

Honey Limits Caustic Effect of Ingested Button Batteries

Diana Phillips

June 12, 2018

Honey can reduce the risk for serious injury resulting from button battery ingestion and should be given as soon as possible and frequently after a battery has been swallowed, research shows.

Using live and cadaver animal models, Rachel R. Anfang, MA, from the Division of Otolaryngology at Children's Hospital of Philadelphia, Pennsylvania, and colleagues, evaluated the protective effect of honey, as well as common low-acid household beverages and the ulcer medication *Carafate* (Allergan), against corrosive damage caused when a button battery makes contact with esophageal tissue. Both honey and Carafate slowed the discharge of the button battery, neutralized the increased tissue pH at the battery contact site to clinically optimal levels, and protected against deep tissue injury, the authors report in a study [published online](#) June 11 in *The Laryngoscope*.

Button battery injuries are becoming increasingly common and more serious, both because these batteries are highly prevalent in today's small electronics and because the latest generation of them are smaller and more powerful than ever, the authors explain.

"Over 3,000 button battery (BB) ingestions are reported annually in the United States. Although this comprises a small fraction of pediatric foreign bodies ingestions, BB contribute a serious risk of morbidity and mortality with the problem only worsening," they write. "There was a 5.8-fold increase in major injuries and a 12.5-fold increase in fatal outcomes in 2006 to 2017 versus 1994 to 2005."

Children under 6 years of age, lured by the shiny, candy-like appearance of the small batteries, are at highest risk for reported ingestions, Anfang and colleagues note.

To investigate potential options for mitigating damage during the interval between ingestion and endoscopic removal, the researchers evaluated the pH-neutralizing effect of weakly acidic viscous solutions on the progression of irritation in juvenile porcine cadaveric esophagi and in the esophagi of live piglets, taking measurements before button battery contact and after its removal. In the in vitro experiments, the esophageal segments were exposed, every 10 to 15 minutes, to various types of honey, Carafate, apple juice, orange juice, various sports drinks, maple syrup, simulated saliva, and a 0.9% sodium chloride control. In the in vivo study, serial irrigations via laryngoscope with saline, Carafate suspension (1 g/10 mL), or Gunter's Pure Clover Honey took place every 10 minutes over a 60-minute timeframe, during which the button battery remained in place.

The analysis of the in vitro segments showed that only honey and Carafate neutralized the increased tissue pH at the battery application site to clinically optimal levels and statistically significant degrees relative to the saline control.

"This held true with their ability to reduce injury severity on cadaveric tissue," the authors report. They note that the saline-treated tissue maintained a highly alkaline pH and caused greater tissue damage.

Similar results were observed in the in vivo study. "Honey was more effective than Carafate, and both were significantly better than saline at slowing the discharge of the BB and neutralizing the tissue pH increase," the authors report.

And whereas there were no significant differences in the surface ulcer area across the in vivo samples, injury severity differed substantially. "Half of the control animals developed delayed esophageal perforations, whereas, no honey- or Carafate-treated animals experienced this severe complication," the authors write. "Assessment of the HE [hematoxylin and eosin]-stained sections revealed significantly greater depths of dead necrotic tissue, and healing granulation tissue [was] present at significantly deeper levels in the control than in the two treatment groups."

The control tissue also showed the most extensive destruction of the deep muscle layer of the esophagus, the authors state. "Interestingly, the tissue injured was not localized to the area directly beneath the ulcerated surface mucosa. All groups experienced destruction in the muscularis propria extending beyond the visible surface injury with a significantly higher degree found in the control group."

Further analysis showed more extensive coagulative necrosis and damage to the muscle with saline and denser reparative collagen fibrosis in areas of severe injury with honey and Carafate.

These findings suggest that extensive injury in the adjacent deep muscle beyond the small surface ulcer margins leads to structural failure of the tissue in the ulcer area, which in turn leads to "surprisingly large perforations with minimal outward extension of the deep muscle injury," the authors write. "[T]his study highlights the increased risk the control group has for developing perforating injuries, and other severe complications, from a BB insult. In comparison, honey and Carafate were effective at blunting injury progression by changing the injury pattern to a more favorable one."

Given the danger of esophageal button battery impactions — serious damage, such as esophageal perforation, vocal cord paralysis, and erosion into the airway or major blood vessels, can occur within 2 hours of ingestion — the authors suggest early intervention with honey or Carafate suspension for witnessed or suspected early-stage battery ingestion.

"Caution against use should be exercised in cases of delayed diagnosis or late-stage ingestions, where clinical suspicion of perforation, mediastinitis, or sepsis already exists," they write. "Additionally, a history of contraindicated medical conditions, including severe allergy to honey or Carafate and the age of the child if less than 1 year due to the small risk for infant botulism associated with honey, should be considered prior to initiating treatment."

The optimal dose frequency and volume of honey or Carafate may be evaluated in future studies, but the frequency and dose used in this study (10 mL or 2 teaspoons every 10 minutes) are a reasonable benchmark, the authors write. In terms of use, they add, "[t]he honey option is meant for home use and meant to be utilized until a child can get to a health care facility; once at a healthcare facility, Carafate can be utilized until BB removal can occur."

Funding for this study was provided by the Children's Hospital of Philadelphia Frontiers Program Grant. The authors disclose relationships with Intertek, Marpac Inc, the national Button Battery Task Force, the American Academy of Pediatrics, and the American Bronch-Esophagological Association. They have disclosed no relevant financial relationships.

Laryngoscope. Published online June 11, 2018. [Abstract](#)

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Cite this article: Honey Limits Caustic Effect of Ingested Button Batteries - *Medscape* - Jun 12, 2018.