The Outcomes of Injuries Due To Button Batteries Becoming Lodged in the Esophagus in Children

Çocuklarda Özofagusa Takılan Pil Yaralanmalarının Sonuçları

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ABSTRACT Objective: The outcomes of button battery lodgment in the esophagus in children can be life threatening. Management of this injury after button battery removal is controversial. The aim of the present study was to compare the relevant studies in the literature with our experience of cases with a button battery lodged in the esophagus. **Material and Methods:** This retrospective study was conducted in all individuals who were referred for ingestion of a foreign body and who underwent eosophagoscopy at the Department of Pediatric Surgery between January 2007 and May 2012. Each operative report was reviewed to determine whether a button battery was present. Cases with a button battery lodged in the esophagus were reviewed regarding patient characteristics, clinical presentation, management strategy, outcome, and button battery features. **Results:** Sixteen patients (10 males, six females; age, 2-99 months; mean age, 34.81±25.23 months) were admitted due to a button battery lodged in the esophagus. The majority of patients were aged <6 years. The time to diagnosis was between 1 h and 7 days. Ingestion of the button battery by ~44% of the patients was not witnessed. The majority of button batteries were lodged in the proximal esophagus (43.7%). Eight patients had esophageal injuries at various stages. Six patients had a normal esophagus. Two patients developed a tracheoesophageal fistula and both died. The mean duration of hospitalization was 6.8 days. **Conclusions:** A button battery lodged in the esophagus in children is an urgent condition. In such cases, urgent endoscopic removal and a close follow up is required.

Key Words: Child; burns; esophagus, foreign bodies; deglutition

ÖZET Amaç: Özofagusa takılı kalan düğme pilin çocuklarda hayati tehlikesi olabilir. Özofagustan düğme pil çıkarıldıktan sonraki yaralanmanın tedavisi halen tartışmalıdır. Bu çalışmanın amacı, özofagusa takılı kalan düğme pil vakalarımızdaki tecrübelerimizi literatürdeki ilgili çalışmalar ile karşılaştırmaktır. **Gereç ve Yöntemler:** Bu retrospektif çalışma, Ocak 2007-Mayıs 2012 tarihleri arasında yabancı cisim yutma nedeniyle çocuk cerrahisi kliniğine kabul edilen ve ösofagoskopi uygulanan tüm bireylerde yapıldı. Her ameliyat raporu, hastada düğme pil mevcut olup olmadığını belirlemek amacıyla gözden geçirildi. Özofagusta düğme pil takılı olan olgular, hastanın özellikleri, klinik bulguları, tedavi şekli, sonuçları ve düğme pilin özellikleri açısından değerlendirildi. **Bulgular:** On altı hasta (10 erkek, altı kız; yaş 2-99 ay; ortalama yaş 34,81±25,23 ay) özofagusta bir düğme pil takılmış olması nedeniyle başvurdu. Hastaların çoğu <6 yaşındaydı. Tanı süresi 1 saat ile 7 gün arasındaydı. Hastaların ~%44'ünde düğme pilin yutulduğuna şahit olan yoktu. Düğme pillerin çoğu (43,7%) proksimal özofagusta takılı kalmıştı. Hastaların 8'inin özofagusunda farklı derecelerde yanık vardı. Altı hastanın özofagusu normaldi. Hastaların 2'sinde trakeoözofageal fistül vardı; bu hastaların ikisi de öldü. Ortalama hastanede yatış süresi 6,8 gün idi. **Sonuç:** Çocuklarda özofagusa takılı kalan düğme pil acil bir durumdur. Bu gibi durumlarda düğme pilleri acil endoskopik olarak çıkarmak ve yakından izlemek gereklidir.

