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ORIGINAL RESEARCH

Foreign Body Aspiration in Infants: Role of Self-Feeding

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Background: Foreign body aspiration (FBA) is a serious life-threatening condition in childhood. ''Baby-led weaning (BLW)'' is a popular method in which the babies are encouraged to self-feed to gain oral motor abilities. The role of BLW in FBA is controversial. A retrospective study was performed to evaluate the results of FBA in infants (<1 year of age) and its relation to the feeding method.
Materials and Methods: Children who underwent bronchoscopy for FBA for the past 10 years were included. Infants (<1 year of age) were evaluated for age, gender, clinical findings, and the results of bronchoscopy. The type of feeding, including self-feeding or caregiver-assisted feeding, was noted.
Results: The medical records of 826 patients who underwent bronchoscopy were evaluated. FBA was noted in 50.2% ($n=417$) of cases. Only 9.07% ($n=75$) of patients were <1 year of age and 67% ($n=50$) of them had a foreign body according to the bronchoscopy. The mean age was 9 months (5–12 months) and 36% of them were male. When the feeding characteristics of patients were surveyed, 80% of cases aspirated when self-feeding and 14% aspirated during caregiver-assisted feeding.
Conclusions: Self-feeding to promote oral motor function may cause FBA in infants. Emergent bronchoscopy is more common in infants and reveals the aspiration of foods that cannot be consumed safely in this age group.

Keywords: foreign body aspiration, bronchoscopy, infants, baby-led weaning

Introduction

Foreign body aspiration (FBA) is one of the most well-known causes of accidental death in children <3 years of age.[1] The variety of aspirated foreign bodies depends on cultural and social influences and feeding habits. The suspicion of FBA mostly arises in 3 steps: a witnessed choking story, positive physical findings, including wheezing, coughing, and dyspnea, and finally, radiological indications such as the existence of a foreign body, hyperinflation, and atelectasis. Bronchoscopy is the most well-known technique for diagnosis and treatment.[2,3]

Baby-led weaning (BLW) is a method for introducing food, rather than milk, in which the infants feed themselves by hand instead of being spoon-fed by a caregiver. Choking is the most common risk factor seen in BLW.[4] There is a noticeable relationship between choking and FBA because the gag reflex does not appear strongly until the end of infancy; therefore, choking is the most important problem in infants who are adapting to BLW.[5] A witnessed choking story is the most significant clinical event for the early diagnosis of FBA.[6] Although BLW has been proposed as a safe feeding method during infancy, the role of self-feeding in FBA has not been evaluated previously. Therefore, a retrospective study was performed to evaluate the role of self-feeding in infants (<1 year of age) with FBA.

Materials and Methods

Children who underwent rigid bronchoscopy with a presumptive diagnosis of FBA between 2007 and 2017 were included. Patient clinical reports prepared by pediatricians and pediatric surgeons were retrospectively evaluated for age, gender, clinical features, diagnostic methods, and the results of the rigid bronchoscopy.

The bronchoscopy findings, type, and location of foreign bodies were also noted. To define the role of the feeding method in FBA, patients <1 year of age were evaluated. They were also divided into 3 groups, including self-feeding, caregiver-assisted feeding, and unknown feeding history. The patients who fully fed themselves and completed a course without the assistance of a caregiver were defined as self-feeding infants. Patients enrolled with caregiver-assisted feeding included infants who were spoon-

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Table 1. The Demographic Features of Cases with Foreign Body Aspiration During Bronchoscopy

Cases with FBA (n = *417*)	*Mean age (months)*	*Gender (M/F)*	*Location,* n *(%)*			*Foreign body,* n *(%)*	
			Left bronchus	*Right bronchus*	*Trachea*	*Organic FB*	*Inorganic FB*
Age <1 year ($n = 50$)	9 (5–12)	9/16	27 (54)	20 (40)	3 (6)	47 (94)	3 (6)
Age ≥1 year ($n = 367$)	32 (13–200)	27/25	147 (40)	195 (53)	25 (7)	333 (91)	34 (9)

F, female; FBA, foreign body aspiration; M, male.

fed or finger-fed with the assistance of an adult. Finally, infants who had no feeding history in their medical records were noted to have ''unknown feeding history.''

