PEDIATRIC CLINICAL CARE GUIDELINES

Alberta Children's Hospital

Alberta Health Services

TRIAGE AND ACUTE MANAGEMENT OF BUTTON BATTERY INGESTIONS IN CHILDREN

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To view the Alberta Provincial Button Battery Guideline, click this link.

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FLOW CHART

**Click on the heading in the flowchart to be taken directly to the text accompanying that heading*

KNOWN OR SUSPECTED BUTTON BATTERY INGESTION

Patient Presenting to a Peripheral Site

Priority notification of pediatric GI service at ACH

For unstable patients and patients with sentinel bleed, urgent involvement of pediatric GI, pediatric general surgery and PICU via RAAPID South (for patients in and south of Red Deer) 1-800-661-1700 or 403-944-4486

Consider direct transfer to Stollery, in discussion with GI / PICU at ACH if:

1. Unwitnessed/unknown time from ingestion
2. > 12h from ingestion
3. There has been a sentinel bleed in a child in a rural centre
4. There is active bleeding but time to transfer will be similar to either site

Patient Presenting to ACH ED

Stable patient, witnessed ingestion

Give as first line, honey or as second line sucralfate suspension

Proceed with imaging and initial management as outlined in text

Initiate call to pediatric GI ASAP (include button battery in text page)

If > 12h from time of ingestion, discussion with Stollery GI and PICU re: consideration of transfer

Stable patient unwitnessed ingestion/unknown time from ingestion

Honey or sucralfate may be considered on a case-by-case basis *

Proceed with imaging and initial management as outlined in text

Initiate call to pediatric GI ASAP (include button battery in text page)

There should be consideration for transfer to Stollery prior to removal

Gastric location

Honey or sucralfate is not routinely recommended in this case but can be administered until esophageal location is ruled out

Consultation with pediatric GI for all cases of gastric button battery

Sentinel bleed or unstable bleeding patient

Emergent consultation to pediatric general surgery, PICU and pediatric GI (include button battery in text page)

Consider Code 88

Additional consultation to vascular surgery +/- IR will be facilitated by pediatric surgery and PICU

Activate massive transfusion protocol

Obtain IV access and initiate resuscitation as outlined in text

Avoid intubation unless required

Have Sengstaken Blakemore tube available at bedside

If not done previously obtain portable x-ray to determine button battery location

ENT involvement may be indicated on a case-by-case basis if there is suggestion that a rigid endoscopy or rigid bronchoscopy may be required.

<u>Honey and sucralfate dosing</u>:

- As first line, honey 10mL (2 teaspoons) every 10 minutes (up to 6 doses) OR
- As alternative, sucralfate suspension 10mL (1 gram) every 10 minutes (up to 3 doses)

* There may be increased risk of perforation with prolonged esophageal impaction and the use of honey in this instance has not been examined.

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INTRODUCTION

Button battery ingestions have been a problem for decades. More recently, there has been a rise in severe and even fatal injuries as a result.[1] This trend has paralleled an increase in the ingestions involving large-diameter (20-25mm), lithium cells.[1] Not only has the severity of injury evolved with time, but the frequency of button battery ingestions by children has also increased. In the US, battery ingestions accounted for 0.14% of all foreign body ingestions in 1995 and 8.4% in 2015. Button batteries were the most frequently ingested batteries (85.9% of battery ingestions by children).[2]

Button battery ingestions can be devastating due to the production of hydrogen radicals and high pH causing severe caustic injury.[3] Animal models show esophageal injury including the lamina propria and inner muscular layer in as little as 15 minutes.[3] Injury may be ongoing, even after removal of the button battery. Fatal hemorrhage due to aortoesophageal fistula has been reported 18 days after initial ingestion.[4] Although evidence is limited, there is considered to be a greater risk of injury for esophageal button batteries retained greater than 2 hours.

In response to the rise in severe injuries resulting from button battery ingestions, a national Button Battery Task Force was established in the US in 2012. There is ongoing surveillance as well as a management algorithm from the National Capital Poison Center available here: https://www.poison.org/battery/guideline. Professional organizations and individual centres also have developed guidelines for suggested management.[3] [5] At our centre, we regularly encounter patients presenting with button battery ingestion. We are also in a unique setting, with pediatric cardiovascular surgery centralized in the province; these services are 3-hours north by transport. These factors have led to the development of a local guideline to guide the triage and management of button battery ingestions in children. This guideline will ultimately be amalgamated with a province-wide guideline currently in development.

