

Need for more clear parental recommendations regarding foreign body aspiration in children

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ABSTRACT

INTRODUCTION: Foreign body (FB) aspiration is a common cause of respiratory emergency in early childhood and is associated with a high rate of airway distress. FB aspiration peaks at the age of 1-2 years. Factors placing children at higher risk include incomplete dentition, immature swallowing coordination and the tendency to be easily distracted while eating. Symptoms may vary from an unaffected child to impending airway failure. Mucosal cough receptors often accommodate and the child may be asymptomatic when evaluated.

MATERIAL AND METHODS: Files of children (0-15 years) admitted with suspected FB aspiration were reviewed. Patients were included if the FB was confirmed by bronchoscopy.

RESULTS: Among 136 children undergoing bronchoscopy, a FB was confirmed in 59 patients. The median age was one year. All children had a history of aspiration and in 48% a persistent cough was present at the initial examination. Eleven children (19%) had a normal physical examination at admission. Nuts were identified in 34% and carrots in 20%. Of the FBs removed, 86% were organic and 14% were inorganic. Organic FBs were more common in patients younger than three years ($p < 0.001$).

CONCLUSION: Parental suspicion of FB aspiration indicates acute bronchoscopy in children, even in case of no abnormal findings. The completion of the bronchoscopy within 24 hours facilitates the examination and reduces the risk of complications. We recommend increased awareness of the hazards associated with small crunchy organic food items, especially nuts and carrots, given to children under three years of age.

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Foreign body (FB) aspiration is a common cause of respiratory emergency in early childhood and is associated with a high rate of airway distress, morbidity and mortality. It is estimated that almost 600 children die annually in the United States following FB aspiration [1-5]. The peak age for FB aspiration is 1-2 years. Factors placing children at higher risk include incomplete dentition (lack of cuspid molars), immature swallowing coordination and the tendency to be easily distracted when eating (e.g. playing or running) [1-10].

The presenting symptom of FB aspiration depends on its location, size and chronicity. The symptoms and findings vary from an unaffected child in no apparent distress to impending airway failure. Patients presenting immediately after an aspiration usually present with sudden onset of choking, cough and shortness of breath. Other symptoms may be throat pain, stridor, dyspnoea, wheezing, hoarseness or fever. Many patients have only some or none of these signs and symptoms, and the classic triad of cough, wheezing and asymmetric breath sounds is neither a sensitive nor a specific indicator of an aspirated FB [1, 2, 4, 7, 8]. These early symptoms resolve when the mucosal cough receptors accommodate, and the child may therefore be completely asymptomatic when evaluated. This may delay the diagnosis of a partial obstruction for weeks to months [9]. Retrieval of aspirated FB is essential due to the risk of asphyxia, atelectasis or bronchiectasis, granulation tissue, recurrent pneumonia and death [1, 7].

The majority of aspirated objects are organic in nature, and several studies show that peanut is the most common food item aspirated, even though there seems to be a certain cultural variation related to different eating habits. Some studies mention melon and sunflower seeds as the predominant cause [2, 3, 5-8].

Within the past years, the authors have noticed that carrot was an increasingly frequent cause of FB aspiration in our department. Hence, the aim of the study was to document the present causes of FB aspiration in children in a tertiary care center in Denmark and, specifically, to evaluate recommendations regarding carrot eating in early childhood.

MATERIAL AND METHODS

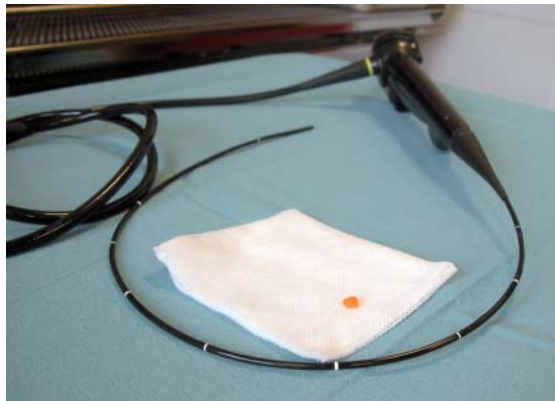
All medical records of children (0-15 years) with suspected FB aspiration admitted to the Department of Otorhinolaryngology at Aarhus University Hospital from January 2000 to December 2010 were reviewed. Only children with visual finding of FB at bronchoscopy were included in the study. The following data were obtained: age, sex, aspiration history, elapsed time from aspiration to diagnosis and elapsed time from diagnosis to bronchoscopy, complaints at admission, results of the physical examination including pulmonary auscultation and radiological findings, information on the endoscopic sur-

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gical approach, the type and localization of aspirated FB, the length of the hospital stay, and complications.

