Stationary injuries in the upper aerodigestive system: Results from the Susy Safe Project

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Rationale and aim: Foreign body (FB) injuries are a relatively frequent event in young children. Clinical picture can be evidently affected from different variables. Among those size, shape, type and FB location cover an important issue. Increased attempts have been made in order to encourage normative interventions for products devoted to children's care and entertainment, reaching acceptable safety level; on the contrary, fewer efforts have been devoted to investigate the risk associated to objects that – even if not expressly created for children – are easy accessed by children, like stationery.

The aim of the present study is to characterize the risk of complications and prolonged hospitalization due to stationary items according to age and gender of patients, FB characteristics and FB location, circumstances of the accident, as emerging from the Susy Safe Registry.

Methods: From 2005 to 2010 case were collected from 70 centers in 32 different countries. Details on the injuries, identified by means of the International Classification of Diseases, Ninth Revision (ICD-9) codes listed on hospital discharge records, were gathered through a standardized case report form, that provides a full set of information on injuries, with specific details on age and gender of the child, location, shape, volume, consistency and ellipticity of the foreign body, behavioral aspects linked to the injury, like the supervision of the parents or the activity concomitant to the accident, any complication occurred, length of hospitalization.

Results: In the years 2005–2010 a total of 17,205 FB injuries in children aged 0–14 years were registered in Susy Safe Database. Among them 425 (2.5%) were due to a stationary item. The majority of FBs were retrieved in the nose (179, meaning 42.1%) and in the ears (176, 41.4%) only 5 cases were observed in children younger than 1 year, while most of the cases, 80.6%, were recorded in children older than 3 years. 193 patients (45.4%) were female, while 232 (54.6%) were male. Adult supervision was indicated in 212 cases. In 143 of these accidents the adult was present (32.6% of the whole group). The most frequent stationary retrieved was rubber, counting for 209 cases (49.2%). According to the FBs types, mostly all cases reported a 3D volume and a rigid or semirigid consistency (49.3%). Looking to the outcomes, 31 (7%) children needed hospitalization and complications were seen in 38 children (8.9%). No significant associations were seen between the outcomes and the FBs' characteristics, excluded those between the consistency of the FB (rigid) and the necessity of hospitalization and the shape (2D) and the presence of complication.

Conclusions: Injuries are events that in many cases can be prevented with appropriate strategies. Passive environmental strategies, including product modification by manufacturers, are the most effective. However, regulation regarding small parts of potentially dangerous objects covers products addressed to
1. Introduction

Foreign body (FB) injuries are a relatively frequent event in young children [1]. From 2005 to 2009 nearly 1200 hospital admission of children 0–14 years were due to foreign body inhalation in United Kingdom [2], while in the United States, foreign body inhalation accounts for 7% of accidental deaths in children under 4 years of age [3]. Worldwide, 55% of children who have inhaled foreign bodies are between 1 and 3 years of age and 7–10% are under 1 year of age [4], while ingestion is a frequent occurrence in children, especially in their first six years of life [5,6], with a peak in children older than 3 years [7].

Clinical picture can be evidently affected from different variables, and among those, shape, size, type and FB location cover an important issue [2,8]; depending on the origin (organic or inorganic) and the impact of the FB in the aerodigestive system, clinical presentation ranges may range from severe forms to forms with insidious and vague symptoms, which are difficult and frequently late diagnosed, carrying therefore more risks of complications [3,4,9,10].

Preventive strategies seems to be the primary objective when dealing with these injuries [11], meaning that scientific literature is needed to better understand the relationship between type of FB, location and clinical presentation with the aim to identify risky objects and to be able to improve effective preventive strategies [5,12].

Type of FB might varies from country to country [11], and inorganic objects appear to be an augmented appraisal in the last years [13], resulting in increased attempts to encourage normative interventions for products devoted to children's care and entertainment, reaching acceptable safety level [7,14].

On the contrary, fewer efforts have been devoted to investigate the risk associated to objects that even if not expressly created for children, are easy accessed by children. For instance, some classes of objects such as stationery items (including pencils, pens and their parts, etc.), are frequently listed in clinical registries among commonly inserted, inhaled, aspirated or ingested objects [6,7,15,16], but rarely receive a specific attention.