Note: this is a guideline only. Clinical decision making for most appropriate management of patient is suggested, deviations from guideline listed here may be warranted.

TRIAGE AND MANAGEMENT

The majority of serious button battery ingestions are unwitnessed.[1] Consider the possibility of a button battery ingestion in patients with airway obstruction, abnormal respiration, drooling, difficulty swallowing, vomiting, chest pain, abdominal pain, decreased appetite, refusal to eat, coughing or choking with eating or drinking. Button battery ingestion should also be suspected in every patient with a "coin" ingestion. To distinguish a battery from a coin, the x-ray should be carefully assessed for the "halo sign" on magnified PA and "step-off" sign on lateral. An obvious step-off cannot always be seen on lateral image.[6]

Button battery ingestions can cause rapid and serious injury; they should be treated as a surgical emergency. In some instances, patients presenting to a peripheral site should be transferred directly to Stollery Children's Hospital, rather than to the Alberta Children's Hospital. Time from ingestion and suspicion for complicating injury should be considered when deciding to which site transfer should occur.

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Ensure that all button battery ingestions lead to a page to pediatric gastroenterology (include button battery ingestion with text page) if child patient at ACH, to pediatric gastroenterology with inclusion of pediatric intensive care physician if required through RAAPID if child patient at a peripheral site (ensure PICU from Stollery, not PCICU if including Stollery with RAAPID). ENT only to be paged if concerns around airway or possibility of rigid endoscopy or bronchoscopy.

Clinicians should be aware of and consult appropriate subspecialties for management of the potential delayed complications following ingestion of a button battery. These include: tracheoesophageal fistula, tracheal stenosis, vocal cord paralysis, tracheomalacia, esophageal perforation, esophageal stricture, mediastinitis, aspiration pneumonia, empyema, lung abscess, pneumothorax, spondylodiscitis and hemorrhage from perforation into a large vessel (i.e. aortoesophageal fistula). Complications should be anticipated based on the location of impaction and orientation of the battery. This guideline outlines an approach to management of a bleeding patient in section 2.4.

Notification (pre-hospital setting, receiving a call from an outside centre):

- Priority notification of pediatric gastroenterology service by ED staff in instances of direct to ED presentation or direct call to ED, even if patient is still at outside facility.
- If there has been evidence of a sentinel bleed (hematemesis or melena stool) or active bleeding, there should also be priority notification of pediatric intensive care, pediatric surgery, vascular surgery and interventional radiology.
- Urgent involvement of pediatric gastroenterology service, pediatric general surgery and PICU for unstable, stable but concerning patients or patients with sentinel bleed, via RAAPID.
  - **RAAPID South (for patients in and south of Red Deer, Alberta)**
    1-800-661-1700 or 403-944-4486

- If patient is at a peripheral site, consider direct transfer to Stollery Children's Hospital if:
  - Unwitnessed/unknown time since ingestion
  - >12 hours from ingestion
  - There has been a sentinel bleed in a child in a rural centre
  - There is active bleeding but the patient is hemodynamically stable or time for transfer will be similar to either site for a child located in a rural centre
- If available and <12 hours from ingestion recommendation give:
  - As first line, honey 10mL (2 teaspoons) every 10 minutes (up to 6 doses) ‡
    OR
  - As alternative, sucralfate suspension 10mL (1 gram) every 10 minutes (up to 3 doses) *

‡ Recommendations from the American Academy of Pediatrics and the National Capital Poison Centre in the USA exclude children under 12 months of age due to potential risk of infant botulism. The Provincial pathway development committee strongly believes that the risk of button battery injury far outweighs the remote chance of infant botulism which disproportionately affects infants < 6 months of age. Recognizing that the age limit of one year is arbitrary the committee recommends the honey protocol for all children with suspected or witnessed button battery ingestion.

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* Sucralfate will leave a white coating and may limit endoscopic visualization.

