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Case Report

Disc battery ingestion; a single event with different outcomes

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ABSTRACT

Foreign body (FB) ingestion is a common problem especially in children below the age of 5 years. This is fueled by their curiosity to explore their surroundings. The ingested foreign body finds its way out of the gastrointestinal tract without any serious consequences most of the time. On the other hand, disc battery ingestion has been reported to cause serious harm when ingested including death. We report two patients who had ingested disc batteries and their respective outcomes.

1. Introduction

Infants and young children are known to explore their surroundings by touch and taste. It is part of achieving their developmental milestones. Many objects find their way to a child's gastrointestinal tract and usually these objects find their way out. Disc batteries have become more common in our homes and so they have become part of a child's surroundings. As disc batteries are smooth and shiny, they are attractive to this age category. Therefore, ingestion of disc battery is becoming a more frequent encounter. Complications of disc battery ingestion are many, ranging from dysphagia to more severe outcomes like esophageal burns and tracheoesophageal fistula. Most complications can be minimized by early detection and intervention. Application of preventive measures are needed if we want to eliminate this event. We are reporting two different patients who had disc battery ingestion and their respective outcomes. Also, we included a background literature review.

2. Case 1

A previously healthy 2-year-old girl presented to our emergency department (ED) after her mother noticed that she was drooling for 2 days. The mother told us the child was interested in disc batteries and she had repeatedly found her playing with them. The child was previously seen at a polyclinic where she was diagnosed with pharyngitis, for which she was given antibiotics. Next day, she developed fever and vomiting. A plain chest x-ray confirmed that the patient had a disc battery in the upper esophagus. The parents were advised to take their daughter to a hospital.

Upon presentation to our (ED), she had shortness of breath, cough, and drooling for the past 48 hours. She was ill-looking with a heart rate of 150 beats per minute, blood pressure of 99/56 mmHg, respiratory rate of 34 breaths per minute, and a temperature of 40 degrees Celsius (°C). A Chest x-ray showed a round disc-like opacity projecting over the esophagus. Both costophrenic angles were clear. The cardiac shadow was within normal limits. No pneumonia or pneumothorax was noted (Fig. 1a and b).

The patient was admitted and taken to the operating room for urgent esophagoscopy and retrieval of the foreign body. Esophagoscopy revealed circumferential burn at the site of the disc battery with moderate to severe inflammatory changes in the mucosa. The disc battery was removed very carefully. The esophagus was inspected again; no signs of perforation were seen and the procedure was ended without advancing the scope beyond the area of the burn. The patient was shifted, ventilated and intubated to the

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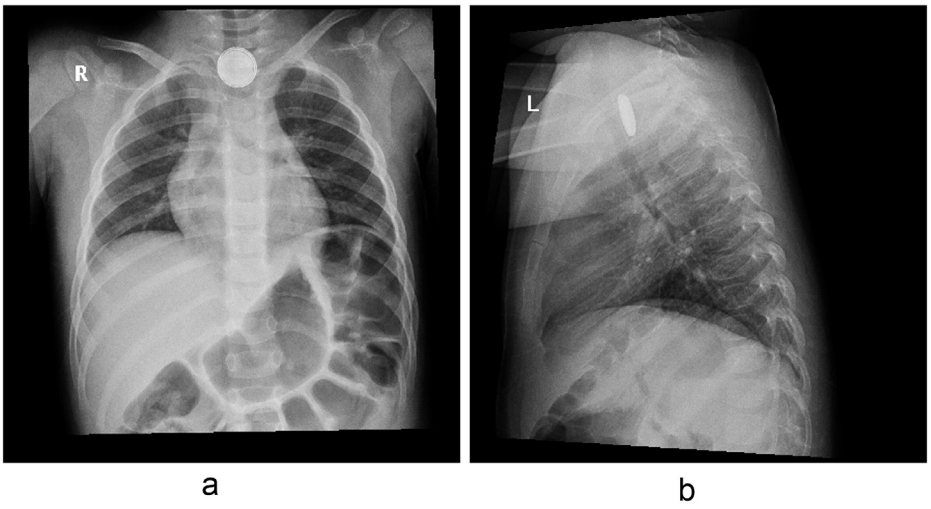

