Isolated fever	22.2%

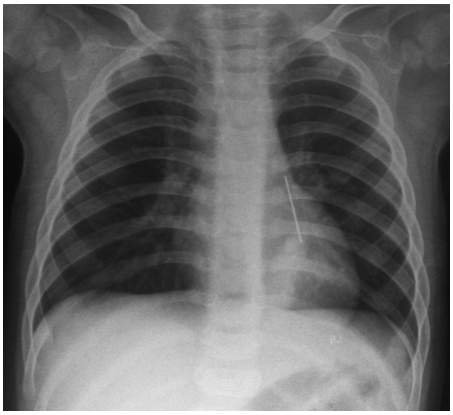

Figure 3. X-ray showing an inhaled scarf pin in a 1 year-old girl

FB was found during bronchoscopy in 73 (96%) of the patients with a history of FBA. Two of the remaining three patients had a history of expectorated organic FB, and in the other child, the FB was discovered intraoperatively. Endoscopy was performed in 30 cases (39.5%) under general anesthesia, and in 46 cases (60.5%) under local anesthesia with mild sedation. We were able to extract the foreign body in 11 children (15.2%) by flexible bronchoscope (Table 3), and by rigid bronchoscope in six others. Among these children, three first underwent a rigid bronchoscopy, and the distal FB was not seen, and for ten others, the rigid bronchoscopy attempted first was unsuccessful. Thirty-three children were referred to an otolaryngologist for rigid bronchoscopy under general anesthesia. Surgical removal was necessary in 12 children (failure to extract by flexible bronchoscope in 11 children and intraoperative discovery of FB in one child). The surgical procedure consisted of a wedge resection for persistent consolidation associated with an unrecognized ear of wheat that migrated to the periphery in one child, a bronchotomy in four children, two pneumonectomies for extensive pulmonary destruction, and five lobectomies for bronchiectasis already installed.

Table 3. Foreign bodies extracted by flexible bronchoscope

Age (years)	Type of foreign body
3	Organic undetermined
4	Organic undetermined
3	Fish bone
16	Scarf pin
5	Piece of plastic
2	Chickpea
3	Piece of paper
6	Metal fragment
5	Organic undetermined
8	Ear of wheat
4	Piece of plastic (toy)

Most FBs were organic in nature in 77.33% of cases (Table 4). Sunflower seeds represented the most common organic FB in 11 children (19.64%); almonds and nuts were also frequent. Scarf pins were the most frequent non-organic FB in six children (7.9%) in the last three years, which is most likely related to the change in clothing habits in our country (Fig 4). The average age for children who inhaled non-organic FB was 96.27 months, whereas it was only 40.3 months for those who inhaled organic FB (p=0.014).

Table 4. Nature of foreign body

Foreign body nature	Number	Frequency
Organic	56	73.68%
Sunflower seeds	11	14.5%
Almonds	5	6.6%
Peanuts	4	5.3%
Popcorn	1	1.3%
Olive kernel	1	1.3%
Ear of wheat	4	5.3%
Grain but	1	1.3%
Piece of apple	2	2.6%
Chickpea	1	1.3%
Chicken bone	2	2.6%
Raw pasta	1	1.3%
Candy	1	1.3%
Fish Bone	1	1.3%
Flower	1	1.3%
Undetermined nature	10	27.6%
Non organic	17	22.4%
Scarf pin	6	7.9%
Spring pen	1	1.3%
Needle	2	2.6%
Metal fragment	2	2.6%
Piece of paper	1	1.3%
Piece of plastic (toy, pen cap…)	5	6.6%
Not seen	3	3.9%

