

Original Article

Ingested foreign bodies causing complications and requiring hospitalization in European children: Results from the ESFBI study

Dario Gregori,¹ Cecilia Scarinzi,² Bruno Morra,³ Lorenzo Salerni,⁴ Paola Berchiolla,¹ Silvia Snidero,² Roberto Corradetti,² Desiderio Passali⁴ the ESFBI Study Group

¹Department of Public Health and Microbiology and ²Statistics and Applied Mathematics, University of Torino, ³ENT Department, San Giovanni Battista Hospital Torino, Torino and ⁴ENT Department, University of Siena, Siena, Italy

Abstract *Background:* In young children, particularly those aged 1–3 years, aerodigestive tract foreign bodies (FB) are a common pediatric problem. The aim of the present study was therefore to characterize the risk of complications and prolonged hospitalization due to FB in the upper digestive tract in terms of the characteristics of the injured patients (age, gender), typology and features of the FB, the circumstances of the accident and hospitalization details.

Methods: A retrospective study was done in 19 hospitals in 19 corresponding European countries of 186 cases of injury due to the presence of an FB in the mouth, esophagus and stomach (ICD935), out of the 2103 overall cases of FB reported in other locations.

Results: Complications arose in 14 cases and hospitalization was required in 164 cases. No deaths were observed. A higher incidence of hospitalization in male patients (61%) was observed. Median age for children who experienced complications was 2 years old. The most common FB removal technique was esophagoscopy. In the majority of cases the children were treated by the ENT Department. The most common FB were coins, batteries and fish bones among food.

Conclusion: Because batteries, as well as coins and fish bones among food were the most common type of FB encountered, and because recent development of technology has accelerated broad use of disk-type batteries, parents should be aware of this hazard, and an educational campaign for public education for this serious problem is advisable.

Key words case management, child injuries, foreign body, upper digestive tract.

The ingestion of a foreign body (FB) is a serious health problem in pediatric patients that causes significant morbidity and mortality.^{1–3} Children in particular, especially those younger than 6 years of age, are naturally susceptible to FB injuries due to the lack of molar teeth, the tendency toward oral exploration, and to play while they eat, and the poor coordination of swallowing.^{4,5}

Reported FB include fish bones, metal objects such as batteries and coins, and broken tooth fragments.^{6,7} Several authors highlighted some differences between Asian and Western pediatric FB injuries, claiming a possible explanation as being the influence that ethnic food habits have on the age distribution and type of esophageal FB.^{4,8}

Frequent symptoms are drooling, gagging, dysphonia, vomiting, and dysphagia, depending on the location and the nature of the FB.⁹ The final situation of an FB lodged in the upper digestive tract depends on several factors including size and consistency of the FB. Most FB pass through the alimentary tract spontaneously,

but when large or sharp objects become lodged a variety of complications have been known to occur including pneumonia, anoxia and cyanosis,^{10,11} some times in association with esophageal atresia.^{12,13} Although rare, perforating objects are potentially life-threatening because they may involve fistula formation between the esophagus and innominate artery, thus causing catastrophic bleeding.^{14–16} Sometimes esophageal FB can cause a perforation of the esophagus; these rare cases may lead to potentially lethal complications such as neck abscesses, mediastinitis, peritonitis, persistent infection of the respiratory tract, or aorto-esophageal fistula. Patients should be closely monitored for signs of perforation with developing suppurative symptoms in the neck, chest, or abdomen. Perforation of the esophagus is almost invariably accompanied by pain, with cervical perforations causing neck or chest pain and thoracic perforations causing chest or abdominal pain. Fever, tenderness, subcutaneous or mediastinal emphysema also accompany perforation. In order to prevent these complications, timely diagnosis and removal are mandatory.^{17,18}

The aim of the present study was to characterize the risk of complications and prolonged hospitalization due to FB in the upper digestive tract in terms of characteristics of the injured patients (age, gender), typology and features of the FB,

Correspondence: Dario Gregori, MA, PhD, Università di Torino, Department of Public Health and Microbiology, Via Santena 5bis, 10126 Torino, Italy. Email: dario.gregori@unito.it

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circumstances of the accident and hospitalization details, as emerging from the European Survey on Foreign Bodies Injuries (ESFBI) study.

