

NCBI Bookshelf. A service of the National Library of Medicine, National Institutes of Health.

StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-.

## Caustic Ingestions

### Authors

Joseph E. Bielecki<sup>1</sup>; Vikas Gupta<sup>2</sup>.

### Affiliations

<sup>1</sup> McLaren Greater Lansing

<sup>2</sup> South Carolina Dept of Mental Health

Last Update: May 29, 2022.

## Continuing Education Activity

Caustic ingestion is the term given to describe the ingestion of an extremely toxic substance such as lye. Caustic ingestions are serious medical emergencies that can result in extensive morbidity and mortality. The care of these patients involves every level of the medical team extending from poison control outreach to the surgeons on the floor. This activity reviews the evaluation and treatment of caustic ingestions and highlights the role of the interprofessional team in the care of patients with this condition.

### Objectives:

- Identify the etiology of caustic ingestions.
- Outline the appropriate evaluation of caustic ingestions as they present in an emergent situation.
- Review the management options available for caustic ingestion.
- Describe the interprofessional team strategies for improving care coordination and communication to enhance the care of patients with caustic ingestion and improve outcomes.

[Access free multiple choice questions on this topic.](#)

## Introduction

Caustic ingestions are severe causes of morbidity and mortality and can easily affect all age groups. 80% of the total cases of caustic ingestion in the United States occur in children. Caustic ingestions are cause for emergent treatment and require coordination between both surgical and medical therapies for the best outcomes. Clinicians must be aware of common pitfalls and resources available to them. Most ingestions (especially in children) are non-toxic and may be managed at home, but immediate triage, rapid evaluation, and the timely institution of treatment are critical in producing favorable outcomes.[1]

## Etiology

The etiology of caustic ingestion is either accidental ingestion (often the case in children) or intentional (such as suicidal acts in the adult). Children often ingest household substances such as bleach or ammonia. Most caustic exposures involved oral ingestion (76 percent) and occur in the home (93 percent of cases). The majority of these ingestions were unintentional (greater than 80 percent). Ingestions usually involve either an acid or an alkali. Each of these categories is unique in its pathophysiology and treatment approach.[2][3]

## Epidemiology

The majority of caustic ingestions occur in pediatrics, with 2.16 million toxic exposures reported in the United States, and half of these occurring in the pediatric population. Most commonly, these ingestions are from household products and accidental in the pediatric population. In the adult population, the vast majority are intentional. "Lye" (alkaline substances such as sodium or potassium hydroxides normally contained in household cleaning products) substances make up the majority of caustic ingestions.[3]

## Pathophysiology

The pathophysiology depends on the type of substance involved: either an alkali or an acid. Alkalis are substances that have a pH above 7.0, and the threshold is usually above 11.5 to cause direct injury to tissue through liquefaction necrosis. Liquefaction necrosis involves the dissolution of the tissue comparatively quickly to coagulation necrosis. As the cells are lysed, digestive enzymes are released and begin to dissolve the architecture of the surrounding stroma. Alkalis cause an early breakdown of the mucosa exposed and allow for deeper penetration and injury. As with all exposures, the contact time and strength of the alkali determine the extent of the injury. However, even weak concentrations of alkali substances can cause severe damage to tissue if left in contact long enough.

Acids are more apt to cause injury if the pH is less than 2 through coagulation necrosis. Coagulative necrosis is the default mode of necrosis for most of the body when tissue is hypoxic or ischemic. It is theorized that injury tends to be less severe in acidic ingestions due to the intact stroma of the tissue performing as a barrier to further injury. The mucosa of the esophagus has a mild alkali surface, and this may help to neutralize acidic substances, further preventing injury.[4][5]

## History and Physical

The history of a patient with suspected caustic ingestion must include five basic parameters in determining the appropriate treatment. Some articles on this subject have done the helpful work of organizing them into a helpful mnemonic known as the "5 W's" which will be summarized here. This aspect encompasses the rapid assessment of relevant history.