Categorical variables were described by frequency distributions and the groups were compared by Fisher's exact test. Continuous variables were described by means and range. A two-sided *p* value of less than 0.05 was considered statistically significant.

Trial registration: not relevant.

RESULTS

Among 136 children admitted with suspected FB aspiration, 59 cases (43%) were endoscopically confirmed. **Table 1** lists the details of the 59 children with confirmed FB aspiration. The ages ranged from 0-15 years, with a median age of one year. The male-to-female ratio was 35:24 (59%:41%).

All children had a history of aspiration, and in 58 cases (98%) the aspiration episode was followed by vigorous coughing. In one case, a 12-year-old girl, the aspiration of a scarf pin was asymptomatic. In general, the children were systemically unaffected; only ten (17%) patients had fever at admission. In approximately half of the children, a persistent cough (48%) and wheezing (51%) was present at the initial examination. Eleven (19%) children had a normal physical examination pre-operatively. The pulmonary auscultation was pathological in 37 cases (63%) and the most common finding was unilateral, decreased breath sound. Chest X-ray was not routinely performed, but in 13 of 19 cases pulmonary pathology was registered (e.g. hyperinflation, atelectasis, infiltrate).

In seven cases (12%), there was a significant delay before referral to the Department of Otorhinolaryngology. Five of these were initially diagnosed with pneumonia and admitted to paediatric care, while the other two patients were rejected at the emergency room despite an aspiration history. In these cases, the elapsed median time from aspiration to diagnosis was four days (range 0-14 days). However, the overall median time

from aspiration to diagnosis was less than 24 hours (range 0-14 days) and all children had a bronchoscopy within 24 hours of admittance. The mean time of hospital stay was one day (range 1-4 days).

At our department, the surgical management of suspected FB aspiration has changed over time. In recent years, it has been common to perform an initial diagnostic, less invasive, flexible bronchoscopy; and if FB aspiration is confirmed, a therapeutic rigid bronchoscopy is then performed in order to remove the FB. In the present study, this was the approach in 24 (41%) children. In previous years, it was more common to perform both a rigid diagnostic and a rigid therapeutic bronchoscopy. This approach was used in 33 (56%) cases. In two patients (3%), the FB was removed using flexible bronchoscopy only.

The most common FB location was the right bronchial tree (40 FBs (68%)), followed by 17 FBs (29%) in the left bronchial tree. Two (3%) FBs were located in the trachea (**Table 2**).

The most commonly identified FB was nuts (20 patients (34%)) followed by carrots (12 patients (20%)) (**Table 2**). Of the FBs removed, 51 (86%) were organic and eight (14%) were inorganic. Organic FBs were more common in patients younger than three years (44 patients) than in patients older than three years (eight patients), while inorganic FBs were observed in patients older than three years only (seven patients). The difference between the two age groups was statistically significant ($p < 0.001$, Fisher's exact test).

Complications to FB aspiration were seen in 15 (25%) children. Pneumonia was the most common with 13 (87%) incidents. A one-year-old boy had an atelectasis after removal of a seed in the right main bronchus, but recovered well on antibiotic therapy. A two-year-old girl was admitted to the Department of Otorhinolaryngology with airway failure after aspiration of a pill. Life-saving measures were started at the site of the accident, but hypoxic encephalopathy was impending. The pill was removed from the right main bronchus, but she unfortunately died after three days of intensive care.

DISCUSSION

In concordance with previous studies, our study confirms that the first three years of life are associated with increased risk of FB aspiration [1-10]. A male predominance was found which is also in agreement with many other studies and may be associated with a higher level of physical activity in boys [2, 3, 5, 7, 8, 11]. The observed nature of the aspirated FB was similar to that reported from other Western countries, but differed from data collected in other parts of the world, e.g. Asia and Africa [3, 12]. However, as opposed to previous studies, aspiration of carrot seems to be a problem in Denmark only.

