

Corrosive Ingestion : A Review

Chittinad Havanond, MD

Department of Surgery, Thammasart University Hospital, Pathum Thani, Thailand

Abstract

Strong acid and alkali can cause severe damage to the esophagus, stomach, and adjacent organs. History and physical examination alone cannot predict the degree of damage. Early endoscopy is advocated to establish the presence and degree of injury. Special treatment in mild or first degree of injury is not needed but aggressive resection is necessary in cases where there is extensive necrosis of the esophagus. Surgical intervention is still controversial in the management of patients with lesser degree of injury.

Corrosive ingestion is not a rare occurrence. In adults, common reasons for ingestion are suicidal attempt and secondary gain, but in children accidental ingestion is a common occurrence. The severity of these injuries depends mainly on the type of corrosive, the concentration, amount and duration of ingestion.¹ While an empty stomach, vomiting and antidotes are other factors, which have been shown to correlate with the extent of injury.^{2,3} However, suicidal patients are often the most severe and extensive cases.

In the Far East, acid ingestion occurs more commonly than in the West^{2,4,6}. For instance, in Thailand, the household cleaning agent industry contains acid in most of their products.

Corrosive agent

The strong acid contains an offensive odor, and taste both sour and bitter. It induces extreme pain in the lips and oral cavity. Strong acids produce

coagulation necrosis and eschar formation, which help prevent further penetration injury. Injury to the esophagus is usually less severe than that of the stomach because of the squamous epithelium's greater resistance to trauma, and the liquid's rapid transit time through the esophagus.^{2,7-11} Because of acidity in the stomach and pyloric spasm, the antrum is affected most.⁷ The patient's posture while ingesting these agents is also known to correlate well with the area injured.⁴

In contrast to acid, strong alkali usually causes more extensive damage. Commercial cleaners in the area for instance, contain: powdered lye, 100% of sodium hydroxide, potassium hydroxide, liquid sodium hydroxide, or as seen in liquid Drano (2-10% sodium hydroxid, Bristol Company).^{2,11} Strong alkali produces more severe liquefaction necrosis and thermal burns that penetrate through the intestinal wall.^{2,8,11,12} It dissolves mucosal lipoprotein and invades deep mucosal

layer.¹¹ Solid lye injures mucous membranes of the mouth, tongue, pharynx and esophagus. Where as, liquid lye rapidly passes into the stomach. Because of pyloric spasms, lye moves to and fro in the stomach.¹³ It may spare the esophagus,² but most patients have severe esophageal and gastric injuries.¹ Saponification progresses to cellular necrosis within a few days. The mucosal sloughing and deep ulceration occur during the first week. During this time, endoscopy is dangerous due to weakness of the mucosal layers. After 3 weeks, stricture formation and cicatrization cause obstruction of gastrointestinal tract. Esophagus and gastric cicatrization, hourglass deformity and linitis plastica-like deformity are late complications in grade 2b and 3 injuries.¹

Clinical manifestation

Corrosive ingestion is not uncommon. Accident ingestion occurs more often in children compared to adults, but the amount of agent ingested is small. Suicidal patients ingested large amounts and the injuries are severe especially from lye ingestion. Vomiting, dysphagia, excessive salivation and abdominal pain are likely to indicate grade 2 or grade 3 oropharyngeal burn.¹⁴ More important than oral burns are esophago-gastric injuries. Vomiting, drooling, stridor and oropharyngeal burn correlate with endoscopic esophageal injury but oropharyngeal burn itself does not reliably indicate the extent of esophageal injury.^{5,15} Crain suggested that a combination of at least two of three specific signs and symptoms: vomiting, drooling and stridor would have predictive power of various esophageal injury.¹⁵ Ferguson reported his experience with 41 patients and the correlation between proximal and esophageal injuries. Among those patients with no injuries proximal to the uvula, they all developed esophageal burn. Twenty five percent of patients with injuries of the oropharyngeal zone had esophageal injury. And lastly, all patients with injuries to the false

and true vocal cord to the cricopharyngeus had esophageal injuries. However, he still suggested that early endoscopic evaluation is important to determine severity and to predict prognosis.¹⁶ The presence of fever is strongly correlated with the presence of an esophageal burn. When epigastric pain and guarding are present, the stomach is involved. Perforation of the stomach or esophagus may occur at any time during the first 2 weeks.² In a retrospective study in 220 patients, Huang reported that the time elapsed between injury and development of peritoneal sign is a good indicator of the severity and extent of the injury.¹⁷ Hematemesis and melena can occur during the first week after lye ingestion.¹ Perforation and massive bleeding are indications for surgery.

Classification

The severity of caustic injuries based on endoscopic examination is categorized into three grades (Table 1).¹¹ This is the most commonly used system to classify injuries in a manner similar to burns of the skin.

