Caustic Ingestion

Jay Doucet MD FRCSC FACS RDMS

Editorial Review: Clay Cothren Burlew, MD
Marc de Moya, MD
Kimberly A. Davis, MD MBA

Injury/Disease Demographics

- Household cleaners are the offending agent in about 200,000 cases reported annually to U.S. poison control centers.
- Fatalities are usually due to alkali containing products like drain cleaners or toilet cleaners.
- 80% of ingestions are in children under 5 years of age.
- Children frequently vomit or expectorate most of the agent before swallowing, reducing exposure.
- Suicidal adults are more likely to ingest larger amounts and therefore have more severe injuries.
- Button batteries and rare-earth neodymium magnets are a special risk in children.
- Most deaths are associated with perforation and mediastinitis.

Clinical Presentation/Evaluation

- Clinical features vary widely and early signs and symptoms may not correlate with the severity of injury.
- Dyspnea, dysphagia, oral pain, odynophagia, chest pain, abdominal pain, hypersalivation, nausea and vomiting may be seen.
- Persistent severe retrosternal or back pain may indicate esophageal perforation with mediastinitis.
- Shock or peritoneal signs may be present in esophageal or gastric perforation.
- Absence of facial or oropharyngeal burns does not exclude significant injury.
- Intubation may be required for respiratory distress or if there is severe airway edema or necrosis; such patients are more likely to have perforation.

Diagnostics

- Esophagogastroduodenoscopy (EGD) is should be performed if there are no signs of perforation once the patient is adequately resuscitated.
- A modification of the burn classification is used to grade injury by EGD:
    - **Grade 1** injuries – edema and hyperemia
    - **Grade 2A** injuries – superficial ulcers
    - **Grade 2B** injuries – deep or circumferential ulcers
    - **Grade 3A** injuries – focal necrosis
    - **Grade 3B** injuries – extensive necrosis
- Grade I and 2A injuries have an excellent prognosis.
- Grade 2B and 3A injuries have a 70-100% incidence of stricture.
- Grade 3B injuries have a 65% early mortality and will likely need gastric or intestinal interposition with a prolonged ICU stay.

Imaging

- Serial chest and abdominal films are obtained, looking for free air, new or increased effusions, pneumomediastinum or pneumothroraces.
- Studies on thoracoabdominal CT scanning of caustic injury show improved prediction of subsequent strictures compared to EGD for higher CT grades of injury, but CT can also miss injuries compared to EGD and should not be in isolation.
- Oral contrast studies are usually reserved for identification of strictures, two weeks or more after injury.

Role of Conservative Management and Associated Considerations

- Asymptomatic patients with a reliable history of accidentally ingesting a small volume of low-concentration acid or alkali may not require endoscopy and can be followed as outpatients.
- Symptomatic patients should be hospitalized.
- Those suspected of having significant ingestion based on history, symptoms or Grade 2B or higher findings on EGD should be placed in an ICU to deal with complications such as shock, respiratory failure, mediastinitis and peritonitis.
- Severe corrosive injury requires rapid resuscitation and urgent surgical debridement when indicated (see next section), otherwise the patient is kept NPO. Adequate pain control is obtained with continuous IV narcotics, IV proton pump inhibitors are given to avoid stress ulceration and appropriate resuscitation and/or vasopressors are administered for hypotension.
- Patients with respiratory distress should undergo laryngoscopy to assess the oropharynx for edema, ulcers or deep necrosis.
- Patients with laryngeal or epiglottic edema should undergo tracheostomy.
- Contraindicated therapies include:
    - pro-emetic agents which risk re-exposure of the esophagus and airway to the caustic agent
    - neutralizing agents such as weak acids or bases which risk exothermic reactions
    - blind nasogastric intubation when it risks retching or vomiting and perforation.
    - Activated charcoal will obscure the view on EGD.
- Nasogastric tubes can be placed during EGD. Endoscopic placement of stents for caustic perforations is still under investigation. Prophylactic long-term stenting to prevent stricture formation using a long stent has had success in small case series.
- Advancing a patient's diet is based upon the grade of injury:
    - stable patients with Grade 1 or 2A injuries can start an oral liquid diet and progress to regular diet in 24-48 hours.
    - Patients with Grade 2B and 3 injuries can undergo tube feeding after 24 hours, and after 48 hours patients who can swallow their saliva are allowed liquids.

Indications for Operative Intervention

- Clinical signs of perforation- sepsis due to mediastinitis and peritonitis are indications for emergency surgery. Most sources do not advocate for immediate surgery based on a grade 3B injury alone.
- Esophagectomy may also be required for a late complications of esophageal caustic injury – severe strictures and esophageal squamous cell carcinomas.

Pre-operative Preparation

- Resuscitation with IV fluids and blood products to aggressively manage hypotension.
- Appropriate vascular access and invasive hemodynamic monitoring are obtained.
- Although no trials exist, patients receive broad-spectrum antibiotics for their mediastinitis and/or suspected perforation.

Impact of Associated Injuries

- If the stomach is damaged as well as the esophagus, a colonic interposition may be required.
- Patients who require both esophageal and pharyngeal reconstruction due to severe oropharyngeal caustic injury (colophayrngoplasty) have poor functional outcomes.