Methods

Sample

The ESFBI Study collected data on FB injuries in the aerodigestive tract in pediatric patients from 19 European Hospitals (Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Finland, Germany, Greece, Italy, Poland, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom). Data on 2103 injuries occurring in the years 2000–2002 were identified by means of the International Classification of Diseases, Ninth Revision (ICD-9) codes listed on hospital discharge records. The main referent in each hospital was an otorhinolaryngology (ORL) doctor, cooperating in collecting data with other specialized structures (pediatric, emergency units and gastroenterology). The current analysis was carried out on FB located in the mouth, esophagus and stomach, corresponding to code ICD935 of the ICD-9 coding system. A total of 186 cases was observed for this ICD9-CM code.

Case report form

Details on injuries were gathered through a standardized case report form (CRF). It encompassed four main aspects of FB injuries: characteristics of the children (age, gender), features of the object (shape, consistency, and dimension), circumstances of FB ingestion (presence of parents, activity) and hospitalization details (length of stay in hospital, complications and removal details).

Objects were characterized by size, shape and consistency, according to Rimell *et al.* classification.¹⁹ With regard to the size, when the object's dimensions (measured in mm) were reported, the volume was calculated according to the shape of the object itself. Such volume measures represent how much space the smallest geometrical figure containing the irregular-shaped FB takes up.

The CRF dedicated five questions to the associations of FB with other kinds of objects, both at the time of the accident and when the product was purchased. These questions were recoded into a new variable in order to highlight the industrial problems about the different components of the products.

As regards objects we considered five different categories: (i) non-industrial component; (ii) piece of an object: the FB was a broken part of the product (e.g. a broken part of a pen, the wheel of a toy car etc.); (iii) co-presence with another object (e.g. when the objects were sold together such as the cap with the pen, the marble with a board game etc.); (iv) package or part of a package of a product (e.g. the tinfoil containing chocolate, a polystyrene ball, a piece of cardboard etc.); and (v) inedible part of a food product containing inedible parts (stickers in crisps, toys in chocolate eggs etc.). When the association was not specified we considered the non-food product as a single object and not as an industrial component.

Outcomes

Examining the physicians' reports two outcomes were identified: (i) complications and (ii) hospitalization.

The ingestion of an FB may cause a wide variety of symptoms ranging from perforation, drooling, gagging, dysphonia to vomiting, dysphagia and cyanosis.¹⁰ Prolonged hospitalization was defined as ≥ 1 day.

Statistical methods

Descriptive statistics, such as absolute and relative number for categorical variables, the three quartiles for the continuous variables, were determined. Moreover odds ratios (OR) and 95% confidence interval (95%CI) were calculated in order to analyze the association of the explanatory variables with the two outcomes. In addition, direct in-hospital costs, including only procedures performed and in-hospital stay, for the extraction of the FB were estimated on the basis of the Italian Diagnosis Related Group (DRG) system. Analyses were performed by means of Design and Hmisc libraries and R version 2.4.²⁰

Results

One hundred and eighty-six injuries due to the ingestion of an FB were observed. A higher incidence in male patients (61%) was observed. Median age of children was 2 years (Table 1). Age distribution is shown in Fig. 1. No deaths were observed. In five cases, FB were spontaneously expelled. Most of the injuries occurred during playing. Co-presence of FB with other kinds of objects are shown in Table 2.

Complications

Complications were observed in 14 patients. In the presence of complications, equal numbers of four children (36%) were hospitalized for 1 or 2 days. In the absence of complications, 96