This study was performed at the pediatric surgery department, Hacettepe University. The Clinical Research Ethics Committee approved the study (approval no. GO 17/659-45).

During bronchoscopy, all procedures were performed under general anesthesia. Anesthetic induction was provided using 8% sevoflurane in 50% oxygen and 50% air maintaining spontaneous breathing. In our hospital, all patients with suspected foreign body airway aspiration have their intravenous lines when they are admitted to the pediatric emergency department; therefore, the patients included in this study already had intravenous lines on arrival at the operating room.

All patients received intravenous 1 mg/kg methylprednisolone before the procedure. Before the laryngoscope was advanced through the airway, 0.6 mg/kg rocuronium was administered intravenously for muscle relaxation. A rigid bronchoscope was advanced through the vocal cords, avoiding upper airway reflexes. During the procedure, the sideline for positive pressure ventilation was used. In addition, inhalational anesthetic sevoflurane was discontinued, 100% oxygen was provided, and anesthesia was maintained by 2 mg/(kg·h) propofol infusion with 0.5 mg/kg intravenous boluses if needed. After removal of the foreign body, intravenous 2–4 mg/kg sugammadex was used to reverse the effect of the muscle relaxant. During emergence from the anesthesia, all patients were placed in the lateral position to facilitate coughing and spontaneous breathing.

Results

We enrolled 826 patients who underwent bronchoscopy to rule out FBA. FBA was noted in 50.2% of cases ($n = 417$). Only 9.07% ($n = 75$) of this subset was <1 year of age and 67% ($n = 50$) of them had an FBA. The demographic data and characteristics as well as the findings of the rigid bronchoscopy procedure for all cases are shown in Table 1. When we investigated the infants diagnosed with FBA, the mean age was 9 months (5–12 months) and male to female ratio was 9/16.

According to the clinical reports, 80% of cases aspirated when self-feeding, 14% of them aspirated during caregiver-assisted feeding, and 6% of them had an unknown feeding history. Choking and coughing were the most common complaints during admission. The time interval between the choking episode and the reported first symptom was 1–8 h in 63 cases. The time interval was >1 week in 7 cases who underwent bronchoscopy because of suspected FBA when they were evaluated for recurrent symptoms. Five cases with severe airway obstruction and cyanosis were admitted to the emergency department shortly after the choking episode. These cases underwent emergent bronchoscopy because of oxygen desaturation and respiratory distress. The remainder of the cases underwent rigid bronchoscopy in the first 24 h of admission according to the severity of airway obstruction.

The incidence of aspirated foods in infants is listed in Table 2. The most commonly aspirated foods were seeds, pistachios, and nuts. Three cases involved aspirating an inorganic substance. During bronchoscopy, a foreign body was detected in the left main bronchus in 27 (54%) cases, in the right main bronchus in 20 (40%) cases, and in the trachea in 3 (6%) cases. There was no mortality and morbidity related to FBA and the bronchoscopy.

Discussion

In this study, we found that self-feeding is an important risk factor for FBA in children <1 year of age. FBA is a common and serious health problem in children and can result in significant morbidity.[1] It may cause severe complications, ranging from chronic cough and recurrent pneumonia to life-threatening airway obstruction.[9] Ninety percent of deaths from FBA occur in patients who are <5 years, and most of these deaths are seen in infants.[6]

The most common clinical finding in FBA is a witnessed choking story.[6–8] Although the types of foreign bodies vary according to the social and cultural influences and the feeding habits of families, organic substances such as nuts, raw vegetables, and fruits are the most common type of foreign bodies found in children.[9] Therefore, the type of feeding becomes a topic of interest in children with FBA.

