

Foreign Bodies Causing Asphyxiation in Children: the Experience of the Buenos Aires Paediatric ORL Clinic

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Inhalation or aspiration of a foreign body (FB) occurs relatively frequently in young children. The size, shape, type and site of arrest of the FB lead to variability in the clinical picture. The present study included data from 65 cases of FB inhalation presenting over 1 year at the Children's Hospital Gutierrez, Buenos Aires, Argentina, compared with information from four well-known published case series chosen as representative of other cultural and geographical backgrounds: the USA, Europe, North Africa (Egypt) and Asia (India). The mean age of children studied was 4.03 years. Injuries happened mainly

at home (53 cases [81.54%]) and under adult supervision (59 cases [90.77%]). The most frequently inhaled FB was nuts, however, in contrast to previous reports, the majority of incidents involved inhalation of an inorganic, rather than an organic (food) FB. Complications included pneumonia (three cases), atelectasis (two cases) and pneumonitis (one case). No deaths were recorded. These data suggest that children play with objects inappropriate for their age, such as pins and nails, that adults may not be aware of the choking risks, and that more effort is required in educating caregivers about these risks.

KEY WORDS: ASPIRATION; INHALATION; ASPHYXIATION; FOREIGN BODY; CHILDREN

Introduction

The inhalation or aspiration of foreign bodies (FB) into the upper airways can be a very serious and, sometimes, fatal event, especially during the first years of life. Behavioural aspects, anatomical characteristics and physiological features, such as immature swallowing co-ordination, poor chewing capacity and high respiratory rates expose children < 3 years old to a

higher aspiration/inhalation risk.^{1,2}

The dynamic of asphyxiation and, consequently, the seriousness of clinical presentation, is influenced by the complex relationship between the FB, the child and the environment. In particular, the size, shape, type and site of arrest of the FB are responsible for variability of the clinical picture; objects causing obstruction in the larynx and trachea are potentially life-

threatening, whereas objects lodged more distally are frequently undiagnosed and retained, and may cause severe complications including pneumonia, atelectasis and bronchiectasis.^{3,4} Details of FB characteristics and the dynamics of the traumatic events involved in FB inhalation are important in understanding the pathogenic pathway. The range of inhaled FBs varies from country to country, depending on the diet and customs of the population, suggesting a need to share information from different geographical areas. Indeed, this issue has received the attention of the public health authorities in Europe, with the inception of the Susy Safe registry aimed at understanding and preventing FB injuries.⁵

In the present study, experience from the Children's Hospital Gutierrez, Buenos Aires, Argentina, is presented and compared with information from four well-known case series representative of other cultural and geographical backgrounds.

Subjects and methods

SUBJECTS

Children with FB inhalation presenting to the Children's Hospital Gutierrez, Buenos Aires, Argentina between February 2008 and March 2009 were included in this study.

DATA COLLECTION AND COMPARISONS

Details of the children and their injuries were collected, including age, gender, features of the FB, circumstances of the incident, clinical presentation, complications and outcome. These data were compared with four other well-known case series: (i) a representative USA study from Boston Children's Hospital involving a retrospective chart review of children who had FBs removed by direct laryngoscopy and bronchoscopy between

1987 and 1997;⁶ (ii) a North African retrospective review of 10 years' experience (1995 – 2005) from two hospitals in Egypt;⁷ (iii) a European retrospective review of FBs in the upper airways involving major hospitals from 19 countries between 2000 and 2002;⁸ and (iv) an Asian case series of data collected from 223 children with laryngotracheo-bronchial FBs seen at an Indian hospital over a 14-year period.⁹

Results

During the 1-year study period, 65 cases of FB inhalation were seen in children (mean \pm SD age 4.03 ± 1.93 years, range 1 – 9 years) at the Children's Hospital Gutierrez. Most objects were small and rigid – only nine of the retrieved FBs were soft. The recovered FBs are listed in Table 1.

TABLE 1:
Types of inhaled foreign bodies retrieved from 65 children at the Children's Hospital, Gutierrez, Buenos Aires, Argentina

Foreign body type	No. of cases
Nuts	10
Pins, nails, screws	8
Bone	5
Pearl	5
Beans	4
Taps	4
Toys	3
Egg shell	2
Crayons	2
Fuse	2
Glass	2
Medications	2
Ring	2
Seeds	2
Wood	2
Apple	1
Cork	1
Paper	1
Stones	1
Vegetables	1
Others	5

The majority of incidents occurred at home (53 cases [81.54%]) and under adult supervision (59 cases [90.77%]) (Table 2). In all cases, FB removal was performed by endoscopy under general anaesthesia with no surgery required. The most frequent symptoms were cough (52 subjects [80.0%]), followed by dyspnoea (seven subjects [10.77%]) and dysphonia (two subjects [3.08%]). In four children (6.15%) the FB inhalation was clinically asymptomatic. Complications included pneumonia (three cases [4.62%]), atelectasis (two cases [3.08%]) and pneumonitis (one case [1.54%]). No deaths were observed. Of the 65 retrieved FBs, 29 (44.62%) were organic and 36 (55.38%) were inorganic. This contrasts with the data from the four selected previously published case series, summarized in Table 2, where the majority of inhaled FB in the current study were organic rather than inorganic.

Discussion

Aspiration and inhalation of FBs are common events in paediatrics and can have severe consequences, particularly if not promptly diagnosed. Laryngeal FBs are more dangerous than those located in the trachea and bronchi as they may cause laryngeal spasm and death; hence a foreign body in the larynx or trachea hinders ventilation to both of the lungs, whereas a FB in the bronchus will cause symptoms in only one lung.¹⁰ If the FB is localized to the bronchial tree, symptoms such as cough, dyspnoea, emottis and reduced breath sounds can guide diagnosis, however, asymptomatic patients are not uncommon – in this study 6.15% of patients had a clinically silent presentation.

