

Toys in the upper aerodigestive tract: Evidence on their risk as emerging from the ESFBI study

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Abstract

Objective: Foreign body inhalation/aspiration or ingestion is a relatively common event in young children and, despite many efforts made in several Countries to reach acceptable safety levels for products devoted to children, small toys or toy parts are frequently mentioned among risky foreign bodies. The aim of the present study is to characterize the risk of complications and prolonged hospitalization due to toys inhalation/aspiration or ingestion according to age and gender of patients, FB characteristics and FB location, circumstances of the accident, as emerging from the ESFBI study.

Methods: A retrospective study in major hospitals of 19 European Countries was realized on children aged 0–14 having inhaled/aspired or ingested a toy, with regard to the characteristics of the child and the FB (shape, volume, consistency), the FB location, the hospitalization's details and the occurrence of complications.

Results: In the years 2000–2003 a total of 2094 FB injuries occurred in children aged 0–14 years. Among them 121 (5.8%) were due to toys (mainly parts of toys) and 95 (4.5%) occurred in the lower/upper aero-digestive tract. 58 children needed hospitalization. The first determinant of a damage requiring hospitalization is the rigid consistence of the object. Almost 27% of toys related injuries happened under adults' supervision.

Conclusions: Despite the adoption of preventive strategies, including products modification by manufacturers, has resulted in a decrease of children's mortality rate for choking in the last decades, our results seem to testify that preventive strategies imposing a regulation of industrial production, even if fundamental, are not sufficient and need to be integrated with other preventive intervention addressed to improve parents ability to be conscious of FB injuries and attentive toward a proper surveillance of children.

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1. Introduction

Foreign body inhalation/aspiration or ingestion occurs commonly in young children, particularly in those aged from 1 to 3 years, and consequences vary based on the object characteristics, its location, and the patient's age and size [1].

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The mechanical obstruction of the airways due to foreign body inhalation/aspiration is the primary source of fatal accidents in children younger than 1, and it represents a major cause of death in children from 1 to 4 years old [2]. Moreover, because of late diagnosis FBs, injury may result in severe complications including asphyxia, pneumonia, atelectasis and bronchiectasis [3]. On the other hand, while most ingested foreign bodies are well tolerated and pass the intestinal tract with no complications, some may cause gastrointestinal perforation or obstruction. The most common complication is entrapment in the esophagus, and possible sequelae include erosion, perforation and even mediastinitis [4].

In case reports and case series reported in scientific literature, small toys or toy parts are frequently mentioned among foreign bodies that may represent choking hazards for children. Many joint efforts have been made in several Countries to reach acceptable safety levels for several kinds of products and to identify prevention standards such as the small parts cylinder (SPC), used to imitate a child under 3 years of age throat to test whether small article may pass or not [5–7].

However, since the evolvement of toys production and the commercialization of new products continuously change the characteristics of potentially risky foreign bodies, a regularly updated surveillance on this issue is needed. The aim of the present study is to characterize the risk of complications and prolonged hospitalization due to toys inhalation/aspiration or ingestion according to age and gender of patients, FB characteristics and FB location, circumstances of the accident, as emerging from the ESFBI study.

2. Methods

2.1. Data collection

The European Survey on Foreign Bodies Injuries (ESFBI) study collected data on FB injuries in children aged 0–14, from 19 European Hospitals (Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Finland, Germany, Greece, Italy, Poland, Romania, Slovakia, Slovenia, Spain, Sweden, Swiss, Turkey and United Kingdom). Data on general FB were already published in a previous study [8], in the present paper we only analyzed toys or part of toys injuries. Data on injuries occurred in the years 2000–2003 were identified by means of the International Classification of Diseases, Ninth Revision (ICD-9) codes listed on hospital discharge records. Details on injuries were gathered through a standardized case report form, that includes information regarding: children age and gender, features of the object, circumstances of injury (presence of parents, activity) and the hospitalization's details (lasting, complications and removal details).

2.2. Toys characteristic definition

According to the Rimell's classification [9], objects were characterized by size, shape and consistency.

With regard to the size, when the dimensions (in mm) of the object were reported, the volume was calculated according to the shape of the objects itself. Such volume measures represent how much space the smallest geometrical figure containing the irregular-shaped FB takes up. Moreover, the ellipticity (the ratio between the maximum and the minimum size reported) was calculated.