ED Response:

ACH ED Management – stable patient, witnessed ingestion

- If <12 hours post-witnessed ingestion give:
  - As first line, honey 10mL (2 teaspoons) every 10 minutes (up to 6 doses) ‡
    OR
  - As alternative, sucralfate suspension 10mL (1 gram) every 10 minutes (up to 3 doses) *
- Immediate imaging for any child with known or suspected button battery ingestion
- Order Stat:
  - A: PA or AP and lateral chest radiograph
  - B: AP supine radiograph of the abdomen
    - Must include GE junction to pubic symphysis
    - **Note: KUB is NOT acceptable**
  - C: AP and lateral neck radiograph
    - Nasopharynx to thoracic inlet
- Evidence of button battery on x-ray includes a "halo sign" on PA view or "step-off" on lateral view (Appendix A)
- Obtain IV access (1 large-bore IV cannula)
- CBC, type and screen with cross match, coagulation studies – STAT
- Maintain nil per os (NPO) status with the exception of sucralfate or honey
- Initiate call to pediatric gastroenterology as soon as possible (state button battery ingestion in text page)
- Consult to pediatric general surgery and pediatric intensive care and consideration of admission to PICU if concerning findings at time of endoscopy. This consult will be initiated by pediatric gastroenterology.
- If greater than 12 hours from time of ingestion, there should be discussion with Stollery gastroenterology, PICU and potentially cardiovascular surgery for consideration of transfer to Stollery Children's Hospital prior to removal.

‡ Recommendations from the American Academy of Pediatrics and the National Capital Poison Centre in the USA exclude children under 12 months of age due to potential risk of infant botulism. The Provincial pathway development committee strongly believes that the risk of button battery injury far outweighs the remote chance of infant botulism which disproportionately affects infants < 6 months of age. Recognizing that the age limit of one year is arbitrary the committee recommends the honey protocol for all children with suspected or witnessed button battery ingestion.

* Sucralfate will leave a white coating and may limit endoscopic visualization.

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ACH ED Management – stable patient, unwitnessed/unknown time of ingestion (CTAS 2)

- Immediate imaging for any child with known or suspected button battery ingestion
- Order Stat:
  - A: PA or AP and lateral chest radiograph
  - B: AP supine radiograph of the abdomen
    - Must include GE junction to pubic symphysis
    - **Note: KUB is NOT acceptable**
  - C: AP and lateral neck radiograph
    - Nasopharynx to thoracic inlet
- Evidence of button battery on x-ray includes a "halo sign" on PA view or "step-off" on lateral view (Appendix A)
- Obtain IV access (1 large-bore IV cannula)
- CBC, type and screen with cross match, coagulation studies – STAT
- Maintain nil per os (NPO) status
- Initiate call to pediatric gastroenterology as soon as possible
- There should be consideration of transfer to Stollery Children's Hospital prior to removal. Discussion to be led by pediatric gastroenterology along with ED physician and pediatric intensivist. This should include discussion with pediatric gastroenterology and possibly pediatric intensivist at the Stollery Children's Hospital.
- Notification of pediatric surgery and anesthesia if plans for pediatric gastroenterology to take the OR for endoscopy. These phone calls will be initiated by pediatric gastroenterology.
- Consult to pediatric intensive care and consideration of admission to PICU if concerning findings at time of endoscopy. This consult will be initiated by pediatric gastroenterology.

ACH ED Management – gastric location

- Ensure pediatric gastroenterology is consulted for all cases of button battery located in the stomach.
  - Endoscopic removal recommended for:
    - Unwitnessed ingestion
    - Child less than 6 years with battery ≥15 mm
    - Any child eligible for observation (see below) who develops symptoms
  - Observation and follow-up X-ray:
    - Smaller Button Batteries (12 mm or less):
      - If the ingestion was witnessed
      - Asymptomatic
      - No co-ingestion of a magnet
      - No known esophageal disease
      - Repeat X-ray in 10-14 days
      - Endoscopic removal if battery still in stomach
    - Larger batteries (≥ 15 mmm):
      - If the ingestion was witnessed
      - Asymptomatic
      - Prompt passage to stomach
      - Repeat X-ray in 48 hours
      - Endoscopic removal if battery still in stomach

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Any child with a button battery in the stomach presenting with bleeding, dysphagia, feeding compromise, airway compromise, hemodynamic instability or suspected aspiration should be treated as an esophageal button battery injury and **urgent referral to tertiary center arranged via RAAPID**.
If proceeding with endoscopic removal:

- Obtain IV access (1 large-bore IV cannula)
- CBC, type and screen with cross match, coagulation studies – STAT

Any child with a button battery in the stomach presenting with bleeding, dysphagia, airway compromise, hemodynamic instability or suspected aspiration should be treated as an esophageal button battery injury.

