

## Button Battery Ingestion in Children: Experience in Kurdistan Center for Gastroenterology and Hepatology

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### Abstract

**Background:** The vast majority of button battery (BB) ingestions occur when curious children explore their environment. Button batteries do not usually cause problems unless they become lodged in the gastrointestinal tract.

**Objective:** To report our experience of button battery ingestion in children focusing on clinical characteristics, management, and outcomes.

**Patients and methods:** Between January 2006 to June 2015 all cases of BB ingestion presented to the Kurdistan center for Gastroenterology and Hepatology (KCGH), Sulaimani, Iraq, were reviewed retrospectively. The diagnosis based on history, clinical examination and results of imaging studies. The clinical data reviewed included gender, age, clinical manifestation, hospital course, imaging findings and endoscopic findings.

**Results:** Twenty children with button battery ingestion referred to KCGH; 12 male and 8 female patients with age range of 10 months to 70 months and the mean age of 28 months. Seven patients passed the batteries spontaneously in the stool without harm within 2-5 days. In 13 patient batteries were retrieved endoscopically from the esophagus in 7 patients and from the stomach in 6 patients. The endoscopic findings in the 7 patients in whom the button batteries were in the esophagus were; severe injury in 5 patients, mild injury in 2 patients; there was perforation of the esophagus in 4 patients associated with Tracheoesophageal Fistula in three patients.

**Conclusion:** Severe injury can occur rapidly following BB ingestion particularly when they are lodged in the esophagus. A high index of suspicion for a BB is necessary to avoid life-threatening sequel. Emergency endoscopic retrieval is required in these situations.

**Keywords:** Button battery; Children; Fistula; Esophagus; Kurdistan

### Introduction

Button batteries (BB) are small coin shaped batteries used to power small portable electronic devices such as wrist watches, pocket calculators, artificial cardiac pacemakers, implantable cardiac defibrillators, hearing aids and children toys. BB is an increasingly common foreign body ingested by children [1]. The vast majority of BB ingestions occur when curious children explore their environment [2]. In a series of 56,535 battery ingestions from 1985-2009 in which the type of battery was known in 57.7% of the cases, 42% were manganese dioxide, 32% were zinc-air, 13% were silver oxide, and 9% were lithium. In 2008, 24% of the batteries ingested were lithium cells; an upward trend that started in the late 1990s with a corresponding drop in the number of mercuric oxide cells [3].

Button batteries do not usually cause problems unless they become lodged in the GI tract. The most common place for BB to become lodged in, and resulting in serious clinical sequels, is the esophagus [4]. Batteries that successfully traverse the esophagus are unlikely to lodge at any other location. The mechanism of injury in these patients is liquefaction necrosis of the mucosa that occur because sodium hydroxide is generated by the electrical current produced by the battery usually at the anode surface [5,6]. Esophageal damage can occur in a relatively short period of time (2-2.5 h); perforation has occurred as rapidly as 6 hours after ingestion [7]. If a battery becomes impacted in the esophagus, it may penetrate the esophageal wall and cause a tracheo-esophageal fistula and even fistulization into major vessels with massive haemorrhage [8] Injury can continue after endoscopic battery removal for days to weeks due to residual alkali or weakened tissues [9].

Usually the child is brought to medical care when battery

ingestion is witnessed or highly suspected. However, in symptomatic patient, without history of battery ingestion, battery ingestion should be considered if there is airway obstruction or wheezing, drooling, vomiting, retrosternal discomfort, difficulty swallowing, decreased appetite, refusal to eat, coughing, choking or gagging with eating or drinking [10]. Most children who ingest a BB remain asymptomatic and pass the battery in their stool within 2-7 days. Only 10% of patients who ingest BB report symptoms. Standard radiologic workup for suspected battery ingestion is the chest X- ray film, in both poster-anterior and lateral views, double rim sign and/or step sign were found in most of the cases but still absence of these signs were considered as not significance because all round foreign bodies considered as button batteries for us until prove otherwise. In case more than several hours have passed since ingestion, it is recommended to perform a radiographic contrast study to rule out perforation [4]. Emergency esophagoscopy is mandated when BB is identified on chest radiography [10]. When substantial esophageal erosion is detected, bronchoscopy may be performed to evaluate the tracheal wall, and a Gastrografin esophagogram will assist in evaluating for a perforation [11]. In the presence of a contained

