The emergency management of three pediatric cases of button battery ingestion with complications

Komplikasyonlu üç düğme pil yutma vakasının çocuk acil serviste yönetimi

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Abstract

Button battery ingestion (BBI) is an increasingly common pediatric condition, both nationwide and worldwide. Management algorithms, including treatment with honey or sucralfate within the first 12 hours, should be prepared for use in the emergency care of patients with suspected BBI without initial complications. In this report, we present three pediatric patients who presented to the emergency department with different symptoms and complications and were diagnosed with BBI.

Keywords: button battery; honey; sucralfate

Öz

Çocuklarda düğme pil yutma (DPY) gerek ülke gerekse dünya genelinde giderek sık rastlanan bir durumdur. İlk 12 saat içinde bal veya sukralfat ile tedavi dahil olmak üzere, DPY şüphesiyle getirilen ve ilkin komplikasyon gözlenmeyen hastalarda kullanılacak acil bakım yönetim algoritmaları oluşturulmalıdır. Bu yazıda farklı semptom ve komplikasyonlarla acil servise getirilip DPY tanısı alan üç çocuk hasta sunulmuştur.

Anahtar sözcükler: bal; düğme pil; sukralfat

INTRODUCTION

Button batteries are used in many household devices today, including watches, calculators, scales, blood glucose meters, and hearing aids. Most of these devices are easily accessible to children, who can perceive them as toys (1,2). The use of lithium batteries with higher voltage and greater potential of chemical damage has been increasingly common (3), with a parallel increase in the pediatric cases of button battery ingestion (BBI).

In patients who present to the emergency department with suspected BBI, prompt (pre-)diagnosis and treatment are important to reduce the risk of developing complications with high morbidity and mortality (4). Patients are diagnosed either anamnestically or regarding the subsequent symptoms, which are usually nonspecific, such as vomiting and cough, leading to delayed diagnosis (4).

In this report based on three patients admitted to our pediatric emergency department (PED), we aimed to offer recommendations using the current guidelines in order to prevent the development of complications in patients with BBI.

CASES

Case 1

A 10-month-old male patient with no history of illness or medication was admitted with the complaints of black stool during the last three days, pallor for a day, and decreased activity. It was learned that he was defecating twice a day and his stool was black-colored, with no fresh blood in it. The admission heart rate (HR) was 150 /min, and other vital signs were normal. Physical examination revealed no pathology. The patient was observed with a pre-diagnosis of upper gastrointestinal bleeding and given 20 mL/kg saline. The values were as follows: hemoglobin (HGB), 7.9 gr/dL; hematocrit (HTC), 25.7%; mean corpuscular volume (MCV), 83.4 fL; red blood cell distribution width (RDW), 13.4%; white blood cell count (WBC), $21.8x10^3$; absolute neutrophil count (ANC), $9.3x10^3$; absolute lymphocyte count (ALC): $11x10^3$; blood urea nitrogen (BUN), 34 mg/dL (normal range [NR]: 5–18 mg/dL); and creatinine: 0.32 mg/dL (NR: 0.16–0.39 mg/dL). Electrolytes were found to be normal. The venous blood gas values were as follows: pH, 7.34; pCO_2, 26.5 mmHg; HCO_3, 16 mmol/L; lactate, 2.4 mmol/L; and base excess, -10 mmol/L. Direct abdominal radiography (DAG) showed a round body, which was thought to be a button battery (Figure 1). When talking to the family again, it was learned that the battery of a scale used in the house was missing. Treatment with proton pump inhibitor (PPI) infusion, ceftriaxone, and metronidazole was started. The values at the third hour were as follows: body temperature, 37.3°C; heart rate, 172 /min, respiratory rate, 40 /min; systolic blood pressure, 90 mmHg; HGB, 6.6 gr/dL; HTC, 21%; MCV, 83.4 fL; RDW, 13.2%; WBC, $17x10^3$; ANC, $9.4x10^3$; and ALC, $6.9x10^3$. Hemorrhagic shock was considered because the blood pressure values were at the lower limit for the age of the patient, with a low HTC value and continued tachycardia despite receiving 20 mL/kg saline three times. Adrenaline infusion and fluid therapy were administered until the blood product was prepared. The patient was transferred to the pediatric intensive care unit for erythrocyte transfusion. After clinical stabilization was achieved, the button battery, which caused mucosal erosion and an ulcerated lesion in the stomach fundus, was removed endoscopically. The PPI and adrenaline infusions were discontinued as the patient had no postoperative bleeding, with stable vital signs. Treatment with sucralfate was started. After two days of intensive care follow-up and one day in the ward, the patient was discharged with the recommendation that the sucralfate treatment be continued. However, no follow-up revisit was made by the family.

