

Caustic Agent Ingestion by a 1.5-Year-Old Boy

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Abstract- We present a case of caustic ingestion by a 1.5-year-old boy. The caustic agent was drain opener which is a strong alkaline substance. Children in Iran and many other countries are still exposed to not "child proof" (child resistant packaging) toxic substance containers. Ingestion of caustic agents may lead to necrosis, perforation, and strictures. Substances that are ingested more frequently are liquid alkali material which causes severe, deep liquefaction necrosis. Common signs and symptoms of caustic agents are vomiting, drooling, refusal to drink, oral burns, stridor, hematemesis, dyspnea, dysphagia and abdominal pain. Even if no oropharyngeal lesion is seen, a significant esophageal injury which can lead to perforation and stricture cannot be ruled out. If abdominal pain or rigidity, substernal, chest or back pain exists, visceral perforation should be considered. The first thing to be checked is airway assessment. A lot of patients should be admitted to intensive care unit, and endoscopic evaluation, surgical intervention, long-term hospitalization, and worsening quality of life or among the complications. Preventive measures especially at the country level and approving proper legislation for obligating the related industries to produce child proof containers for household toxic products are the urgent measures to be followed by all of us.

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Introduction

Children in Iran and many other countries are still exposed to not "child proof" toxic substance containers.

Ingestion of caustic agents may lead to esophageal necrosis, perforation, and strictures. Substances that are ingested more frequently are liquid alkali material which causes severe, deep liquefaction necrosis. Drain decloggers are most common, and as they do not have any taste, more amounts are ingested. Acidic substances have a bitter taste. Therefore, fewer amounts may be ingested, and they cause coagulative necrosis and a kind of protective thick eschar. Severe gastritis and respiratory symptoms by volatile acids are other damages of acidic substances (9).

Case Report

We admitted a 1.5-years-old boy, from a provincial

hospital, ingested the unknown amount of drain opener, on the previous day. On presentation he was fully conscious, agitated, intubated, receiving respiratory support with a T-Tube and supplementary oxygen and had moderate respiratory distress. There were burning erosions on his mouth, upper chest and buttock that considered being caused by the caustic agent. He ingested the toxic substance about 12 hours before admission. He had not received anything by mouth since the accident happened and had been receiving maintenance infusion.

The accident happened when child had been sitting by his mother in the kitchen, the mother left him unattended to respond a phone call, and in these few minutes the unattended child get attracted to the bright and attractive color of the toxic substance bottle which its orange color resembled the commercial fruit juice containers that wasn't also child-proof.

By admission, he was normally conscious, agitated, not fully sedated on arrival, seemed no need for positive

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pressure support (he had a tracheal tube to protect the edematous upper airways from obstruction), with subcostal retractions and nasal flaring, and on chest auscultation; diffuse fine symmetrical crackles on the upper chest were heard. The abdominal and heart exam, peripheral perfusion, hydration status and other examinations were unremarkable. There wasn't any evidence of subcutaneous emphysema around neck and chest or abnormal chest auscultation signs of mediastinitis (mediastinal crunch or Hamman's sign). His previous medical history was unremarkable.

His vital signs were as follows: heart rate=130/beats/minute, respiratory rate=34 breath/minute, temperature=37.2°C, blood pressure= 98/60 mmHg. His weight was 10 kilograms, and the hemodynamic condition was stable.

He was transferred to the intensive care unit for close monitoring, the respiratory capacity evaluated and continuous positive pressure (CPAP) with 30% oxygen supplementation through tracheal tube seemed to be sufficient to maintain the normal pulse oxygen saturation.

A femoral central venous line was inserted. Considering the risk of infection and the probability of mediastinitis, clindamycin and ceftriaxone were prescribed, in order to cover gram positive, gram negative, mouth anaerobes and staphylococcal infections. Pantoprazole, Atrovent and Ventolin inhalation and maintenance fluid and electrolyte (with 154 meq/l sodium for probable inappropriate antidiuretic hormone syndrome caused by pain and stress) were also administered. Analgesic, sedative and dexamethasone 2 mg/kg/day qid and pantoprazole were added to the prescription list. Skin burn lesions received proper treatment by normal saline cleaning and compress, silver sulfadiazine and Vaseline gauze dressing. He had a large amount of respiratory secretions and suction of secretions had been performed repeatedly and gently just at the proximal part of the mouth to be sure that no more irritation and injury imposed on the inflamed and damaged mucosa of the oropharynx or deeper parts. On the coming days, serial chest x rays obtained, and signs of mediastinal widening were looked for carefully.