Fig. 1. **a** PA chest xray showing a round disc battery in the upper esophagus. No pneumomediastinum or signs of pneumonia noted. **b** Lateral chest xray showing disc battery to be in the esophagus not the trachea. Trachia is anterior to The Foreign Body.

pediatric intensive care unit (PICU) for observation for 24 hours. A post-operative chest x-ray revealed no pneumomediastinum. So, she recovered slowly and extubated. On the ward, the patient was kept nil per mouth. She received intravenous (IV) hydration, histamine receptors blocker (H2 blocker) and amoxicillin/clavulanic acid IV for five days. Later; she had a water-soluble contrast swallow which showed no leak and no stricture in the esophagus. After which, she was started on clear fluids and progressed gradually to soft diet. The patient was discharged home on ranitidine (2mg/kg) per 24 hours in two divided doses. Instructions were given to come to the ED in case of fever, drooling or difficulty swallowing.

The patient was seen in the clinic after one month. She was tolerating her food well. A repeat esophagogram did not show any stricture. Ranitidine was stopped. The patient remained well on repeated outpatient follow up 3 and 6 months later.

3. Case 2

A 15 months old girl presented to another hospital's ED due to a history of difficulty swallowing that started one week before presentation. Chest x-ray revealed a round disc like foreign body in the esophagus. The patient was admitted there and an upper gastrointestinal (GI) flexible endoscopy was done. It revealed a disc battery impacted in the upper part of the esophagus which was removed. During the procedure, a very deep large esophageal ulceration with gangrenous tissue and local bleeding was found possibly due to long-lasting impaction.

The patient was admitted to PICU for five days due to stridor which started on the day of presentation to the hospital. On the sixth day, she was transferred to the pediatric floor on nasal cannula oxygen therapy, IV antibiotics, total parenteral nutrition(TPN), and frequent suctioning from the mouth due to excess secretions.

While on the ward, the patient suffered three attacks of chocking and cyanosis which improved on suctioning and oxygen. Examination at that time, showed the patient to be fully conscious, having stable vital signs, with a lot of mouth secretions. Chest examination showed equal bilateral air entry with transmitted sounds and coarse crepitation. Complete blood count (CBC), C-reactive protein (CRP), renal panel, bone biochemistry, and blood culture were all within normal range.

Computed tomography (CT) scan of the chest with oral contrast showed no evidence of pneumomediastinum. The contrast was seen around the esophagus middle and lower parts mostly in keeping with periesophageal leak. No significant amount of contrast was noted inside the trachea and its main branches, tracheoesophageal fistula possibility was raised.

The patient was kept under close observation, respiratory care, TPN and antibiotics (Meropenem, vancomycin) for 6 weeks.

Afterwards, she underwent diagnostic esophagoscopy which proved the presence of the fistula. Repair of tracheoesophageal fistula with pericardial patch interposition through a right thoracotomy was done.

The first contrast study after the repair showed no stricture or leak. The child was discharged home on anti-reflux medication.

The patient initially presented to us about 5 weeks after tracheoesophageal fistula (TEF) repair. She was only allowed to take fluid diet since the day of surgery. On examination, she was healthy and afebrile with clean right thoracotomy wound. An upper GI contrast study showed mild narrowing but good flow of contrast at the repair site with no evidence of stricture. She was allowed full diet with regular follow-up appointments with our outpatient service.

Three months after the repair, the mother reported noticing difficulty swallowing solid foods, choking and some drooling as well. An urgent contrast study (Fig. 2a and b) showed a very tight esophageal stricture.

The patient was admitted on semi urgent basis for esophageal dilatation. Esophagoscopy and attempted esophageal dilatation failed due to failure of passing a guidewire into the stomach. There were multiple foreign bodies that were seen which looked like peanut pieces. Those were retrieved using the optical forceps. Upon retrieval of these foreign bodies, there was some inflammation and bleeding at the esophagus where the foreign bodies were impacted so the procedure was stopped. The patient was given steroids and antibiotics for several days. She was taken again to the theater 4 days later. This time, ureteric dilators were used followed by balloon dilation up to the size 10mm. The patient tolerated the procedure well and recovered uneventfully. She tolerated a soft diet and was discharged on Ranitidine (2mg/kg/day) with an elective readmission for another dilatation in one month.