2.3. Statistical analysis

The analysis was carried out on injuries due to toys. Age and gender injury distributions were assessed. Data regarding adult supervision were also evaluated.

FB location was reported according to ICD9-CM code [10]: nose (ICD932), pharynx and larynx (ICD933) trachea, bronchi and lungs (ICD934), mouth, esophagus and stomach (ICD935).

Descriptive statistics (absolute and relative number or median, I and III quartile according to the categorical or continuous variable characteristics, respectively) were calculated for each considered toy characteristic; FB features distributions by children class age and site of obstruction were assessed.

Two different outcomes were considered: complications and hospitalizations. Complications include all the pathological conditions due to delayed diagnosis or to the attempts of removing the FB. Hospitalization has been defined whether the child was admitted in the hospital for at least 1 day.

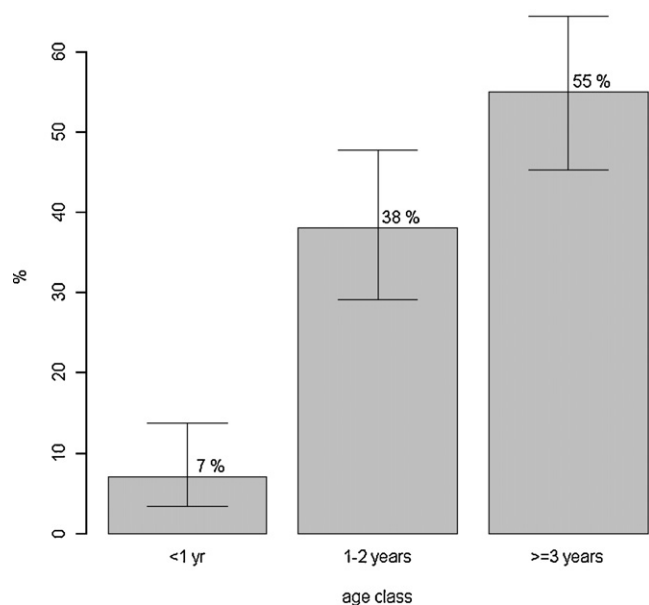


Fig. 1. Distribution of incidence (%) of FB injuries by age class. Over the bars, 95% confidence intervals are plotted.

Table 1

FB location according to ICD9-CM code: nose (ICD932), pharynx and larynx (ICD933) trachea, bronchi and lungs (ICD934), mouth, esophagus and stomach (ICD935). Total amount of toys injuries, complicated injuries and injuries requiring hospitalization are reported.

Location	Toys related injuries	Complications		Hospitalization	
		Yes	No	Yes	No
Nose	74% (70)	75% (3)	74% (53)	16% (3)	93% (54)
Pharynx and larynx	6% (6)	0% (0)	8% (6)	11% (2)	7% (4)
Trachea, bronchi and lungs	13% (12)	0% (0)	12% (9)	47% (9)	0% (0)
Mouth, esophagus and stomach	7% (7)	25% (1)	6% (4)	26% (5)	0% (0)
Total	95	4	72	19	58

Table 2

Description of the toys which caused the incident.

Toy description	N (%)
Part of a toy	17 (18%)
Lego type toys	16 (17%)
Spherical toys	6 (6%)
Generic plastic toys	6 (6%)
Wheel of a toy car	5 (5%)
Plastic nail	4 (4%)
Piece of combination box	4 (4%)
Bullet seed	3 (3%)
Plastic coin	2 (2%)
Puzzle piece	2 (2%)
Toy	29 (31%)

The association between outcomes and children's age, adult presence and toys characteristics was computed using unweighted odds ratios and the related 95% confidence intervals. Odds ratios not possible to be evaluated due to small cell frequency were labeled as NS (not significant).

Analyses were performed using Design and Hmisc libraries from R version 2.8 [11].

3. Results

In the period from January 2000 and the first semester 2003 a total of 2094 FB injuries occurred in

children aged 0–14 years. No significant variation in injury occurrence has been observed, the number of recorded injuries per semester ranging from 290 to 339 without temporal trends. Among them 121 (5.8%) were due to toys and 95 (4.5%) occurred in the lower/upper aero-digestive tract, without any significant temporal trend.