ACH ED Management – patient with sentinel bleed (CTAS 2) or unstable bleeding (CTAS 1) patient

An **aortoesophageal fistula** may develop in the presence of the battery or following removal in the setting of severe esophageal injury. **A sentinel bleed (hematemesis or melena stool)** may precede a severe, life-threatening hemorrhage. In the context of a sentinel bleed, there should be a high-index of suspicion for an aortoesophageal fistula. When a patient presents to the ACH ED having had a sentinel bleed, the following steps should occur:

- If there has been a sentinel bleed, anticipate possible imminent exsanguination; patient is at risk for sudden life-threatening hemorrhage.
- Emergent consultation by ED MD to, pediatric surgery, pediatric intensive care, pediatric gastroenterology. Additional consultation to vascular surgery, and interventional radiology can be assisted and facilitated by pediatric surgery and pediatric intensive care physician.
- For patients with sentinel bleed, consider activation of ED code 88. Decision to activate code 88 to be made by ED MD along with pediatric surgery.
- For unstable patients or those with active bleeding, activation of code 88 by ED MD (code 88 will access OR RNs, anesthesia and PICU), pediatric gastroenterology, pediatric general surgery and any other consultants required (vascular, IR) will need to be paged separately). Vascular surgery attending to be paged directly by an attending physician at Alberta Children's Hospital.
- Activate massive transfusion protocol and ensure blood box accompanies patient to the OR. Consider having the cell saver set up in the OR.
- Obtain IV access (2 large-bore IV cannula)
- Rapid correction of circulatory instability
- CBC, type and screen with cross match, coagulation studies– STAT
- Avoid intubation in ED unless required for respiratory failure due to airway obstruction secondary to blood, inability to protect airway due to level of consciousness or prior to insertion of Sengstaken Blackmore. If must intubate, ensure ready for cardiovascular collapse.
  - Prepare push pull with NS/plasmalyte/pRBCs
  - Have epinephrine at bedside (resuscitation dose and spritzer)
  - Consider ketamine and/or fentanyl and rocuronium and avoid propofol
  - Have CPR board and Zoll pads in place
  - Designate CPR provider and coach
- Have 12 French Sengstaken Blakemore and manometer at bedside (for insertion instructions see Appendix B). This will be stocked in the Bleeding Cart in the ED. This should be available, but not inserted unless required due to ongoing refractory bleeding as this may result in dislodgement of clot.

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This is only to be placed in an intubated patient. **Note: must not be inserted if battery is present in the esophagus.**

- If not done previously, obtain portable x-ray to determine button battery location.
- Avoid CT angiography in unstable patient to not delay emergent surgical intervention.

OR planning for patient with sentinel bleed or unstable, active bleeding:

OBJECTIVE is attempted endovascular control of fistula if possible.

- Consult with Cardiothoracic Surgery at Stollery Children's Hospital about plans/approach
- Since aortoesophageal fistula is present or suspected, anticipate proceeding with emergent surgical intervention. Anticipate a combined pediatric surgery and vascular surgery approach (potentially with IR). Endovascular support TOTE will be ready and available in the OR core, found on the E0 cart.
- Patient should be prepped for urgent thoracotomy and laparotomy. Plan will include isolating the vessels (aorta if small child, femoral vessels if large child) and placing endovascular stent prior to endoscopic removal of the button battery, if still in place. There will then be transfer to Stollery Children's Hospital for definitive management.
- OR should be set up so that patient can be positioned for optimal c-arm access.
- Preferred imaging will likely be intra-operative angiogram using the C-ARM, facilitated by interventional radiology in conjunction with vascular surgery. If fistula suspected in ascending aorta endovascular approach not indicated/not appropriate.
- If aortoesophageal fistula is present, proceed with emergent surgical intervention.
- If aortoesophageal fistula is not visualized, proceed with upper endoscopy to evaluate source of bleeding. Pediatric surgery and vascular surgery should be present at time of endoscopy.
- If button battery is present, proceed to urgent endoscopic removal with pediatric surgery and vascular surgery present in the OR. Consider consultation to ENT if there is the possibility that a rigid bronchoscopy will be required.