In agreement with the present data, previous studies have observed that the FB usually enters the right bronchus, perhaps

due to its anatomical position.¹⁰ Other authors have, in contrast, found the FB more frequently to enter the left bronchus, possibly as a consequence of the tendency of children to inhale while lying down and holding the FB in the right hand.¹¹ This position also causes a slight straightening of the angle between the trachea and the left bronchus.

It is clear that a lack of knowledge regarding the association between object characteristics, behavioural variables and FB distribution patterns in the bronchial tree complicates diagnosis.¹² Diagnosis is further impeded by the fact that radiolucent items (including food) constitute a large proportion of inhaled FBs in children; 20 – 35% of cases have a normal chest x-ray.¹³

Previous reports have shown that the most common FBs to pose a choking risk are nuts, seeds, berries, corn, beans and, in general, any small, round, crunchy food.⁸ In the present case series the most frequently inhaled FBs were nuts. The characteristics of food are fundamental to determining the extent of injury, with nuts known to irritate the bronchial mucosa and lead to an intense local inflammatory reaction and oedema. Children who have inhaled nuts usually show more severe symptoms and signs of respiratory distress, requiring urgent treatment.^{14,15} Local inflammation, oedema, cellular infiltration, ulceration and granular tissue formation may contribute to airway obstruction, making bronchoscopic identification and removal of the object difficult.^{16,17} Moreover, the airway becomes more likely to bleed with manipulation and the object is then more likely to be obscured and become more difficult to dislodge.¹⁸ Air trapping may occur distal to the obstruction, leading to local emphysema, atelectasis, hypoxic vasoconstriction, post-obstructive pneumonia, and the possibility of volume loss, necrotizing pneumonia or abscess,

TABLE 2: Comparison of foreign body (FB) inhalation data from the present study on South American (Argentine) children with four other previously published case series from other cultural and geographical areas

	Current study	Tan <i>et al.</i> , ⁶ 2000	Sersar <i>et al.</i> , ⁷ 2006	Gregori <i>et al.</i> , ⁸ 2008	Banerjee <i>et al.</i> , ⁹ 1988
Country or region	Argentina	USA	Egypt	Europe	India
No. of retrieved FBs	65	135	2165	722	223
Gender (%)					
Males	47.69	63.70	47.71	N/A	70.40
Females	52.31	36.29	52.29	N/A	29.60
Age (%)					
0 – 3 years	49.23	77.77	43.83	30.60	47.98
> 3 years	50.77	22.23	56.17	69.40	52.02
FB type (%)					
Organic	44.62	69.40	72.10	76.03	66.36
Inorganic	55.38	30.60	27.90	23.97	33.63
Adult present (%)					
Yes	90.77	N/A	21.57	84.21	N/A
No	9.23	N/A	78.43	15.78	N/A
Site of obstruction (%)					
Larynx	12.31	1.48	0	23.55	6.73
Trachea	0	6.66	0	–	10.76
Right bronchus	52.30	54.06	45.31	–	48.87
Left bronchus	35.39	38.51	54.69	–	33.63
Bronchus overall	87.69	92.59	100	74.45	82.51
Most frequent symptom (%)	Cough (80.00)	Cough (91.85)	Cough (69.10)	–	Choking (87.4)
Most frequent complication (%)	Pneumonia (4.62)	Larynx oedema (17.7)	Cardiopulmonary arrest (11.08)	Pneumonia (1.94)	Cardiopulmonary arrest (2.69)

N/A, data not available.

suppurative pneumonia or bronchiectasis.¹⁶ Even if the object is removed, the inflammatory changes may not be completely reversible.¹⁹

In our experience in Argentina, pneumonia and atelectasis were the most common complications, analogous to observations made by Gregori⁵ in a retrospective study of 19 European countries. Cardiopulmonary arrest was the most frequent complication in India⁹ and Egypt⁷, while, in the USA, relatively minor complications, such as larynx oedema, were found to be the most common.⁶

The current case series differs from those previously published in that the majority of inhaled or aspirated FBs were inorganic as opposed to organic (food) items. This suggests that children were allowed to play with small objects inappropriate for their age, such as pins and nails. The introduction of safety rules for toy design has constituted an important advance in the prevention of injuries;²⁰ however, these regulations apply to toys and objects for children and exclude items not intended for use by children. Correct adult supervision is, therefore, fundamental in preventing injury due to FB inhalation. The present study revealed that, in > 90% of the current cases, injury occurred at home in the presence of an adult, a pattern that is repeated in Europe (> 80%).⁸ In India, Bannerjee *et al.*⁹ also reported that a proportion of injuries (unspecified

percentage) occurred under adult supervision, requiring prompt action by the responsible adult.⁹ Regrettably, incident dynamics and, particularly, the presence or absence of an adult are often not reported. In the few cases when this information is available it indicates that more effort is needed in educating caregivers about choking risks and that the risks relating to certain foods and small, mainly rigid objects, should also be included as part of paediatric visits.

The current data confirm that information about safe behaviour and choking risk should be made available to all caregivers; however, preventive and educative strategies are possible only when a large amount of information is available. Reviews and meta-analyses of the scientific literature are commonly used to integrate and synthesize knowledge, but these have suffered from heterogeneity in coding FBs, clinical presentation and complications. The adoption of national or international surveillance systems able to collect information in a standardized way is necessary in order to identify which objects, products and behaviours could be dangerous for children.

Conflicts of interest

The authors had no conflicts of interest to declare in relation to this article.

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