

Responding Faster to Prevent Severe Damage Caused by Button Battery Ingestions: Recommendations for Action

Summary

In the United States, approximately **3,500 children** are treated annually in emergency departments for **button battery ingestions**. Despite education and prevention efforts by national organizations, rates of **serious and fatal outcomes** due to ingestions continue to rise dramatically. It is paramount that **diagnosis and surgical extraction are expedited** to prevent serious clinical outcomes once a battery is ingested. At Connecticut Children's, the addition of button battery ingestions to the **Critical Airway Response Team (CART) activation protocol** has led to a more than **50% reduction** in time from diagnosis to battery extraction. We recommend that emergency departments adopt management algorithms for this indication to facilitate prompt surgical removal.

The Problem Posed by Button Batteries

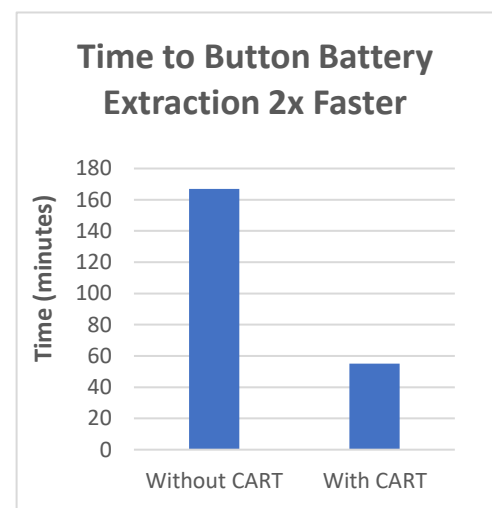
Lithium cell batteries, often referred to as button batteries, have been a known childhood hazard for the past 30 years. When ingested, button batteries are a surgical emergency increasingly associated with significant morbidity and mortality. Approximately 3,500 ingestions are reported annually in the United States and while rates of ingestion have remained relatively stable, the National Capital Poison Center reported a seven-fold increase in the percentage of severe injuries and fatal outcomes between 1985-2009.^{1,2} This rise correlates with the increase in availability of electronics containing larger-diameter, higher-voltage lithium batteries. The American Broncho-Esophageal Association created the Button Battery Task Force in conjunction with the American Academy of Pediatrics in 2012 with a mission to reduce button battery injuries in children. Despite their public education and prevention efforts, ingestions of button batteries and serious injuries continue to occur. Thus, while prevention efforts continue, many have turned their focus to developing early intervention strategies to mitigate esophageal injuries.³

One study showed that ingestions were unwitnessed in 92% of fatal and 56% of serious outcomes. The same study demonstrated that providers initially misdiagnosed 54% of fatal cases and 27% of serious cases because of their non-specific presentations.² These statistics clearly illustrate the challenges in injury reduction once ingestion has occurred.

Life Threatening When Swallowed

Button batteries are now 3.0V, compared to a 1.5V variant that was once more common. We know from animal studies that a chemical reaction in the esophagus, caused by the charge in the battery, is responsible for causing the tissue damage associated with button battery ingestion.⁴ The electrical current generates hydroxide ions within the esophageal tissue which quickly raises the pH leading to caustic injury and necrosis that can persist after the battery is removed. Given the higher voltage of newer batteries, serious injury can start as soon as 15 minutes after ingestion.⁴ Even used batteries have been shown to lead to significant injury. Serious injury can also occur when button batteries are lodged in the nose or ears.

Button batteries can be found in nearly every home in a variety of electronic devices including (but not limited to) games and toys, remote controls, flameless candles, hearing aids, bathroom scales, watches and electronic



jewelry, musical greeting cards and key fobs⁵. In many electronic devices, button batteries can be easily removed by children. The large diameter batteries make it more likely to get stuck when ingested, this is especially true in children under six years of age in whom data suggest 12.6% experienced a severe outcome³. Unfortunately, many ingestions by children are not witnessed by an adult and children may initially be asymptomatic or have symptoms that are non-specific. This can lead to a delay in diagnosis and management.

Diagnosis and Treatment

At Connecticut Children's, we have established a clinical management algorithm and a STAT protocol for expeditious management. This involves activation of our Critical Airway Response Team (CART) when a button battery ingestion is diagnosed or suspected. This immediately alerts the anesthesia, pediatric surgery, ENT and GI teams of an ingestion and expedites their evaluation and subsequent extraction of the ingested button battery. Preliminary review of internal data reveals a >50% decrease in time to battery extraction, from 167 minutes ($n=14$) to 55 minutes ($n=3$) on average, since the initiation of the CART activation process (see the figure on page one). Providers can make a diagnosis by x-ray and seeing a circular object with a "double-halo" sign on the A-P (front-to-back) view or the "step-off" sign on the lateral view, which differentiate a button battery from a coin or other object.

Recommendations for Action

Recognizing that identification and extraction are key to the prevention of severe or fatal injury following a button battery ingestion, we recommend the following actions:

1. Medical centers should adopt a button battery ingestion clinical management algorithm which includes early activation of a critical response team. This may decrease the overall time to battery extraction which is the key to minimizing the significant clinical sequelae.
2. Providers caring for patients with button battery ingestion should contact the Poison Center or National Battery Ingestion Hotline to report the ingestion to allow for improved national data collection.
3. Primary care providers should include discussion of button battery ingestions in their anticipatory guidance to parents of young children during their well child visits – to raise awareness about the dangers of button batteries and to reinforce the need to get immediate medical attention if an ingestion is suspected.

Additional considerations: If there is a witnessed ingestion at home, swallowing a small amount of honey will reduce the alkali effect and may reduce the degree of injury.⁶ When ingestion occurs, clinicians should report the occurrence to the National Battery Ingestion Hotline at (202) 625-3333 with the size/type of battery, source of battery ingestion and all clinical data.

REFERENCES

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The Connecticut Children's Health Brief series represents evidence-based recommendations that are intended to impact practices that support the optimal health and welfare of children and families. Questions regarding this Health Brief can be directed to Kevin Borrup, DrPH, JD, MPA, Editorial Board Chair, Connecticut Children's Office for Community Child Health, at HealthBrief@connecticutchildrens.org.