

# Esophageal button battery ingestion in children

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## ABSTRACT

**BACKGROUND:** Button battery lodged in the esophagus carries a high risk of morbidity and mortality. The purpose of this study was to present cases of patients with esophageal button battery ingestion treated at our clinic and to emphasize the importance of early diagnosis and treatment.

**METHODS:** Records of patients admitted to our hospital for foreign body ingestion between January 2010 and May 2015 were retrospectively reviewed. Cases with button battery lodged in the esophagus were included in the study. Patient data regarding age, sex, length of time after ingestion until admission, presenting clinical symptoms, type and localization of the battery, management, and prognosis were analyzed.

**RESULTS:** Among 1891 foreign body ingestions, 71 were localized in the esophagus, and 8 of those (11.2%) were cases of button battery ingestion. Mean age was 1.7 years. Admission was within 6 hours of ingestion in 5 cases, after 24 hours had elapsed in 2, and 1 month after ingestion in 1 case. All patients but 1 knew the history of ingestion. Prompt endoscopic removal was performed for all patients. Three patients developed esophageal stricture, which responded to dilatation.

**CONCLUSION:** Early recognition and timely endoscopic removal is mandatory in esophageal button battery ingestion. It should be suspected in the differential diagnosis of patients with persistent respiratory and gastrointestinal symptoms.

**Keywords:** Button battery ingestion; children; esophagus.

## INTRODUCTION

Ingestion of button battery is a serious problem in childhood due to the widespread use of these batteries. Button batteries are the second most frequently ingested foreign body after coins.<sup>[1]</sup> Esophageal button battery necessitates urgent removal, as they can cause major corrosive injury within hours of ingestion.<sup>[2]</sup>

Batteries have a negative and a positive terminal.<sup>[3]</sup> The negative terminal of the battery is made of zinc or lithium and the positive terminal is made of lithium, manganese, manganese dioxide, oxygen, silver oxide, or mercuric oxide.<sup>[4,5]</sup> When a button battery becomes lodged in the esophagus, the mucosa bridges the positive and negative ends, thus completing

a circuit and allowing current to flow, which results in the generation of hydroxide radicals. Lithium batteries provide a higher voltage and have a longer charge than other batteries.<sup>[6]</sup> Therefore, they are more commonly used in many households. Major complications, such as perforation, mucosal burn, or fistula, are encountered more often after ingestion of lithium batteries.<sup>[4]</sup>

The aim of this study was to present cases of patients with esophageal button battery ingestion who were treated at our institution and to emphasize the importance of early diagnosis and treatment.

## MATERIALS AND METHODS

Records of patients who were admitted to our hospital for foreign body ingestion between January 2010 and May 2015 were retrospectively reviewed. Patients with esophageal button battery ingestion were included in the study. Data regarding age, sex, length of time since ingestion until admission, presenting clinical signs and symptoms, type, size, and localization of the battery, management, and follow-up findings were analyzed.