Case 2

A previously healthy 28-month-old male patient with no history of medication presented with the complaint of vomiting. It was learned that he started vomiting the day before his admission, vomiting small amounts without bile, two or three times a day, with no additional symptoms. He had been taken to an external center before his admission and evaluated with DAG and abdominal ultrasonography (USG). No pathology had been found and he was then sent to our hospital for hydration. Similarly, we found that the general condition of the patient was good, with stable vital signs. DAG and complete urinalysis were normal. The

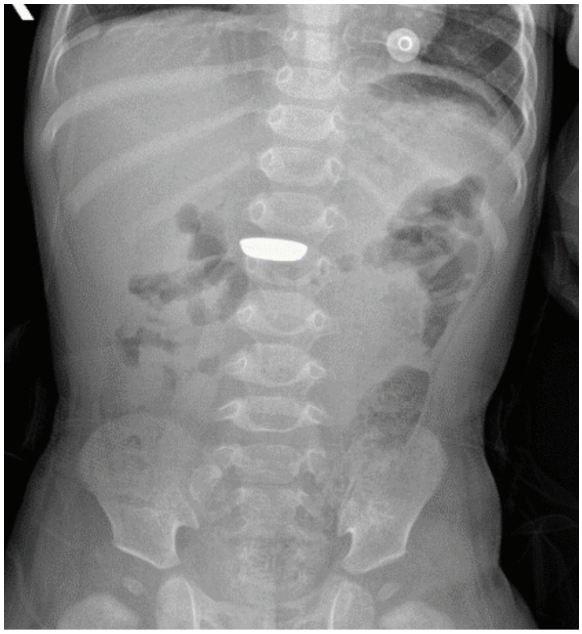

Figure 1. Radiopaque body seen at the level of the lumbar vertebrae 1–2 on direct abdominal radiography.

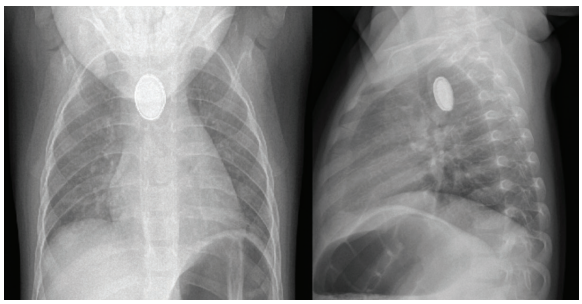

Figure 2. Radiopaque body seen at the level of the thoracic vertebrae 3–4 on anterior chest radiography. The double-ring appearance of the battery is seen.

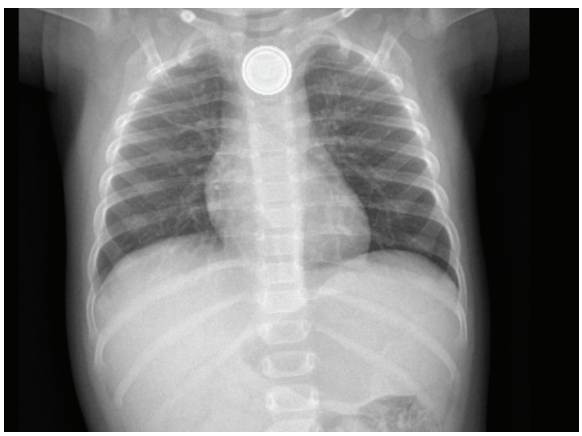

Figure 3. Radiopaque body seen at the level of the thoracic vertebrae 1–2 on anterior chest radiography. The double-ring appearance of the battery is seen.

patient, who did not need intravenous hydration and tolerated oral feeding, was fed during a three-hour follow-up without vomiting and discharged with recommendations.