Zargar slightly modified the above classification by subdividing grade 2 into grade 2a (superficial localized ulceration, friability, and blisters) and grade 2b (grade 2a plus circumferential ulceration).⁵

Evaluation

Initially, plain radiographic studies usually suggest unremarkable studies.⁸ In any case, chest and plain abdominal films are still recommended in the initial evaluation.^{1,5,8,18} In severe patients, plain radiographs may show free air in the peritoneal cavity or pneumomediastinum in perforated cases,⁵ but free air is not always demonstrated in cases of perforation.³ Bubbles and streaks of gas may be seen in cases of gastric wall necrosis.⁸ Ultrasound and abdominal CT scan are not recommended as in cases of caustic injury because they offer little benefit.¹⁹ Contrast examination during

Table 1 Classification of the depth of injury

| Endoscopy | Pathological condition |
|--|--|
| Grade 1 Edema, erythema, exudate | Minimal or no loss of mucosa |
| Grade 2 Extensive ulcers and hemorrhage | Injury to submucosa and muscle layer |
| Grade 3 Extensive ulcerations hemorrhage, Atonic lumen | Injury through entire wall, penetration or perforation |

the acute phase usually proves normal in cases that are later classified as grade 1 or 2a by endoscopy.⁵ Findings of thickened mucosal folds, ulceration, radiolucent filling defects because of blood clots, and atony are all found during the acute phase.⁵ Muhletaler reported radiographic findings of 24 patients who ingested acid. In the acute phase, first 10 days after the ingestion, consisted of mucosal edema, submucosal edema or hemorrhage, ulcerations, slough of the mucosa, atony and esophageal dilatation. All of nine esophagograms in the subacute phase, 11-16 days after ingestion, showed narrowing, mucosal ulceration, submucosal edema and atony. He suggested that the esophageal atony with or without significant dilatation is probably an indication of the severe mucosal injury or inflammation.²⁰ Significant dilatation of the esophagus in the acute phase has been considered a sign of impending perforation.^{7,20,21} Ferguson used esophagograms to assess the presence or absence of perforation in patients with suggestive clinical findings, but this technique could not show significant assessment of the degree of injury.¹⁶ In the cicatrization phase, 2 to 3 weeks after the injury, esophagogram is preferred to assess the degree of stricture.¹⁶ The decreased peristalsis of stomach from stenosis and linitis plastica-like deformity is shown by barium study in chronic cases.⁵

After 1970s, fiber-optic endoscopy became widely used. Early endoscopic examination with flexible endoscope in corrosive ingestion patients is strongly recommended to evaluate extension and severity,^{2,5,12,13,16,22,23} because it is safer than the rigid ones due to the risk of perforation.¹ In the past, there had been some contradictory opinions about risk of perforation from insufflation air of flexible endoscope.^{8,9,13,18,24} In any case, endoscopic evaluation between 7-14 days after ingestion is not recommended.^{1,18} Not because of the pressure that will be exerted, but the esophageal wall is soft during that period. Most physicians attempt to assess the entire esophagus and stomach even in severe cases.^{2,7,23} Area of brown-black discoloration of mucosa does not necessarily mean full thickness injury^{7,23} but it is likely to be associated with necrosis and indicative of high risk of perforation.^{7,25} If there are findings of frank necrosis of the esophagus, diffuse blackish discoloration with paper thin walls, or massive edema that obliterate the lumen, then the examination should be terminated.^{1,13} In severe gastric injury, it is not necessary to pass the scope into the duodenum.¹

Management

Because of pathophysiologic difference between acid and alkali,²⁵ mixing of strong alkali and gastric juice initiates a powerful chemical reaction, and especially heat from the hydration reaction.²⁶ Injury of 2nd degree from alkali ingestion has significantly worst progressive nature.³ Exploratory laparotomy should be considered first in this situation.^{13,26} Wu MH et al, suggested that the criteria for emergency laparotomy were endoscopic finding of severe corrosive injury, peritoneal signs and continuous bleeding.^{3,18} However, it is difficult to assess the degree of injury from only endoscopic findings. Several surgeons advocate laparotomy in second or third degree burns and full assessment may require thoracotomy.^{23,26} Meredith also recommended exploratory laparotomy in circumferential second and third degree esophageal burn. In addition, he passed a string through a gastrostomy wound for retrograde dilatation.¹³ In severe gastric necrosis, many surgeons prefer total gastrectomy combined with esophageal removal without thoracotomy, because of significant esophageal injury occurring together.^{3,13,16} Feeding jejunostomy is preferred for nutritional support, not only in esophago-gastrectomy patient but also for patients with esophageal stricture resulting from corrosive injury.^{3,10,16,27} The risk of infection and mediastinitis increases considerably in those patients with carcinoma and stricture that often require multiple dilatation.²⁸ Based on Lai's experience, he recommended stripping of the esophagus which is simpler than the thoracoabdominal approach for esophagectomy.^{3,17} In milder degree of injuries to the esophagus, proper management has yet to be concluded. Esophageal stent placement through a gastrostomy had been suggested by Estrera whose experience in the treatment of second degree and non-extensive third degree esophageal burns, or necrosis was extensive.²⁶ Panieri reported that the stents are not well tolerated and may dislodge, resulting in aspiration or hemorrhage, as well as promoting regurgitation.²⁹ The stents should be left to remain in place for at least 3-6 weeks.^{4,29} Early esophageal dilatation before 2-3 weeks after ingestion is not recommended because of the risks of perforation.^{7,12} However, early bougienage and stent to avoid stricture development are currently the controversial issues in management.¹