- **Who:** Patient demographics are key in this section. Determine the patient's age and weight, along with any accompanying family, friends, or witnesses
- **What:** Characteristics of medications and poisons ingested
- **When:** Time and date of ingestion
- **Where:** Route of poisoning in addition to geographic location to determine any environmental factors that may be confounding
- **Why:** The clinician must determine intentionality as this may greatly affect discharge disposition when the patient has been stabilized

Patients with caustic ingestions may present with oral and tongue edema, drooling, and vomiting. Some patients may have upper airway edema and present with voice changes, stridor, and respiratory distress. Hematemesis may be present if there has been erosion into a vessel. If the esophagus or stomach are perforated, mediastinitis and peritonitis, respectively, can occur.[6] The physical exam includes a customary primary and secondary assessment, consistent with emergency department practice.

## Evaluation

The primary assessment involves ABC's: airway, breathing, and circulation. Particular attention in the full assessment must be paid to the adequacy of ventilation, mental status function, and cardiac functioning. Unstable patients should be monitored continuously on telemetry and assessment of vitals occurring every fifteen minutes until stable.[5]

Lab studies obtained may include a complete blood count, a metabolic profile that includes electrolytes, and an arterial or venous blood gas. Plain radiographs of the chest and abdomen may identify free air or pneumomediastinum.

In caustic ingestion, the grade of the injury should be determined, which will guide the next steps of management after initial resuscitation has been performed. Endoscopy has traditionally been used as a method of evaluating gastrointestinal injury. Contrast-enhanced computed tomography (CECT) has been proposed as an alternative to endoscopy for the evaluation of lesions.[6]

## Treatment / Management

The airway should be secured in patients with signs of impending respiratory failure including drooling and voice changes. One study showed that 50% of adults with caustic ingestions required intubation.[6] Acquiring intravenous access is necessary. Determining the ingested substance will guide management.

In terms of caustic injury, current recommendations are to dilute with water, although this has limited benefit due to the damage being determined within the first few minutes of the injury. Activated charcoal and induction of emesis should not be used in these patients.[6]

Patients with suspected evidence of mediastinitis, peritonitis, or hemodynamic instability will require emergency surgery for evaluation of the extent of the injury. If there is scant evidence of these, CECT may be performed of the neck, thorax, and abdomen to determine grades of injury.

- Grade I: Normal-appearing organs
- Grade II: Mucosa is enhanced due to edema, with soft tissue inflammatory change
- Grade III: The absence of postcontrast wall enhancement

Grade I generally indicates no endoscopy and early discharge. Grade II generally indicates non-operative treatment and endoscopy if CECT is non-diagnostic. Intravenous corticosteroids may be indicated for some Grade II burns, however, this is somewhat controversial.[6] Grade III indicates emergency surgery.

The goal of emergency surgery is to remove all necrotic tissue with laparotomy being the standard approach. What is resected is determined by the extent of injured surfaces with a spectrum ranging from resection of specific spots to major procedures such as pancreaticoduodenectomy.[5]

## Differential Diagnosis

Differential diagnoses should include but not be limited to other forms of trauma, including physical trauma (including car accidents or purposeful abuse), congenital abnormalities, and direct heat-base burns. These must be worked up depending on clinical suspicion. Often the history will be sufficient along with presenting symptoms of toxidromes, but concurrent injury or suspicious findings must be included in the clinician's initial differential.[5]

## Prognosis

Prognosis depends most heavily on the extent of the initial injury with mild-moderate ingestions having the most favorable prognoses and severe ingestions requiring emergency surgery having the most complications. Grade III injury or above, involves emergency surgery immediately and follow-up care. Patients tend to do worse if they require surgery, and complications are high such as mediastinitis and perforation.[2][7][8]

An extremely important topic that the surgical team should discuss with the patient before radical resection or esophageal reconstruction is the quality of life after such surgical procedures. In one study, there were significant

drops in quality of life scores compared to normal populations. This should not dictate whether surgery is performed or not, but discussing with and priming the patient for potential problems is paramount.[9]

## Complications

The most common early-term sequelae are those of mediastinitis or hemodynamic instability related to bleeding. These require emergency surgery to salvage and repair the damage present in the thorax or abdomen. The most common late-term sequelae of caustic ingestion are stricture at any part of the gastrointestinal tract affected by the ingestion, with the most common being esophageal stricture. Often the treatment for this comes down to esophageal dilatation, but if this is unresponsive or not feasible, then the treatment becomes surgical resection with bypass or replacement. The choice to use bowel for bypass or to use gastric tissue to bypass depends on the severity of the stricture.