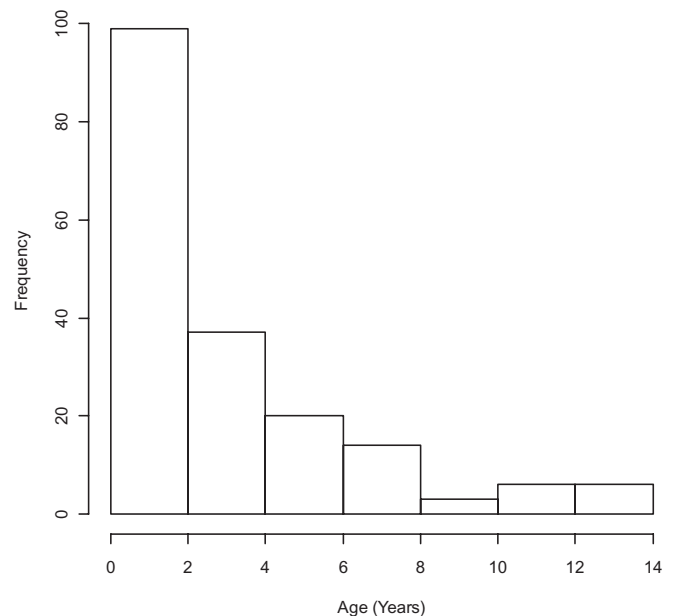


Fig. 1 Age distribution of foreign body injury in children.

Table 1 Characteristics of overall sample vs presence of complications and hospitalization (≥ 1 day)

Variable	Category	n	Presence of complications			P	n	Hospitalization			P
			No % (n)	Yes % (n)	Combined % (n)			No % (n)	Yes % (n)	Combined % (n)	
Gender‡	Female	184	38 (60)	57 (8)	40 (68)	0.166	184	46 (6)	39 (63)	39 (69)	0.606
Age†		185	1.00/2.00/ 4.00 ^a	1.25/3.50/ 5.00 ^a	1.00/2.00/ 5.00 ^a	0.489	185	1/2/6 ^a	1/2/4 ^a	1/2/5 ^a	0.96
FB removal‡	Endoscopy Operation Other	176	94 (148) 3 (5) 3 (5)	71 (10) 0 (0) 29 (4)	92 (158) 3 (5) 5 (9)	<0.001	176	67 (8) 0 (0) 33 (4)	93 (152) 4 (6) 4 (6)	91 (160) 3 (6) 6 (10)	<0.001
Hospitalization	Yes	177	97 (154)	79 (11)	95 (165)	0.00179	177	31 (4)	100 (164)	95 (168)	<0.001
Length of stay†		177	1.0/1.0/2.0 ^a	1.0/1.5/2.0 ^a	1.0/1.0/2.0 ^a	0.623	177	0/0/0 ^a	1/1/2 ^a	1/1/2 ^a	<0.001
Length of stay‡	1 day 2 days 3 days >3 days	164	64 (96) 22 (33) 11 (17) 3 (4)	36 (4) 36 (4) 9 (1) 18 (2)	62 (100) 23 (37) 11 (18) 4 (6)	0.00314	164		62 (102) 23 (37) 11 (18) 4 (7)	62 (102) 23 (37) 11 (18) 4 (7)	
Regime hospitalization‡	Ordinary Day Hospital Emergency Service	167	35 (53) 23 (35) 42 (65)	55 (6) 0 (0) 45 (5)	36 (59) 21 (35) 43 (70)	0.160	167	20 (1) 40 (2) 40 (2)	37 (60) 21 (34) 42 (68)	37 (61) 22 (36) 42 (70)	0.548
First accident‡	Yes	176	97 (154)	100 (14)	98 (168)	0.547	176	100 (13)	98 (159)	98 (172)	0.568
How many accidents‡	1 2 3	3	33 (1) 33 (1) 33 (1)		33 (1) 33 (1) 33 (1)		3 3 3		33 (1) 33 (1) 33 (1)	33 (1) 33 (1) 33 (1)	
Age at first accident		66	2/3/5 ^a	2/3/7 ^a	2/3/5 ^a	0.91	66	1.5/2.0/3.5 ^a	2.0/3.0/5.5 ^a	2.0/3.0/5.0 ^a	0.421
Type of transportation	In ambulance By taxi or in a private car By public transport	169	20 (31) 77 (118)	42 (5) 58 (7)	22 (36) 75 (125)		169	20 (2) 70 (7)	21 (34) 76 (121)	21 (36) 76 (128)	
to reach hospital‡	Walking Other		3 (5) 0 (0)	0 (0) 0 (0)	3 (5) 0 (0)			10 (1) 0 (0)	3 (4) 0 (0)	3 (5) 0 (0)	
Dept first look after the child‡	ENT Dept Pediatrics Reanimation Accident Emergency Other	177	55 (88) 18 (28) 0 (0) 14 (23) 13 (20)	21 (3) 36 (5) 0 (0) 36 (5) 7 (1)	53 (91) 19 (33) 0 (0) 16 (28) 12 (21)		177	46 (6) 15 (2) 0 (0) 31 (4) 8 (1)	53 (87) 20 (32) 0 (0) 15 (25) 12 (20)	53 (93) 19 (34) 0 (0) 16 (29) 12 (21)	
Dept discharged the child‡	ENT Dept Pediatrics Reanimation Accident Emergency Other	177	75 (119) 1 (2) 0 (0) 1 (1) 23 (37)	57 (8) 0 (0) 0 (0) 0 (0) 43 (6)	73 (127) 1 (2) 0 (0) 1 (1) 25 (43)		177	77 (10) 8 (1) 0 (0) 0 (0) 15 (2)	72 (118) 1 (2) 0 (0) 1 (1) 26 (43)	72 (128) 2 (3) 0 (0) 1 (1) 25 (45)	
Hospitalization cost (euro)†		160	277.34/277.34/ 1634.07 ^a	277.34/1634.07/ 1634.07 ^a	277.34/277.34/ 1634.07 ^a	P = 0.142	160	277.34/277.34/ 1634.07 ^a	277.34/277.34/ 1634.07 ^a	277.34/277.34/ 1634.07 ^a	