The patient's second dilatation went smoothly. Savory Gillard dilators were used up to size of 12mm. Six weeks later, the third dilatation was done with reaching up to the size of 12.8mm easily. The last dilatation was done after another 6-weeks interval.

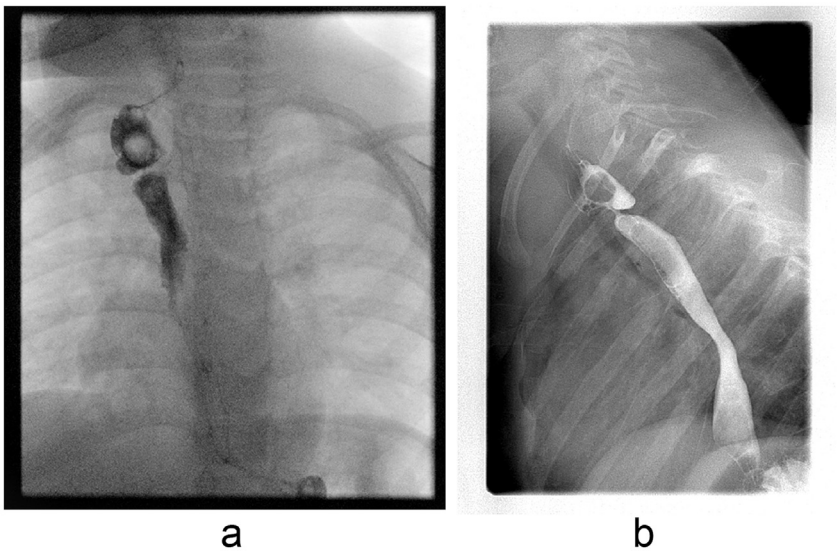

Fig. 2. **a** Esophagogram AP view showing severe narrowing in upper third of esophagus with pre stenotic dilatation and filling defects, possible food particles. **b** Same esophagogram, lateral view.

In total, the patient had four dilatations in the 3rd, 4.5th, 6th, and 8th months post TEF repair. She has been followed-up in the clinic every 4–6weeks for about 20 months now. She continues to be asymptomatic and tolerating all types of food without any issues (Fig. 3).

4. Discussion

Foreign body ingestion is a common encounter in pediatric emergency departments. It is estimated that 80% of all cases of swallowed foreign bodies occur in children between 6 months and 6 years of age [1]. Most of them, 90%, pass through the gastrointestinal tract without any complication [2,3]. According to the American Association of Poison Control Center, 10,213 cases of battery exposures were documented across the United States (US) in 2007 and 53% were by children under the age of 6 years, with a peak incidence between the ages of 1–2 year olds [4]. The 20 mm sized disc batteries seem to carry the most hazard for developing complications. In fact, 12.6% of children who ingested a 20 mm battery suffered severe or fatal injuries [5]. Reported complications of disc battery ingestion include tracheoesophageal fistula, vocal cord paralysis, and esophageal burns with or without perforation and aortoesophageal fistula [6].

Fig. 3. Last esophagogram showing marked improvement at area of stricture with resolution of pre stenotic dilatation.

There are many suggested pathophysiological hypotheses by which ingested disk batteries could affect the esophageal wall. These hypotheses include direct pressure effect, mercury release, and electrical circuit conduction. Direct pressure effect seems to be the least acceptable theory as it can occur with any ingested foreign body and because it cannot explain the really severe outcomes associated with disc battery ingestion [1]. Release of mercury could be a reasonable theory, however mercury poisoning from a battery leakage is only theoretical because digestive enzymes help reduce the mercury to a more stable, less toxic form [1]. Formation of an electrical circuit turns to be the most accepted theory as in vivo studies showed that when a battery was implanted in a rabbit esophagus, tissues in contact with cathode became very alkaline (pH 10.79), and injury was significantly more severe on the alkaline side [4]. This effect is mainly due to the generation of sodium hydroxide ions at the negative pole of the battery caused by the hydrolyzing current through the adjacent tissue. The resulting sodium hydroxide accumulation is comparable to an alkaline caustic injury, leading to tissue liquefaction and necrosis [5].

