Button battery ingestion requiring upper gastrointestinal endoscopy: A retrospective study at a tertiary care hospital (2014-2024)

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ABSTRACT

Introduction. Ingestion of a button battery constitutes an endoscopic emergency due to the risk of serious injury.

Objective. To describe the clinical, endoscopic, and clinical course characteristics of patients who swallowed a button battery and required upper gastrointestinal endoscopy in the pediatric emergency department of a tertiary care center between 2014 and 2024.

Population and methods. Observational, descriptive, and retrospective study. The study included patients younger than 15 years of age with a radiological diagnosis of button-cell battery ingestion who underwent upper gastrointestinal endoscopy.

Results. A total of 106 patients (63 males) were included. The median age was 24 months (IQR 15-48); 35.8% of the patients were initially evaluated at another institution. In 51% of cases, the time since ingestion was unknown. At the time of consultation, 39/106 patients (36.5%) were asymptomatic. Among those with symptoms (67/106), the most common symptom was hypersalivation, present in 36/106 patients (33.9% of the total). Hypersalivation was significantly associated with severe lesions (OR 8.115; 95%CI 2.913-24.3; p <0.01). Lesions located in the upper esophagus also showed a significant association (OR 2.461; 95%CI 1.077-5.775; p = 0.029).

Conclusion. Esophageal impaction was common and was associated with a high percentage of severe injuries. Hypersalivation was significantly associated with greater severity.

Keywords: *button battery; gastrointestinal endoscopy; foreign body migration; esophageal perforation; pediatrics.*

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INTRODUCTION

The ingestion of foreign bodies (FB) is a common reason for pediatric visits.[1] Among these, button batteries (BB) require special attention due to their potential to cause serious and even life-threatening injuries. In recent decades, there has been an increase in morbidity associated with their ingestion.[2]

Unlike other FB, button batteries can cause rapid and extensive damage through electrochemical mechanisms, including hydroxide formation at the negative pole, an increase in local pH, and tissue necrosis.[3] Lesions are more common when the battery becomes lodged in the esophagus, especially with larger batteries and in young children.[4,5] Proximity to vascular and respiratory structures increases the risk of serious complications, such as tracheoesophageal or aortoesophageal fistulas.[6]

If BB ingestion is suspected, anteroposterior and lateral X-rays can help locate the object.[4] Esophageal impaction is an endoscopic emergency that requires urgent removal.

The objective of this study is to describe the clinical, endoscopic, and clinical course characteristics of patients who swallowed a BB and required upper gastrointestinal endoscopy, as treated in the pediatric emergency department of a tertiary care center between 2014 and 2024.

POPULATION AND METHODS

An observational, descriptive, and retrospective study was conducted.

The study included patients under 15 years of age with a radiological diagnosis of BB ingestion who underwent upper gastrointestinal endoscopy at a pediatric gastrointestinal endoscopy unit in a tertiary care center in the province of Buenos Aires between January 2014 and January 2024. Patients who had ingested other foreign bodies and those with BB located distal to the gastric chamber who did not require endoscopy were excluded. It was recorded whether the patient had previously been seen at another institution.

An upper gastrointestinal endoscopy was performed using a Pentax endoscope with an outer diameter of 7.8 mm and 9 mm, under general anesthesia. In all cases, the parents signed the informed consent form for the endoscopic procedure and for the use of images for scientific and publication purposes.

The variables analyzed were sex (male and female), age (months), prior consultation at another institution (yes/no), time since last meal at the time of endoscopy (less than 6 hours, 6 hours or more, unknown),[7] location of the battery (upper, middle, or lower esophagus; stomach, and unlocalized), symptoms (asymptomatic, hypersalivation, vomiting, gastrointestinal bleeding, chest pain, cough, dyspnea)—in cases of multiple manifestations, the predominant symptom was recorded, although all were recorded in the original database to avoid variable overlap—, type of lesion (normal, mild: erosion and erythema; severe: ulcer, laceration, and necrosis).

The severity classification of endoscopic lesions was based on previously published criteria adapted for this study, in accordance with international guidelines for the management of PB ingestion.[3] It was also consistent with the Zargar classification used for esophageal lesions caused by caustic substances.

The type of lesion was operationalized as a dichotomous variable: no lesion/mild vs. severe lesion. The grouping of “no lesion” and “mild lesion” is based on clinical and prognostic criteria: mild lesions are typically limited to erythema or superficial erosions without transmural involvement, whereas severe lesions involve more extensive damage and carry a higher risk of structural complications.[3,6]

The treatment performed (endoscopic and/or surgical) and complications (perforation, tracheoesophageal fistula, and esophageal pseudodiverticulum) were also recorded.

Statistical analysis

Qualitative variables are summarized by their absolute and percentage frequencies. Quantitative variables were expressed as the median and interquartile range (IQR). To explore associations between categorical variables, the chi-square test or Fisher’s exact test was used, as appropriate, based on the expected frequencies in the cells. A p-value of <0.05 was considered statistically significant.