BLW has become a popular method among new parents to introduce their children to solid foods through a self-feeding method rather than spoon-fed pureed foods.[10] It has been suggested that the method promotes healthier eating and weight gain by improving the feeding skills of children. However, health professionals mention concerns about the

Table 2. The Aspirated Foods by Infants

Gender	*Seeds*	*Pistachio*	*Nuts*	*Walnut*	*Almond*	*Chestnut*	*Apple*	*Unknown*
Male [$n = 18$], *n* (%)	9 (50)	3 (17)	2 (11)	1 (6.5)	1 (6.5)	1 (6.5)	0	1 (6.5)
Female [$n = 32$], *n* (%)	14 (44)	5 (16)	6 (19)	1 (3)	2 (6)	1 (3)	1 (3)	2 (6)

safety of this method, especially with respect to the risk of choking.[4] Studies that advocate BLW report that choking is no more likely than for spoon-fed babies when safety rules are implemented, such as feeding in an upright seated position and controlling food type and size.[4] In contrast, some small-sample studies suggest that BLW increases the risk of choking.[4] However, none of the studies evaluated the rate of FBA in children who had been using BLW. In this study, we aimed to evaluate the relationship between the types of feeding and FBA. In our retrospective analysis, we found that 80% of cases aspirated the foreign body when self-feeding.

Bronchoscopy is considered to be the gold standard for foreign body diagnosis and treatment. Recurrent pneumonia, atelectasis, or bronchiectasis can be seen as a result of a late diagnosis of FBA and surgical procedures such as segmentectomy and lobectomy may be required. Therefore, rigid bronchoscopy should be performed in children for suspected FBA. If the aspiration event is witnessed, the positive rate of FBA reaches 87%, whereas a low rate of positive bronchoscopy is seen if the aspiration event is not witnessed. Cameron et al. suggested that infants had a lower rate of positive bronchoscopy than older children. When all of our cases are considered, the rate of positive bronchoscopy was 50% and increased to 67% in infants.[4] In addition, we noticed that severe respiratory failure due to FBA in infants requires prompt bronchoscopic intervention.

In a large study of FBA cases, organic substances constituted the most commonly aspirated foreign bodies and organic foods were removed in 68% of all bronchoscopies. Therefore, the type of feeding—either self-feeding or caregiver-assisted feeding—becomes a point of interest, especially in small infants. Self-feeding methods such as BLW promote feeding abilities and oral motor functions in children.[11] Since, the gag reflex is not mature until 1 year of age, feeding-related choking events are common.[4,5] Some recent studies have reported no difference in the frequency of choking between BLW and the traditional spoon-feeding approach.[12,13] Even if this was proven in those studies, it is not known if there was a delay between the choking event and the diagnosis of FBA.

Moreover, BLW studies have shown that choking periods occur more often at 6 months of age and become less frequent after 8 months.[12,13] These results suggest that choking during feeding is related to the chewing and swallowing functional ability that improves with age. In this study, most of the children who had been diagnosed with FBA had a self-feeding clinical history and witnessed choking and coughing were the most common complaints. The mean age of our patients was 9 months and the youngest case was 5 months old. Therefore, we suggest that solid foods cannot be consumed safely and are common foreign bodies in this age group. The feeding method and the consumption of solid foods were also considered as risk factors for FBA.

Among the 826 bronchoscopy interventions, we found that FBA is encountered more frequently in boys than in girls. This result is similar to the results of other large studies[14]; however, most of the patients with positive bronchoscopy results <1 year of age were girls. Although it was not evaluated in this study, we speculate that girls tend to be self-fed earlier than boys since their motor development is more advanced earlier than in boys. Interestingly, the most common localization of the foreign body was the left bronchus. This finding was also not comparable with the results of previous studies.[15,16]

The retrospective design is the most important limitation of our study. Similar to previous BLW studies, since the exact definition and criteria of the BLW method are lacking, it is difficult to reach a firm conclusion that the BLW method is a risk factor for FBA. Randomized controlled studies are needed to define the causative relationship between self-feeding and FBA. However, we suggest that self-feeding with foods that cannot be consumed safely in this age group is a significant risk factor for FBA. When popularizing the self-feeding methods, caregivers should be informed that FBA may occur if safe feeding cannot be achieved.

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Author Disclosure Statement

No competing financial interests exist.

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