Two days after the first admission, the patient was readmitted to the emergency service because the vomiting continued together with a fever starting approximately 12 hours after discharge. The patient was examined and his general condition was found to be good with stable vital signs and no pathological finding, except for decreased tears. The oral mucosa was wet and skin turgor tone was normal. The patient was considered to be slightly dehydrated and hydration was started. A chest radiograph was taken to rule out lower lobe pneumonia, given that the vomiting continued for three days and fever for two days without a clear etiology. A round body compatible with a button battery was seen in the esophagus on the lateral graph (Figure 2). Talking to the family, it was understood that the battery of the blood glucose meter at their home was missing. Treatment with ceftriaxone was started. Computed tomography (CT) showed no sign of mediastinitis because more than 48 hours had passed. Thoracic CT showed a nodular metallic body compatible with a battery with a diameter of 18 mm at the level of the thoracic vertebrae 3–4. In esophagoscopy, it was observed that it adhered to the surrounding tissues and fibrin tissue was formed. The battery was removed by separating it from adherent tissues. The patient was discharged after a five-day follow-up in the ward, during which he developed stenosis in the esophagus and dilatation was required three times.

Case 3

A previously healthy 10-month-old male patient presented with suspected BBI. The family had been unable to find a button battery used in the controller of a toy during the last 2.5 hours. It was learned that they had visited an external center and a battery had been seen in the esophagus on direct radiography. He had vomited three times before admission. His vital signs were stable and physical examination was normal. Direct radiography showed a body compatible with a button battery in the proximal esophagus (Figure 3). Endoscopy was done approximately one hour after admission to our clinic, but the battery could not

be removed because it was embedded in the mucosa and covered with fibrin tissue, and was pushed into the stomach. Prophylactic antibiotherapy with sulbactam/ampicillin (SAM) was initiated. Subcutaneous emphysema and pneumomediastinum were detected immediately after the endoscopy and esophageal perforation at the sixth hour. The patient was operated on by the pediatric surgeon at the tenth hour, and the battery was removed from the stomach, with gastrostomy and tube thoracostomy. The SAM treatment was discontinued and treatment with meropenem was started. On the 3rd postoperative day, the gastrostomy nutrition was started and gradually increased. In the following period, the fluid content coming from the thoracic tube decreased and the tube was withdrawn. No leak was detected in the esophagography performed on the postoperative 14th day, and oral nutrition was started. In the postoperative 2nd month the gastrostomy was closed because the patient resumed full oral nutrition. He was being followed up in the postoperative 3rd month without any sequelae.

Report ethics

Verbal informed consent was obtained from the parents of the patients for the publication of this case report and the accompanying images.

DISCUSSION

The first two of our patients were admitted with nonspecific symptoms (black stool, pallor, vomiting) and diagnosed as a result of the evaluation at the emergency room. The BBI time was unknown. Although the third patient appeared to present earlier with suspected BBI, the reliability of the history reported by the family was considered to be low regarding the complications that developed. In cases of BBI, early admission to the emergency department and immediate endoscopic removal of the ingested battery are crucial to prevent complications. However, most of the time the exact time of ingestion cannot be determined.

BBI is particularly common and a major cause of morbidity and mortality in children under the age of 5 years. Button batteries, including lithium batteries with higher voltages and greater potential of chemical and electrical damage, have recently been used in many areas (5). Batteries cause mucosal damage through three known mechanisms: (i) direct pressure, (ii) the chemical content of the battery, and (iii) the electric current between the poles of the battery and the mucosa. Complications are often caused by necrosis due to electric current. In the area where the negative pole touches the mucosa, hydrolysis occurs in an alkaline environment within the first 15 minutes and liquefaction necrosis develops affecting deeper tissues within the next two hours (5). For this reason, the removal of the battery within the first two hours is very important to prevent damage progression and complications. The most important reason for the complications in our cases was the late arrival of the patients to our PED.