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perforation, conservative measures such as total parenteral nutrition, nasogastric tube placement under fluoroscopy, anti-reflux medication, and intravenous antibiotics should be considered. Conservative management can be continued if radiologic evaluation suggests that the perforation is getting smaller [12]. If the perforation persists after several weeks or enlarges or the patient deteriorates, surgical treatment should be considered [13].

The aim of this study was to report our experience of button battery ingestion in children focusing on clinical characteristics, management, and outcomes.

## Patients and Methods

We reviewed retrospectively records of cases of button battery ingestion in children managed, during the period from January 2006 to June 2015, by the authors in the Kurdistan center for Gastroenterology and Hepatology (KCGH), Sulaimani, Iraq. The KCGH is the main tertiary center in Kurdistan serving about 4,000,000 populations; with average annual 1000 pediatric patients. The diagnosis of BB ingestion was based on history, clinical symptoms, and results of imaging studies. The clinical data reviewed included gender, age, clinical manifestation, hospital course, imaging findings, and endoscope results. A fully informed written consent was obtained from the parents of all the patients. The button batteries lodged in the esophagus were emergently retrieved by Olympus Q GIF videoscope under general anesthesia with airway protection.

## Results

During the study period there were twenty children with BB ingestion referred to KCGH. There were 12 male and 8 female patients with age range of 10 months to 60 months and a median age of 28 months. Fifteen patients were witnessed when ingested the BB, they presented within 4-24 hours to KCGH (mean  $8.15 \pm 6.5$  hours). Five patients had no history of battery ingestion, presented with dysphagia and cough of 5-7 days duration. All patients had plain radiographic evaluation showing the neck, chest and abdomen in posterior-anterior and lateral views. In seven patients the BB was in the abdomen away from the stomach, they passed the batteries spontaneously in the stool without harm within 2-5 days. In 13 patient batteries were retrieved endoscopically from the esophagus in 7 patients, (Figure 1), and from the stomach in 6 patients. The size of the button batteries ranged from 10 mm to 23 mm, Mean size was  $14.2 \pm 2.4$  mm. Although the standard Zargar's grading classification of mucosal injury is not well documented in the literature for BB ingestion mucosal assessment still we used for assessing the degree of mucosal injury at the site of impaction. The endoscopic findings in the 6 patients in whom the BB were in the stomach were minor erosions. The endoscopic findings in the 7 patients in whom the button batteries were in the esophagus were; Grade 2b in 5 patients, Grade 1 in 2 patients. The site where they were lodged was the upper esophagus in 1 patient, mid-esophagus in 4 patients and lower esophagus in 2 patients. Fluoroscopic examination by radio-opaque water soluble contrast was done to all these seven patients in the post-endoscopy procedure immediately; it was normal in 3 patients (2 with mild injury and 1 with severe injury that developed esophageal stricture later); however, there was perforation of the esophagus in 4 patients associated with TEF in three of them, (Figure 2). Two patients underwent surgery for esophageal perforation and TEF repair at 24 hours after removal of the BB. The standard right posterior-lateral thoracotomy used for both cases, the fistulas were found at the junction of upper third and middle third of the esophagus. In both cases disconnection of the TE fistula done, repair of the trachea

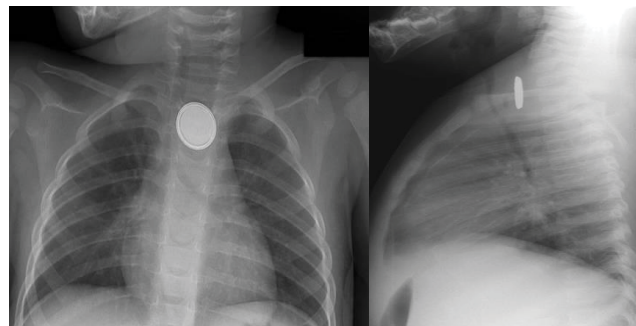


Figure 1: Plain radiograph showing the button battery (with double rim sign) lodged in the esophagus in both posteroanterior and lateral views.