Disposition:

- For the following high-risk patients, there should be a discussion around transfer to PICU at Stollery Children's Hospital depending on transport time to tertiary care centre(s) and stability of patient.
- Consider direct transfer to Stollery if patient in a peripheral centre with:
  - Unwitnessed/unknown time from ingestion
  - >12 hours from ingestion
  - There has been a sentinel bleed
  - There is active bleeding but the patient is hemodynamically stable and time for transfer will be similar to either site for a child
- Consider discussion with **PICU(not PCICU)** at Stollery regarding transfer of patient at ACH with:
  - Unwitnessed/unknown time from ingestion
  - >12 hours from ingestion
  - Findings on CTA/MRA of vessel injury/troubling integrity
  - Significant esophageal injury identified at time of endoscopy

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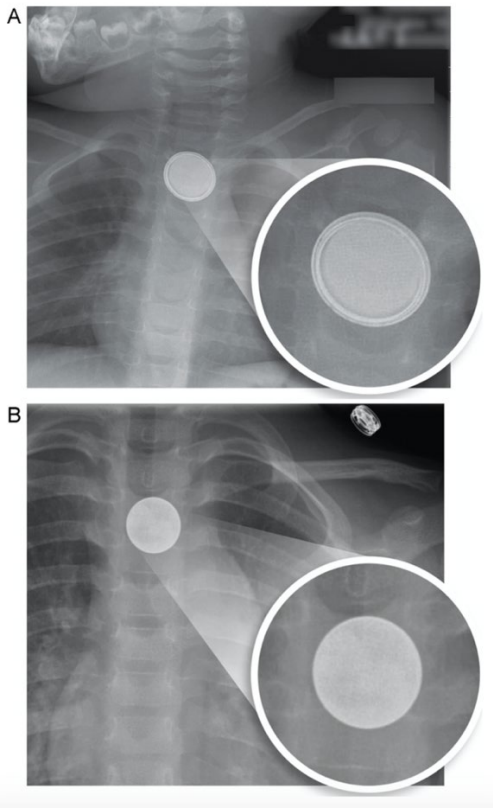
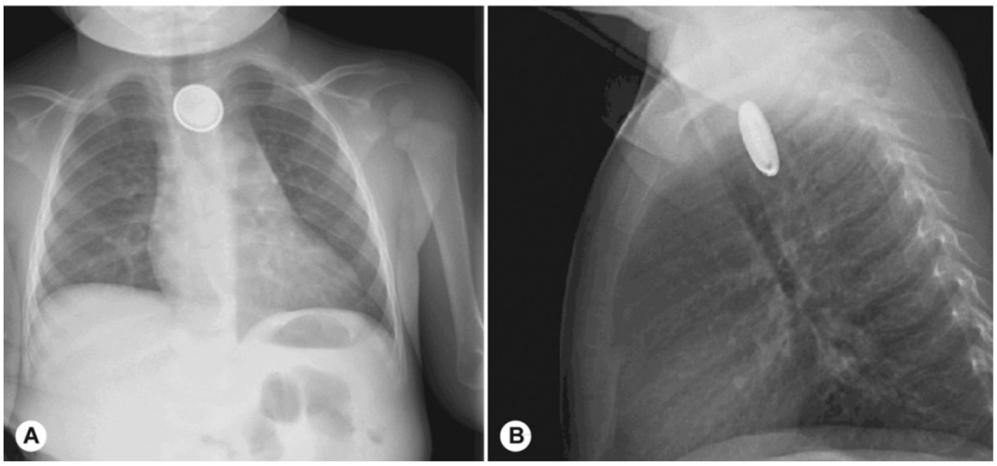
If the patient is present in ACH ED with sentinel bleed or active bleeding, discussion with gastroenterology, General Surgery, Vascular Surgery, Cardiothoracic Surgery (Stollery), PICU (ACH and Stollery) re: best management plan and site for the provision of care. This decision will be based on the location of the button battery (near ascending aorta/arch or closer to descending aorta), size of the child (ability to place stent), and stability of the child. Some children will be initially managed at ACH (with a stent to temporize) prior to transfer to Stollery, others may be transported immediately to Stollery.