To analyze the association between age and injury severity, age was categorized into two groups: 24 months or younger and older than 24 months. This decision was based on evidence showing a higher incidence and risk of complications in young children, often between 1 and 3 years of age, as well as on the age distribution in our series (median 24 months). Furthermore, this categorization facilitates clinical and epidemiological comparisons with previous studies that identify the breastfeeding and toddler

stages as periods of greatest vulnerability.[8]

The association between injury severity and age, time of ingestion, symptoms, and location was evaluated using bivariate analysis.

To assess the association between injury severity and sialorrhea versus asymptomatic cases, the odds ratio (OR) and its 95% confidence interval (CI) were calculated, as was done for lesions in the upper esophagus versus other locations.

The analysis of associations between variables was considered exploratory, as the sample size did not permit definitive inferences or multivariate adjustments. The data were analyzed using IBM SPSS Statistics™ software.

Ethical considerations

The Research Ethics Committee of the Hospital Nacional Profesor Alejandro Posadas approved the protocol. Protocol registration number with the CEIHP: 755 LUPOSO/23. The study complies with the CIOMS Guidelines (2016) and Resolution 1480/11 of the National Ministry of Health.

This study complies with the ethical principles for medical research involving human subjects outlined in the World Medical Association's Declaration of Helsinki (2013 version) and the Guidelines for Good Clinical Practice (ANMAT Regulation 6677/10).

RESULTS

During the study period, 1649 cases of CE ingestion were recorded. Of these, 119 patients had ingested PB. The final sample analyzed consisted of 106 patients (*Figure 1*).

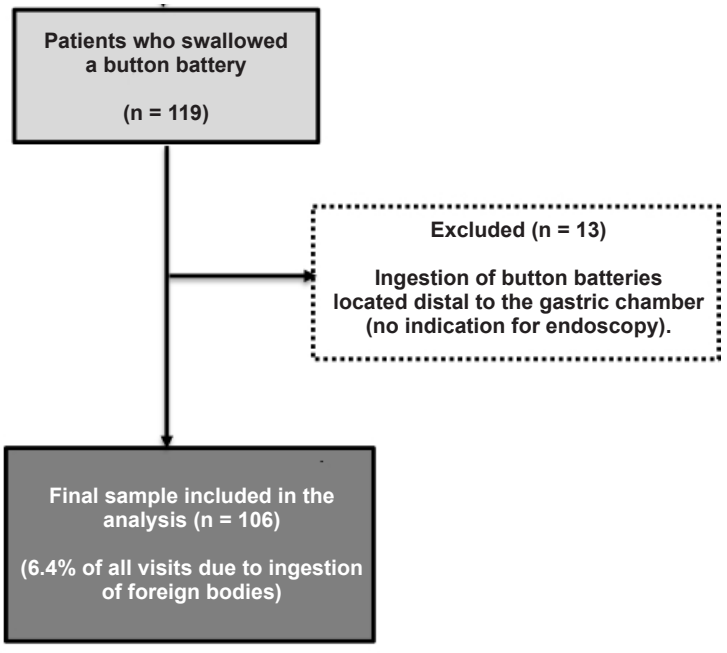
Of the total number of patients, 63 were male, and the median age was 24 months (IQR 15-48). A total of 35.8% (38/106) had previously been seen at another institution.

Regarding the time of ingestion, it was unknown in 51% of the cases.

Regarding endoscopic findings, endoscopy was normal in 35.8% (38) of patients, showed mild lesions in 15.1% (16), and severe lesions in 49.1% (52). Of the total number of patients with severe lesions, 38 had ulcerative lesions, 11 had necrosis, and 3 had lacerations. Two patients experienced complications: one had esophageal perforation with a tracheoesophageal fistula, and one developed an esophageal pseudodiverticulum. Eight patients required surgery to remove the PB. Patients with severe lesions required admission to the pediatric intensive care unit and medical treatment.

No differences in age were observed between patients with severe injuries and those with no injuries or mild injuries (p = 0.43) (*Table 1*).

Figure 1. Sample selection flowchart



When analyzing the factors associated with lesion severity (*Table 2*), no association was found with time since ingestion. In contrast, the presence of sialorrhea at the time of the consultation was significantly associated with severe lesions (OR 8.1; 95% CI 2.9-24.3; *p* <0.01). Likewise, a lesion located in the upper esophagus was associated with a higher probability of a severe injury (OR 2.46; 95% CI 1.07-5.77; *p* = 0.029).

DISCUSSION

The ingestion of button batteries is a growing problem in pediatrics worldwide. In our study, 6.4% of all FB ingestions involved BB, consistent with the frequency reported in the international literature (7-25%).[3,9] This variability can be attributed to differences in household habits, the availability of electronic devices, and epidemiological surveillance systems.

In sharp contrast to European and British series, in which gastric localization predominates,[10] our population showed a predominance of impaction in the upper esophagus. This finding reinforces its role as the primary site of risk for the development of serious injuries, consistent with Asian reports, which associate it with a higher risk of complications.[11,12] This difference could be explained by the size of the ingested batteries, the time elapsed until presentation, or anatomical characteristics specific to the pediatric age group. Furthermore, more than one-third of the patients had previously sought care at another institution, which may have contributed to delays in timely diagnosis and treatment.