Figure 2: Fluoroscopic contrast study during endoscopy showing tracheoesophageal fistula.

done by non-absorbable polypropylene and the esophagus repaired by interrupted stiches absorbable Polyglactan 910 and buttressed by pedicle intercostal flap. One patient with esophageal perforation was treated conservatively successfully and one patient with esophageal perforation and TEF died as the family refused surgery. Two patients developed esophageal stricture required repeated endoscopic dilation of the esophagus. Length of the hospital stay ranged from 1 day to 29 days (mean  $3.92 \pm 6.8$ ) (Table 1).

## Discussion

Although BBs have been used for almost 30 years, initial experience with gastrointestinal ingestion of these batteries was fairly benign. Although there had been concern that degradation of the integrity of the battery itself may lead to caustic injury or increased levels of mercury, compiled data on battery ingestions published by the National Capital Poison Center in 1992 of 2300 BB ingestions during a 7-year period found no deaths and only a 0.1% prevalence of major effect (defined as life-threatening or disabling; in this series, there were 2 patients with esophageal stricture) [4]. During the ensuing 18 years, however, that clinical experience changed dramatically with a follow-up paper from the National Capital Poison Center in 2010 [3]. In this cohort of 8600 BB ingestions, there was a major effect in 73 patients (0.8%), with death in 13 patients (0.15%). There have been additional reported deaths

| Age in months | Sex | Battery Size in mm | Presenting symptoms | Location        | Endoscopic finding | Fluoroscopic Finding | Treatment       | Hospital stay duration in days | Out come  |
|---------------|-----|--------------------|---------------------|-----------------|--------------------|----------------------|-----------------|--------------------------------|-----------|
| 10            | ♀   | 10                 | Dysphagia           | Upper esophagus | Sever injury       | Normal               | Conservative    | 5                              | Stricture |
| 12            | ♂   | 20                 | Dysphagia           | Mid esophagus   | Severe Injury      | Perforation an TEF   | Surgery         | 14                             | Normal    |
| 16            | ♀   | 12                 | Witness             | Stomach         | Severe injury      | Perforation          | Conservative    | 14                             | Stricture |
| 17            | ♂   | 10                 | Witness             | Lower esophagus | Mild injury        | Normal               | Conservative    | 1                              | Normal    |
| 18            | ♂   | 12                 | Witness             | Lower esophagus | Mild injury        | Normal               | Conservative    | 1                              | Normal    |
| 20            | ♂   | 20                 | Dysphagia           | Mid esophagus   | Severe injury      | Perforation an TEF   | Surgery refused | 1                              | Death     |
| 24            | ♂   | 10                 | Witness             | Stomach         | Normal             | N/A                  | Conservative    | 1                              | Normal    |
| 24            | ♀   | 10                 | Witness             | Stomach         | Normal             | N/A                  | Conservative    | 1                              | Normal    |
| 36            | ♀   | 10                 | Witness             | Stomach         | Normal             | N/A                  | Conservative    | 1                              | Normal    |
| 42            | ♂   | 10                 | Witness             | Stomach         | Normal             | N/A                  | Conservative    | 1                              | Normal    |
| 45            | ♀   | 23                 | Cough               | Mid esophagus   | Severe injury      | Perforation an TEF   | Surgery         | 29                             | Normal    |
| 48            | ♂   | 10                 | Witness             | Stomach         | Normal             | N/A                  | Conservative    | 1                              | Normal    |
| 60            | ♀   | 10                 | Witness             | Stomach         | Normal             | N/A                  | Conservative    | 1                              | Normal    |