†F-test; ‡ χ^2 test.
ENT, Ear Nose Throat; FB, foreign body.
^aFirst quartile/median/third quartile.

Table 2 Distribution of the overall sample and according to the presence of complications and the hospitalization (for at least 1 day) with respect to the characteristics of the foreign body and the circumstances of the accident

Variable	Category	Presence of complications				Hospitalization							
		<i>n</i>	No % (<i>n</i>)	Yes % (<i>n</i>)	Combined % (<i>n</i>)	OR	<i>P</i>	<i>n</i>	No % (<i>n</i>)	Yes % (<i>n</i>)	Combined % (<i>n</i>)	OR	<i>P</i>
Shape‡	Spherical	158	8 (12)	17 (2)	9 (14)	Ref	Ref	158	10 (1)	9 (13)	9 (14)	1.13 (0.09–13.7)	0.9233
	3D		15 (21)	17 (2)	15 (23)		0.57 (0.07–4.59)		20 (2)	16 (23)	16 (25)		0.7435
	2D		5 (7)	8 (1)	5 (8)		0.86 (0.07–11.26)		10 (1)	5 (8)	6 (9)		0.8244
First dimension†	2D circle	94	69 (98)	58 (7)	68 (105)	–	0.43 (0.08–2.3)	–	60 (6)	68 (100)	67 (106)	–	–
	other		3 (4)	0 (0)	3 (4)		–		0 (0)	3 (4)	3 (4)		–
			10.00/18.00/22.00 ^a	12.5/20.0/22.5 ^a	10.00/18.00/22.75 ^a	1.06 (0.79–1.44)	0.6882	94	6.00/8.00/14.50 ^a	10.00/18.00/22.75 ^a	10.00/18.00/22.75 ^a	10.00/18.00/22.75 ^a	0.72 (0.44–1.18)
Second dimension†	10	16.25/20.00/23.75 ^a	11.00/15.00/27.50 ^a	9.00/17.50/23.75 ^a	9.00/17.50/23.75 ^a	1.08 (0.73–1.61)	0.692	10	9.00/17.50/23.75 ^a	9.00/17.50/23.75 ^a	9.00/17.50/23.75 ^a	–	–
	7	4.25/5.00/8.25 ^a	9.00/11.00/13.00 ^a	5.00/5.00/11.00 ^a	5.00/5.00/11.00 ^a	1.23 (0.68–2.24)	0.4964	7	5.00/5.00/11.00 ^a	5.00/5.00/11.00 ^a	5.00/5.00/11.00 ^a	–	–
	173	5 (8)	7 (1)	5 (9)	11.00 ^a	Ref	Ref	173	8 (1)	6 (9)	6 (10)	–	–
Consistency‡	Semi-rigid	10 (16)	21 (3)	11 (19)	11 (19)	1.6 (0.18–14.1)	0.6721	173	25 (3)	11 (17)	12 (20)	1.83 (0.21–16.31)	0.5868
	Rigid	83 (128)	71 (10)	82 (138)	82 (138)	2.4 (0.6–9.64)	0.7423	185	67 (8)	82 (132)	81 (140)	2.91 (0.7–12.04)	0.7059
	Unknown	2 (3)	0 (0)	2 (3)	2 (3)	–	–	–	0 (0)	2 (3)	2 (3)	–	–
Co-presence‡	Not industrial component	89 (141)	79 (11)	88 (152)	88 (152)	Ref	Ref	185	85 (11)	88 (144)	88 (155)	–	–
	Part of another object	6 (10)	7 (1)	6 (11)	6 (11)	1.28 (0.15–10.95)	0.8206	185	0 (0)	7 (11)	6 (11)	–	–