Prevention of stricture is a controversial topic. In patients with a superficial injury, early oral feedings are thought to prevent stricture. Nasogastric placement can be helpful but is thought to contribute to more stricture development overall. Stents have been tried in the past with limited success (less than 50%) and high rates of migration (up to 25%). No pharmacologic agents have been noted to have success in preventing the development of strictures in the gastrointestinal tract.[7][8]

## Postoperative and Rehabilitation Care

Surgical care of esophagectomy and post-caustic ingestions may require intensive unit care. This is due to intubation procedures required though a recent study has shown that this may not be necessary. Airway management is critical in these patients due to the surgery site. Hemodynamic support may be required in these patients. Nutritional support is also critical in these patients, requiring a balance of protein and other nutrients to maintain adequate wound healing. Enlisting nutritional staff is critical in maintaining healing in these patients due to the change in eating habits, even long past postoperative care.[10][11] Patients with intentional ingestions will need close follow-up with mental health practitioners.

## Deterrence and Patient Education

Prevention of caustic ingestions is a systemic and community-wide effort due to the extreme burden that is placed on society. Robust legislation is recommended in making containers child-proof and ensuring that proper precautions are maintained in preventing easy-child access to caustic chemicals. Education is needed to ensure that parents know to place obstacles to prevent having easy access to household chemicals. The vast majority of adult ingestions are intentional, and so improved access to mental health services, and social support systems are to be placed and maintained to prevent suicide attempts.[12]

## Enhancing Healthcare Team Outcomes

Patients with caustic ingestions are best managed with an interprofessional team approach. Healthcare outcomes and patient outcomes can be vastly improved through training in and improvement of design. Implementation science is the discipline that has emerged to help address the translational gap between the background theory and actually carrying out of intervention. A review of the literature comments on the coordination between clinicians in the operating room and in emergency settings setting clear lines of communication to determine where the patient must go in terms of medical intervention appropriateness improves outcomes. Patients benefit greatly, and the reduction of healthcare stress is evident in places where systems work in conjunction with the individuals implementing the system.[13][14][15][16] In addition to emergency clinicians and surgeons, the interprofessional team may also include intensivists, nurses, nutrition services, and mental health practitioners.

Some studies have found that early endoscopy to assess for injury is mandatory for symptomatic patients but may be deferred in patients that are asymptomatic and without oral or mucosal burns. [Level 3][17] Early endoscopy is being studied and is showing favorable results. The most common injury found in several studies is a grade I injury, but earlier endoscopy helps guide treatment if there is no evidence for severe signs such as mediastinitis. [Level 3][17][18] A large retrospective study noted that an individualized approach is the most important when deciding when to do an endoscopy for caustic ingestions. This is due to severe signs that may be present that require immediate surgical intervention with hemodynamic stabilization. [Level 3][19]

## Review Questions

- [Access free multiple choice questions on this topic.](#)
- [Comment on this article.](#)