Severity of injury in suicidal patients is related to: the amount of ingested strong acid or alkali, delayed diagnosis and treatment.¹⁹ Extensive injury beyond the pylorus is rare,¹⁹ in which cases, a Whipple's operation is necessary.^{3,19} Management of the pancreatic duct varies, depends on the injury and condition of the patient.^{3,19} Cattani preferred to occlude pancreatic duct with a polymer.¹⁹ While Benjamin Jeng reported his two patients who had survived from immediate reconstruction of the pancreatic and bile ducts, but another three patients who underwent a simpler procedure died.²⁵ Secondary organ necrosis had to be removed. Radical resection of damaged tissue, even minimal lesion, must be done to prevent bleeding, necrosis and infection, of which if not done will usually result in a fatal outcome.^{3,19} Other conservative procedures with second-look operation are not recommended.^{19,23,25} Benjamin Jeng found that the result of treatment depended on the degree of severity and length of injury. The length of resected injuries to bowel more than 100 cm long is definitely related to prognosis.²⁵

Because of improvement of laparoscopic techniques in many abdominal operations, laparoscopy may have a key role in corrosive ingestion management.¹⁹ Laparoscopic evaluation of the thickness of gastric wall injury takes time to complete, especially at the fundus and posterior surface of the fluid-filled stomach or when there is gastric atony. Although in some particular cases such as 2b injury of the antrum and blackish discoloration sign, laparoscopy may reduce unnecessary exploration.

Patients who have upper airway obstruction require intubation, but tracheostomy is necessary only in cases of severely damaged supraglottic and glottic structures.¹⁶ Tracheostomy may interfere with esophageal reconstruction.²³ Endotracheal intubation is an adequate management in cases of edematous larynx. Cattani recommended that tracheobronchial endoscopy must be performed whenever the upper esophagus is found necrotic.¹⁹

Incidence of esophageal stricture is high in grade 2 and 3 injuries. Assessment with esophagogram should be done between the second and third weeks after ingestion.^{16,23} Conservative treatment of stricture by dilatation should be done; surgery is necessary in failed cases.¹⁶ Lahoti reported that esophageal thickness is a significant predictor of the response to endoscopic

dilatation rather than length of stricture. Wall thickness greater than 9 mm needs a significant higher number of sessions for adequate dilation.³⁰ Panieri reported in children that predictive factors of failed conservative treatment were delayed presentation for more than one month, severe pharyngoesophageal damage that required tracheostomy, esophageal perforation during dilatation, and a stricture longer than 5 cm.²⁹

In late esophageal reconstruction, the colon is a good esophageal substitute. Either right or left side colon can be used.^{4,12,16,18,29} The right side with part of ileum has better blood supply and the ability of the ileocaecal valve to prevent regurgitation. Its length is also long enough for a high anastomosis.^{4,12,31} Esophagectomy is not always necessary because carcinoma development is not common.^{4,11,12,16} Nonetheless, the incidence of esophageal carcinoma does not depend on severity of esophageal injury; these figures vary from 2-8 percent.²⁸ Longer duration after injury correlates with a higher risk of malignancy.²⁸ However, Sugawa advised prophylactic esophagectomy in young patients because of long life expectancy.¹¹ Wu MH et al and Campbell et al preferred the substernal route because they considered the route being the immaculate zone.^{4,12} High anastomosis to the hypopharynx has poor outcome.⁴ Salivary leakages from cervical anastomosis usually close spontaneously, but it may develop into stricture in which endoscopic dilations can have good results.⁴

Campbell reported his data which indicated that use of corticosteroid may decrease stricture formation from 85 to 15 percent, and corticosteroid should be continued for 4 to 6 weeks.¹² However, Anderson reported a controlled trial study of corticosteroids in children with corrosive injury of the esophagus^{13,16,24} showing that the use of steroid to prevent development of stricture proved not beneficial in regards to the eventual stricture formation. Steroids have various serious side effects especially the infection. Antibiotics are not recommended routinely in uncomplicated patients,¹⁶ however, patients treated with steroids should be given antibiotics as well.²

CONCLUSION

Corrosive ingestion is not an uncommon occurrence. Alkali ingestion is found to cause more severe injury than acid. It is highly recommended that early

endoscopic evaluation should be made. Management for grade 2b injury is controversial; the results from clinical trials may eventually guide us in the right direction. Exploratory laparotomy is treatment of choice in grade 3 injury, and extensive removal of necrotic tissues or involved organs is essential and will result in the best prognosis. The role of steroids for stricture prevention is controversial.

ACKNOWLEDGMENT

I am grateful for the encouragement and assistance of Mark P. Sundrakes MD, who has been a great help to me in preparation of this manuscript.

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