	Package	1 (1)	0 (0)	1 (1)	1 (1)	–	–	–	8 (1)	1 (1)	1 (2)	13.09 (0.77–223.79)	0.0758
Volume†	Different objects	2 (3)	14 (2)	3 (5)	3 (5)	8.55 (1.29–56.65)	0.0262	13	0 (0)	3 (5)	3 (5)	–	–
	FPCI	2 (3)	0 (0)	2 (3)	2 (3)	–	–	–	8 (1)	1 (2)	2 (3)	6.55 (0.55–77.97)	0.1372
		13	1125/1436.03/2143.57 ^a	874.17/1225.00/3987.5 ^a	625.00/1225.00/2143.57 ^a	1.01 (0.96–1.07)	0.7332	13	113.04/113.04/113.04 ^a	1000.00/1330.51/2388.93 ^a	625.00/1225.00/2143.57 ^a	625.00/1225.00/2143.57 ^a	–
Adult presence‡ before accident‡	Yes	167	45 (69)	73 (8)	47 (77)	3.25 (0.83–12.71)	0.0908	167	67 (6)	46 (73)	47 (79)	2.33 (0.56–9.64)	0.2435
	Eating	168	19 (29)	42 (5)	21 (34)	Ref	Ref	168	36 (4)	20 (31)	21 (35)	–	–
Death‡	Playing	74 (113)	58 (7)	73 (120)	73 (120)	2.78 (0.82–9.41)	0.0995	185	45 (5)	75 (117)	73 (122)	3.02 (0.76–11.92)	0.1147
	Other	7 (11)	0 (0)	7 (11)	7 (11)	–	–	–	18 (2)	6 (9)	7 (11)	5.2 (0.88–30.66)	0.5652
		185	0 (0)	0 (0)	0 (0)	–	–	185	0 (0)	0 (0)	0 (0)	–	–
FB organic‡	Inorganic	82 (131)	64 (9)	81 (140)	81 (140)	Ref	Ref	186	69 (9)	82 (134)	81 (143)	–	–
	Organic	17 (27)	36 (5)	18 (32)	18 (32)	2.7 (0.84–8.68)	0.0964	186	31 (4)	18 (29)	19 (33)	2.05 (0.59–7.13)	0.257
	Unknown	1 (1)	0 (0)	1 (1)	1 (1)	–	–	–	0 (0)	1 (1)	1 (1)	–	–
FB type‡	Balls, marbles and beads	1 (1)	0 (0)	1 (1)	1 (1)	Ref	Ref	185	0 (0)	1 (1)	1 (1)	–	–
	Batteries	2 (3)	14 (2)	3 (5)	3 (5)	–	–	–	8 (1)	2 (4)	3 (5)	–	–
	Buttons	2 (3)	0 (0)	2 (3)	2 (3)	–	–	–	0 (0)	2 (3)	2 (3)	–	–
Fish bones and bones	Coins	57 (90)	29 (4)	55 (94)	55 (94)	–	–	–	38 (5)	55 (90)	54 (95)	–	–
	Food	4 (6)	7 (1)	4 (7)	4 (7)	–	–	–	8 (1)	4 (6)	4 (7)	–	–
	Jewelry	10 (16)	29 (4)	12 (20)	12 (20)	–	–	–	23 (3)	11 (18)	12 (21)	–	–
Nuts, seeds, berries, peas, corns and beans	Other inorganics	4 (6)	7 (1)	4 (7)	4 (7)	–	–	–	0 (0)	2 (4)	2 (4)	–	–
	Other organics	1 (1)	0 (0)	1 (1)	1 (1)	–	–	–	0 (0)	1 (1)	1 (1)	–	–
	Paper	1 (1)	0 (0)	1 (1)	1 (1)	–	–	–	0 (0)	1 (1)	1 (1)	–	–
Pebbles, stones and grit	Pins, screws, needles and nails	7 (11)	0 (0)	6 (11)	6 (11)	–	–	–	0 (0)	7 (12)	7 (12)	–	–
	Plastic	4 (6)	0 (0)	3 (6)	3 (6)	–	–	–	0 (0)	4 (6)	3 (6)	–	–
	Toys	3 (4)	7 (1)	3 (5)	3 (5)	–	–	–	0 (0)	3 (5)	3 (5)	–	–

