CLINICAL NOTE

Recognition of Esophageal Disc Battery on Roentgenogram

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Pediatric esophageal foreign bodies (FBs) that involve disc batteries are increasingly common. Emergent retrieval may minimize potentially avoidable morbidities, such as esophageal perforation, tracheoesophageal fistula, and death. Management strategies for removal of pediatric esophageal batteries differ from those for retrieval of coins, for example, where serial imaging during a period of observation may be appropriate. Emergency physicians who also practice FB retrieval or advancement in the emergency department setting must be certain that the object is not a disc battery.

Patient history may not include a witnessed ingestion, and the physical examination cannot distinguish coins from batteries. A chest roentgenogram establishes the diagnosis and location of an esophageal FB, while an important finding is often overlooked. That is, the appearance of a disc battery is unique on roentgenogram and must be recognized. The patients with esophageal disc battery ingestion require emergent FB retrieval in the operating room.

With the increasing prevalence of disc batteries in the home, investigators have brought to light the potential dangers of accidental ingestion. Of particular concern are the 20- to 25-mm disc batteries, which have a propensity to become lodged in the esophagus. From 1990 to 1993, large-diameter cells (≥20 mm) represented 1% of all button battery ingestions; in 2008 they represented 18% of all button battery ingestions.[1] During this same period, the number of clinically significant outcomes (moderate, major, or fatal) increased 4.4-fold, from 0.60% to 2.65%.[1] The 20-mm type lithium cell is the most hazardous battery to ingest.[2] The lodged battery produces an external current, causes electrolysis of tissue fluids, and generates hydroxide.[1,3] Hydroxide is basic and can cause liquefactive necrosis of the esophagus.

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Figure 1 and **Figure 2** show an esophageal FB at the cricopharyngeal level in a 13-month-old boy and an 11-month-old boy, respectively. Both FBs were round, radio-opaque, asymptomatic, and the ingestions were unwitnessed. The FB in Figure 1 is a penny. The FB in Figure 2 has a distinct inner rim, which represents the anode side of a disc battery. The FB in the 13-month-old boy (Figure 1) could have been managed either by retrieval or expectantly, whereas the 11-month-old boy (Figure 2) required emergent retrieval. Operative findings of the 11-month-old boy 4 hours after disc battery ingestion revealed a leaking 20-mm lithium cell (**Figure 3**). A circumferential mucosal burn of the esophagus without perforation was evident 12 cm from the incisors where the FB was lodged (**Figure 4**). A nasogastric tube was passed atraumatically under direct visualization, and its final position in the stomach was confirmed by intraoperative radiography.

Symptomatic patients, regardless of the esophageal FB being a coin, battery, or a different object, undergo retrieval. Asymptomatic esophageal batteries also warrant retrieval because of the potential for severe and avoidable morbidity. The dilemma in treatment arises for the asymptomatic esophageal FB because (1) there are potential complications associated with esophageal FB removal; (2) retrospective

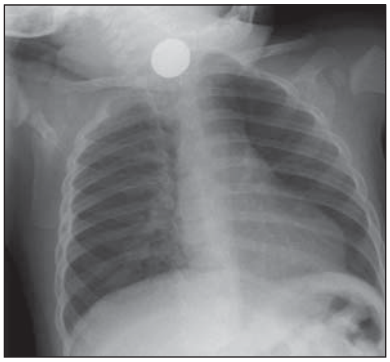

Figure 1. Round, radiopaque esophageal coin in a 13-month-old boy.

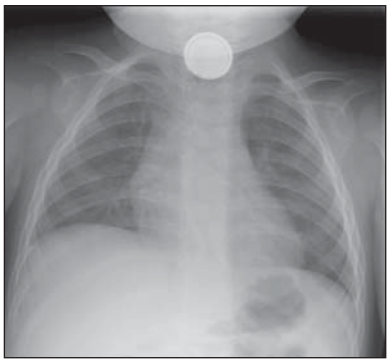

Figure 2. Round, radiopaque esophageal disc battery in an 11-month-old boy. The distinct inner circle on the foreign body represents the anode side of the disc battery.