Distribution of incidence of toys injuries by age class is shown in Fig. 1. 59 (62%) of patients were males, while 36 (38%) were females.

Almost 27% of toys related injuries happened under adults' supervision.

Details regarding FB location are given in Table 1; data regarding hospitalization and complications were available in 76 and 77 cases, respectively. The total amount of toys injuries, the number of complicated injuries and the number of injuries in which hospitalization is needed are reported for each site.

FB type was known in 94 cases: a short description of the toys that caused the incident is provided in Table 2. Toys volume, shape, ellipticity and consistency by age and by location in aero-digestive tract are described respectively in Tables 3 and 4. Rigid tridimensional objects seem to be most frequently involved in injury occurrence at all ages and they constitute the most frequent find in all the considered locations.

Looking to the outcomes, 58 children needed hospitalization; the median in hospital stay was 1 day in the

Table 3

Toys characteristics by age. Data are first quartile/median/third quartile for continuous variables and percentages (absolute numbers) for categorical variables. N is the number of valid cases for each given variable.

Foreign body characteristics	N	Age class		
		<1 year (N = 7)	1–2 years (N = 36)	≥3 years (N = 52)
Volume	37	1225/1225/1225	80.71/175/225	65.42/150/267.95
Shape	71			
Spherical		0% (0)	17% (5)	21% (8)
3D		50% (2)	62% (18)	58% (22)
2D		25% (1)	7% (2)	8% (3)
2D circle		25% (1)	14% (4)	13% (5)
Other		0% (0)	0% (0)	0% (0)
Ellipticity	27	3.57/3.57/3.57	1.6/2/2.5	1.33/1.6/2.33
Consistency	75			
Conforming		0% (0)	7% (2)	5% (2)
Semi-rigid		25% (1)	34% (10)	36% (15)
Rigid		75% (3)	59% (17)	60% (25)
Do not know		0% (0)	0% (0)	0% (0)

Table 4

Toys characteristics by FB location. Data are first quartile/median/third quartile for continuous variables and percentages (absolute numbers) for categorical variables. *N* is the number of valid cases for each given variable.

Foreign body characteristics	<i>N</i>	Foreign body location			
		Nose (<i>N</i> = 70)	Pharynx and larynx (<i>N</i> = 6)	Trachea, bronchi and lungs (<i>N</i> = 12)	Mouth, esophagus and stomach (<i>N</i> = 7)
Volume	37	65.42/179.5/267.95	45/96/113.04	105/105/105	1700/2175/2650
Shape	71				
Spherical		23% (12)	17% (1)	0% (0)	0% (0)
3D		57% (30)	67% (4)	75% (6)	50% (2)
2D		9% (5)	0% (0)	12% (1)	0% (0)
2D circle		11% (6)	17% (1)	12% (1)	50% (2)
Other		0% (0)	0% (0)	0% (0)	0% (0)
Ellipticity	27	1.38/1.6/2	1.623/5.83/15	2.33/2.33/2.33	3.93/4.29/4.64
Consistency	75				
Conforming		7% (4)	0% (0)	0% (0)	0% (0)
Semirigid		41% (23)	17% (1)	0% (0)	50% (2)
Rigid		52% (29)	83% (5)	100% (9)	50% (2)
Do not know		0% (0)	0% (0)	0% (0)	0% (0)

Table 5

Odds ratio of complications and of hospitalization with the 95% confidence intervals are presented. *p* values are also presented. *N* number of valid cases for each given variable. NS: not significant, not possible to be evaluated due to small cell frequency. Ref: reference category.

