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Review article

Pediatric button battery injuries: 2013 task force update

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ABSTRACT

Over the last 10 years, there has been a dramatic rise in the incidence of severe injuries involving children who ingest button batteries. Injury can occur rapidly and children can be asymptomatic or demonstrate non-specific symptoms until catastrophic injuries develop over a period of hours or days. Smaller size ingested button batteries will often pass without clinical sequellae; however, batteries 20 mm and larger can more easily lodge in the esophagus causing significant damage. In some cases, the battery can erode into the aorta resulting in massive hemorrhage and death. To mitigate against the continued rise in life-threatening injuries, a national *Button Battery Task Force* was assembled to pursue a multi-faceted approach to injury prevention. This task force includes representatives from medicine, public health, industry, poison control, and government. A recent expert panel discussion at the 2013 American Broncho-Esophagological Association (ABEA) Meeting provided an update on the activities of the task force and is highlighted in this paper.

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1. Introduction

Injuries related to button batteries in children have been a problem for several decades [1–3]; however, a dramatic rise in severe or fatal outcomes has occurred [4]. In the United States, a child may be seen in the emergency room with a battery related complaint as often as every 3 hours [5]. This has prompted increased attention to this issue. There are more and more consumer electronics available today that are powered by button batteries. Many of these batteries are 20 mm or greater and contain 3 V, making them large enough to get stuck and more powerful, leading to more severe injuries in children. In fact, 12.6% of children who ingested a 20 mm battery suffered severe or fatal injuries [6]. Furthermore, it is typical in nearly all households, to find several button battery-powered devices and button batteries themselves.

To develop prevention strategies for pediatric battery ingestions, battery ingestions ($N = 3989$) reported to the National Battery Ingestion Hotline (NBIH) with known battery source, occurring in children younger than 6 years, were analyzed [6]. In these young children, 61.8% of ingested batteries were most often obtained directly from the product by the child, 29.8% were loose, sitting out or discarded, and 8.2% were obtained from battery packaging.

Until safer battery technology is developed and common in the market place, securing the battery compartment of the product is the single most important intervention required to prevent battery ingestion injuries. Parent and caregiver education is needed to eliminate those left out, loose. Finally, battery package redesign with child-resistant packaging enclosing each battery in the package has the potential to further reduce ingestions.

Knowledge of the intended use of the ingested batteries also helps us direct our prevention efforts. While hearing aid batteries lead the list when all battery sizes are considered (31% of ingested batteries reported to NBIH from July 2010 to June 2012), these batteries are smaller (7.9 or 5.8 mm in diameter), thus pose a risk of nasal cavity or ear canal insertion, but much less risk when swallowed. In contrast, during this same period, the most common intended use of ingested 20 mm lithium cells was remote control devices, implicated in 36.2% of cases, and not surprisingly readily-accessible to young children. Other ingested 20 mm lithium cells were intended for games and toys (13.1%), watches and stopwatches (8.5%), flameless candles (7.7%, ironically this "safer candle" introduces another hazard), bathroom and kitchen scales (3.8%), and key fobs (3.1%). Less common uses remind us that these dangerous batteries are everywhere, as evidenced by ingestions of 20 mm lithium batteries intended for book lights, calculators, garage door openers, glucometers, talking books, timers, lighted jewelry, digital thermometers, music players, and cameras.

To effectively mitigate injuries, a formalized, multi-disciplinary national task force was established in 2012 and includes members of the American Broncho-Esophagological Association (ABEA), American Academy of Pediatrics (AAP), American Academy of Otolaryngology-Head and Neck Surgery (AAO-HNS), American College of Surgeons (ACS), American Society of Pediatric Otolaryngology (ASPO) and representatives from industry, government, poison control, and public health.

The *Button Battery Task Force* has been divided into subcommittees including industry re-design, education, government relations, and funding/finance. The goals stem from a multi-prong strategic approach:

(1) Outreach and education of medical and non-medical community: Can we increase awareness of this issue?
(2) Button battery compartment design: Can these be more secure?
(3) Electronic product and button battery warning labels: Can these be made more effective?
(4) Button battery packaging: Can this be as safe as possible to limit a child's direct access from packaging?
(5) Button battery design: Can we eliminate the hazard by making the battery safe?

The taskforce established a central mission statement:

A collaborative effort of representatives from relevant organizations in industry, medicine, public health and government to develop, coordinate and implement strategies to reduce the incidence of button battery injuries in children.

In this report, we provide an update on pediatric button battery injuries and outline the strategies of the task force based on a recent expert panel of the taskforce at the ABEA meeting in Orlando, FL.

2. Clinical diagnosis

When caretakers do not witness the event, foreign body ingestion (including button battery ingestion) can be a difficult diagnosis for physicians to make, as the symptoms are similar to other common viral illnesses seen in children. Symptoms of cough, fever, decreased oral intake, difficulty swallowing, sore throat, vomiting can be seen with both situations. Not every child with any of these symptoms will have an X-ray performed looking for a foreign body. With button battery ingestion, the challenge is that the clock is ticking, and injury can occur from the moment the battery is placed within the body. In as little as 2 hours, severe injury can occur. Even when a witnessed button battery ingestion occurs, it can be very difficult to get that child to an emergency room and taken to surgery for removal in less than 2 hours. When diagnosed at non-pediatric facilities, prompt communication and expedited transfer to a capable facility is imperative; an alert to the accepting surgical team can help avoid any further delay. The current NBIH triage and treatment guideline (Fig. 1) focuses on the 2 hours window during which esophageal batteries must be removed to avoid serious esophageal damage. The algorithm urges providers to X-ray immediately to exclude an esophageal position for ingested batteries and to remove those batteries expeditiously [4]. While all children 12 years and younger who have ingested a battery must get an X-ray immediately, whether symptomatic or not, older patients who ingest a single battery that is 12 mm in diameter or less need not have an initial X-ray if completely asymptomatic (assuming no co-ingested magnet, no pre-existing esophageal disease and reliable follow-up is possible). When the ingested battery diameter is unknown or uncertain, an X-ray is always indicated. It is important to consult the guideline for specific nuances of case management.

3. Radiographic diagnosis

X-ray imaging is essential to make the diagnosis of button battery ingestion and confirm the exact location in the body. When looking at any round, opaque foreign body on anterior–posterior X-ray, it is useful to *zoom in* and look for a *double ring* or *halo sign* to distinguish it from a coin (Fig. 2), [7]. The lateral X-ray can be helpful if a *step-off* can be noted, as seen with some batteries, however, there are some slimmer designed batteries on the market now that may not be distinguishable from a coin on a lateral image alone (Fig. 3). Close inspection of the imaging is important to quickly make the correct diagnosis. The negative or narrower