Anahtar Kelimeler: Çocuk; yanıklar; özofagus; yabancı cisimler; yutma

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Button battery (BB) lodgment in the esophagus has the potential for serious complications compared with other foreign bodies, and is an increasingly prevalent ingestion injury in children because it has par-

alleled the transition of the battery industry to the production of 20-mm lithium coin cell.[1-3] Cost, high voltage, shape, resistance to cold, and long life are the advantages of lithium BBs compared to other batteries.[4] BBs are becoming more frequently ingested in children because they are the power source in many household electronic devices, electronic toys, and children's devices.[1-3,5] Litovitz et al. reported that the incidence of BB ingestion was approximately 11.1 cases per million population in 2009 in the United States.[3]

BB ingestion is common in children aged <5 years with a peak between 1-3 years; serious complications usually develop in patients <2 years old due to the size of the BB and children's behavior, anatomical characteristics, and physiological features, such as immature swallowing coordination and undeveloped chewing capacity.[2,3,4,6,7] A BB causes tissue damage by producing a flow of electric current through tissue.[8] The flow of electricity and hydroxide leads to pH changes and hydrolysis in the surrounding tissue.[2,9]

The first case of esophageal damage caused by BB ingestion was reported in 1977.[10] Batteries generally pass spontaneously through the upper gastrointestinal (GI) tract and are eliminated in the stool within a few days.[11] However, 12.5% of all BBs lodge in the esophagus, leading to severe complications.[3] Two deaths related to a tracheoesophageal fistula (TEF) caused by a BB lodged in the esophagus have occurred within the last 2 years in our department. Therefore, we want to improve our readiness for future cases. To our knowledge, the present report is the only large series of patients with BBs lodged in the esophagus. The aim of this study was to assess our experience with BBs lodged in the esophagus of children and to identify common clinical signs and symptoms at presentation, to determine the management strategy and outcome, and to provide a brief review of the literature related to BBs lodged in the esophagus.

MATERIAL AND METHODS

After Ethical Committee approval, this retrospective study included patients referred due to ingestion of a foreign body and who underwent an eosophagoscopy at the Department of Pediatric Surgery between January 2007 and May 2012. Each operative report was reviewed to determine whether a BB was present. Further medical chart review was conducted for each BB case, and data were collected on patient sex, age, presenting symptoms, preoperative radiography findings, intraoperative findings, treatment provided, outcome, and follow-up. Patients who had ingested a BB that lodged in the esophagus were included. Patients were excluded if the BB was not lodged in the esophagus or another type of foreign body was involved.

The diagnosis of BB ingestion and a BB lodged in the esophagus was based on history, clinical symptoms, and results of imaging studies. Ingested BBs lodged in the esophagus were removed urgently by endoscope under general anesthesia. Accordingly, the Holinger classification was used for the results of the endoscopic examination and the esophageal burns were graded in four stages.[12]

RESULTS

The study included 105 patients who were admitted with a foreign body lodged in the esophagus and who underwent esophagoscopy. Data from 16 patients were analyzed with regard to BB ingestion. Only in 5 out of 16 patients were aware of the characteristics of the BB where all were lithium size 20 mm and four of them caused esophageal damage.

AGE AND GENDER

Eleven of the 16 patients were <5 years old (range, 2-99 months). All patients were aged <9 years. Sixteen (10 male and six female) patients had a BB lodged in the esophagus. The male:female ratio was 1.66:1. Patient data were shown in Table 1.

SYMPTOMS

Patients exhibited a variety of symptoms. The most common complaint was the awareness of parents that their child had ingested an unknown object. Symptomatic patients most commonly presented with dysphagia (n=6) and upper respiratory tract symptoms (n=2); the remaining patients were asymptomatic (n=8).

TABLE 1: The characteristics of children with button battery ingestion in the present study.