The aim of the present study is to characterize the risk of complications and prolonged hospitalization due to stationery items according to age and gender of patients, FB characteristics and FB location, circumstances of the accident, as emerging from the Susy Safe Registry.

2. Methods

2.1. Data collection

The Susy Safe Project is aimed at establishing a registry of cases of Foreign Bodies (FB) injuries in children age 0–14 years. From 2005 to 2010 case were collected from 70 centers in 32 different countries. Details on the injuries, identified by means of the International Classification of Diseases, Ninth Revision (ICD-9) codes listed on hospital discharge records, were gathered through a standardized case report form, that provides a full set of information on injuries, with specific details on age and gender of the child, location, shape, volume, consistency and ellipticity of the foreign body, behavioral aspects linked to the injury, like the supervision of the parents or the activity concomitant to the accident, any complication occurred, length of hospitalization.

2.2. Objects characteristics definition

According to the Rimell's classification [17] 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, in order to understand the impact of spherical objects to the risk of injuries, the ellipticity, defined as the ratio of the longer and the shorter axis of the object (thus being 1 for spherical objects) was assessed.

2.3. Statistical analysis

For the scope of this paper, statistical analysis was performed, assessing age and gender injury distributions. Data regarding adult supervision were also evaluated. FB location was reported according to ICD9-CM code: ears (ICD931), nose (ICD932), pharynx and larynx (ICD933) trachea, bronchi and lungs (ICD934), mouth, esophagus and stomach (ICD935). Descriptive statistics (absolute and relative frequencies or median, I and III quartile according to the categorical or continuous variable characteristics) were

---

**Table 1**

<table>
<thead>
<tr>
<th>Location</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ears</td>
<td>176</td>
<td>41.4</td>
</tr>
<tr>
<td>Nose</td>
<td>179</td>
<td>42.1</td>
</tr>
<tr>
<td>Pharynx and larynx</td>
<td>5</td>
<td>1.2</td>
</tr>
<tr>
<td>Trachea, bronchi and lungs</td>
<td>25</td>
<td>5.9</td>
</tr>
<tr>
<td>Mouth, esophagus and stomach</td>
<td>23</td>
<td>5.4</td>
</tr>
<tr>
<td>Other</td>
<td>17</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>425</td>
<td>100</td>
</tr>
</tbody>
</table>

---

**Fig. 1.** Distribution of incidence (%) of FB injuries by age class.
calculated for each foreign body’s characteristic. FB features distribution by children class age and site of obstruction were assessed. Two different outcomes were considered: complication and hospitalization. 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. The association between children age, adult presence, object characteristics and outcomes 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 [18].

### Table 3
Objects characteristics by FB location. Data are median 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. No objects observed with circle shape and conforming consistency.

<table>
<thead>
<tr>
<th></th>
<th>ICD931</th>
<th>ICD932</th>
<th>ICD933</th>
<th>ICD934</th>
<th>ICD935</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N = 137</td>
<td>N = 73</td>
<td>N = 5</td>
<td>N = 19</td>
<td>N = 22</td>
</tr>
<tr>
<td>Volume</td>
<td>275 1/1/1</td>
<td>1/1/1</td>
<td>1/1/1</td>
<td>1/1/149</td>
<td>1/1/1</td>
</tr>
<tr>
<td>Shape</td>
<td>71</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2D</td>
<td>9% (3) 0% (0)</td>
<td>100% (1)</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>50% (2)</td>
</tr>
<tr>
<td>2D circle</td>
<td>0% (0) 0% (0)</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>50% (2)</td>
</tr>
<tr>
<td>3D</td>
<td>71% (25) 69% (9)</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>89% (16)</td>
<td>50% (2)</td>
</tr>
<tr>
<td>Other</td>
<td>11% (4) 15% (2)</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>Spherical</td>
<td>9% (3) 15% (2)</td>
<td>0% (0)</td>
<td>11% (2)</td>
<td>0% (0)</td>
<td></td>
</tr>
<tr>
<td>Ellipticity</td>
<td>30 1.00/1.67/2.37</td>
<td>1.29/1.50/5.00</td>
<td>2.00/2.00/2.00</td>
<td>2.50/6.25/9.50</td>
<td></td>
</tr>
<tr>
<td>Consistency</td>
<td>73</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conforming</td>
<td>3% (1)</td>
<td>8% (1)</td>
<td>0% (0)</td>
<td>11% (2)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>Don’t know</td>
<td>0% (0)</td>
<td>15% (2)</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>Rigid</td>
<td>46% (17) 8% (1)</td>
<td>100% (1)</td>
<td>78% (14)</td>
<td>75% (3)</td>
<td></td>
</tr>
<tr>
<td>Semi-rigid</td>
<td>51% (19)</td>
<td>69% (9)</td>
<td>0% (0)</td>
<td>11% (2)</td>
<td>25% (1)</td>
</tr>
</tbody>
</table>

