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Case Report

Button Battery Code: A Case Series of Button Battery Ingestion in Children at a Tertiary Referral Center and Proposed Management Protocol

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Summary

Background: Button battery ingestion is a pediatric emergency associated with significant morbidity and mortality. Rapid recognition and removal are critical to prevent severe esophageal and mediastinal complications.
Methods: We report a case series of five patients with a mean age of 22 months (SD= 11.4 months) with confirmed button battery ingestion who were managed at a tertiary referral center.
Results: Patients ranged from 13 to 41 months of age. Presentations varied from asymptomatic delayed presentation to acute respiratory distress. Endoscopic removal was required in all cases, with findings ranging from superficial mucosal erythema to severe grade 3 caustic necrosis. One child demonstrated features suggestive of an impending aortoesophageal fistula. Supportive care included parenteral nutrition, antibiotics, and proton pump inhibitors. Despite successful retrieval in most of the cases, long-term complications remain a concern.
Conclusion: Button battery ingestion in children is unpredictable both in presentation and in outcome. Delays in recognition and failed initial removal attempts are associated with higher grades of esophageal injury. Based on these findings, we propose the establishment of a "Button Battery Code" to standardize rapid response, expedite referral, and coordinate multidisciplinary management, similar to STEMI and stroke codes.

Keywords: Button Battery, Burns, Chemical, Child Preschool, Emergency Treatment, Endoscopy, Esophageal Injuries, Foreign Bodies.

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INTRODUCTION

Button battery ingestion is a rapidly increasing and highly morbid paediatric emergency, particularly when the battery becomes lodged in the oesophagus. Young children, especially those under five years of age, are at greater risk due to behavioural factors and anatomical vulnerability, with the majority of impactions occurring in the proximal oesophagus [1,2]. The oesophageal location is associated with the highest risk for severe injury and death, as the battery's direct contact with the mucosa leads to rapid generation of hydroxide ions at the negative pole, causing liquefactive necrosis and deep tissue injury within as little as two hours [1].

Clinical presentation is often nonspecific or asymptomatic, with vomiting and dysphagia being the most common symptoms when present. However, unwitnessed ingestions are frequent, resulting in delayed diagnosis and increased risk of complications [2,3]. The spectrum of injuries includes oesophageal perforation, mediastinitis, tracheoesophageal fistula, oesophageal stricture, vocal cord paralysis, and catastrophic vascular injuries such as aortoenteric fistula, with larger batteries (>20 mm) and longer impaction times being significant risk factors for adverse outcomes [2,4]. Prompt recognition and emergent endoscopic removal are essential to minimize tissue injury and prevent life-threatening sequelae following oesophageal button battery ingestion. Diagnosis relies on timely imaging with anteroposterior and lateral radiographs, in which the characteristic "double halo" and "step-off" signs help distinguish button batteries from coins [2]. Despite successful removal, delayed complications may still occur weeks to months later, necessitating structured post-removal surveillance [4]. Given the increasing incidence and severity of these injuries, heightened clinical vigilance, rapid intervention, and sustained efforts in prevention and caregiver education remain clinically meaningful [1].

CASE SELECTION

This case series examines paediatric patients with confirmed oesophageal button battery ingestion, managed at a tertiary institution during the study period and identified retrospectively through a review of medical records. Cases were selected based on delayed diagnosis or delayed definitive management, the focus of this study, to highlight the impact and necessity of a standardized rapid response code. No formal exclusion criteria were applied beyond incomplete records or alternative diagnoses. As a retrospective descriptive series, the intent was not to capture all button battery ingestions but to illustrate the clinical and system-level impact of delayed management.

CASE PRESENTATION

Case 1

A 17-month-old boy presented 22 hours post-ingestion. He was asymptomatic and vitally stable and was taken within 2 hours of arrival to the paediatric emergency department's endoscopy unit, which revealed esophagitis with circumferential ulcerations. CT angiography showed oesophageal laceration, raising concerns of impending aortoesophageal fistula, consistent with Zargar classification grade 2B. Despite counselling, the family opted for discharge against medical advice; proton pump inhibitor therapy was prescribed upon discharge.