No	Age /Gender	LE***	Initial symptoms	Injury	DH*	Outcome	Witnessed	TIBB**
1	77/ M	Mid	Dysphagia	2ndº burn	4 days	Spontaneous heal	Yes	1h
2	17 /M	Mid	Dysphagia-cought	TEF	45 days	Death	No	Unknown
3	14/ M	Proximal	Vomiting	2ndº burn	4 days	Stricture	No	Unknown
4	39/ M	Distal	Asymptomatic	1stº burn	1 day	Spontaneous heal	Yes	2h
5	28/ F	Mid	Asymptomatic	2ndº burn	2 days	Spontaneous heal	No	Unknown
6	34/ F	Proximal	Asymptomatic	1stº burn	1 day	Spontaneous heal	Yes	1.5h
7	39/ M	Distal	Asymptomatic	No	1 day	Spontaneous heal	Yes	2h
8	99/ F	Distal	Dysphagia- pain	1thº burn	4 days	Spontaneous heal	No	Unknown
9	36/ M	Mid	Dysphagia	1thº burn	1 day	Spontaneous heal	No	Unknown
10	2/ F	Proximal	Dysphagia	2ndº burn	25 day	4 days later TEF occurred and death	No	Unknown
11	8/ M	Proximal	Asymptomatic	No	2 days	Spontaneous heal	Yes	2h
12	42/ F	Proximal	Asymptomatic	2ndº burn	7 days	Spontaneous heal	Yes	30 minutes
13	55/ F	Proximal	Asymptomatic	No	2 days	Spontaneous heal	Yes	3h
14	15/ M	Proximal	Asymptomatic	No	3 days	Spontaneous discharge after 15 days	Yes	1.5 hours
15	23/ M	Mid	Asymptomatic	No	12h	Spontaneous discharge after 3 days	Yes	1 hour
16	29/ M	Distal	Asymptomatic	No	6 days	Lodged in the ileum and laparatomy	No	Unknown

*DH: Duration of hospitalization; ** TIBB: Time of ingested button batery when admitted hospital; ***LE: Location of eosophagus; ****TEF: Tracheoesophageal fistula; M: Male; F: Female.

TIME OF DIAGNOSIS AND REMOVAL

The time of the diagnosis was between 1 h and 7 days. In 10 out of 16 patients, parents knew when the BB was ingested and the battery was removed within the first 12 h. In one of these patients, TEF occurred 4 days after the removal of the BB from the esophagus.

Four of the 16 patients had their BBs removed within 24 h. A TEF occurred in one of these patients. Although the remaining three patients had burn injuries, they recovered completely.

DELAYED AND UNWITNESSED

Seven of 16 patients were unwitnessed BB ingestion cases. Two cases were misdiagnosed initially and were suspected to have a respiratory infection. Diagnosis was delayed in one patient, in whom a perforation occurred.

MANAGEMENT AND ENDOSCOPIC FINDINGS

All patients underwent a plain radiological examination. Most of the BBs were located in the upper esophagus (44.4%). In 12 patients, lodged BBs were removed during esophagoscopy using foreign body forceps. One BB was removed with a Magill forceps below the oropharynx. The BBs passed through the stomach during esophagoscopy in the remaining three patients.

The spectrum of esophageal injury ranged from a TEF to a normal examination. Five patients had a normal esophagus. Esophageal damage was observed in eight patients. Second-degree burn injuries were present in three patients. The BB caused a second-degree burn injury in the esophageal wall within 2 h of being lodged in the esophagus, and a first-degree burn injury occurred within 5 h. Transesophageal fistulae had developed in two patients. The remaining six patients had a normal esophagus.

HOSPITALIZATION AND CLINICAL OUTCOME

The mean duration of hospitalization was 6.8 days (range, 12 h-45 days) (Table 1). Two patients died due to TEF complications. One patient who had second-degree burns and a stricture was diagnosed at late follow up (21 days after BB was removed) and required esophageal dilatation. That patient underwent an operation for esophageal atresia but did not require dilatation during this period. However, we do not know whether the stricture was related to the esophageal atresia, the BB injury, or both.

One patient developed an intestinal perforation at the jejunum near the Treitz ligament 4 days after BB ingestion. Full-thickness necrosis with minimal perforation was observed during exploration. The BB passed into the intestine during esophagoscopy.

DISCUSSION

The number of reports regarding injury due to BB lodgment in the esophagus is increasing. In the present study, 75% of patients were admitted within the last 2 years and 12.1% of the foreign bodies were BBs.