†F-test; ‡ χ^2 test.
 CI, confidence interval; ENT, Ear Nose Throat; FB, foreign body; FPCI, food product containing inedible parts; OR, odds ratio.
^aFirst quartile/median/third quartile.

(64%) of the children experienced a hospital stay of 1 day (Table 1). The most common observed symptoms were dysphagia (23%) and vomiting (15%), and among complications, pneumonia (15%) played a major role. A case of esophagus perforation due to the ingestion of a coin and a tracheo-esophageal fistula provoked by the ingestion of a battery were also observed.

The most common FB that caused complications was food (29%), coins (29%), and batteries (14%; Table 2).

Hospitalization

Hospitalization occurred in 164 children (92%), 63 of whom were female; 53% of the children who experienced a hospitalization were >3 years of age. The median length of stay was 2 days (Table 1).

In 21% of all cases, hospital was reached by ambulance while in 76% of cases it was reached by taxi or private car.

In most cases (53%), children were directly referred to ENT Department, whereas in a smaller number of cases, pediatricians (19%) and emergency physicians (16%) looked after the child first.

Many children were redirected to the ENT Department, which discharged the child in 72% of cases. FB extraction was mostly performed on endoscopy (esophagoscopy). In two cases the FB was removed using a forceps (Table 1).

The median volume of the objects causing hospitalization was 1330.51 mm³, that is, significantly larger than the volume of the objects that did not cause hospitalization (113.04 mm³; $P < 0.001$).

The median cost of hospitalized children is 277.34€, being higher in the presence of complications (1634.07€, $P = 0.142$).

In most cases (55%) the FB causing hospitalization was coins. Food caused hospitalization in 11% of cases and pins, screws, needles and nail in 7% of cases (Table 2).

Discussion

Clinical findings

Various factors can be responsible for the swallowing of FB. In very young children, the accident could be attributable to their natural propensity to gain knowledge by putting things into their mouth, their inability to masticate well and their inadequate control of deglutition, as well as their tendency toward oral exploration and to play as they eat. In the present study a very large number of accidents occurred in children older than 3 years of age, with no gender effect. This has been reported also in other studies, and indicates the existence of a risk pattern specific for this age group.