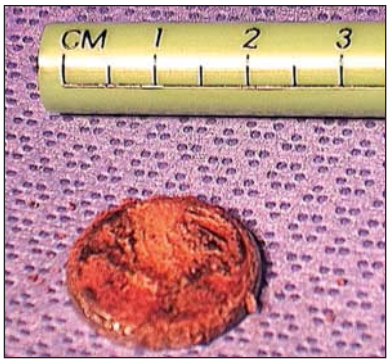

Figure 3. A 20-mm disc battery shows leakage.

data suggest that spontaneous passage of the esophageal coins into the stomach occurs about 30% of the time; and (3) regardless of coin size, 50% pass into the stomach by 6 hours after ingestion and the remainder by 19 hours.[4] These data, however, must not be extrapolated to suggest the same management strategy for asymptomatic esophageal batteries. Yardeni et al[5] reported the case of a 7-year-old boy with a disc battery lodged at the proximal two-third and distal one-third esophageal junction. Retrieval was delayed 6 hours during

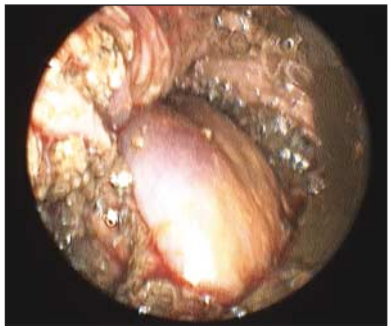

Figure 4. Circumferential alkaline injury revealed on rigid esophagoscopy after removal of a 20-mm disc battery, about 4 hours after ingestion.

transport to the treating hospital, and mucosal burns involving two-thirds of the esophageal circumference were noted. This suggests that esophageal batteries should not be managed expectantly, even if it is in the distal esophagus. Thus, a noninvasive, cost-effective, and accurate method to distinguish an esophageal battery from a coin is critical in directing patient treatment.

The literature acknowledges that coins mimic the shape, size, and contour of disc batteries, which can make them undistinguishable (to radiologists and otolaryngologists).[6] Although 20- to 25-mm disc batteries have similar dimensions to coins (eg, a US nickel is 21.21 × 1.95 mm [www.usmint.gov]), the appearance of a disc battery is unique on a roentgenogram. The battery anode appears as a distinct inner circle that is readily identified (Figure 2). This distinction must be appreciated early to avoid delays in treatment. A chest roentgenogram is a simple, effective, and readily available tool that can make the diagnosis of esophageal batteries.

In 2008, Lee et al[7] asked 14 otolaryngologists (attending physicians and residents) and 9 radiologists (attending physicians and residents) to distinguish between a coin and battery on anteroposterior roentgenograms using a plain background. They reported that the sensitivity in detecting a battery was 80.4%; specificity, 79.1%; false-positive rate, 20.9%; and false-negative rate, 19.6%. These data imply that, even with prompting to look for a battery, about 1 in 5 batteries would not be correctly identified. With further prompting of the otolaryngologists by asking them whether they would take the theoretical patient to the operating room based on the roentgenogram, then the sensitivity increased to 94.4%, and the corresponding false-positive rate increased to 32.9%.[7] Given the dangers of missing an esophageal battery, a higher false-positive rate may be acceptable.

Another area of interest is that some emergency medicine physicians are managing pediatric esophageal FBs in the emergency department setting. Bhargava and Brown[8] reported that emergency medicine physicians successfully retrieved 96 of 101 radiographically confirmed esophageal coins (95%). Similarly, Arms et al[9] reported successfully advancing 355 of 372 esophageal coins with bougienage into the stomach (95%). These approaches seem reasonable if it is certain that the FB is not a disc battery. Discovery of a disc battery at the time of retrieval in the emergency department setting, for example, may render complete esophageal evaluation and treatment of any esophageal injuries difficult or impossible.

Animal studies of battery-induced esophageal injury suggest that damage is possible as early as 1 hour after ingestion and perforation by 8 hours.[10,11] Tissue damage is mediated by leakage of an alkaline electrolyte, pressure necrosis, and tissue fluid electrolysis to generate hydroxide at the anode.[2,3] Recommendations for esophageal FB removal emergently[12] when a battery is suspected or at least by 2 hours after ingestion[1,2] are certainly appropriate.

In conclusion, pediatric ingestion of large (20-25 mm) disc batteries has increased 18-fold in the past 25 years.[1] These batteries must not be mistaken for coins since esophageal damage occurs as early as 1 hour after ingestion in animal models.[10] The case presented herein (Figures 2-4) demonstrates that circumferential mucosal burns in the esophagus are possible at 4 hours after ingestion. The battery anode appears as a distinct inner circle on roentgenogram, and this feature must not be overlooked (Figure 2). Thus, a chest roentgenogram early in the treatment of patients with sus-

pected esophageal FBs can help identify battery ingestions and prompt emergent retrieval. When in doubt, retrieval of the esophageal FB in the operating room is advised.

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