

Tension pneumothorax and subcutaneous emphysema during retrieval of an ingested lithium button battery

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Abstract We present a case of a child with an ingested lithium battery causing esophageal perforation with mediastinal injury extending to the pleural cavity. During the endoscopic retrieval of the battery, the child developed the rare complication of subcutaneous emphysema, tension pneumothorax, and pneumomediastinum from excessive iatrogenic air insufflation. The patient developed mediastinitis and had a complicated postoperative course.

Keywords Tension pneumothorax · Endoscopic complication · Button battery ingestion

Introduction

The ingestion of a foreign body can be asymptomatic in children, with a majority of the ingested objects passing through the gastrointestinal tract without any complications. However, in a few cases, ingested foreign bodies can sometimes lead to life-threatening complications [1].

Button batteries are used to power a wide array of devices and can easily be swallowed by children [2]. Although most cases of battery ingestion are asymptomatic, complications may arise if the batteries leak or become impacted in the esophagus [2]. The common sites of impaction are the proximal esophagus, at the level of the aortic arch and the gastroesophageal junction [3]. Mucosal damage from a button battery occurs as a result of pressure

necrosis, chemical burn, and low-voltage electric burn [4, 5].

Case report

A previously healthy 4.5-year-old girl, weighing 16 kg, presented to the emergency department with complaints of dysphagia and refusal to eat for 24 h. Her parents suspected ingestion of a foreign body as the cause of the complaint. The child appeared awake, alert, and in no obvious distress. Vitals included a temperature of 37.7°C, heart rate of 115 beats/min, blood pressure of 119/77 mmHg, and oxygen saturation of 100% on room air. Auscultation of the lungs revealed equal bilateral breath sounds. Physical examination was otherwise unremarkable. Her chest radiographs revealed a round button battery 2.3 cm in diameter at the thoracic inlet level of the esophagus (Fig. 1).

The patient was brought to the operating room for emergent retrieval of the foreign body under general anesthesia. A 22-gauge intravenous access was obtained in the left upper extremity.

Intravenous induction was achieved with propofol, and the patient's airway was easily secured with a 5.0-mm I.D. cuffed endotracheal tube (ETT) (Mallinckrodt; Tyco Healthcare, St. Louis, MO, USA). Correct placement of the ETT was confirmed by auscultation and capnography. Anesthesia was maintained with oxygen, air, and sevoflurane, and the patient was mechanically ventilated. A pediatric surgeon performed direct laryngoscopy and visualized the top of the button battery with a circumferential area of mucosal necrosis around it at the upper portion of the esophagus. Multiple attempts were made to remove the battery initially by McGill's forceps and then by flexible endoscopy. The battery appeared to be adherent to the

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Fig. 1 Chest radiograph showing the ingested button battery

mucosa and could not be dislodged. Twenty minutes into the procedure, the patient became increasingly difficult to ventilate, and the peak airway pressures abruptly increased from 16 to 40 cm of H₂O. At this point, oxygen saturation dropped to 40–50%. Manual ventilation with 100% oxygen via ETT increased saturation only to the high 80s. Subcutaneous emphysema was noticed around the neck. Auscultation of the lungs revealed markedly decreased air entry on the right side. Her heart rate and blood pressure remained stable. The surgical procedure was stopped and stat chest radiography ordered. Chest radiogram revealed a tension pneumothorax on the right side with pneumomediastinum and shift of the mediastinal contents to the left (Fig. 2). A 16-French chest tube was quickly placed in the fourth intercostal space on the right side for decompression of tension pneumothorax with immediate results. Ventilation improved, and the peak airway pressures dropped with oxygen saturation increasing to 100%. A repeat chest radiograph showed good lung expansion on the right side. An otolaryngologist was then consulted who, after several attempts, succeeded in retrieving the battery using a flexible endoscope. On examination the battery was a Panasonic 23 mm, 3 V lithium battery model BR2330 (Panasonic Corporation of North America, Secaucus, NJ, USA) with mechanical damage to the outer covering. The upper end of the esophagus was explored, which showed a small perforation, transmural sloughing, and necrosis. A Penrose drain was placed for controlled drainage of the esophageal perforation. The patient was kept intubated, sedated, and mechanically ventilated in the intensive care unit. Postoperatively, the patient developed mediastinitis