Although dysphagia and odynophagia are very common after disc battery ingestion, they are nonspecific symptoms. Presentation similar to viral illness like cough, fever, decreased oral intake, difficulty swallowing, sore throat, and vomiting might hinder the diagnosis of cases in which the battery ingestion was unwitnessed. This could explain why some cases were diagnosed days or even weeks after the event [1,5]. The standard radiologic workup for suspected battery ingestion is chest film, in anteroposterior (AP) and lateral views, because of its availability, cost-effectiveness and high accuracy in outlining radiopaque objects [4]. A thorough history from caretakers or potential witnesses plays a major rule in ruling in or out foreign body ingestion. A chest X-ray image should be performed whenever ingestion is suspected, or if foreign body ingestion cannot be ruled out by clinical history [4]. Jatana K et al.

described in detail how to distinguish a disc battery from a coin by a double ring or halo sign on X-ray AP view, or step-off sign on lateral view [5].

Rigid esophagoscopy and removal of the impacted foreign body is the standard of care whereas post-operative medical therapy with high-dose steroids, antibiotics, and anti-reflux therapy is a point of controversy [4]. After diagnosis, endoscopy should be performed as soon as possible to remove the battery and perform a complete exploration of the esophagus to rule out early complications [1]. The assessment includes assessing the extent of the acute injury and the location and direction of the negative pole of battery if possible. This may allow the physician to anticipate the location of delayed complications. In the operating room, airway evaluation with laryngoscopy and bronchoscopy should be considered to evaluate the membranous trachea for acquired tracheoesophageal fistula (TEF). Fluoroscopic removal of esophageal disc batteries with a magnet has been reported, however, this technique fails to assess the site of acute injury after removal [5]. In case of disc battery located beyond the stomach, serial radiographs should be used to monitor its progress through the intestinal tract [1].

After surgical removal of the battery, the patient may be managed by a nasogastric tube if the inflammation is not severe, started on gastric protection treatment with proton pump inhibitors and nil per oral for 3 to 5 days. Then either a contrast study or endoscopy can be performed to rule out any further damage [1]. Long-term surveillance of esophageal strictures and esophageal cancer should be commenced since there is 1000 to 10,000 times higher risk compared to normal population after caustic injury to esophagus [4]. Although severe injuries can occur as early as 2 hours post ingestion, some complications are delayed up to 9 days following battery removal like in TEF, and up to 28 days in aortoesophageal fistulas, and weeks to months in case of esophageal strictures [5].

There are many controversial points in the management of complications of disc battery ingestion. Esophageal stenting (by NG or silastic stent) is used to prevent contact between sides to decrease stricture formation. However, it has not been widely accepted in clinical practice because it may result in esophageal perforation through the damaged tissues. There is no evidence for the use of antibiotic therapy in partial thickness burns resulting from battery ingestion. However, based on animal studies, a significantly higher rate of complications was noticed when steroids were used without concomitant antibiotic administration [4].

In case of acquired TEF, open surgery may be necessary to repair the esophagus and/or trachea. Some cases with severe inability to feed orally may need gastrostomy tube placement [5]. Also, repeated esophageal dilatation maybe needed in case of stricture formation.

Primary prevention is the key to elimination of these serious sequels. The mainstay of prevention is to educate parents on how to create a safe environment at home for their children. One way to achieve this goal is to move tiny objects out of reach of children younger than three years of age. Objects such as bottle caps and controllers' batteries, peanuts, and small part toys also need to be discarded or locked up. Toys that run on disc batteries should be avoided or at least the battery compartment should be secured by a tight screw.

Sometimes, older siblings may facilitate the ingestion of a disc battery or other small objects. That is especially true when the older sibling is left unsupervised with small toddlers or infants. Close supervision of siblings' interactions should be emphasized.

Play bins and safety gates limit the area where the child plays, such limited area can be easely made child safe [7]. When the mother is otherwise occupied doing home chores, small children can be kept in their beds or play bin away from danger.

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