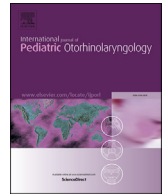




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Identifying predictive factors for long-term complications following button battery impactions: A case series and literature review[☆]



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ABSTRACT

Objectives: To complement a case series review of button battery impactions managed at our single military tertiary care center with a thorough literature review of laboratory research and clinical cases to develop a protocol to optimize patient care. Specifically, to identify predictive factors of long-term complications which can be used by the pediatric otolaryngologist to guide patient management after button battery impactions.

Methods: A retrospective review of the Department of Defense's electronic medical record systems was conducted to identify patients with button battery ingestions and then characterize their treatment course. A thorough literature review complemented the lessons learned to identify potentially predictive clinical measures for long-term complications.

Results: Eight patients were identified as being treated for button battery impaction in the aerodigestive tract with two sustaining long-term complications. The median age of the patients treated was 33 months old and the median estimated time of impaction in the aerodigestive tract prior to removal was 10.5 h. Time of impaction, anatomic direction of the battery's negative pole, and identifying specific battery parameters were identified as factors that may be employed to predict sequelae.

Conclusion: Based on case reviews, advancements in battery manufacturing, and laboratory research, there are distinct clinical factors that should be assessed at the time of initial therapy to guide follow-up management to minimize potential catastrophic sequelae of button battery ingestion.

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1. Introduction

Ingestion, aspiration, and impaction of small, coin-shaped, button batteries account for over 3300 exposures reported annually to the American Poison Control Centers and can result in clinically morbid and even fatal sequelae [1–8]. In 2013, incidence of button battery ingestions was estimated at 10.5 per million people with a fatality rate of 0.5% [1]. Invasive procedures are often required to remove ingested disc batteries from the aerodigestive tract or external auditory canal. Clinical presentation frequently involves mucosal damage to respiratory or digestive epithelium from direct pressure necrosis, electrolysis, caustic exposures, or possibly heavy metal toxicity. However, atypical and grave sequelae

from battery impactions have been described to include pneumonia, tympanic membrane perforation, vertebral osteomyelitis, vocal fold paralysis, trachea-esophageal, aorto-esophageal fistula, and death [2–8].

Long-term and morbid complications of disc battery impaction are being reported in the literature but guidance on measures to predict or even prevent these sequelae has been disparately presented. The objective of this manuscript is to complement an introspective assessment of cases managed at our single military tertiary care center with a thorough literature review of laboratory research and clinical cases to develop a protocol to optimize patient care. Specifically, predictive factors of long-term sequelae are identified which can be used to guide patient management.

2. Methods

After obtaining approval from the local Institutional Review Board, a retrospective review of the Department of Defense electronic medical record systems at a single military tertiary care

[☆] Research data derived from an approved Naval Medical Center, Portsmouth, VA IRB protocol.

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medical center was performed. Inpatient and outpatient records were queried using three International Code of Disease, Version 9 (ICD-9) codes thought to be most predictive of clinically relevant button battery impactions in the aerodigestive tract. The codes included were 935.1 (foreign body in esophagus), 934.9 (foreign body in respiratory tree), and 478.19 (nasal septum abnormalities) from a period of 01 January 2008 to 22 July 2015 occurring at our tertiary medical center responsible for 253,000 beneficiaries. Records were subsequently reviewed for evidence of button battery ingestion or impaction. Additionally the institution's pediatric otolaryngology and gastroenterology physicians were queried for recollection of cases of button battery impactions that occurred during this timeframe and could have been missed with record review.

2.1. Results

Eight cases of accidental button battery impaction were managed at our institution during the time period analyzed and are described (Table 1). The median age at time of injury was 33-months old. As shown, the presenting symptoms were variable and only two of the eight cases were witnessed ingestion/impactions. The long-term outcomes of these patients varied and multiple patients required repeated procedures for management of long-term complications following the initial ingestion. Two cases with unique, long-term complications are reviewed here with a focus on factors that may have been used to predict their sequelae. The other six patients required physician intervention for direct or endoscopic visualization and subsequent removal of the disc battery from the aerodigestive tract or external auditory canal. Their initial presenting symptoms are described in Table 1, but following removal and recovery from minor epithelial injuries they suffered no significant long-term complications.