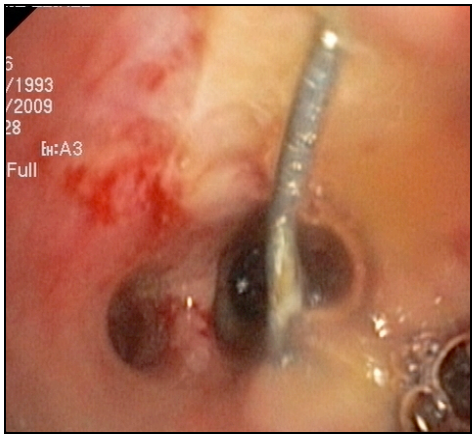

Figure 4. Bronchoscopy image showing an inhaled scarf pin in a 16 year-old girl

The right bronchial tree was involved in almost half of FBAs (50.6%), and the left bronchial tree in 43.8% of cases. Tracheal and laryngeal FBs were found in 3.9% of cases, and in one child, the FB was bilateral. Inflammatory bronchial mucosa was always encountered. Granuloma was found in 29 children (38.15%), and it was totally obstructive in four of them. Organic foreign bodies were responsible for most of the granulomas in 23 cases (79.31%), with a majority of sunflower seeds in nine children. (Fig 5,6).

Figure 5. Bronchoscopy image showing a partially obstructive granuloma in a case of foreign body aspiration

Figure 6. Bronchoscopy image showing a completely obstructive granuloma in a case of foreign body aspiration

Follow-up after FB removal was possible with 44 children. The duration of follow ranged from 10 days to 4 years, with a median of 120 days [30-365].

Thirty-one children (70.45%) remained asymptomatic during the various controls. Nine children (20.45%) developed bronchiectasis; this required lobectomy in four of them, and two children (4.54%) presented with recurrent respiratory infections without bronchiectasis. Among the children who developed bronchiectasis, the FB was organic in all cases and represented only 60.71% of asymptomatic children (p=0.003). There was an important delay in the extraction of the FB in the group of children who developed complications (bronchiectasis and recurrent respiratory infections) compared to asymptomatic children: 52.5 days [11.75-476.25] versus 9.50 days [4-41.25] (p=0.064).

Finally, surgery was necessary to remove the FB in 16 children (21.05%), or for the treatment of complications.

Discussion

Consistent with the literature, our results showed that FBA was most common in children aged less than 3 years, accounting for 61.1% of cases [1-4]. The gender and age of our patients paralleled with other studies [1, 5-8].

The clinical presentation of FBA varies from no signs to asphyxia. Cough, choking and dyspnea are the most common symptoms; however, children may be asymptomatic. [9]

Choking is the most specific symptom with a good sensitivity for the diagnosis of FBA. Aydoğan et al. [10] showed that in 93.2% of children presenting with penetration syndrome, the FB was found at endoscopy.

Despite a history of choking in 79.6% of the children, there was an important delay in diagnosis. Parents may forget to mention a choking episode when they visit the clinician, but if the question is directly asked they often remember it [11].

The occurrence of FB inhalation may be followed by a symptom-free period. This leads to misdiagnosis and the FB remains unnoticed, especially when chest radiograph findings are normal. Even if chest radiograph findings are compatible with an inhaled FB as air trapping or atelectasis, these findings are not pathognomonic for FB inhalation -in our study almost 18% of cases had normal radiography, while definitive diagnosis is usually performed by flexible endoscopy.

In the literature, air trapping was the most commonly observed abnormality, accounting for 60% of cases compared to only 7.4% in our study [12-15]. This radiological abnormality was mainly observed in early-diagnosed forms of FBA, while atelectasis and pneumonia were more often seen when FBA was diagnosed later [16]. Indeed, the most common radiological abnormalities in our study were atelectasis and consolidation signing the delay in diagnosis.

In other patient series, parents in 50-70% of cases were reported to consult a physician within 24 hours of their child inhaling a FB. In a series of 310 children with FBA, Cutrone et al [12] reported that diagnosis was made after a week in 29% of cases, and after 30 days in 10% of cases. Similarly, Rizk et al [13] showed that 29% of children consulted within 24 hours after the accident, and 49% consulted after more than 72 hours. In our series, parents consulted within the first 72 hours after inhalation in 47.6% of cases, and in 23.8% of cases, diagnosis was delayed by more than a month; this is a high percentage compared to that reported in the literature.

