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Review article

The complimentary role of diagnostic and therapeutic endoscopy in foreign body aspiration in children

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ABSTRACT

Objective: To review the importance and benefits of flexible bronchoscopy and rigid bronchoscopy in airway foreign body inhalation in children. Prompt diagnosis will lead to safer outcomes when both types of endoscopy are employed within the operating room setting.
Methods: Retrospective review of all cases of foreign body inhalation seen and treated in our Department between July 1986 and December 2010.
Results: Three-hundred and ten children were admitted to our Department from Pediatric Emergency Room for a suspected foreign body inhalation. All patients with suspected FB inhalation underwent bronchoscopy. Of 310 evaluations of tracheobronchial tree performed at our Department, 104 were negative, while an airway FB were observed and removed in 206 cases.
Conclusions: Rigid bronchoscopy under general anesthesia is an extremely accurate surgical technique to identify, localize and remove airway foreign body. In our experience, flexible bronchoscopy under total intravenous sedation and topical anesthesia is very useful in doubtful cases to absolutely exclude the presence of foreign body in upper airway tracheobronchial tree.

Contents

1. Introduction

Airway foreign body (FB) inhalation in children, although uncommon, is a very dangerous and potentially life-threatening event that requires prompt diagnosis and definitive successful treatment. It is considered a true emergency in the pediatric age group [1].

FB aspiration/inhalation is the most common cause of accidental death in children under 1 year old [2], and the risk for FB aspiration is very high up to 3 years of age [3]. In USA, FB inhalation represents about 7% of deaths in children younger than 4 years of age [4,5]. In Italy, about 400 pediatric FB aspirations occur every year [4]. Many retrospective studies on pediatric FB inhalation have been published in English literature [4–6], and suggested that approximately 80% of pediatric FB inhalation occurs in children under 3 years of age. At this age children tend to explore their environment via the oral route [7] and often they have access to small objects and inappropriate food. Reilly et al. [8] concluded that children ≤4 years are more susceptible to FB injuries due to their lack of molar teeth, oral exploration of the objects, and poor swallowing coordination.

The more frequent inhaled FB are organic items (food, such as peanuts, seeds, and dried fruits) and inorganic items (such as little toys, pen caps and pieces of plastic) [3,6,9]. Organic items are most commonly aspirated in the younger age groups, while older

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children are more likely to inhale inorganic items [6]. The range of aspired FB varies from country to country, depending on diet and customs of the population [10].

The anatomical sites of inhaled foreign bodies are variable. Due to the anatomic and physiological characteristics of airways, most FB are located in the right bronchial tree [4,11]. In the majority of cases, the FB tends to lodge distally, in one of the main bronchi or its branches, in which case the clinical condition is likely to be more stable [6].

FB inhalation must be suspected from a witnessed choking episode. History of an inhalation event is elicited in 80% of cases [6]. Signs and symptoms associated with FB inhalation are observed in 3 stages [12]. Initially, there is chocking episode followed by violent coughing, gagging, and possibly complete airway obstruction. An asymptomatic period follow: the FB is lodged and reflexes become fatigued, resulting in the symptoms died down. The third stage is characterized by symptoms of complications. Children who present with signs of severe respiratory distress require urgent rigid bronchoscopic removal of the foreign body.

However, more commonly the clinical situation is relatively stable, and often signs and symptoms are nonspecific [13]. In these cases clinical examination may reveal cough, wheeze and focally reduced air entry on chest auscultation [6].

Parents or caregivers may not witness or remember chocking episodes, and children may not disclose a history of chocking or of inhaling FB [7]. Children often are unable to communicate the circumstances leading to the aspiration event [13], because of limited speech, fear of being punished or embarrassment [14]. Various series have shown presentation within 24 h of inhalation to occur in between 50 and 75% of cases [6]. Diagnosis of an inhaled FB was delayed by more than a week in 29% of cases and by more than 30 days in 10% [15]. If misdiagnosed, it may cause chronic and irreversible lung injury [13]. Inhaled FB that do not cause an intense inflammatory response (i.e. piece of plastic) or that result in only partial airway occlusion are the most difficult to detect [7]. The rate of serious complications (including pneumonia, atelectasis, bronchiectasis, pneumothorax, and subglottic oedema) is 2.5 times higher when diagnosed more than 24 h after aspiration, than when diagnosed within 24 h [7]. Long term complications (such as chronic persistent cough, recurrent pneumonia, lung abscess, and bronchiectasis) rates are higher if diagnosis is delayed [7].

