

Aim: To provide guidance for management of children with suspected button battery ingestion.

EXCLUSION GUIDELINES

Patients **excluded** from this guideline:

- Complex chronic conditions
- Esophageal anomalies preceding ingestion
- Co-ingestions
- Unknown duration of ingestion
- No battery seen on imaging

Patient presents with suspected button battery ingestion (Note 1)

Pre-Arrival + Triage

Refer immediately to Children's MN (Minneapolis) ED (do not delay transfer)
If patient is at Children's St. Paul, do not delay OR; if needed, can transfer after removal.

- Call battery ingestion hotline (for support and to report) 800-498-8666
 - *NPO aside from honey/sucralfate.* Avoid ineffective interventions (Note 2)
 - If honey available, give 10 ml PO Q10 min (up to 6 doses) if ≥ 1 yr age
 - May also give sucralfate 10 ml every 10 min up to 3 times
- **Activate standing order for STAT AP and lateral chest X-ray**
- Strongly consider rooming as resuscitation (required if showing any symptoms)
- **Provider to obtain STAT X-ray results to verify location of button battery and if any co-ingestion of magnet**

STAT GI consult: state 'Button Battery Ingestion.' See note 3. Esophageal location OR high-risk ingestion?

Yes

No

Off guideline.
Management per GI. Refer to note 6 for family education

ED management and endoscopy prep

- Move to resuscitation room if not already there
- ENT consult if button battery is in esophagus or airway concerns
- Call RN supervisor to arrange OR for endoscopy (can happen at either campus)
- Keep patient NPO (do not delay procedure for NPO status) *aside from honey/sucralfate*
- Continue sucralfate 10 ml PO Q 10 min (up to 3 doses). Avoid ineffective interventions (Note 2)
- Place PIV and initiate IV fluids
- CBC w/ diff, BMP, PT/INR, PTT, fibrinogen, blood type & cross
- ED RN to complete pre-OR checklist
- If in STP, ED provider to alert the St. Paul HNS for possible transfer to Mpls after OR

OR management

After confirming NO esophageal perforation- irrigate injured area with 0.25% sterile Acetic acid 50 to 150 ml to neutralize residual alkali.

Was there evidence of esophageal injury?

Yes

No

Obtain contrast esophagram and CT angio:

- 48-72 hrs after removal of battery if stable
- Earlier if concern for perforation, bleed (Note 8), or sepsis

Are there signs of perforation on imaging?

Yes

No

- STAT page CT surgery, OR, PICU and blood bank (Note 8)
- *Off-Guideline*

Place NG endoscopically

Admit patient (to MPLS PICU, unless very mild findings and clinically well, then consider MPLS med-surg).

- Standard unit vital signs and cares
- Alert provider STAT for any bleeding, trouble swallowing, respiratory changes
- Daily hemoglobin
- NPO
- Monitor for complications (Note 4, Note 8)

Consider discharge if:

- Patient tolerating oral intake
- No barriers to outpatient follow-up
- Education completed with caregivers on signs to watch for (Note 6)
- Follow-up coordinated (Note 7)

- Ongoing imaging/tests per GI consultant's discretion
- Clear liquid diet. Advance as tolerated to soft diet, for 4 weeks. Remove NG once tolerating soft diet
- May transfer to floor once NG removed, consider discharge criteria (Note 5). Before discharge, ensure education with family complete (Note 6) and follow-up coordinated (Note 7)

Aim: To provide guidance for management of children with suspected button battery ingestion.

Note 1. Signs of possible button battery ingestion include: difficulty swallowing, throat pain, irritability, refusing to eat/drink or loss of appetite, airway obstruction, wheezing, drooling, vomiting, chest discomfort, coughing, choking, gagging. Some patients (~1/3) may have fever. Approximately 1/5 patients will be asymptomatic.

Note 2. Ineffective interventions: Ipecac, blind bougie, blood/urine heavy metal testing, and chelation have not shown to provide benefit in patients with button battery ingestion.

Note 3. Key history to discuss with GI: age of patient, time of ingestion, location of battery, size of battery (≥ 15 mm), magnet co-ingestion (yes/no), vomiting, dysphagia, choking, gagging, drooling, airway concerns, chest discomfort, refusal to eat/decreased appetite, etc. Consider endoscopy even if battery has passed into stomach.

Note 4. Delayed complications: include tracheoesophageal fistula, esophageal perforation, mediastinitis, vocal cord paralysis, tracheal stenosis or tracheomalacia, aspiration pneumonia, empyema, lung abscess, pneumothorax, spondylodiscitis, or exsanguination from perforation into a large vessel. Severe complications have been estimated in one study at 0.165%, with lethality of 0.04%. Another study (Shaffer et. al.) found severe esophageal complications included stricture (28.6%), perforation (24.5%), tracheoesophageal fistula formation (8.2%), pneumothorax (4.1%), and bilateral true vocal fold paresis (4.1%).