2.2. Case 1

A two year old male presented to the emergency room (ER) with two hours of excessive drooling and intolerance of anything by mouth. A chest radiograph revealed the classic “double ring sign” concerning for a button battery (Fig. 1) and a 3-V lithium button battery (CR 2032) was ultimately removed using rigid esophagoscopy in the operating room. Superficial charred mucosal and muscular injury at the level of the cricopharyngeus muscle was noted at time of removal with low concern for esophageal perforation. At the time of battery removal neither the imaging nor intra-operative views evaluated the orientation of the battery to see where the narrow end, or negative pole, of the battery was facing.

Six-weeks after removal he presented to the otolaryngology clinic with new onset hoarseness and productive cough concerning for aspiration since the battery ingestion. Office flexible fiberoptic laryngoscopy revealed left true vocal fold immobility and a swallow study demonstrated aspiration of thin and thick liquids. He has

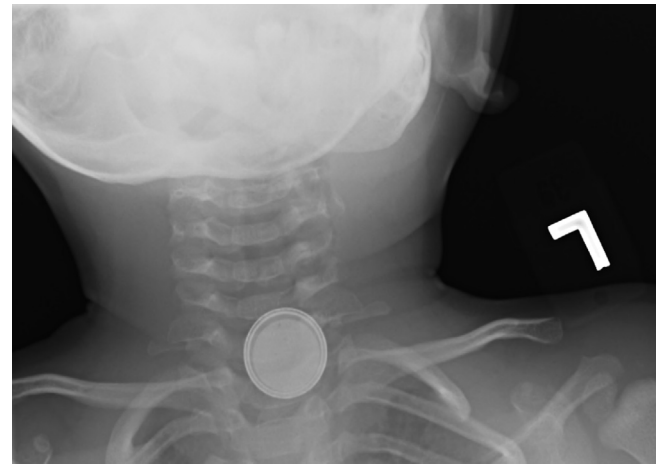


Fig. 1. Chest radiograph in AP view showing double ring or halo concerning for impacted disc battery in the proximal esophagus.

subsequently required multiple injection medialization procedures for prevention of aspiration. The patient continues to be observed periodically without full return of vocal fold function presumably the result of direct injury caused by the proximity of the battery's negative pole to his left recurrent laryngeal nerve. He also underwent multiple esophageal dilations to manage subsequent proximal esophageal stricture formation. He continues to struggle with oral aversion secondary to his history of aspiration, although he now has return of normal esophageal caliber. He has been admitted for inpatient intensive feeding therapy in the past and currently requires outpatient occupational therapy.

2.3. Case 2

A two year old female presented to the ER with a 48-h history of mild intermittent epistaxis and purulent drainage from her left nasal passage along with left-sided facial swelling. No aspiration or placement of a foreign body was witnessed. X-rays obtained in the ER revealed two concentric radiopaque circles (double ring) on lateral view and a “step-off” on anterior-posterior (AP) view (Figs. 2 and 3). ENT was then consulted for airway foreign body removal. Anterior rhinoscopy revealed extensive sloughing of soft tissue and necrotic drainage from the left nasal passage with a button battery abutting the nasal septum. On rigid nasal endoscopy a three centimeter area of necrotic tissue destruction was present on the left along with near complete erosion of the inferior turbinate after removal of the battery (Fig. 4). Cartilaginous exposure of the nasal septum with contralateral mucosal necrosis was also noted on exam. Nasal stenting was considered but not required to maintain a patent nasal airway. Over the next week her facial edema and epistaxis resolved, but a small perforation persisted in her anterior

Table 1

Patient results summary.

Age (Months)	Gender	Presenting symptom	Location of impaction	Estimated time of impaction
19	M	Decreased oral intake, Reflux Symptoms	Esophagus	3 months
38	M	Acute abdominal pain, Vomiting	Esophagus	12 h
49	F	Witnessed ingestion, chest pain	Esophagus	5 h
27	F	Witnessed ingestion	Esophagus	9 h
38	F	Sore throat, chest pain	Esophagus	6 h
26	M	Decreased oral intake, drooling, cough	Esophagus	6 h
28	F	Epistaxis, Facial swelling	Left nasal passage	48 h
121	M	Otalgia, Muffled Hearing	External Auditory Canal	3 days

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