**Table 1:** Summary of patient's data undergone endoscopic retrieval of disc batteries.

since this publication [14,15]. Although the incidence of BB ingestions had not changed significantly during the course of the 2 studies; the relative risk of major effect had increased almost 7-fold. As these two studies revised treatment guidelines they promote expedited removal of BB from the esophagus, increase vigilance for delayed complications, and identify patients who require urgent radiographs [10].

All of our patients were less than 6 years old and most patients were between 1 and 2 years old and male gender was predominant (60%), the age and gender distribution of our patients was similar to earlier reports [16]. Children with history of BB ingestion presented earlier and had less complications, as compared to those without history of BB ingestion; Litovitz et al., reported that clinicians missed the diagnosis of a battery lodged in the esophagus in at least 27% of major outcome and 54% of fatal cases because of nonspecific presentations, especially in un-witnessed ingestions [10].

Most cases of BB ingestion run uneventful course, however esophageal BBs have emerged as the most critical indication for emergency endoscopy in children [4]. The mechanism of injury in these patients is related primarily to the generation of hydroxide radicals in the mucosa, resulting in a caustic injury from high pH, instead of an electrical-thermal injury. Animal data have documented a rise in pH from 7 to 13 at the negative pole of implanted BBs within 30 minutes of ingestion. These animal models document that necrosis within the esophageal lamina propria may begin as soon as 15 minutes from the time of ingestion, with extension to the outer muscular layer within 30 minutes [6]. This corresponds with anecdotal reports of significant esophageal stricture within 2 hours of ingestion. As such, continued injury may occur days to weeks even after removal of the battery, with death from aortoenteric fistulas reported up to 19 days later [14]. Not surprisingly, new batteries confer a 3-fold greater risk of injury compared with spent batteries [10]. We retrieved BB from the esophagus in 7 cases, 5 of them had major events, 1 perforation, 1 stricture, 3 perforations and TEF including one death. Two of the patients with perforation and TEF required surgical repair. Management of a contained esophageal perforation requires a multidisciplinary approach involving at least pediatric surgery and thoracic and vascular surgery. In the presence of a contained perforation, conservative

measures such as total parenteral nutrition, nasogastric tube placement under fluoroscopy, anti-reflux medication, and intravenous antibiotics should be considered. Conservative management can be continued if radiographic evaluation suggests that the perforation is getting smaller [12]. If the perforation persists after several weeks or enlarges, surgical treatment should be considered [17,18].

Endoscopic intervention for gastric BB remains controversial. Data from a large cohort in the national registry are reassuring, with no reported significant gastric injuries from BB ingestions [3]. The potential danger, however, is evident through a report of an infant with severe gastric injury [19] and another report of BB impacted in a Meckel's diverticulum causing perforation [20]. In addition, one of the fatalities reported from aorto-esophageal fistula presented with a gastric BB that had apparently caused esophageal injury before reaching the stomach [14]. This suggests that passage of a BB to the stomach alone cannot be used as a criterion that the child is free from potentially catastrophic underlying injury. Factors supporting observation alone, without endoscopic removal of gastric batteries, are confirmed short duration of ingestion (2 hours), size of the battery 20 mm, absence of clinical symptoms, and a child 5 years of age or older. Consistent with American Society for Gastrointestinal Endoscopy guidelines, larger batteries (>20 mm) in the stomach should be checked by radiograph and removed if in place after >48 hours [21].

In conclusion, severe injury can occur rapidly following BB ingestion. A high index of suspicion for a BB is necessary to avoid life-threatening sequel. Emergency endoscopic retrieval is required in these situations.

Public campaign should be encouraged to highlight more the serious effects of battery ingestion and to promote better battery isolation system by the manufacturers.

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