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When Button Batteries Become Breakfast: The Hidden Dangers of Button Battery Ingestion

Mollie K. McConnell BScN (Honors), MSN, NP - Paediatrics*

Division of Paediatric Emergency Medicine and Division of Paediatric Medicine, The Hospital for Sick Children, Toronto, Ontario, Canada

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Injuries due to button battery ingestion continue to evolve with worsening clinical outcomes reported in recent years. These batteries pose a unique hazard to children due to the severity of complications that may arise within a short period of time as well as their availability in almost every home environment in the United States. It is crucial that health care providers maintain a high level of clinical suspicion for foreign body ingestion and facilitate rapid triage and treatment in these cases. Nurses should educate all children and families about button battery safety to prevent injury and decrease the morbidity and mortality related to ingestion.

FOREIGN BODIES ARE a common presenting complaint at primary care offices, emergency rooms and urgent care centers worldwide. The majority of these items are present in external orifices such as the nose, ears, or vagina (Slapak, Passali, & Gulati, 2012). A lesser percentage are ingested, which has been increasing in recent years due to the prevalence of small parts in electronic toys (Amantidou et al., 2011; Gregori et al., 2008). In 2010, the American Association of Poison Control Centers received 116,659 telephone calls from patients and health care providers related to foreign body ingestions (Bronstein et al., 2011). This number may not reflect the absolute incidence of events as the majority of foreign bodies pass spontaneously without intervention and may remain unrecognized or undiagnosed. Foreign bodies are usually benign and cause serious morbidity in less than 1% of cases (Kay & Wyllie, 2005). The potential for harm related to foreign bodies should not be underestimated, however, as they continue to be responsible for over 1500 deaths per year in the United States (Chung, Forte, & Campisi, 2010).

Foreign Bodies and Developmental Milestones

As infants grow and begin to explore their environment through reaching and grasping, foreign bodies become increasingly dangerous. As soon as a fascinating object such as a rattle is grasped, the baby will bring the object to their mouth for further exploration. Hand-to-mouth activity is one of the primary mechanisms that young infants utilize to connect with their surroundings and experience the world around them (Boynton, Dunn, Pulcini, St. Pierre, & Stephens, 2010). Unfortunately, as infants grow and become increasingly mobile, the risk of foreign body ingestion substantially increases. Any small object within their indoor or outdoor environment such as a dropped peanut on the kitchen floor or a pebble in the sandbox becomes a potential danger (Boynton et al., 2010).

Ingestion of a foreign body is most likely to affect children between the ages of 3 months and 6 years with a slight predominance of males (Chung et al., 2010). Repeated

* Corresponding author: Mollie K. McConnell BScN (Honors), MSN, NP - Paediatrics.
E-mail address: mollie.mcconnell@sickkids.ca.

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foreign body ingestions are more common in children with a history of pica or developmental delay (Srivastava, 2010). The most frequently ingested objects include coins, earrings, marbles, barrettes and rocks. These items often pass spontaneously and cause few long term sequelae.

Unfortunately, not all foreign bodies are as benign. The incidence of button battery ingestion in the United States is rising (Yardeni, Yardeni, Coran, & Golladay, 2004). This hazardous item accounts for 2% of all foreign body ingestions and was responsible for 13 deaths between 1977 and 2009 (Litovitz, Whitaker, Clark, White, & Marsolek, 2010b; Mortensen, Hansen, & Schiodt, 2010). The recent rise in mortality from button battery ingestion is alarming with 9 of these 13 deaths occurring between 2004 and 2009 (Litovitz, Whitaker, & Clark, 2010a).

What Is a Button Battery?

Button batteries (Figure 1) are disc batteries that are popular due to their increased energy and voltage capacity, resistance to thermal extremes and electrochemical stability (Litovitz et al., 2010a). Button batteries are more commonly ingested than cylindrical batteries possibly due to their small size and lightweight nature (Litovitz et al., 2010a). These batteries pose a unique hazard to children due to the severity of complications that may arise within a short period of time as well as their availability in almost every home environment in the United States. Battery ingestion is more concerning than ingestion of other objects of a similar size and shape, such as a coin, due to their electrochemical composition and resulting trauma to local tissue (Marom, Goldfarb, Russo, & Roth, 2010).

Mechanism of Injury

When a button battery is ingested, there are four primary means by which it damages the local tissue leading to erosion, perforation and even death (Chouhan, Yadav, & Bakshi, 2011; Litovitz et al., 2010a). These are (a) the generation of an electrical current, (b) leakage of battery contents, (c) local pressure and (d) heavy metal toxicity (Chouhan et al., 2011; Litovitz et al., 2010a).

Figure 1 Button Battery. Note. Adapted from Wikimedia Commons, Retrieved from https://upload.wikimedia.org/wikipedia/commons/5/53/LR44_Button_Cell_Battery_IEC_Standard_Version.jpg.

Generation of an electrical current is the primary mechanism by which button batteries cause serious and even fatal sequelae (Litovitz et al., 2010a). This low voltage, direct current is immediately potentiated upon the battery's contact with the moist environment of the gastrointestinal tract and travels between the two poles, or anode and cathode, of the battery (Leclerc, 2003). This direct current leads to the creation of hydroxide ions in adjacent tissue which subsequently results in an electrical burn and severe, focal tissue destruction (Chung et al., 2010).

The moist environment of the GI tract also liberates the contents of the battery, an alkaline electrolyte solution (Leclerc, 2003). Leakage of battery contents does not require disruption of the external casing and occurs almost instantaneously upon contact with a moist environment (Samad, Ali, & Ramzi, 1999). Over time, this alkaline solution causes liquefaction necrosis and caustic injury at the site of battery impaction, contributing to ongoing tissue damage (Leclerc, 2003).

Physical pressure has also been implicated as cause of tissue trauma and necrosis after button battery ingestion. The majority of batteries will traverse the GI tract without incident. Those that become entrapped, however, place pressure on adjacent tissue structures. Pressure alone does not generally lead to extensive tissue damage but may compound the other deleterious effects of button battery ingestion (Litovitz et al., 2010a).

While the most detrimental effects of button battery ingestion are related to local tissue trauma and erosion, there remains a risk of systemic poisoning (Litovitz et al., 2010a). Heavy metal toxicity is theoretically plausible due to the potential for battery degradation and systemic absorption via the gastrointestinal tract. According to an in vitro study by Rebhandl et al. (2002), a button battery submerged in simulated gastric contents will begin to defragment within 24–72 hours with perceptible amounts of toxic metal present after just 4 hours.

Common button batteries are composed of various materials including zinc, alkaline manganese, silver oxide, mercuric oxide and lithium. In 2004, Mallon, White and Thompson published a case report of a 5-year-old boy with a transiently increased blood lithium level after ingesting a button battery (Mallon, White & Thompson, 2004). Although there was no adverse outcome or additional treatment required in this case, it demonstrated systemic absorption of battery ingredients from the gastrointestinal tract and supports the theoretical risk of lithium toxicity in children that have ingested lithium batteries. Currently, routine blood levels of battery ingredients to monitor serum concentrations are not recommended (Litovitz et al., 2010a). This is controversial, however, and there is variation in practice among clinicians.