Regarding FB type, coins were associated with both a high risk of complications and hospitalization, whereas batteries were associated with a higher risk of complications, and pins, needle, nails with a higher risk of hospitalization. Bones, representing a highly variable percentage of FB in the digestive tract in the world population, were often reported as FB with higher risk of complications, and in the present study were associated with only 4% of the complications. Types of FB obviously vary according

to the impacted locations. Bones are commonly found in the pharynx, and fish bones are frequently impacted in the esophagus. Coins and lighters passed through the pharynx and the esophagus spontaneously and are often located in the stomach.²¹

Nevertheless, even though the FB type is clearly associated with the onset of complications or prolonged hospitalization, what emerges from the present study is that FB characteristics play an independent role. Indeed, semi-rigid objects with higher volumes are associated with an increased risk of complications.^{4,22,23} Inorganic objects, although having a higher incidence, are less associated with complications compared to organic objects. Nevertheless inorganic FB most often require hospitalization. Out of the 164 patients who required hospitalization, with symptoms usually ranging from dysphagia and vomiting to pain, only 14 of them presented a complication. This is attributable to the clinical management of these patients, for which the period of in-hospital observation was associated with the procedure of extraction of the FB. Indeed, in the present study, 92% of FB were removed on endoscopy, this being a definitely higher rate compared to the guidelines of the American Society for Gastrointestinal Endoscopy, in which it is suggested that only 10–20% of FB may need to be removed endoscopically.²⁴ A complication rate of up to 5%, in line with the present study, is usually reported for endoscopic treatment and sometimes complications are severe.^{16,25–28} In the present study the most severe FB ingestions were a case of esophagus perforation, a case of pneumonia due to the ingestion of a coin and a case of tracheo-esophageal fistula due to the ingestion of a battery. One of the limitations of the present study was the fact that surgical departments have not been involved in the study, thus limiting the overall data collection strategy, because in several countries the surgeons are in charge of treating such patients. In addition, the possible differences among countries can be only in part attributable to a different treatment, given the potential biases in the mix of severity of cases and organizational aspects of the participating hospitals. Finally, although important from the epidemiological point of view, outpatient data were excluded from the data collection, which was exclusively based on in-hospital patients.

Consumer protection

The present study confirms the poor awareness among parents of the risks related to FB ingestion. Almost 50% of the accidents occurred under adult supervision and 73% of them were associated with onset of complications.²⁹ Very impressively, one out of five cases occurred while eating, stressing the importance of adequate preparation and mastication of food, particularly among children with esophageal abnormalities. The inadequacy of adult supervision had already been reported and constitutes a major indication toward the implementation of appropriate educational campaigns. Such intervention should be addressed also to promote the awareness of prompt intervention in the case of an accident. Impressively, only 25% of cases were evaluated by the parents as requiring emergency transport to the hospital. This lack of prompt intervention potentially leads to serious complications, as indeed observed, in the case of batteries and pins.

Final remarks

Foreign body injuries in the upper digestive tract continue to be a common health problem in pediatric patients. The clinical management of patients is effective in removing the FB and in reducing the impact of the accident, in particular due to the wide use of endoscopic techniques. This does not directly impact on the rate of hospitalization, which, in particular in view of the age of the children involved, is often seen as a precautionary measure. In contrast, prevention of FB ingestion is not addressed adequately in families, both in terms of stressing the need for active supervision of children when playing or eating, and in the need for prompt intervention, because the FB ingestion is often not perceived as requiring urgent or specialized treatment.

ESFBI Study Group**Coordinating Center**

Prof. Roberto Corradetti, University of Torino, Italy
 Prof. Dario Gregori, University of Torino, Italy
 Prof. Desiderio Passali, University of Siena, Italy
 Dr Silvia Snidero, University of Torino, Italy

Austria

Prof. Albegger Klaus, Head of the ENT-Department, Salzburg, Austria

Dr Huttegger Isidor, Universitätsklinik für Kinder- und Jugendheilkunde, Salzburg, Austria

Dr Schulz Gernot, Universitätsklinik für Kinder- und Jugendheilkunde, Salzburg, Austria

Dr Bauer Jan, Universitätsklinik für Kinder- und Jugendheilkunde, Salzburg, Austria

Belgium

Prof. Bertrand Bernard, Cliniques Universitaires UCL de Mont-Godinne, ENT Department, Yvoir, Belgium

Bulgaria

Prof. Karchev Todor, University Hospital 'Tzaritza Joanna', Sofia, Bulgaria

Prof. Tzolov Tzolo, University Hospital 'Tzaritza Joanna', Sofia, Bulgaria

Croatia

Prof. Mladina Ranko, ORL Department, University Hospital Salata-KBC, Zagreb, Croatia