In our series, most foreign bodies (77.33%) were organic in nature, in fact in our country most cases of FBA are caused by food. The type of inhaled FB may be explained by the socio-cultural habits in different parts of the world. In the world, peanuts and seeds are the most commonly identified cause of FBA [18,19], with peanuts being particularly frequent in Western countries, while melon seeds are the main offenders in Arab countries and in China [2,17]. Sunflower seeds are a major cause of aspiration accidents in children in our country. In an Algerian study, sunflower seeds were the second most-aspirated organic FB after peanuts, and were responsible for the death of one child who suffered a severe hemoptysis. [19] In a study from the United States and Canada, which included 1,429 infants and children, peanuts

caused the highest frequency of injury in 26% of cases, while sunflower seeds accounted for 7% [20].

Headscarf pins were the most common inorganic FBs found in our series; this is consistent with other studies from Arabic countries [19, 21, 22,23].

Once the diagnosis of FBA is considered, rapid confirmation is needed. Bronchoscopy is the gold standard technique in airway FB removal, but in several studies there is a high rate of false negative results. In fact, in an ENT department in Tunisia, Mnejja et al [3] found that rigid bronchoscopy confirmed 57.4% of FB. The same percentages were found in a more recent study, with 56% of FB diagnosed by rigid bronchoscopy [24]. However, Oncel et al [25] reported that 74.3% of rigid bronchoscopies identified a FB in children despite a normal chest X-ray in 49% of them.

Although bronchoscopy is the gold standard, it may cause more or less severe complications such as desaturation with a need to re-intubate. One study found that these complications were described in 40% of children in whom a FB was not found [26].

Although rigid bronchoscopy has been the gold standard for FB management, accumulated data have shown the interesting role of flexible bronchoscopes in children for whom the diagnosis of FBA is doubtful. We recommend performing a flexible endoscopy in all children with suspected FBA, except those with respiratory distress or a radio-opaque FB. Firstly, it will avoid unnecessary rigid bronchoscopy in children without FB, or with a FB that is located in distal bronchus and is therefore difficult to reach using a rigid bronchoscope. Secondly, it will localize the FB and so guide the bronchoscopist. Flexible bronchoscopy is a helpful tool in FB removal. Recently two studies reported high FB removal success rates in children in 91.3% and 100% of cases [27-28].

In our department flexible bronchoscopy was used for FB removal in cases where the ENT specialist had not seen a FB because it was distal, or when the attempt to remove the FB by rigid bronchoscopy failed. In some cases, the shape of the FB allowed us to grasp it easily and to attempt removal at the same time. Nevertheless, we do not attempt removal by flexible bronchoscope when the FB is proximal, or when it is friable, or when it can become blocked in the larynx. In all cases, removal is made in the operating room by a trained bronchoscopist, and in the presence of an anesthetist.

From this study, we would like to stress the complications related to a delay in diagnosis of FB, particularly when the FB is organic in nature. Granulomas, which may be completely obstructive, occur when an organic FB quickly inflates, leading to mucosal injury and making extraction difficult. Another more serious complication is the need for surgery to remove the FB, or to treat complications as bronchiectasis. Few authors reported the late complications of FBA in children. In our study the number of children who developed bronchiectasis after FB removal seems to be very high. Gang et al [2] showed that bronchiectasis occurred in only three children among 1,024 after FBA. Indeed, in 73% of the children, the FB remained in the tracheo-bronchial tree for less than 72 hours. Recently, Foltran et al [29] reported that complications are more frequent in low-middle income countries compared to high income countries (20% versus 10%), and death occurs in about 5-7% of cases.

Conclusions

FBA is a real health problem in Tunisia and authorities must be aware of its magnitude. Primary prevention consists of active care of children by adults by removing potentially dangerous objects. This kind of intervention may not completely avoid cases of FBA, but lead to faster and more appropriate treatment. Prompt removal of the FB decreases the risk of complications. Secondary prevention is based on parent's education to recognize choking syndrome, and specific training for doctors to suspect FBA in cases of recurrent lower respiratory infection. This will help to avoid mistreating patients with multiple antibiotics.

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