According to the guideline of our hospital, patients who ingested caustic agents should be evaluated by esophageal endoscopy, not sooner than 12 hours (to let the injuries get developed and can be properly evaluated) and no later than 36 hours (because of the progressive esophageal wall weakness and the risk of perforation) after the ingestion. An esophageal endoscopy showed circumferential ulcer with

necrosis and Grade 3 corrosive esophagitis.

On day 3, total parenteral nutrition started. Considering the possibility of extubation, epinephrine inhalation prescribed (dexamethasone had already been administered on day 1), but the extubation attempt that performed on day 4, caused severe stridor and was unsuccessful.

Considering the better respiratory condition, decreasing the respiratory secretions, good hemodynamic situation and hearing the air flow around the tracheal tube on neck auscultation (which means no tube and mucosa adhesion) the tracheal tube discontinued successfully on day 6. We had asked the surgery team to be ready for emergency tracheostomy in the case of the need for re-intubation and tracheal stenosis.

On day 8, when the patient could manage his saliva and don't have a drooling, little amount of liquid feeding from oral route administered successfully and gradually increased, however, two times attempts of per mouth administration had been failed previously.

On day 10, he didn't have respiratory distress, but the temperature raised to 38, a blood culture test ordered, and 5 days later the culture was positive for *Stenotrophomonas maltophilia* sensitive to cotrimoxazole and ciprofloxacin, and intravenous cotrimoxazole was administered, and he was transferred to Gastrointestinal ward. Fever stopped in a few days afterward, and the next blood culture was negative.

On day 30, he afflicted by mild diarrhea and mild fever, he wasn't dehydrated, and his general condition wasn't bad, and the stool exam was normal. At this time, he had lost 20 percent of his previous weight.

On day 32, as intermittent fever still continued, serial blood cultures obtained that were negative for any pathogen and antibiotics changed to ampicillin/sulbactam and vancomycin, in order to provide proper coverage for possible mediastinal abscess collection. Cervical and upper thoracic MRI imaging performed in order to search for the probably infected thrombosis caused by supraclavicular central venous access. Stool exam for *Cholestridium defficille* toxin ordered and enteral Metronidazole was prescribed. As central venous line (CVL) was necessary for administering parenteral nutrition (the child had lost weight and blood culture from CVL was negative), we couldn't discontinue the line in spite of refractory fever. Stool exam and culture were normal and negative for the *C.difficile* toxin. The intermittent, low-grade fever lasted for 20 days and loose stool excretion lasted for about 10 days. We didn't find any specific reason for these two

problems that caused a lot of anxiety for parents. However, the first positive blood test of an opportunistic pathogen, staying for long time hospital, having a central venous access, physiologic stress and systemic response to the inflammation, could be responsible

Barium esophagography, on day 40 showed gastroesophageal reflux, no significant stricture, no malrotation, the contrast media transferred from esophagus to stomach completely and normally (Figure 3).

An esophageal endoscopy at the day 47, showed, "Stricture and Fibrotic tissue". He discharged on the 50th day after admission with omeprazole and recommended to come for more evaluation in 2 weeks, or in the case of any complications. He didn't need endoscopic dilation on follow-ups and his condition got better and could take semisolid food.



Figure 1. The first chest x-ray showed hyperinflation of both lung fields



Figure 2. Chest x-ray 10 days after admission, reported as "hyperinflation and increasing peribronchial thickness and evidence of aspiration"



Figure 3. Barium esophagography showed gastroesophageal reflux, without significant stricture

Discussion

The annual economic burden of caustic ingestions (CI) in the United States of America in 2009 was 22,900,000 dollars and from the total of 807 patients, 45.3% had an endoscopic evaluation (3). In one study performed in some developing countries, most of the children ingested caustic materials were less than 5 years old (80%), 70% were boys, and the most consumed fluid has been caustic soda and after that was kerosene and sodium hypochlorite. The absence of the preventive measures has been the most important risk factor of these injuries (2).

In the United States, the Federal Caustic Act of 1927, for proper labeling for the caustic agents and the poison prevention packaging act of 1970 for providing childproof containers for household caustic agents, has decreased the number of corrosive substances ingestion by children (3). Most of the cases seen in children under 4-year-old and the next age peak happen in the late teenage years, the latter group has more complications as many of them do it deliberately and consume more amounts (3).