Operative Techniques

- A minimally invasive surgical (MIS) approach to esophagectomy via thoracoscopic and laparoscopic approaches may reduce length of stay when performed by an experienced surgeon, as compared to conventional esophagectomy in restorative surgery. MIS esophagectomy negates the need for thoracotomy and is associated with reduced perioperative morbidity in non-caustic injury esophagectomy.
- Transhiatal esophagectomy and gastric pull-up with cervical anastomosis has been shown to be safe, with similar rates of anastomotic stricture (up to 50%) or leak (up to 25%) compared to conventional esophagectomy. Ivor-Lewis procedures have also been performed for distal injuries via open and MIS techniques.
- There are no randomized trials on caustic injury surgery, but in studies of esophageal reconstruction for malignancies, the experience of the surgeon was an important determinant of outcome.

Intraoperative Considerations

- In the acutely perforated patient, the surgeon must identify and manage all injured organs in both the thoracic and abdominal cavities. Perforations may be in the esophagus, stomach or both. EGD is performed by >85% of centers. CT scans of the chest and

abdomen are indicated in patients suspected of peritoneal irritation or suspected perforation.

- In the abdomen, MIS approaches, such as laparoscopy to examine the stomach, if not performed by expert hands, risks missing the true extent of injuries. A comprehensive abdominal examination, including the posterior stomach and duodenum is usually faster and easier via laparotomy.
- Unlike other injury types, it is important in the operative caustic injury patient to resect all obviously injured organs at the first operation. Minimal resection followed by planned second-look procedures is not advisable as transmural injury often progresses to necrosis. Caustic injury has an unpredictable course however, and if there is doubt on the patient's subsequent course, re-exploration should be done.
- Extended resections for adjacent organs after gastric perforation, such as pancreas have been necessary in some cases. When possible, viable colon is preserved for later use as an esophageal conduit. Discovery of massive intestinal necrosis will usually indicate a palliative approach.
- In the chest, caustic perforation of the esophagus usually requires total esophagectomy, subtotal esophagectomy is performed only there is evidence of a salvageable proximal esophagus which may be difficult to ascertain in the acute setting, and a desire to perform an intrathoracic esophagogastrectomy (i.e. Ivor-Lewis procedure).
- In the acutely perforated and septic patient, esophageal reconstruction may not be immediately possible. In hemodynamically unstable patients, a staged or "damage-control" approach may be warranted such as esophagectomy and cervical esophagostomy (spit fistula) with delayed reconstruction. Gastrostomy or jejunostomy should be performed for feeding.
- Severe mediastinitis or peritonitis may require open management of the chest and/or abdomen in the ICU, with multiple operative debridements and delayed closure via gastric or colonic conduits.
- Restorative operations are usually performed based on patient stability, a survey of board members of the World Society of Emergency Surgery indicated only 31% would consider a restorative procedure at the initial acute operation.

Postoperative Management

- Early enteral feeding is started via nasogastric tube or jejunostomy tube. In gastric pullup procedures, the NG tube should be placed through the pylorus, even if pyloromyotomy is done.
- After reconstruction, the nasogastric tube usually stays in place until a barium swallow is performed on post-operative day seven and shows no anastomotic leak. Patients remain on a liquid diet only for two weeks to keep the conduit decompressed.

Complications

- Early complications are due to the sequelae of esophageal or gastric perforation, mediastinitis or peritonitis and include sepsis, multiple organ failure, hemorrhage and death.
- Esophageal strictures:
    - develop in up to one-third of those with caustic injury.
    - occur predominantly in patients with Grade 2B and 3 injuries.
    - may manifest as early as two weeks post injury.
    - have a peak incidence two months post injury, but can appear years later.
- Esophageal strictures are usually managed by endoscopic dilation or bougienage:
    - dilation is often first performed 3-6 weeks post injury to avoid iatrogenic perforation.
    - dilation is successful over 90% of esophageal strictures as measured by complete resolution of dysphagia.
    - dilation is associated with a perforation rate of 0.5%.
    - long strictures may require dilation under fluoroscopy to avoid perforation.
    - combined pharyngeal and esophageal strictures may be more difficult to dilate and may require retrograde dilation via mini-laparotomy and gastrostomy.
    - gastric and pyloric strictures can also occur, causing gastric outlet obstruction.
- Delayed surgery (i.e. late esophagectomy) may be required for:
    - uncontained perforation after dilation.
    - strictures intractable to dilation.
- Severe, uncontrolled late gastric bleeding can occur, usually 1-2 wk after ingestion. Total gastrectomy may be necessary. In duodenal hemorrhages, under-sewing of a posterior bleeding vessel through a duodenotomy may be required.
- Dysmotility of the distal esophagus is seen in 1/3 of caustic injury survivors, possibly due to vagal nerve entrapment and injury in scarring around the distal esophagus. The same cause may explain the decreased gallbladder emptying seen in patients after caustic injury.
- The risk of esophageal squamous cell cancer in victims of lye ingestion is 2.6%, which is 1000-fold higher compared to the general population. The American Society for Gastrointestinal Endoscopy (ASGE) recommends surveillance EGD starting 15-20 years post-caustic injury.

Considerations for Special Populations

- Children who swallow button batteries may have these lodged in the esophagus where they can rapidly cause injury to the esophagus and critical surrounding structures, in part due to leakage of alkaline material. Injuries can include perforations, tracheoesophageal fistulae and even aortoesophageal fistulae which have appeared in lethal fashion as late as three weeks after removal of the battery. The battery type most associated with perforation is a 20mm lithium “coin cell”.
- Caustic ingestion in children maybe be a manifestation of child abuse.

- Ingestion of multiple neodymium rare-earth magnets or a single magnet and a metallic foreign body also poses a risk of perforation when lodged in the esophagus or stomach, published guidelines recommend removal by endoscopy with surgical backup.

Suggested Readings

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