The decision to perform bronchoscopy is based on history, physical examination, and radiologic findings. However no single parameter of diagnostic tools (history, auscultation, and chest X-ray) is both sensitive and specific for diagnosis [16], and positive findings usually are not specific to FB inhalation, and may occur in condition mimicking FB inhalation or may be absent in some cases [5]. Airway FB aspiration continues to be a diagnostic and therapeutic challenge for otolaryngologists and pediatricians [17].

Definitive diagnosis of FB aspiration is by endoscopic evaluation. In children with higher suspected FB inhalation (such as suggestive history, symptoms, signs, or chest radiograph findings), rigid bronchoscopy under general anesthesia is indicated. Rigid bronchoscopy was the procedure of choice for the diagnosis and treatment of FB inhalation in pediatric patients [4,7]. In cases where clinical and radiographic findings are equivocal, flexible bronchoscopy under total intravenous sedation and topical anesthesia is very useful in confirming the presence and the exact site of FB [7]. The most appropriate procedure depends on the likelihood of FB being present, but is always performed in the safety of the operating room.

2. Materials and methods

From July 1986 to December 2010, 310 children were admitted to Department of Endoscopic Airways Surgery of Padua Hospital (Italy) from Pediatric Emergency Room for a suspected FB inhalation. They all have a history of suspected FB inhalation. Each patient was examined by an experienced team of pediatricians and/or otolaryngologist, that evaluated the history, symptomatology, physical examination (especially objective chest evaluation) and radiologic findings.

Written informed consents to perform bronchoscopy and anesthesia were given by parents or legal tutors before the procedure and then all of them underwent bronchoscopy within 24 h of hospitalization. Flexible or rigid bronchoscopy was performed after 6 h of fasting, under general anesthesia or under sedation and topical anesthesia. All bronchoscopies were performed by qualified pediatric otolaryngologist, in close cooperation with an experienced anesthetist.

The surgical procedures were always performed in operative room, where patients were continuously monitored for heart rate, electrocardiography, pulse oximetry and non-invasive blood pressure at 5 min intervals. When identified, the FB was removed using rigid broncoscopes equipped with optic telescopes and camera. The size and the length of instruments were related to the age and weight of each child. Alligator or peanut-type forceps were used to grasp the FB. During endoscopic procedures, all children were in controlled respiration or positive pressure ventilation with high FiO_2 and breathed with high rates of oxygen through a circuit connected to the rigid bronchoscope. Total intravenous anesthesia (TIVA) was used for the induction and maintenance of anesthesia in all patients, associated with topical airway anesthesia with lidocaine 2%.

All patients with suspected FB inhalation underwent bronchoscopy. From July 1986 to December 2008, only rigid bronchoscopies under general anesthesia were performed. From January 2009 to December 2010, in doubtful cases a flexible bronchoscopy under total intravenous sedation and topical anesthesia was performed to identify the presence of FB and its exact site. During the procedure, the rigid bronchoscopy was anyway ready for use. If negative the endoscopy stopped. If positive, the patient promptly underwent rigid bronchoscopy under general anesthesia to remove the FB.

After the removal of the FB, the tracheobronchial tree was investigated for a second time to detect others retained fragments or to look for iatrogenic injury.

During the procedure, a dose of intravenous corticosteroids (i.e. betamethasone 0.1 mg/kg die) was always administered. A postoperative aerosol with corticosteroids was done in each patients. If no complications occur, the patients were dismissed the day after the procedure.

3. Results

From July 1986 to December 2010, 310 children were admitted to Department of Endoscopic Airways Surgery of Padua Hospital (Italy) from Pediatric Emergency Room for a suspected FB inhalation. One hundred and eighty-four (59.4%) were male and 126 (40.6%) female. The children have an age from 1 month to 14 years (mean age: 2.7 years; median age: 1.6 years). Two hundred and forty-six of the 310 patients (79.4%) were under 3 years of age, while the remaining 64 (20.6%) were older than 3 years.

A witnessed inhalation was described in 274 (88.4%) children.

All 310 patients were so classified: children with abnormal physical and radiologic findings with symptoms (108 cases), children with abnormal physical findings and normal radiologic findings with symptoms (86 cases), children with normal physical findings and abnormal radiologic findings without symptoms (10 cases), children with normal physical and radiologic findings but with symptoms (74 cases), and children with normal physical and radiologic findings and without symptoms (32 cases).