Acids with pH less than 3 and alkali with PH more than 11 are of the most important concern (8).

In a study performed in our hospital (Children's Medical Center-Iran) on 100 cases of accidental caustic agents, 76 patients were symptomatic, 29 had grade 1, 17 had grade 2b, 4 had grade 3a, and 4 had grade 3b esophageal injury and drain opener which is a strong alkaline substance had caused grade 2b-3b esophageal injuries (5). Correlation between Attention deficit/Hyperactivity disorder and impulsiveness and caustic agent ingestion has been seen (4). Many cases of caustic ingestions (CI) require minimal intervention, but some lead to severe esophageal injuries like chemical burns, necrosis or perforation of esophageal mucosa or even esophageal strictures. Countries which have setup prevention programs focused on parents and families have reached a decline in caustic ingestion cases. One of the reasons that developing countries have a higher rate of CI is the use of secondary containers, which are unlabeled and can be used to store household products or sold in market places (10).

Patients who ingest caustic agents can be asymptomatic but examination may show burn lesions on the lips, chin and hands (7). Common signs and symptoms of caustic agents are vomiting, drooling, refusal to drink, oral burns, stridor, hematemesis, dyspnea, dysphagia and abdominal pain. Even if no oropharyngeal lesion is seen, a significant esophageal injury which can lead to perforation and stricture cannot

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be ruled out (9). There are reports that Caustic agent ingestion was mistaken for anaphylaxis reaction, and it shows the importance of considering caustic ingestion in the presence of gastrointestinal symptoms, respiratory distress, and oropharyngeal edema. In one report, a 5 year old child with previous history of asthma and eczema, presented to emergency ward with; cough lips and tongue swelling that occurred just after eating and treated as refractory anaphylaxis, and after 10 days the mother disclosed that the patient ingested detergent before the initial complaint and esophageal endoscopy revealed injuries of caustic ingestion. In another case, a 3 year old boy presented with; retching, vomiting and lips and tongue swelling after eating peach tea and was treated with the impression of anaphylaxis, and because of lack of improvement, a nasopharyngolaryngoscopy performed and revealed burning of mouth and tongue, swelling of epiglottitis and other signs of caustic ingestion (6).

The signs and symptoms of CI, such as burning lips or mouth and oropharynx may not be so obvious, but presence or absence of these lesions do not correlate with esophageal and stomach injuries. Stridor, hoarseness, dyspnea or aphonia could be the result of laryngeal or epiglottic edema. Nonspecific signs like nausea, vomiting, hematemesis, dysphagia, odynophagia and drooling could be present. If abdominal pain or rigidity, substernal, chest or back pain exists, visceral perforation should be considered (8).

It should be taken in mind that the patient's presenting signs and symptoms are not necessarily correlated with extend of oropharyngeal and esophageal injury (10). Some authorities believe that endoscopy should be done after 12 hours and before 24 hours of the trauma and performing endoscopy after 48 hours is discouraged, because of progressive esophageal wall weakening and risk of perforation (8).

Hemogasanalysis can be useful in defining the severity of the injury, and metabolic acidosis with PH less than 7.22 indicates tissue necrosis and significant damage (7). Performing Barium Esophagogram, 3-4 weeks after caustic ingestion for assessing stricture formation is suggested (8).

The first thing to be checked is airway assessment, and sometimes tracheal intubation or tracheostomy is necessary (8). Whether the patient is at risk of respiratory compromise or shock, is the first concern in the management of CI (10). Gastric lavage, induced emesis, and neutralization are contraindicated (9) (Table 1).

In a case report, a child ingested "hair and grease

remover", the time for extubation, was assessed by visualizing the patient's upper airway, which was severely edematous with exudate, and he was extubated 11 days after the ingestion, when the airway evaluated by a repeated laryngoscopy and bronchoscopy (8).

Table 1. Endoscopic staging of esophageal injury (9)

Grade 1	Hyperemia and mucosal edema
Grade 2a	Exudates, hemorrhages, blisters, erosions, not circumferential
Grade 2b	Grade 2a + deep or circumferential ulceration
Grade 3a	Small scattered area of ulcers and necrosis
Transmural	
Grade 3b	Extensive necrosis

Corticosteroid is not recommended in the 1st-degree burns, but in more advanced cases it may reduce the risk of strictures (9). Normal gastric acid reflux can impair healing, and patients with grade 2 or higher damage should receive acid suppression therapy until ulceration heals completely (10).