The post-BBI symptoms of cough, vomiting, difficulty in swallowing, and fever are nonspecific and the diagnosis is often made when the patient is admitted with suspected BBI. In a review of 188 children with BBI (6), the common symptoms were reported to be dysphagia (30.2%), cough (26.4%), fever (26.4%), and vomiting (17.3%). It was also reported that when there was no suspicion by the family or caregiver, the diagnosis was delayed leading to more serious complications (7). Similarly, the first two of our patients presented with the nonspecific symptoms of black stool and vomiting, which are frequently encountered in the emergency department, and the diagnosis was made incidentally during the etiological investigation. Nonspecific symptoms, coupled with no reported history of BBI, reduced the chance of early intervention.

The time from battery localization to battery removal is also important (5). The longer this period, the higher the risk of developing complications (7). In cadaveric and live piglet studies, it was shown that treatment with honey or sucralfate delayed esophageal damage and optimally neutralized the pH increase in the esophagus (8,9). Batteries that could be located in the esophagus should be checked with anteroposterior and lateral radiography. Honey or sucralfate should be given every 10 minutes. After the first evaluation and the first dose of honey or sucralfate, the location of the battery should be determined by direct radiography (8).

Cadaveric and live piglet studies comparing honey and sucralfate found that honey was more effective and

should be the first choice in all patients aged >1 year. It has been reported that up to six doses of honey and three doses of sucralfate can be given (10 mL/dose) until the battery is removed (3,4,8,9). Honey was not given to our first two patients, who had complications in the later period, and our third patient was not given sucralfate because the duration of endoscopy was very short and because its effect on image quality during endoscopy was unknown.

Regardless of patient age and battery diameter, all batteries located in the esophagus should be removed endoscopically as soon as possible. Patients with batteries located in the stomach or more distally, aged >12 years, asymptomatic, and with batteries <12 mm in diameter and known not to have been ingested with a magnet can be followed up in an outpatient setting. In asymptomatic patients, batteries that seem to progress with passage can be followed for 10 to 14 days until they are excreted with stool. In patients aged <6 years and with a battery diameter known to be ≥15 mm, the battery should be removed endoscopically if it is still seen to be in the stomach after four days of follow-up. When endoscopy is done, the patient should be evaluated with bronchoscopy for complications. When the battery is removed from the esophagus with no evidence of perforation, washing with acetic acid (50–150 mL, 0.25%) or saline is recommended to minimize the alkaline damage in the area (5–8,10). In animal experiments acetic acid was found to be more effective than saline (9). In our cases, washing with saline was applied only in Case 2.

Although the importance of intervention within the first 2 hours of BBI is emphasized in many publications, it has been shown that serious complications developed even in cases where battery removal was done within the first hour (9,11). A study evaluating 290 severe cases of BBI reported that esophageal perforation developed in 65% of the patients, within 11 hours after battery removal (12). Although our third patient was admitted within the first 3 hours according to the account of the family, the fact that he developed perforation suggests that the information given by the family was not reliable.

In agreement with our views, the literature shows that treatment with honey (in patients aged >1 year) and sucralfate (in those aged <1 year) has begun to be included in the BBI management algorithms within the first 12 hours, as a critical measure to minimize the development of pre-endoscopy complications. In conclusion, families and caregivers should be given preventive information about BBI as it has been an increasingly common condition, both nationwide and worldwide. When the family or caregivers do not suspect and report that BBI might have occurred, clinical suspicion becomes essential for early diagnosis because of the nonspecific symptoms.

Conflict-of-interest and financial disclosure

The authors declare that they have no conflict of interest to disclose. The authors also declare that they did not receive any financial support for the study.

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