## RESULTS

A total of 1891 patients were admitted to our hospital for in-

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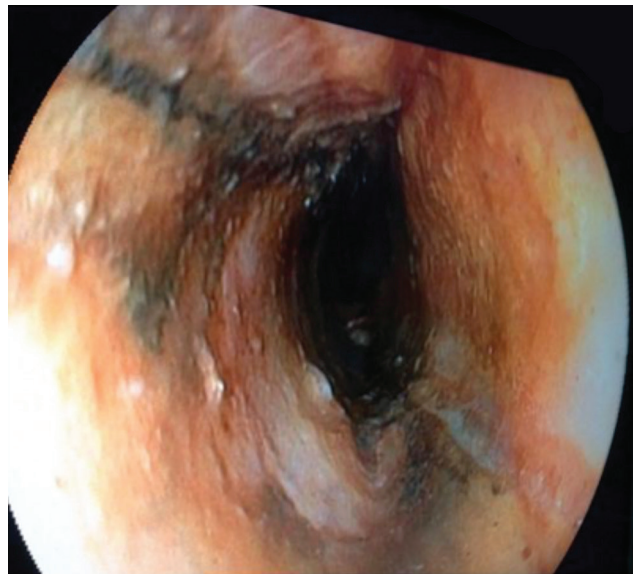
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gested foreign body in the gastrointestinal system during the study period. Among those, 71 patients had foreign body localized in the esophagus. In 8 of the 71 patients (11.2%), button battery was lodged in the esophagus. Six patients were female (75%), 2 patients were male (25%). Mean age of the patients was 1.7 years (range: 6 months-3 years). Time of admission was within 6 hours after ingestion of button battery in 5 patients, 24 hours or more in 2 patients, and 1 month in 1 patient. The presenting clinical symptoms were dysphagia, coughing, vomiting, hypersalivation, fever, poor appetite, and recurrent pulmonary infection. All of the patients knew the history of battery ingestion, with exception of the patient who was admitted 1 month after ingestion. When the history of that child was questioned more in detail, it was learned that he had been playing with the television remote control device with his 6-year-old sister about a month prior. The patient then had persistent upper respiratory symptoms and a poor appetite for a month. He had been treated by another clinician, but without any X-ray imaging, and there had been no response to treatment. The patient was referred to our institution for further treatment.

Chest X-ray image revealed battery lodged in the first physiological narrowing, which is the upper esophageal sphincter, in 4 patients, and in the second physiological narrowing at the level of the aortic arch in the other 4 patients (Fig. 1). Emergent endoscopy was performed under general anesthesia for every patient. The batteries were removed with rigid esophagoscopy and foreign body forceps in 5 patients. Flexible esophagoscope and basket forceps were used for the removal of the battery in 2 patients. The battery was covered by granulation tissue in the patient who was admitted 1 month after ingestion, and both rigid and flexible esophago-



**Figure 1.** Button battery observed in the first narrowing of the esophagus.



**Figure 2.** Grade 3a mucosal injury.

scopes were ultimately used in very difficult removal of the battery. According to Zargar classification<sup>[7]</sup> used to evaluate mucosal injury, 2 patients in the study had grade 3a and 4 patients had grade 3b mucosal injury, whereas there was no injury (grade 0) in the other 2 (Fig. 2). The 2 patients with grade 0 injury score were admitted within 6 hours after ingestion. One of the patients with grade 3a injury was also admitted within 6 hours, and the remaining patient in that category was admitted 24 hours after ingestion. Of the 4 patients with grade 3b injury, 2 were admitted within 6 hours, 1 after 24 hours had passed, and the other was the patient admitted 1 month after ingestion of the battery. One patient with grade 3a and 1 patient with grade 3b mucosal injury developed esophageal stricture 1 month after ingestion, which responded to 1 dilatation procedure. The patient admitted 1 month after ingestion, and who had grade 3b mucosal injury, also developed esophageal stricture 3 weeks after ingestion. Dilatation was performed total of 8 times with intervals of 3 weeks. All patients continued follow-up with no symptoms. Patient characteristics are summarized in Table 1.

## DISCUSSION

Foreign body ingestion is a common problem in the pediatric age group. The majority of cases, 75%, occur before 4 years of age.<sup>[8]</sup> Button battery ingestion makes up less than 2% of all foreign bodies ingested.<sup>[9]</sup> The incidence of button battery ingestion is about 10 cases per million people each year.<sup>[10]</sup> This low incidence has increased, however, with the widespread use of button batteries in the household.<sup>[11-13]</sup> Button batteries range in size from 6 to 25 mm in diameter. Batteries larger than 12 mm are more likely to become lodged in the esophagus of young children. All of the batteries presented in this study were 20 mm in diameter.