It is well documented that delayed diagnosis (> 24 hours) of an inhaled FB is associated with a 2.5 times higher rate of serious acute complications than when the inhaled FB is diagnosed within 24 hours. Previous studies have compared early and late diagnosis and found complication rates of 27% and 67%, respectively [4]. Long-term complication rates are also higher if diagnosis is delayed [4, 7, 11]. In our study, the diagnosis was delayed in 12% of cases, and 71% of these children suffered from pneumonia. Clinicians may fail to consider the diagnosis of an inhaled FB if a child has no symptoms at presentation and the physical examination and chest X-ray findings are normal. In this study, almost 20% of the children presented without any objective findings which is comparable to the figure reported in the literature (14-45%) [1, 2, 7].

However, as timely diagnosis is critical in ensuring the optimal clinical course, targeted questions regarding choking history should be asked when children present with coughing, wheezing, recurrent pneumonia or persistent cough refractory to medical therapy [9]. Parental recall of a choking or gagging events followed by a cough is highly suspicious for a FB aspiration [1, 5, 8].

Cohen et al performed a three-year prospective study of 142 children to define the criteria for bronchoscopy in children with suspected FB aspiration and concluded that there was no clinical or radiological finding with a sufficiently high sensitivity and specificity or positive or negative predictive value that could reliably differentiate between children with and without FB aspiration [10].

In studies examining the utility of computed tomography (CT) in pediatric patients suspected of FB aspiration, the authors conclude that CT scans may be useful in selected cases with diagnostic dilemmas [13]. Hong et al performed a retrospective study of 51 patients and reported a sensitivity of spiral CT of 100%, a specificity of 66.7%, a positive predictive value of 93.3% and a negative predictive value of 100% for detecting airway FBs using rigid bronchoscopy findings as gold standard [14].

Physicians' awareness of the potential "silent" clinical presentation of FB aspiration in children is essential, but parental knowledge of the dangers associated with FB aspiration and how to avoid these may be even more important. Prevention is a critical element in reducing morbidity and mortality of FB aspiration; and heightened public awareness through the mass media and parental education could reduce the incidence. An interpretation of our findings could be that it is a well-known recommendation to keep small inorganic object out of reach of young children, but the risk of aspiration of organic food items is commonly underestimated. Especially the risk of carrots seems to be greatly underesti-

TABLE 1

Clinical characteristics of 59 patients with verified foreign body (FB) aspiration.

Suspected FB, n	136
Confirmed FB, n	59
< 3 years, n	44
Male:female, n	35:24
Age, median (range), years	1 (0-15)
<i>Initial symptoms, n (%)</i>	
Cough	58 (98)
Dyspnoea	49 (83)
<i>Symptoms at admission, n (%)</i>	
Fever	10 (17)
<i>General symptoms</i>	
Cough	28 (48)
Dyspnoea	24 (41)
Wheezing	30 (51)
Respiration failure	1 (2)
Normal physical examination	11 (19)
<i>Pulmonary auscultation, n (%)</i>	
Pathology	37 (63)
Normal	20 (34)
No information	2 (3)
<i>Chest X-ray, n (%)</i>	
Pathology	13 (68)
Normal	6 (32)

TABLE 2

Type and localisation of foreign body.

	< 3 years, n (N = 44)	≥ 3 years, n (N = 15)	Total, n (%) (N = 59)
Nuts	20	0	20 (34)
Carrot	8	4	12 (20)
Apple/pear	5	2	7 (12)
Needle	0	4	4 (7)
Seeds	3	0	3 (5)
Pearl	0	2	2 (3)
Popcorn (unpopped)	1	1	2 (3)
Piece of metal	0	2	2 (3)
Pill	1	0	1 (2)
Other organic (pea, pasta, potato)	6	0	6 (10)
<i>Localization</i>			
Right lung	27	13	40 (68)
Left lung	15	2	17 (29)
Trachea	2	0	2 (3)

ated in the Danish society as health visitors even recommend raw carrot to toddlers during dentition to relieve gum pain. Small crunchy organic food items should be avoided (especially carrots and nuts) until children are able to chew and swallow with a high degree of coordination, which sets in around the age of five years [5].

CONCLUSION

Parental or adults' suspicion of FB aspiration, respiratory clinical signs, pulmonary auscultation or a chest X-ray pointing at FB aspiration indicate acute bronchoscopy in children. Parental suspicion of FB aspiration indicates acute bronchoscopy, even in case of no abnormal findings.

The completion of the bronchoscopy within the first 24 hours facilitates the examination and reduces the risk of complications.

We recommend a revision and rectification of the existing National Board of Health recommendations in order to increase health visitors' and especially parents' awareness of the hazards of small crunchy organic food items, especially nuts and carrots, given to children under three years of age.

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