Case 2

A 41-month-old girl with asthma presented 4 hours after ingestion and was moved to the endoscopy unit after 1.5 hours. Endoscopy identified that the battery was lodged in the upper oesophagus, and it was successfully removed. The mucosa was erythematous with multiple ulcers, consistent with Zargar grade 2A. The patient was admitted, managed with proton pump inhibitors, and discharged later in a stable condition.

Case 3

A 13-month-old boy presented to the hospital 4 hours after ingestion, which had been witnessed by his mother who inadvertently pushed the battery further during attempted removal. The child

developed cyanosis and drooling. Imaging confirmed a foreign body in the upper oesophagus; rigid esophagoscopy was performed 3 hours after the patient's arrival at the paediatric emergency department, with successful removal. Findings included localized mucosal impaction without perforation, consistent with Zargar grade 1-2A. The patient received steroids and proton pump inhibitors and was discharged after observation.

Case 4

A 26-month-old boy was transferred after a failed endoscopy at an outside hospital, which showed mucosal necrosis and adhesions. He was stable on arrival, and was transferred to the endoscopy unit 2.5 hours after arrival at the paediatric emergency department. A repeat endoscopy confirmed necrosis at the site of impaction (Zargar 3A), and the battery was retrieved. He was managed in the intensive care unit (ICU) with antibiotics and proton pump inhibitors and discharged after stabilization with multiple follow-ups for endoscopic dilatations.

Case 5

A 16-month-old girl was referred 9 hours after ingestion. She remained asymptomatic, but imaging revealed a battery embedded in the proximal oesophagus. She spent 3.5 hours in the paediatric emergency department before being taken to the endoscopy unit, where the foreign body was successfully removed after multiple failed endoscopic attempts. The mucosa showed grade 3 caustic necrosis and CT angiography demonstrated wall thickening; however, Zargar grade 3A injuries such as fistula or perforation were absent. She was managed with parenteral nutrition, antibiotics, and proton pump inhibitors, and was discharged in a stable condition with follow-up.

DISCUSSION

The duration of exposure following button battery ingestion plays a critical role in determining clinical outcomes; tissue damage can initiate rapidly and progress with extended exposure. Oesophageal impaction of a button battery can lead to observable mucosal injury within as few as 15 minutes; by 30 minutes necrosis may extend to the muscularis propria, and there have been documented cases of significant oesophageal stricture occurring as soon as two hours after ingestion [5,6]. As demonstrated in case 5, delayed management not only increases the risk of complications but also compromises the success of battery removal. This directly supports the aim of this study to highlight the clinical impact of delayed intervention in such cases. The risk of significant complications, including tracheoesophageal fistula, aorto-oesophageal fistula, and vascular injury, is heightened as the duration of impaction increases. Furthermore, prolonged exposure is strongly linked to adverse outcomes, including fatalities [3,6,7]. On the other end, while severe injury can occur within hours of oesophageal button battery impaction, the extent and pattern of tissue damage are influenced by multiple factors, including battery size and charge, orientation of the negative pole, degree of mucosal contact, and intermittent displacement. Thus, the absence of catastrophic perforation despite a prolonged ingestion-to-endoscopy interval does not exclude severe injury and is consistent with reported variability in clinical outcomes.

Published studies consistently highlight that oesophageal button battery impaction is a surgical emergency requiring prompt removal due to potential severe injury within hours. The average time to removal varies based on institutional protocols and specific clinical circumstances. In a multi-institutional retrospective study, the mean time from diagnosis to battery extraction from the aerodigestive tract was 2.5 hours (range, 0.4-72 hours) [5]. In a separate single-center study focusing on oesophageal battery impactions, the mean time to removal after ingestion was 1.7 hours [6]. Additionally, a systematic review on airway complications reported an average duration of 5.8 days for button battery impaction. However, this partic-

ular group of patients often presented late and experienced severe complications. The authors highlighted that this duration is excessively long and does not represent optimal medical practice [1].