The high proportion of severe injuries observed in our series is consistent with the findings reported by Kiefer *et al*.,[13] who noted that BB are responsible for most of the severe complications associated with CE ingestion. However, few major complications were recorded in our population, possibly due to the availability of urgent endoscopy at our center.

The proportion of severe injuries was higher among children aged 24 months or younger,

Table 1. Endoscopic findings by age group

	Endoscopic findings	
Age	**No lesions/mild lesions (n = 54)**	**Severe injuries (n = 52)**
≤24 months, n = 59 (58%)	28 (47.5%)	31 (52.5%)
>24 months, n = 47 (42%)	26 (55.3%)	21 (44.7%)

Percentages are expressed in every row.
p = 0.43 (chi-square.

Table 2. Association between clinical variables and severity of injuries

Variable	No lesion/mild lesion (n = 54)	Severe injury (n = 52)	*p*-value
Time since ingestion			
<6 hours	10 (18.5%)	16 (30.8%)	
≥6 hours	15 (27.8%)	13 (25.0%)	0.547
Unknown	29 (53.7%)	23 (44.2%)	
Symptoms			
Asymptomatic	28 (51.9%)	10 (19.2%)	
Sialorrhea	9 (16.7%)	27 (51.9%)	<0.01
Others*	17 (31.5%)	15 (28.8%)	
Location			
Upper esophagus	29 (53.7%)	39 (75.0%)	0.029
Other locations	25 (46.3%)	13 (25.0%)	

The values are expressed as absolute numbers and percentages by column.
The p-values correspond to the overall comparison between the categories of each variable and the severity of the injuries, using the chi-square test or Fisher's exact test, as appropriate.
**Includes vomiting, dysphagia, cough, stridor, dyspnea, and chest pain.*

although this finding was not statistically significant, possibly due to the limited sample size and statistical power. The higher frequency of severe injuries in young children has been attributed to age-specific anatomical and behavioral factors.[7] The "≤24 months" category used in our analysis was intended to represent this stage of greater vulnerability and to facilitate clinical comparisons with previous series and guidelines.

A clinically relevant aspect is diagnostic suspicion. In our series, more than one-third of the patients were asymptomatic at the time of consultation, which reinforces the need to maintain a high index of suspicion regarding the possibility of BB ingestion, especially in young children. These data support international reports confirming that the absence of symptoms does not rule out a substantial injury.[8] In this context, the presence of excessive salivation stood out as a warning sign, significantly associated with severe injuries, making it a useful clinical indicator for initial decision-making.

Regarding the time of ingestion, in more than 50% of cases, the exact time of the event could not be determined, consistent with reports in the literature.[7] Although the literature describes an approximate critical window of 2 hours for reducing the risk of severe injury, in our series, it was not possible to analyze this cutoff point due to the limited availability of precise data on the time of ingestion, which was affected by delays in presentation or referrals from other institutions. For this reason, the time of ingestion was categorized based on a 6-hour cutoff. Although no statistically significant association was found between the time of ingestion and injury severity, this result should be interpreted with caution, given the high proportion of unknown times.

From a therapeutic standpoint, our findings reinforce the need for urgent endoscopic intervention when esophageal impaction is suspected. The high proportion of severe lesions observed at this site is consistent with current recommendations, which indicate that immediate removal is a key measure for reducing the risk of complications.

In terms of prevention, although the reduction in mercury content in batteries following the Minamata Convention has decreased the systemic toxic risk,[14] the primary mechanism of harm remains electrochemical. It depends on contact time and battery voltage. In this context, various countries have implemented specific regulations, such as secure battery compartments and warning labels, which have helped reduce these incidents.

The existence of systematic registries, such as the National Battery Ingestion Hotline in the United States, has enabled improved epidemiological surveillance and optimized treatment strategies.[15] In our setting, the development of multicenter registries could help generate local evidence and strengthen prevention policies.

Our study represents the first case series on PB ingestion covering a 10-year period to be published in our country. Previous studies consist mainly of case reports or smaller-scale series.

These findings highlight the importance of having local data to guide diagnostic, therapeutic, and preventive strategies.

Among the main limitations of this study are its retrospective design and its reliance on a single center's experience. Furthermore, the fact that it is a tertiary care hospital may have introduced referral bias, resulting in a higher proportion of more complex cases. In more than half of patients, the lack of knowledge of the exact time of PB ingestion may have affected the analysis of the association between exposure time and injury severity, constituting one of the study's main limitations. Furthermore, the sample size may also have limited the statistical power to identify significant differences between subgroups. There is no systematic long-term follow-up available to assess possible late sequelae, which constitutes an additional limitation. However, the uniformity in institutional management and access to urgent endoscopy represents a methodological advantage.

CONCLUSION

In our series, ingestion of a button battery resulting in esophageal impaction was common and was associated with a high percentage of severe injuries. The presence of sialorrhea was identified as a clinical sign associated with greater severity, highlighting its value in the initial evaluation. These findings underscore the importance of early diagnostic suspicion and urgent endoscopic intervention and provide relevant local evidence to optimize clinical management and prevention strategies for this condition. ■

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