### Table 4
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.

#### Complications

<table>
<thead>
<tr>
<th>Hospitalization</th>
<th>Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes (N=28)</td>
<td>Yes (N=9)</td>
</tr>
<tr>
<td>No (N=44)</td>
<td>No (N=64)</td>
</tr>
<tr>
<td>OR (95% CI)</td>
<td>OR (95% CI)</td>
</tr>
<tr>
<td>P</td>
<td>P</td>
</tr>
</tbody>
</table>

#### Class age

<table>
<thead>
<tr>
<th></th>
<th>Yes (N=28)</th>
<th>No (N=44)</th>
<th>OR (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1 year</td>
<td>4% (1)</td>
<td>2% (1)</td>
<td>1.80 (0.09; 35.42)</td>
<td>0.70</td>
</tr>
<tr>
<td>1–2 years</td>
<td>18% (5)</td>
<td>20% (9)</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>&gt;3 years</td>
<td>79% (22)</td>
<td>77% (34)</td>
<td>1.16 (0.34; 3.94)</td>
<td>0.81</td>
</tr>
</tbody>
</table>

#### Adult supervision

<table>
<thead>
<tr>
<th></th>
<th>Yes (N=9)</th>
<th>No (N=64)</th>
<th>OR (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult present</td>
<td>26% (7)</td>
<td>43% (18)</td>
<td>0.47 (0.16; 1.34)</td>
<td>0.16</td>
</tr>
<tr>
<td>Volume</td>
<td>1.0100.054.50</td>
<td>0.68 (0.28; 1.65)</td>
<td>0.39</td>
<td></td>
</tr>
<tr>
<td>Shape</td>
<td>1.0000.611.00</td>
<td>1.000.237.23</td>
<td>1.23 (0.73; 2.07)</td>
<td>0.44</td>
</tr>
</tbody>
</table>

#### Shape

<table>
<thead>
<tr>
<th></th>
<th>Yes (N=9)</th>
<th>No (N=64)</th>
<th>OR (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>2D</td>
<td>4% (1)</td>
<td>7% (3)</td>
<td>0.42 (0.04; 4.36)</td>
<td>0.47</td>
</tr>
<tr>
<td>2D circle</td>
<td>7% (2)</td>
<td>0% (0)</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>3D</td>
<td>81% (22)</td>
<td>67% (28)</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>0% (0)</td>
<td>14% (6)</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Spherical</td>
<td>7% (2)</td>
<td>12% (5)</td>
<td>0.51 (0.09; 2.88)</td>
<td>0.44</td>
</tr>
<tr>
<td>Ellipticity</td>
<td>1.671.273.00</td>
<td>1.01 (0.82; 1.26)</td>
<td>0.90</td>
<td></td>
</tr>
</tbody>
</table>

#### Consistency

<table>
<thead>
<tr>
<th></th>
<th>Yes (N=9)</th>
<th>No (N=64)</th>
<th>OR (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conforming</td>
<td>4% (1)</td>
<td>5% (2)</td>
<td>1.71 (0.13; 21.82)</td>
<td>0.68</td>
</tr>
<tr>
<td>2D</td>
<td>71% (20)</td>
<td>37% (15)</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>Rigid</td>
<td>25% (7)</td>
<td>59% (24)</td>
<td>4.57 (1.56; 13.40)</td>
<td>0.006</td>
</tr>
</tbody>
</table>

### Results

In the years 2005–2010 a total of 17,205 FB injuries in children aged 0–14 years were registered in Susy Safe Database. Among them 425 (2.5%) were due to a stationery item. The majority of FBs were retrieved in the nose (179, 42.1%) and in the ears (176, 41.4%). All data regarding FB location are reported in Table 1.