- Monitor for acute complications peri-endoscopy and in the days and weeks to follow for acute and delayed onset of complications.
- The risk of potential complication depends on the location and orientation of Negative pole of the button battery (side without the + sign and without imprint).
 - Negative pole has smaller diameter - Narrower side in the Lateral x ray. (Negative, Narrow, Necrosis)
 - When negative pole facing anterior surface of the esophagus causes TE fistula, esophago-vascular fistula.
 - When facing the posterior wall of the esophagus causes spondylodiscitis.
- During stay in the PICU close monitoring for voice change, stridor and respiratory distress will alert *vocal cord paralysis*.
- Monitor for respiratory symptoms, especially those associated with swallowing, to diagnose *tracheoesophageal fistulas*.
- Expect *esophageal strictures* delayed weeks to months.
- Expect *perforations and aorto-enteric fistulas* to be delayed (98% diagnosed by 48 days after battery removal)
 - Aorto-enteric fistula leads to **rapid exsanguination**. Even with immediate intervention, mortality is very high from this complication. Inpatient monitoring for ~ 4 weeks should be considered in patients felt to be at higher risk and with any barriers to immediate return to care. See Note 8.

Note 5. Discharge criteria

- Recommend social work consult for all patients to aid in consideration for barriers to return to emergent care.
- If family lives > 30 minutes away, barriers to transport, or other psychosocial barriers to rapid return to Children's Minnesota Minneapolis campus, consider in-hospital monitoring for ~ 4 weeks given the risk of catastrophic hemorrhage
 - *Because catastrophic hemorrhage has been seen up to ~4 weeks after battery removal, consideration of the timing of hospital discharge must include the proximity of the family to Children's MN Minneapolis (preferred campus due to the presence of CV Surgery and ECMO)*
- Medical alert bracelet and information magnet given to patient/family by MN GI rounding provider
- School contacted and alerted to things to watch for and what to do (call 911, EMS to take Children's MN-Minneapolis)
- Soft diet x 4 weeks

Aim: To provide guidance for management of children with suspected button battery ingestion.

Note 6. Family education: Watch for any symptoms of respiratory and GI tracts, particularly within the first 4-6 weeks after battery removal.

- Symptoms will vary depending on the complication.
 - Call 911 for any sign of bleeding (coughing/spitting/vomiting blood, blood in stool, black stool), sudden pallor, change in mental status, seizure, trouble breathing, stridor
 - Take to the ED for new cough, trouble swallowing, voice change
- If battery was beyond the stomach and not retrieved, may recommend: regular diet, senna suspension 5 ml Qday until button battery expelled, monitor stool for passage

Note 7. Follow-up

- **If mucosal injury:** See PCP within 7 days of discharge, Follow-up with GI within 1-2 months
- **If no mucosal injury:** See PCP as needed, Follow-up with GI as needed

Note 8: If needed, protocol for acute life-threatening hemorrhage:

- Code Blue
- ECPR activated
- Massive transfusion activated
- Transfer to CVOR

References

1. Button Battery Ingestion Guideline for Health Care Providers. 10 December 2019 ©2010-2020 National Capital Poison Center.
2. Litovitz T, Whitaker N, Clark L, White NC, Marsolek M. Emerging battery ingestion hazard: Clinical implications. *Pediatrics* 2010;125(6):1168-1177.
3. Kramer RE, Lerner DG, Lin T, et al. Management of ingested foreign bodies in children: a clinical report of the NASPGHAN Endoscopy Committee. *J Pediatr Gastroenterol Nutr.* 2015; 60(4):562– 74.
4. Varga, A., Kovacs, T., Saxena, (2018). Analysis of Complications After Button Battery Ingestion in Children. *Pediatric Emergency Care* 34 (6) ISSN: 0749-5161
5. Krom H, Visser M, Hulst JM, Wolters VM, Van den Neucker AM, de Meij T, van der Doef HPJ, Norbruis OF, Benninga MA, Smit MJM, Kindermann A. Serious complications after button battery ingestion in children. *Eur J Pediatr.* 2018 Jul;177(7):1063-1070. doi: 10.1007/s00431-018-3154-6. Epub 2018 May 2. PMID: 29717359; PMCID: PMC5997112.
6. Jatana KR, Barron CL, Jacobs IN. Initial clinical application of tissue pH neutralization after esophageal button battery removal in children. *Laryngoscope.* 2019 Aug;129(8):1772-1776. doi: 10.1002/lary.27904. Epub 2019 Mar 5. PMID: 30835848.
7. Shaffer AD, Jacobs IN, Derkay CS, Goldstein NA, Giordano T, Ho S, Kim BJ, Park AH, Simons JP. Management and Outcomes of Button Batteries in the Aerodigestive Tract: A Multi-institutional Study. *Laryngoscope.* 2021 Jan;131(1):E298-E306. doi: 10.1002/lary.28568. Epub 2020 Feb 18. PMID: 32068903.

Workgroup: Ramalingam, Redmann, Skrypek, Hetzel, Yang, Maslonka, Singewald, Short, Glander. Previous guideline workgroup members: Hester