Button batteries lodged in the gastrointestinal tract mucosa

**Table 1.** Patient characteristics

Age	Sex	Admission time	Symptom	Localization	Management	Mucosal injury	Follow-up
1 year	Female	6 hours	Dysphagia+ hypersalivation	First narrowing	Rigid esophagoscope	Grade 3b	Dilatationx1
1 year	Male	6 hours	Hypersalivation	Second narrowing	Flexible esophagoscope	Grade 3a	Normal
3 years	Female	6 hours	Coughing+fever	Second narrowing	Rigid esophagoscope	Grade 3b	Normal
3 years	Female	6 hours	Dysphagia	Second narrowing	Flexible esophagoscope	Grade 0	Normal
6 months	Male	6 hours	Dysphagia+vomiting	First narrowing	Rigid esophagoscope	Grade 0	Normal
1 year	Female	24 hours		First narrowing	Rigid esophagoscope	Grade 3a	Normal
3 years	Male	24 hours	Dysphagia+coughing	Second narrowing	Rigid esophagoscope	Grade 3b	Dilatationx1
1 year	Male	1 month	Coughing+ poor appetite+ recurrent lung infection	First narrowing	Rigid + flexible esophagoscope	Grade 3b	Dilatationx8

can cause mucosal ulceration, corrosive injury, and perforation, if the duration of impaction is long enough. The esophagus is the most uppermost part of the gastrointestinal tract. The severity of esophageal damage depends on the size and the electrical charge of the battery and the length of time that the battery is lodged in the esophagus.<sup>[14-16]</sup> Damage to the esophageal mucosa starts within 2 hours after ingestion of a battery.<sup>[5,17,18]</sup> As the duration of exposure increases, the mucosa becomes edematous, and the battery can fuse to the mucosa, leading to ulceration and perforation.<sup>[16-19]</sup> Denney et al. reported that foreign bodies localized in the same site for more than 24 hours were more likely to cause mucosal ulceration compared with those that remained less than 24 hours (46% vs 23%).<sup>[20]</sup> In the present study, both of the patients with normal endoscopic findings were among those who were admitted within 6 hours. However, severe injury may occur even in cases with early diagnosis.<sup>[21]</sup> In this study, 1 of the patients who was admitted within 6 hours after ingestion had grade 3a injury, and 2 other patients also admitted within 6 hours had grade 3b mucosal injury.

Button batteries can cause mucosal injury in the esophagus through several mechanisms. These include electrical discharge, leakage of battery contents, and pressure necrosis.<sup>[4,5,11]</sup> The charge state of the button battery is an important factor in the development of mucosal injury. However, even discharged batteries have the potential to cause tissue damage, as they have enough voltage to generate external electrolytic current.<sup>[22]</sup>

The seal of the battery dissolves in the acidic environment of the esophagus. This leads to the leakage of alkaline solutions (sodium or potassium hydroxide) from the battery.<sup>[17,23,24]</sup> In an *in vitro* study, it was demonstrated that the amount of erosion was directly correlated with the charge of the battery.<sup>[24]</sup> When these alkaline solutions react with the protein in the mucosal surface of the esophagus, it leads to lique-

faction necrosis, which is the main characteristic of caustic esophageal injury in children.<sup>[25]</sup>

Another potential mechanism of injury following button battery ingestion is the absorption of heavy metals, such as lithium or mercury, which are released from the fragmented battery. However, mercury or lithium toxicity after battery ingestion is very rare.<sup>[9]</sup>

If the lodged battery remains in the same site within the esophagus for a long time, it can cause inflammation and ischemia due to pressure necrosis.<sup>[2,11,25]</sup> Therefore, prompt removal is important to prevent damage.

Many patients may be largely asymptomatic, but may present with symptoms of cough, vomiting, fever, chest pain, diarrhea, epigastric, or abdominal pain after ingestion of button battery.<sup>[3,5,9,26]</sup> If there is esophageal perforation or tracheo-esophageal fistula, symptoms may include refusal of oral intake, drooling, hematemesis, and respiratory distress.<sup>[21]</sup> All of the patients in this study presented with some of the mentioned symptoms. Presence of recurrent lung infection or coughing despite medical therapy should raise the suspicion of esophageal foreign body, even if there is no history of ingestion. Anteroposterior chest X-ray demonstrates button battery with a halo sign and step-off sign on lateral X-ray. The double-ring shadow helps to differentiate battery from coin ingestion. No chest X-ray had been obtained for the patient in this study who was admitted 1 month after ingestion of button battery. If the clinician had raised the suspicion of battery ingestion, since the patient had not responded to medical therapy and continued to have respiratory symptoms, the patient would not have developed such severe esophageal mucosal injury and his symptoms would not have persisted for so long.