Distribution of incidence of analyzed injuries by age class is shown in Fig. 1. Just 5 cases were observed in children younger than 1 year, while most of the cases, 80.6%, were recorded in children older than 3 years. 193 patients (45.4%) were female, while 232 (54.6%) were male.

Adult supervision was indicated in 212 cases. In 143 of these accidents the adult was present (33.6% of the whole group).

Details regarding FB types are given in Table 2: the most frequent stationery retrieved was rubber, counting for 209 cases (49.2%).

Specific data on volume and shape were found in 275 cases (Table 3). According to the FBs types, mostly all cases reported a 3D volume and a rigid or semirigid consistency (49.3%).

Looking to the outcomes, 31 (7%) children needed hospitalization and complications were seen in 38 children (8.9%). Complications and hospitalization are considered in their correlation with different FBs’ characteristic. No significant associations were seen excluded those between the consistency of the FB (rigid) and the
necessity of hospitalization and the shape (2D) and the presence of complication (Table 4).

4. Conclusions

Characteristics of food, like shape, dimension, consistency are fundamental in determining the damage that might occur [19]. Small items represent a real issue and the impact on different systems varies depending on permanence, dimension, and composition. FBs injuries located in the upper airways can be a very serious event, sometimes resulting in fatal outcome [20]. Without an early treatment it remains a major cause of morbidity and mortality in children, especially during the first years of life.

Children are more prone to aspirate/inhale FBs for several reasons including behavioral aspects (such as the tendency to explore their surrounding using the mouths and to talk and run around while chewing), anatomical characteristics (the incomplete dentition with presence of incisors to tear foods but lack of cuspsids necessary to grind food into a smooth bolus) and physiological features (including immature swallowing coordination, poor chewing capacity and higher respiratory rates compared with adults) any objects placed in mouths are more likely to be aspirated in children younger than 4 years than in older children [21].

Injuries are not simply accidents but events that in many cases can be prevented with appropriate strategies [22]. Interventions may be active or passive. In general, passive environmental strategies, including product modification by manufacturers, are the most effective because they provide automatic protection to large groups of people, including those less prone to undertake “active” measures and change their behavior [23].

Passive strategies often require legal or regulatory enforcement to impose the required changes [24]. An important advance in the prevention of foreign body injuries was the introduction of safety rules for toy design regarding small parts [25].

However, two facts must be indicated. Small parts regulation not projected objects that cannot be manufactured in a way preventing them from breaking into small parts, or that need to be small to perform their intended purpose and therefore several potentially dangerous objects are excluded. Secondary, as seen from recent European surveys [26] evidence based national level policies present inequities and great differences among different countries, preventing from a global framework of action.

Stationery items are an example of risky objects that although might end in fatalities, are poorly regulated from a choking, suffocation, ingestion point of view.

The most frequent foreign body belonging to the stationery macro-category was rubber, pieces and whole. As seen in other studies [27] elective locations for inorganic objects retrieval were ear and nose, mostly interesting in most of the cases children older than 3 years, that therefore are more prone to actively explore and one source of influence on childhood injury is physical risk taking (i.e., doing things that increase risk of injury when there are alternative behaviors that do not do so to the same extent). The contribution of risk activities to injury is particularly evident for young children 5 years and under [28].

When passive preventive strategies are not practical and easily developable, active strategies promoting behavior change are necessary. Recent research findings confirm that risk factors for injury to young children include not only child behavioral attributes but also caregiver supervisory patterns [29]. Increasing parental awareness of the injury-risk implications of young children’s emerging advancements in motor skills is essential to aid their making appropriate decisions about children’s supervisory needs. Education of adults is essential as a primary prevention tool, including counselling on safe behavior in every pediatricians’ visit, would mean improving adults’ consciousness on potential FB injuries and therefore being more attentive toward an active supervision.

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Dr. Lorenzo Rubio, Ruber International Hospital, Spain

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References