APPENDIX A: EVIDENCE OF BUTTON BATTERY ON X-RAY



Adapted from Jatana et al., 2013. A = button battery with characteristic "halo sign" on PA view; B = coin.[6]

TRIAGE AND ACUTE MANAGEMENT OF BUTTON BATTERY INGESTIONS IN CHILDREN



Adapted from Ruhl et al., 2014. A = button battery with characteristic "halo sign" on AP view; B = button battery with lateral "step off" sign indicating that negative anode is against anterior wall of the esophagus.[7]

APPENDIX B: INSERTION OF SENGSTAKEN BLAKEMORE TUBE FOR BUTTON BATTERY RELATED BLEEDING

Blakemore tube should not be used if the button battery is present in the esophagus. The patient should be intubated prior to insertion.

- Required Materials:
  - Pediatric size 12F Sengstaken Blakemore Tube (kept in bleeding cart in the ED and another is stored in the GI workroom opposite OR 10)
  - Orogastric tube
  - 1L saline bag
  - 3-way stopcock (2)
  - Christmas tree adapter
  - Water-based lubricant
  - Kerlix gauze
  - Manometer

- Preparation:
  - Insert 3-way stopcock into gastric balloon port using a Christmas Tree adapter
  - Insert 3-way stopcock into esophageal balloon port using a Christmas Tree adapter
  - Line up the OG tube so that the tip is just above the gastric balloon
    - Label the OG tube with a "G" at the 50cm mark of the Blakemore tube
  - Line up the OG tube so that the tip is just above the esophageal balloon
    - Label the OG tube with an "E" at the 50cm mark of the Blakemore tube
  - Test the balloons
    - Attach a 60cc syringe (full of air) to the gastric balloon stopcock
    - Immerse the balloon in a container of water
    - Inflate to ensure no leaks

TRIAGE AND ACUTE MANAGEMENT OF BUTTON BATTERY INGESTIONS IN CHILDREN

- Repeat this for the esophageal balloon to ensure no leaks
- Deflate balloons

- Insertion:
  - Lubricate the tube and balloon with water-based lubricant
  - Insert tube as you would insert an orogastric tube
  - Confirm placement:
    - Insufflate air into the stomach via the suction port and auscultate stomach for confirmation of gastric sounds
    - Insert 50ml of air into gastric balloon
      - Obtain AXR to confirm placement, with air bubble below diaphragm
  - Once placement is confirmed, insert a final volume of 250ml of air into the gastric balloon
  - Ensure that stopcock is OFF and place caps over the remaining two ports

- Traction:
  - Use the bag of saline and the Kerlix gauze
  - Tie a slip knot around the tube
  - Push free ends of the gauze through the hole in the bag and knot
  - Hang gauze over an IV pole for traction (1L = 1kg of traction)
  - Connect low-intermittent suction to the gastric port and aspirate stomach contents

- Esophageal balloon:

  NOTE: for button battery-related aorto-esophageal fistula manoeuvre (A) is not required, proceed to (B).
  - (A) Insert OG tube so that the "G" mark lines up with the 50cm mark on the Blakemore (tube just above gastric balloon, at GE junction)
    - Clamp the gastric suction port
    - Move the suction to the OG tube
    - If there is residual ongoing bleeding, then you will need to inflate the esophageal balloon for hemostasis
  - (B) Pull the OG back so that the "E" mark is at the 50cm mark on the Blakemore tube
    - Tape the tubes together to prevent movement
  - Attach manometer to 3-way stopcock on esophageal balloon port
  - Place a cap over the other port on the 3-way stopcock
  - Inflate the balloon to 40mmHsg (can go as high as 60 if inadequate tamponade)
  - Close the stopcock
  - Remove manometer
  - Cap the open port on the esophageal stopcock
  - Attach suction to the OG tube to ensure hemostasis

TRIAGE AND ACUTE MANAGEMENT OF BUTTON BATTERY INGESTIONS IN CHILDREN

APPENDIX C: HOW TO ARRANGE TELECONFERENCE

You can call in to the conference call from any one of these numbers depending on where you are in the country. I have highlighted the toll free and our local number.

The person who called the meeting will follow the prompts on the call and input the MODERATOR code. All other participants will input the PARTICIPANT code.

Call In:
1-877-385-4099 Toll Free (Canada & USA)
613-212-4220 Ottawa
514-395-9913 Montreal
604-899-2339 Vancouver
403-232-0994 Calgary
780-421-1483 Edmonton
416-883-0133 Toronto

Codes:
Moderator – 3425318#
Participant – 5092491#

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