Button battery impacted in the esophagus requires emergent endoscopic removal under general anesthesia with endotra-

cheal intubation to protect the airway during the removal procedure. Flexible endoscopy may not be successful if adhesion of the battery to the esophageal mucosa is dense; rigid esophagoscopy may be necessary.<sup>[27]</sup> In this study, flexible esophagoscopy was performed in the removal of the battery in patients who were admitted within 6 hours after ingestion, and rigid esophagoscope was used for the patient who was admitted 1 month after ingestion.

Vocal cord paralysis, esophageal perforation, and tracheo-esophageal fistula with erosion into the aorta or other arteries are rare complications that may occur in patients with severe mucosal injury at the time of battery removal.<sup>[28,29]</sup> Stricture formation is another risk in mild to moderate esophageal injury. Dysphagia can occur weeks, or even years, after ingestion. Dilatation of the esophagus is helpful in the treatment of swallowing problems.

In conclusion, button battery ingestion is a serious condition with high risk of life-threatening complications in childhood. Early diagnosis and immediate endoscopic removal may prevent these complications. The history of ingestion is not always available. Therefore, clinicians must raise the suspicion of battery ingestion in patients with persistent respiratory or gastrointestinal symptoms, and chest X-ray should be obtained if symptoms persist despite medical therapy. Prevention of button battery ingestion is, of course, the best management of all. Therefore, parents and caretakers should be aware of the dangers of button battery ingestion and the importance of prompt care. Batteries should be kept out of reach of children and battery compartments of household products should be more securely designed. Once ingested, urgent endoscopic removal is the best treatment to reduce the risk of morbidity and mortality.

Conflict of interest: None declared.

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ORIJİNAL ÇALIŞMA - ÖZET

## Çocuklarda özofagus yerleşimli disk pil yutmaları

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**AMAÇ:** Özofagusta takılı kalan disk piller yüksek morbidite ve mortalite riskine sahiptir. Bu çalışmada, kliniğimizde özofagus yerleşimli disk pil nedeniyle tedavi edilen hastalar sunuldu, erken tanı ve tedavinin önemi vurgulandı.

**GEREÇ VE YÖNTEM:** Ocak 2010–Mayıs 2015 tarihleri arasında yabancı cisim yutma nedeniyle başvuran hastalar geriye dönük olarak incelendi. Özofagusta takılı kalan piller çalışmaya dahil edildi. Hastalar yaş, cinsiyet, başvuru süresi, başvuru semptomları, pilin yerleşim ve boyutu, uygulanan tedavi ve seyir açısından incelendi.

**BULGULAR:** Yabancı cisim yutma ile başvuran 1891 olgunun 71'inde yabancı cisim özofagusta yerleşmişti. Yetmiş bir özofageal yabancı cismin sekizi disk pildi (%11.2). Ortalama yaş 1.7 yıl idi. Başvuru süresi beş olguda ilk altı saat, iki olguda 24 saat sonra, bir olguda bir ay sonra idi. Bir hasta dışında hastaların tümünde yabancı cisim yutma öyküsü vardı. Tüm hastalarda pil endoskopik yolla çıkartıldı. Üç hastada dilatasyonlara yanıt veren özofageal striktür gelişti.

**TARTIŞMA:** Özofagusta takılı kalan disk piller acil olarak tanınıp çıkartılmalıdır. Uzun süren solunum ve gastrointestinal sistem semptomları olan hastaların ayırıcı tanısında özofageal yerleşimli disk pil akılda tutulmalıdır.

**Anahtar sözcükler:** Çocuk; disk pil yutma; özofagus.

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