## References

1. Hollenbach M, Tünnemann J, Struck MF, Feisthommel J, Schlosser T, Schaumburg T, Mössner J, Hoffmeister A. Endoscopic findings and outcome in caustic ingestion of acidic and alkaline agents in adults: A retrospective analysis. *Medicine (Baltimore)*. 2019 Aug;98(35):e16729. [PMC free article: PMC6736469] [PubMed: 31464902]
2. Hall AH, Jacquemin D, Henny D, Mathieu L, Josset P, Meyer B. Corrosive substances ingestion: a review. *Crit Rev Toxicol*. 2019 Sep;49(8):637-669. [PubMed: 32009535]
3. Li Y, Langworthy J, Xu L, Cai H, Yang Y, Lu Y, Wallach SL, Friedenberg FK. Nationwide estimate of emergency department visits in the United States related to caustic ingestion. *Dis Esophagus*. 2020 Jun 15;33(6) [PubMed: 32129451]
4. Adigun R, Basit H, Murray J. StatPearls [Internet]. StatPearls Publishing; Treasure Island (FL): Aug 11, 2021. Cell Liquefactive Necrosis. [PubMed: 28613685]
5. Kalayarasan R, Ananthakrishnan N, Kate V. Corrosive Ingestion. *Indian J Crit Care Med*. 2019 Dec;23(Suppl 4):S282-S286. [PMC free article: PMC6996660] [PubMed: 32021005]
6. Hoffman RS, Burns MM, Gosselin S. Ingestion of Caustic Substances. *N Engl J Med*. 2020 Apr 30;382(18):1739-1748. [PubMed: 32348645]
7. Judkins DG, McTeer AV. StatPearls [Internet]. StatPearls Publishing; Treasure Island (FL): Jun 23, 2021. Alkali Toxicity. [PubMed: 31334955]
8. Mensier A, Onimus T, Ernst O, Leroy C, Zerbib P. Evaluation of severe caustic gastritis by computed tomography and its impact on management. *J Visc Surg*. 2020 Dec;157(6):469-474. [PubMed: 32088182]
9. Faron M, Corte H, Poghosyan T, Bruzzi M, Voron T, Sarfati E, Cattani P, Chirica M. Quality of Life After Caustic Ingestion. *Ann Surg*. 2021 Dec 01;274(6):e529-e534. [PubMed: 31972647]
10. O'Grady M, Firth R, Roberts R. Intensive care unit utilisation post-oesophagectomy. *N Z Med J*. 2020 Feb 21;133(1510):56-61. [PubMed: 32078601]
11. Findlay M, Purvis M, Venman R, Luong R, Carey S. Nutritional management of patients with oesophageal cancer throughout the treatment trajectory: benchmarking against best practice. *Support Care Cancer*. 2020 Dec;28(12):5963-5971. [PubMed: 32281035]
12. Povilavičius J, Samalavičius NE, Verkauskas G, Trainavičius K, Povilavičienė M. Conservative treatment of caustic oesophageal injuries in children: 15 years of experience in a tertiary care paediatric centre. *Prz Gastroenterol*. 2019;14(4):286-291. [PMC free article: PMC6983767] [PubMed: 31988676]
13. Sharp CA, Swaites L, Ellis B, Dziedzic K, Walsh N. Implementation research: making better use of evidence to improve healthcare. *Rheumatology (Oxford)*. 2020 Aug 01;59(8):1799-1801. [PubMed: 32252071]
14. Labrague LJ, De Los Santos JAA, Falguera CC, Nwafor CE, Galabay JR, Rosales RA, Firmo CN. Predictors of nurses' turnover intention at one and five years' time. *Int Nurs Rev*. 2020 Jun;67(2):191-198. [PubMed: 32252071]

32202329]

15. Roy A, Druker S, Hoge EA, Brewer JA. Physician Anxiety and Burnout: Symptom Correlates and a Prospective Pilot Study of App-Delivered Mindfulness Training. *JMIR Mhealth Uhealth*. 2020 Apr 01;8(4):e15608. [PMC free article: [PMC7160707](#)] [PubMed: 32234708]
16. Moore KA, O'Brien BC, Thomas LR. "I Wish They Had Asked": a Qualitative Study of Emotional Distress and Peer Support During Internship. *J Gen Intern Med*. 2020 Dec;35(12):3443-3448. [PMC free article: [PMC7728891](#)] [PubMed: 32232665]
17. Di Nardo G, Betalli P, Illiceto MT, Giulia G, Martemucci L, Caruso F, Lisi G, Romano G, Villa MP, Ziparo C, Pensabene L, Vassallo F, Quitadamo P. Caustic Ingestion in Children: 1 Year Experience in 3 Italian Referral Centers. *J Pediatr Gastroenterol Nutr*. 2020 Jul;71(1):19-22. [PubMed: 32142003]
18. Acehan S, Satar S, Gulen M, Avci A. Evaluation of corrosive poisoning in adult patients. *Am J Emerg Med*. 2021 Jan;39:65-70. [PubMed: 31982223]
19. Gschossmann JM, Schroeder R, Wyler F, Scheurer U, Schiemann U. [Whether or not to perform an early endoscopy following ingestion of potentially caustic agents - a retrospective longterm analysis in a tertiary referral institution]. *Z Gastroenterol*. 2016 Jun;54(6):548-55. [PubMed: 27284929]

Copyright © 2022, StatPearls Publishing LLC.

This book is distributed under the terms of the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>), which permits use, duplication, adaptation, distribution, and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, a link is provided to the Creative Commons license, and any changes made are indicated.

Bookshelf ID: NBK557442 PMID: 32491374