Interventions to expedite removal have demonstrated significant reductions in time to treatment. Institutional procedures that streamline assessment and removal have shown reductions in the time to surgical intervention and in complication rates, including trauma activation. One study reported that the mean time from emergency department arrival to removal was reduced from 183 minutes (standard triage) to 33 minutes (trauma activation) [8]. Similarly, another study reported that the implementation of a critical airway response team shortened the time from chest x-ray to removal from 73 ± 32 minutes to 35 ± 11 minutes [9].

A CT scan is not typically required for every case of oesophageal button battery impaction. However, it is essential when there is a significant risk of severe injury, particularly in cases of delayed presentation (more than 12 hours) or when there is clinical suspicion of complications [8,9]. Moreover, the available medical literature supports prompt administration of honey or sucralfate as a temporizing intervention for oesophageal button battery ingestion. This approach is intended to mitigate the severity of injury while awaiting definitive endoscopic removal. Optimal outcomes are observed when these treatments are rendered within 12 hours of ingestion and in the absence of perforation [10-14].

It is in light of such results that we propose the Button Battery Code (Appendix 1) to standardize management across institutions, in a similar manner to Trauma, ST-Elevation Myocardial Infarction (STEMI), and Stroke codes. As demonstrated by this discussion, the duration between button battery ingestion and removal represents a critical, potentially modifiable determinant of injury severity and adverse outcomes. Immediate identification and escalation are imperative, as tissue injury can begin within minutes and the risk for life-threatening complications increases with each hour of continued exposure. The proposed <30-minute door-to-endoscopy target serves as an aspirational benchmark to highlight current system delays and guide rapid activation, analogous in structure to other emergency response codes. The effects of individual adjunctive therapies (steroids, proton pump inhibitors, antibiotics) were not analysed, as evaluating the relative contribution of these interventions was outside the scope of this study.

While implementation of the Code may be challenged by factors such as delayed recognition and limited endoscopic availability, the proposed protocol is intended to standardize early recognition and care escalation to reduce management delays. Its effect on patient outcomes requires prospective evaluation, which should focus on measurable outcomes including time to endoscopy, success of initial removal, complication rates, and need for care escalation. In addition, standardized data collection would enable more precise assessment of the roles of adjunctive therapies and communication strategies, as well as the identification of institutional barriers to timely interventions. Such work is essential to translate recognition of delayed management into measurable improvements in patient safety and outcomes.