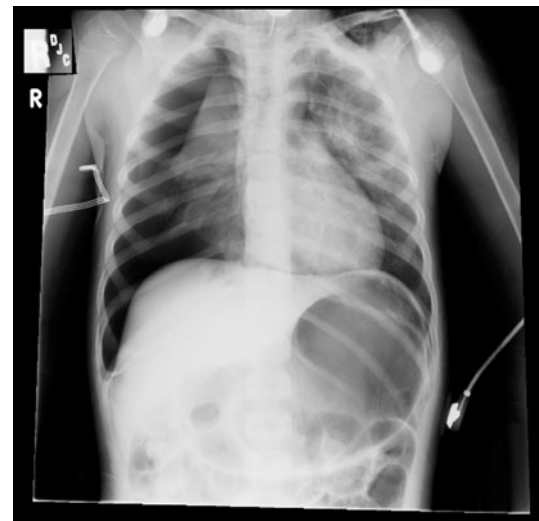


Fig. 2 Chest radiograph of the chest showing tension pneumothorax on the *right side*

with hemodynamic instability and was treated with intravenous antibiotics and vasopressors. The patient subsequently had a gastrostomy tube placed for enteral feeding and a silastic stent placed to prevent esophageal stricture. Once the emphysema, pneumothorax, and mediastinitis had resolved, the patient was weaned from vasopressors and extubated 5 days later. A week later, a swallowing study showed no esophageal stricture and the patient was started on a soft oral diet. She was discharged home in a stable condition 2 weeks later and scheduled for further follow-up with the surgery department.

Discussion

Button batteries (also called disc batteries) are coin shaped and used to power electronic devices. With the increased use of electronic gadgets, the incidence of ingestion in children is increasing [2]. Most ingestions of these batteries are unnoticed and uneventful [2, 6]. Children less than 6 years of age account for the majority of ingestions, with a peak incidence between the ages of 1 and 2 years [1]. Common complaints with the lodged button battery in the esophagus are refusal to eat or drink, sialorrhea, vomiting, coughing, and gagging [6]. A button battery has a two-part metal casing covered by a plastic grommet. The casing contains mercury, silver, zinc, manganese, cadmium, lithium, or nickel with concentrated alkaline electrolyte solutions of potassium or sodium hydroxide (depending on the type of battery) [6]. When ingestion is suspected, radiography is used to confirm and locate the button battery. A button battery appears similar to a coin on plain chest radiographs but can be distinguished by a radiolucent halo

and notch on anteroposterior and lateral neck views [7]. Complications resulting from battery ingestion depend upon the state of the battery, whether it is intact or damaged, the size and type of battery, and the duration and location of impaction. Batteries with a diameter greater than 20 mm are more likely to cause complications as they become impacted in the esophagus [6, 8]. The electric current flow from the higher-voltage lithium battery results in more extensive damage of the adjacent tissues than a zinc battery [4, 9]. Complications that can occur are mucosal erosion by chemical burns from the leaking alkaline electrolyte, burns caused by an electric charge, pressure necrosis, and iatrogenic perforations during retrieval [4, 5, 10]. Esophageal burns can occur 4 h after ingestion and esophageal perforation 6 h after ingestion [5, 6, 8]. Other complications are tracheoesophageal perforation, pneumoperitoneum, aorto-esophageal fistula, esophageal stenosis, and heavy metal poisoning [5, 6, 10]. Rare complications include pneumomediastinum, subcutaneous emphysema, and tension pneumothorax during intraoperative endoscopy as a result of excessive air insufflation, causing the air to leak through the perforation into the mediastinum and pleural space [11]. Perforation of the tracheobronchial tree by corrosive action of the battery can also cause these complications [6, 10]. Tension pneumothorax occurring during upper gastrointestinal endoscopy without any perforation has also been reported [12].

A button battery lodged in the esophagus needs to be retrieved emergently before any injury occurs. Endoscopic retrieval is usually preferred [2, 6, 8, 13]. Surgical intervention may be rarely needed when endoscopic retrieval is not possible or when gastrointestinal injury is present [10]. Patients with battery ingestion can be a challenge for the anesthesiologist. Depending on the duration of ingestion, the patient may be dehydrated and may have pulmonary aspiration from the inability to swallow. Rapid sequence induction and intubation may be indicated to minimize risk of pulmonary aspiration. If the battery has been in the subglottic area for some time, tracheal edema may necessitate use of a smaller-size ETT [14]. Increasing difficulty with lung ventilation, worsening compliance, a fall in oxygen saturation, or increase in peak airway pressures during the retrieval under general anesthesia could indicate a pneumothorax or pneumomediastinum. Nitrous oxide should not be used in these patients as it can expand the pneumothorax or pneumomediastinum. In our patient, the lithium battery was lodged in the esophagus for more than 24 h. Naked eye examination at the site of lodgment revealed an area of circumferential necrosis and transmural sloughing. Esophageal perforation in this patient was likely because of the electric current from the high-voltage lithium battery and by pressure necrosis [4, 9]. Multiple and vigorous attempts to retrieve the battery for more than

90 min possibly caused more damage to the necrotic tissues. The esophageal perforation and tissue damage may have extended into the mediastinum and pleura cavity, creating a communication. Repeated and excessive air insufflations during the multiple endoscopic attempts caused the air to track through this communication causing subcutaneous emphysema, tension pneumothorax, and pneumomediastinum [11].

Conclusion

Ingested button batteries can lead to severe complications. Chest radiograph should be obtained early to determine and confirm the position of the impacted button battery in the esophagus.

The battery must be retrieved emergently followed by endoscopic evaluation to rule out any damage. Tension pneumothorax and pneumomediastinum are rare complications during endoscopic retrieval of button batteries.

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