Australian Paediatric Surveillance Unit
STUDY INFORMATION SHEET
Severe Injury Related to Disc Battery (SIRDB)

COMMENCED
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BACKGROUND

There has been an increasing trend in the number of reported severe and fatal disc battery exposures in children and adults in the United States[1]. This has paralleled the increasing utilisation of these compact batteries in domestic products. Having initially reported that the majority of batteries (if ingested) pass uneventfully, researchers have subsequently identified higher risk of severe injury or death associated with larger disc batteries (3V in strength and greater than 20mm in diameter)[1].

The mechanism of injury from impacted disc batteries involves generation of hydroxide ions at the negative pole of the battery causing liquefactive necrosis of surrounding tissues. The effects of this process are particularly severe when a disc battery is lodged in one location (e.g. oesophagus, nostril) for more than one hour. Almost all deaths described have been associated with ingestion, oesophageal lodgement and erosion into the aorta or other large vessel and subsequent massive haemorrhage. To date there have been 3 deaths of children in Australia due to aorto-oesophageal fistulae (in 2013, 2015 and 2020), and a report of one child who survived this serious complication[2,3,4].

Poisons information centres and Emergency Departments (EDs) in Australia have seen increasing numbers of children presenting with possible battery exposures. The majority are able to be discharged (either no battery is demonstrated on x-ray or a small to medium sized ingested battery is in the stomach and allowed to pass). For children with a battery lodged in the oesophagus, expedited removal within 2-4 hours can minimise damage, but perforation has been described within 2 hours. Caustic injury can persist and fistula development can occur up to a month after battery removal [4]. Recent studies in the US and Australia has shown that for oesophageal batteries, first aid with oral honey/jam and irrigation in theatre of dilute acetic acid can mitigate the caustic effect[5,6,7]. Both treatments have been incorporated into the US National Battery Ingestion Guidelines[8] and are becoming standard practice in Australia. Not all children tolerate honey/ jam, particularly where the battery is in the proximal oesophagus. Honey is contraindicated in infants 12 months due to the risk of botulism.

A small subset of children have sustained severe injury when the battery ingestion/ insertion is unrecognised by the parents/carers and the battery remains in situ for days. These children present with non-specific symptoms (cough or grunting, drooling, vomiting, refusal to feed, nasal/ear discharge). Identification of the battery insertion/ingestion is complicated in that many of these children are pre-verbal. In addition, pre-mobile children (not usually thought to be at risk of foreign body ingestion) have sustained battery related injury, presumably after being 'fed' the battery by a sibling. Whilst 20mm or larger batteries are most likely to lodge in a child's oesophagus, small to medium sized batteries have also resulted in severe oesophageal injury [9].

Identification of the battery exposure can be further complicated by failure to distinguish between a coin and a battery on x-ray. Disc batteries appear on x-ray to have a distinct radiolucent ring around the perimeter, but this feature is dependent on the penetration (windowing) and, at times, the battery may be almost

indistinguishable from a coin. This has implications for the priority with which removal of the foreign body is planned.

Update:

The SIRDB commenced data collection in December 2017. In 2020, Australia became the first jurisdiction globally to implement regulation aimed at restricting access to button batteries from packaging and products[10]. The regulation specifies that:

- Consumers are advised about the button battery hazard at point of purchase
- Button batteries are sold in child-resistant packaging
- Products that contain button batteries are durable
- Button battery compartments in products are child resistant

Suppliers will need to comply with the new regulation by 23rd June 2021, but there will be a long legacy of older batteries and products in homes.

In 2021, Duracell™ released a new bitterant coated battery with the aim of deterring ingestion. The bitterant is applied to one side of their 20mm batteries. There is evidence to suggest that application of a bitterant to a 'one gulp' poison is unlikely to reduce the incidence or severity.[11] Genetically not everyone can taste the bitterant, so for some children this will offer no protection.

In 2022, The US followed suit in enacting Reese's law (named after a young girl who died after ingesting a BB).[12] The regulations place similar durability, accessibility (packaging and products) and warning requirements on suppliers of button batteries and the products that use them.

In Aug, 2024**,** Energizer is launching a new design for their 20mm batteries with bitterant on one side (like the Duracell battery) as well as a blue indicator dye that is triggered by moisture. This has the potential to expedite diagnosis, though there are still likely to be logistic challenges in getting children to a definitive point of care for battery removal. It is important to note that absence of blue dye does not mean no battery has been ingested. It remains unclear how well this system will work in real life, and the majority of button batteries (both Energizer and other brands) do not have the indicator.

Deliberate self harm:

Button batteries (and other batteries) are increasingly becoming a tool for deliberate self-harm, particularly amongst young girls and women, who ingest them or insert them into their vagina. Alternative batteries with sufficient residual charge are also capable of causing severe caustic burns and fistulisation into adjacent structures. Many of these patients are frequent representers to health services.

Collation of these deliberate ingestion/insertion cases will facilitate advocacy for safer inherent battery design such that caustic damage does not occur. The case definition does not exclude deliberate BB exposures.

STUDY OBJECTIVES

1. To estimate the incidence of SIRDB in Australian children aged <16 years.
2. To describe the types of serious injuries sustained by children due to disc batteries.
3. To describe the demographic features of children injured (ethnicity, age, sex).
4. To describe the type of battery associated product and how the battery was accessed.
5. To formulate recommendations for the prevention of severe injury related to disc batteries.
6. To monitor the impact of advocacy, regulation and innovation on the frequency and severity of SIRDB.

CASE DEFINITION:

Please report any child < 16 years of age with newly diagnosed injury related to disc or button battery ingestion or insertion that required procedural intervention either to remove the battery or to assess or repair damage related to the battery.

Exclusions:

Please do not report cases where the battery has been ingested/inserted and it has passed/fallen out of the patient **unless** the patient required a procedure to remove the battery or to assess or repair damage related to the battery.

FOLLOW UP OF NOTIFICATIONS:

Clinicians notifying a case of severe injury related to disc battery will be requested to complete a brief survey at presentation and at a 3-month follow-up about the child's longer term outcomes. If the 3 month follow-up survey indicates that additional imaging and/or procedures are planned for the child, then clinicians will be requested to complete an additional follow-up survey at 6 months after the initial presentation.

PRINCIPAL INVESTIGATOR

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FURTHER INFORMATION

For further information related to this study or assistance completing the Case Report Form, please contact the APSU by email at SCHN-APSU@health.nsw.gov.au

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