BB lodgment in the esophagus is associated with a more serious outcome than one lodged in the distal gastrointestinal tract.[1,11] A previous study reported a reaction to BBs in the small intestine, suggesting a risk of intestinal injury if a BB lodges in regions other than the stomach.[8,13] In the present study, one patient had a jejunal perforation 4 days later when the BB passed spontaneously through the intestine during esophagoscopy. That patient experienced progressively increasing abdominal pain and vomiting. A full-thickness burn and minimal perforation were seen when the patient underwent an exploration.

The clinical presentation varies (asymptomatic or immediate with respiratory difficulty) and depends on both BB location and lodgment duration. Most ingestions occur in nonverbal children. Therefore, the diagnosis may be missed or delayed.[3,14-16] In the present study, males and those aged <2 years predominated; the time between ingestion and removal of the BB ranged from 6 h to 7 days; 46.7% of the patients had unwitnessed ingestion and 12.5% were misdiagnosed initially. Misdiagnoses included an upper respiratory infection that was treated for 2-7 days, whereas in previous studies misdiagnoses were treated for 2–12 days prior to the correct diagnosis.[14,17]

BB lodgment in the esophagus can result in various serious complications such as stricture, perforation, mediastinitis or damage to local nerves, vessels or the trachea.[1-6,17] The mechanism of injury severity is multifactorial and the size/content of the BB, voltage, age, and duration of contact with local tissue determine the complication rate.[1,2,4,9,14,17,18] A BB causes superficial necrosis in 15 min, which can extend into the trachea within 1 h. Perforations occur frequently after 8 h of lodgment at a specific site.[8,18-20] Burns from a BB become severe 2–2.5 h after ingestion, and burning may continue after BB removal from the esophagus.[2,10,17] Tissue injury, fistula, or scarring may develop several weeks after BB removal due to residual alkali or weakened tissues, and most cases of perforation are detected postoperatively and not during the initial esophagoscopy.[2,3] In the present study, one patient had a BB removed 4 h after ingestion, although a second-degree burn injury was the initial diagnosis. The patient showed no improvement, and a perforation was identified on the fifth day.

Early recognition of BB lodgment in the esophagus is important during the clinical evaluation to avoid complications and to ensure successful therapeutic management. A BB should be removed urgently by endoscopy because evaluation of the tracheoesophageal wall is important (visualize tissue injury and inspect the mucosa in terms of the extent, depth, and location of tissue damage). Endoscopic removal of a BB lodged in the esophagus is preferable to a blind approach using a Foley catheter or combination techniques.[21] These techniques are not safe since their use may result in esophageal injury.[1,3,22]

The appropriate medical therapy [antibiotic therapy, H_2-receptor blockers and proton pump inhibitors (PPIs), total parenteral nutrition (TPN), nasogastric (NG) tube intubation, steroids and stent/dilatation] after BB removal remains controversial.[1,11,23] Management of a TEF after BB ingestion has included waiting for spontaneous closure rather than surgical repair.[1,2,24] The time required for conservative treatment may be 6-8 months.[15,19] However, some authors have stated that a TEF related to a battery lodged in the esophagus will heal spontaneously.[24] In the present study, we used conservative therapy in two patients with a TEF; however, their general condition deteriorated. Therefore, they underwent surgery at week two and four after the removal of the BB from the esophagus. However, both patients died during the

postoperative period. Both patients were aged <2 years, both BBs were lodged in the proximal esophagus, and the fistulas were >2 cm. Therefore, age, location in the proximal esophagus, and fistula size are important in selecting the type of treatment.

The present study has some limitations. First, few patients were included. Second, the data were collected retrospectively; therefore, we were limited by a lack of BB data.

In conclusion, the main goal of treatment is prevention of complications. The practitioner treating BB ingestion must conduct a careful follow up and must be aware of the possibility of complications. Preventing BB ingestion may be more effective than an improved approach to treatment. Therefore, the public and healthcare workers should be educated about the potential outcomes of BB ingestion.

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