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APPENDIX

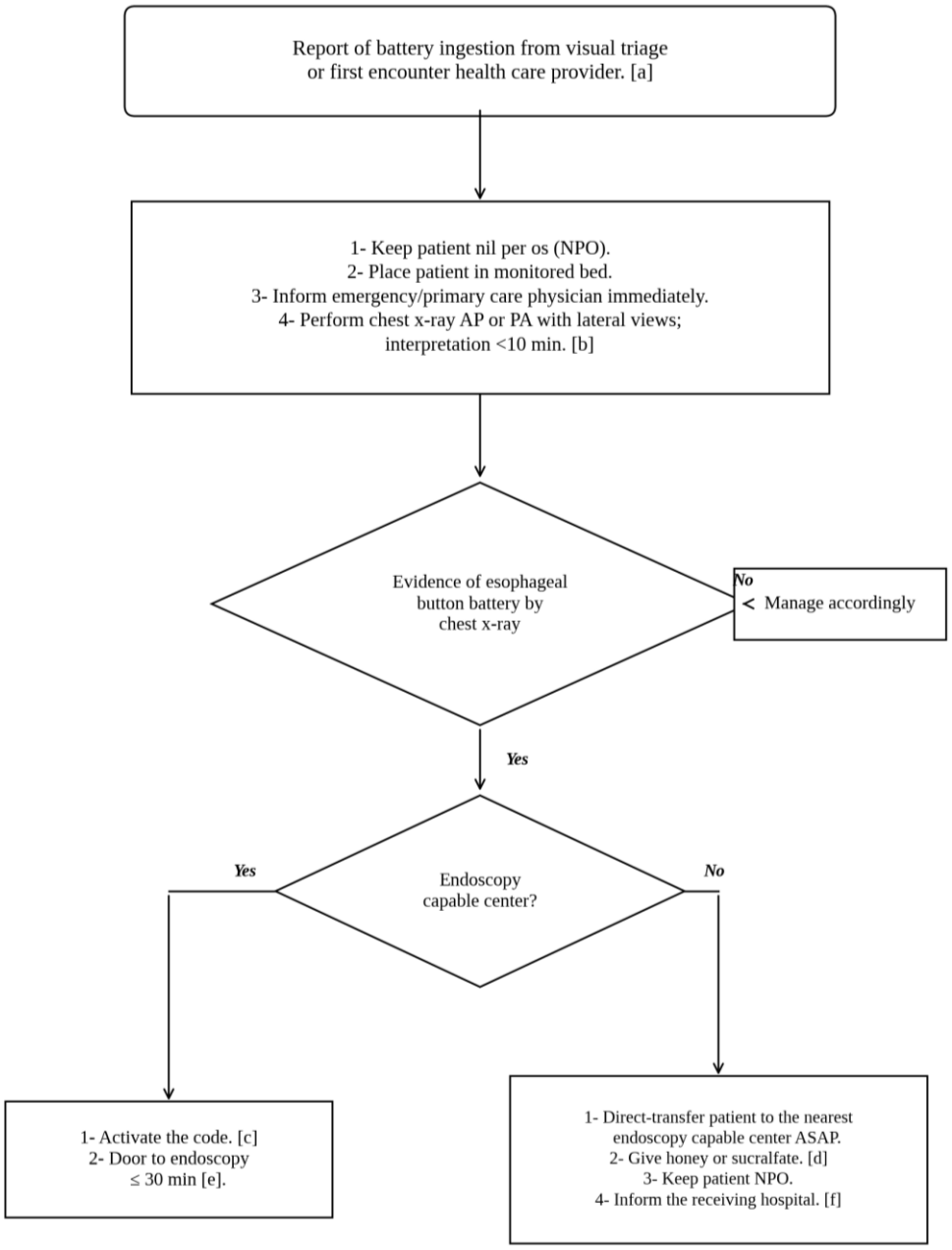

Figure 1. Flowchart for the activation and initial response to battery ingestion.

a. In the event that the first encounter is with the Emergency Medical Services dispatcher, it is preferred to transfer the patient directly to an endoscopy-capable center if possible.
b. In case of airway compromise, active bleeding, or instability, resuscitation takes priority until a chest x-ray is possible.
c. The code team includes: paediatric gastroenterologist, anaesthesiologist, and endoscopy unit nurses.
d. The available medical literature supports the prompt administration of Honey or Sucralfate as a temporizing intervention for oesophageal button battery ingestion. This approach is intended to mitigate injury severity

while awaiting definitive endoscopic removal. Optimal outcomes are observed when these treatments are rendered within 12 hours of ingestion and in the absence of perforation. The recommended dose for honey is 10 mL (approximately two teaspoons) every 10 minutes, up to 6 doses, for children older than 1 year (honey should not be used in children under 1 year due to risk of botulism), and for sucralfate (Carafate) the dose is 1 g (10 mL oral suspension) every 10 minutes, up to 3 doses [10-14].

e. A CT scan is not typically required for every case of oesophageal button battery impaction. However, it is essential when there is significant risk of severe injury, particularly in cases of delayed presentation (more than 12 hours) or when there is clinical suspicion of complications [15-16].

f. The receiving hospital should prepare to receive the patient by preparing the endoscopy unit and informing the responsible physicians.