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.
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 esophagoscopes were ultimately used in very difficult removal of the battery. According to Zargar classification[7] 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.[8] Button battery ingestion makes up less than 2% of all foreign bodies ingested.[9] The incidence of button battery ingestion is about 10 cases per million people each year.[10] This low incidence has increased, however, with the widespread use of button batteries in the household.[11-13] 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...
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.\cite{14–16} Damage to the esophageal mucosa starts within 2 hours after ingestion of a battery.\cite{5,17,18} As the duration of exposure increases, the mucosa becomes edematous, and the battery can fuse to the mucosa, leading to ulceration and perforation.\cite{16–19} 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%).\cite{20} 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.\cite{21} 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.

Table 1. Patient characteristics

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

Button batteries can cause mucosal injury in the esophagus through several mechanisms. These include electrical discharge, leakage of battery contents, and pressure necrosis.\cite{4,5,11} 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.\cite{22}

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.\cite{17,22,24} In an in vitro study, it was demonstrated that the amount of erosion was directly correlated with the charge of the battery.\cite{24} When these alkaline solutions react with the protein in the mucosal surface of the esophagus, it leads to liquefaction necrosis, which is the main characteristic of caustic esophageal injury in children.\cite{25}

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.\cite{9}

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.\cite{2,11,25} 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.\cite{3,5,9,26} If there is esophageal perforation or tracheo-esophageal fistula, symptoms may include refusal of oral intake, drooling, hematemesis, and respiratory distress.\cite{21} 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 endo-
cheal intubation to protect the airway during the removal procedure. Flexible esophagoscopy may not be successful if adhesion of the battery to the esophageal mucosa is dense; rigid esophagoscopy may be necessary.[27] 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 esophagoscopy was used for the patient who was admitted 1 month after ingestion.

Vocal cord paralysis, esophageal perforation, and tracheoesophageal 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. [28,29] 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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Sencan et al. Esophageal button battery ingestion in children
Çocuklarda özofagus yerleşimli disk piller yutmaları

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


Özofagusda takılı kalan piller çalışmaya dahil edildi. Hastaların yaş, cinsiyet, başvuru süresi, başvuru semptomları, pilin yerleşim ve boyutu, uygulanan tedavi ve seyir açısından incelendi.


TARTIŞMA: Özofagusda takılı kalan disk piller acil olarak tanınıp çıkarılmalıdır. Uzun süren solunum ve gastrointestinal sistem semptomları olan hastaların ayrıntıları özofageal yerleşimli disk pil altında tutulmalıdır.

Anahtar sözcükler: Çocuk; disk pil yutzma; özofagus.