Variables	<i>N</i>	Hospitalization				Complications				
		Yes (<i>N</i> = 19)	No (<i>N</i> = 58)	OR (95%CI)	<i>p</i>	Yes (<i>N</i> = 4)	No (<i>N</i> = 72)	OR (95%CI)	<i>p</i>	
Age class	95									
<1 year		26% (5)	0% (0)	NS		25% (1)	6% (4)	3.25 (0.27;3.9)	0.35	
1–2 years		16% (3)	45% (26)	0.34 (0.08;13.3)	0.12	0% (0)	40% (29)	NS		
≥3 years		58% (11)	55% (32)	Ref		75% (3)	54% (39)	Ref		
Adult supervision	65									
Adult present		50% (9)	36% (17)	1.76 (0.59;5.3)	0.31	25% (1)	41% (25)	0.48 (0.05;4.88)	0.53	
Volume	37	57.75/100.5/ 945	89.23/179.5/ 267.95	1.34 (0.92;1.96)	0.13	95/149.75/ 440.88	65.42/175/ 267.95	1.05 (0.75;1.46)	0.79	
Shape	71									
Spherical		0% (0)	24% (13)	NS		25% (1)	18% (12)	1.08 (0.1;1.14)	0.95	
3D		65% (11)	57% (31)	Ref		75% (3)	59% (39)	Ref		
2D		12% (2)	7% (4)	1.41 (0.23;8.8)	0.71	0% (0)	9% (6)	NS		
2D circle		24% (4)	11% (6)	1.88 (0.45;7.93)	0.39	0% (0)	14% (9)	NS		
Ellipticity	27	1.54/2/3.26	1.5/1.6/2.5	0.96 (0.76;1.21)	0.72	2/2.5/3.04	1.48/1.63/2.38	0.96 (0.68;1.34)	0.8	
Consistency	75									
Conforming		0% (0)	7% (4)	NS		0% (0)	6% (4)	NS		
Semirigid		17% (3)	40% (23)	Ref		25% (1)	35% (25)	Ref		
Rigid		83% (15)	53% (30)	3.83 (0.99;14.84)	0.05	75% (3)	59% (42)	1.79 (0.18;18.11)	0.62	

absence of complications, whereas for complications the hospitalization stay was reported in the database for only one child (27 days); removal was performed in the great part of cases by endoscopy while one case required surgery; complications were obstructions [2], pneumonia, esophageal atresia [1] and unilateral nasal odorous discharge [1]. No deaths were observed. In order to verify the association among children age, adult supervision, object characteristics and outcomes, odds ratios of complications and hospitalization, with 95% confidence intervals, are presented in Table 5; particularly, rigid

consistency seems to play a not negligible role in increasing hospitalization risk.

4. Conclusions

Aspiration and ingestion of foreign bodies are common events in paediatric patients, which can have severe, even fatal, consequences.

An important advance in the prevention of injuries was the introduction of safety rules for toy design [12]: the

European regulation bans objects for children under three years having small parts. On the other hand, products designed for children from 3 to 6 years and having small parts must be labeled to warn purchasers not to buy them for children under 3 years [5,6].

The adoption of these preventive strategies mainly based on products modification by manufacturers, has resulted in a decrease of children's mortality rate for choking in the last decades [7]; however, our results seem to testify that more than 5% of FB injuries are still due to toys.

The most documented incident is the insertion of a toy or a piece of it in the nose. Even if complications are underreported, severe consequences seem to be rare, probably because the relative inert nature of the plastic material implies a mild tissue inflammation and allows a relatively quick response of the patient upon removal of the FB [13]. Objects are mainly tridimensional and at most with a very small ellipticity ratio of 2. The first determinant of a damage requiring hospitalization is the rigid consistence of the object: the risk of a stay in hospital longer than 1 day is in fact, three times greater when children inhale or ingest a rigid product, compared with a semi-rigid item.

More than half of injuries due to toys involve children older than three years. This fact seems to testify the effectiveness of regulations finalized to limit the commercialization of products for children up to three years having small parts. However, when details regarding toys are at disposal, in our study the most frequently retrieved foreign bodies are part of toys. Possible explanations include: (i) the commercialization of unsafe products; (ii) when the injury involves young children (younger than 3 years), the accessibility to inappropriate for age toys; (iii) when children are more than 3 years old, poor parents and children education regarding this issue. Incorrect adult supervision is commonly involved in the injury mechanism. In our study, in fact, an adult was present in more than 25% of cases. These results stress the evidence that preventive strategies imposing a regulation of industrial production, even if fundamental, are not sufficient and need to be integrated with other preventive intervention, addressed to improve parents consciousness and attention toward a proper surveillance of children [14].

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