Dr Kovac Lana, ORL Department, University Hospital Salata-KBC, Zagreb, Croatia

Czech Republic

Dr Slapak Ivo, Pediatric ENT Department of Children's University Hospital, Brno, Czech Republic

Denmark

Prof. Tos Mirko, Gentofte University Hospital of Copenhagen, Hellerup, Denmark

Prof. Per Caye-Thomasen, Gentofte University Hospital of Copenhagen, Hellerup, Denmark

Finland

Dr Pitkäranta Anne, Helsinki University Central Hospital, Helsinki, Finland

Germany

Prof. Jahnke Volker, Charité Campus Virchow-Klinikum, Berlin, Germany

Dr Göktas Önder, Charité Campus Virchow-Klinikum, Berlin, Germany

Greece

Prof. Nikola Simasko, Democritus University of Thrace, ENT Department, Alexandroupolis, Greece

Dr Chroni Matilda, Agia Sophia Children Hospital, ENT Department, Athens, Greece

Dr Ioannis Christopoulos, Agia Sophia Children Hospital, ENT Department, Athens, Greece

Italy

Prof. Desiderio Passali, Department of Otorhinolaryngology, University of Siena, Italy

Prof. Luisa Bellussi, Department of Otorhinolaryngology, University of Siena, Italy

Dr Giulio Cesare Passali, Department of Otorhinolaryngology, University of Siena, Italy

Dr Francesco Passali, Department of Otorhinolaryngology, University of Siena, Italy

Dr Valerio Damiani, Department of Otorhinolaryngology, University of Siena, Italy

Poland

Prof. Chmielik Mieczysław, Department of Paediatric Otorhinolaryngology,

The Medical University of Warsaw, Poland

Romania

Prof. Sarafoleanu Dorin, Clinica ORL, Sfanta Maria Hospital, Bucharest, Romania

Dr Sarafoleanu Codrut, Clinica ORL, 'Sfanta Maria Hospital', Bucharest, Romania

Dr Dan Cristian Gheorghe, Clinica ORL, 'Spitalul de Copii Marie Curie', Bucharest, Romania

Slovakia

Prof. Jakubíková Janka, Pediatric Otolaryngology Department of Medical Faculty of Comenius University, Bratislava, Slovakia

Slovenia

Prof. Žargi Miha, Department of Otorhinolaryngology and Cervicofacial Surgery, University Medical Centre, Ljubljana, Slovenia

Dr Grošelj Aleš, Department of Otorhinolaryngology and Cervicofacial Surgery, University Medical Centre, Ljubljana, Slovenia

Dr Matos Aleš, Department of Otorhinolaryngology and Cervicofacial Surgery, University Medical Centre, Ljubljana, Slovenia

Spain

Prof. Rubio Lorenzo, Jefe de la Unidad ORL–Hospital Ruber International, Madrid Spain

Dr Cervera Javier, Hospital Niño Jesus, Madrid, Spain

Sweden

Prof. Stierna Pontus, Karolinska University Hospital Huttunge, Stockholm, Sweden

Switzerland

Prof. Pasche Philippe, Service ORL, Centre Hospitalier Universitaire Vaudois, Lausanne, Switzerland

Dr Cherif Ahmed, Service ORL, Centre Hospitalier Universitaire Vaudois, Lausanne, Switzerland

Turkey

Prof. Önerci T. Metin, Hacettepe University, Department of Otorhinolaryngology, Ankara, Turkey

Dr Çiftçi Arbay Özden, Hacettepe University, Faculty of Medicine, Dept of Pediatric Surgery, Ankara, Turkey

Dr Doğan Riza, Hacettepe University, Faculty of Medicine, Dept of Cardiovascular Surgery, Ankara, Turkey

United Kingdom

Prof. Graham John, Royal Free Hospital, London, UK

Dr Rea Peter, Royal Free Hospital, London, UK

Dr Obholtzer Rupert, Royal Free Hospital, London, UK

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