Prescribing proton pump inhibitors (PPI) in grade 2 and 3, and antibiotics, PPI, and corticosteroids in grade 3 are indicated. Dexamethasone 1 mg/kg/day is more effective than Prednisolone 2 mg/kg/day in decreasing the severity of esophageal stricture (7).

Antibiotics are only indicated if there is fever or evidence of deep ulceration on endoscopy (11). Ampicillin 50-100 mg/kg/day for 10 days have been recommended (7).

Placing the nasogastric tube (NGT) by an endoscopic guide, in very severe cases for prevention of esophageal wall adhesions and stricture is useful (7). In the case of severe esophageal injury, a nasogastric or nasointestinal tube passed over a guide wire should be left in place. The guide wire is placed as the endoscope is removed. The tube works as feeding route and a stent. When the swelling improves, the child can be fed through the tube. As the child gets better and can swallow saliva normally, oral feeding is initiated (10). For grade 2b and 3 injuries, nasogastric tube placement by endoscopic guidance, to stent the damaged area and providing nutritional support has been suggested, and the stent should remain in place for 2-3 weeks to let the epithelization improves (8).

All patients with grade 2 esophageal damage should have a follow-up endoscopy 3 weeks after CI, to assess the presence of stricture. Even if the child, who has taken the certain product, doesn't have any symptoms, observation with endoscopy needs to be considered (10).

When strictures develop, repeated dilations may be required over a period of several years (11). Endoscopic dilation and in some severe burns, surgical colon or

small bowel interposition are needed (9).

In the case of severe early esophageal injury, late esophageal stricture will happen in 50% of the cases (2). The severer ulceration (circumferential ulcer, sloughing of the mucosa and white plaques) has more risk of stricture (9).

The most important factors that determine the severity of the injury are the type and the amount of the ingested substance. Esophageal perforation may cause hemorrhage from the extension of ulceration to the major blood vessels. Stomach perforation can cause injuries to the pancreas, bowels, and peritonitis with an urgent indication of surgical intervention (10). Esophageal perforation can lead to mediastinitis, tracheoesophageal fistula, pneumonia and sepsis (8). Corrosive agents can also make damages to the tracheobronchial tract, and tracheal tube can act as a stent to reduce the risk of stricture formation (1). Larynx involvement is rare and in the presence of dysphonia and dyspnea, laryngoscopic assessment is indicated (7). In the case of esophageal stenosis, 4 to 6 week after the digestion, endoscopic esophageal dilation should be considered (7). In assessing the outcome of treatment, the main points of successful esophageal dilation are; improvement of nutritional status and maintain esophageal patency (2). Late cases of esophageal carcinoma are a rare complication (9).

We extubated the patient on day 6. The patient tolerated little amounts of liquid on day 8. He had lost 20% of his weight on day 25, which notifies the importance of nutrition care for critical children. We couldn't feed the patient through a feeding tube, as the gastrointestinal team didn't insert a feeding tube by the endoscope, considering the risk of perforation. The mild intermittent refractory fever and mild diarrhea postponed discharging the patient and an opportunistic infection (*Stenotrophomonas Maltophilia*) detected and treated accordingly.

Stenotrophomonas maltophilia is gram negative multiple-drug-resistant organism that in humans is mostly associated with respiratory system infections. It is a waterborne bacteria; it causes nosocomial infections, but there have been reports of community acquired infections. Central venous line infections by *Stenotrophomonas maltophilia* have been reported, and removal of the central line is mandatory for successful treatment. Immune deficiency, prior use of antibiotic and indwelling devices like central lines are the risk factors of the infection (11). Use of broad spectrum antibiotics specially carbapenems, long stay in hospital specially intensive care unit, mechanical ventilation,

central venous lines, chemotherapy and malignant diseases and neutropenia are also the risk factors (12). It is resistant to a wide range of antibiotics such as beta-lactams, TMP-SMX, macrolides, carbapenems, cephalosporins, and aminoglycosides. The combination of TMP-SMX and ciprofloxacin was used for the treatment of meningitis caused by *Stenotrophomonas maltophilia* in preterm newborns, but resistance to TMP-SMX has also been reported. Ticarcillin-clavulanate is an alternative. However, resistant strains have also been seen (11).

The right time to extubation was a challenge in this case, and as mentioned above, careful multidisciplinary preparation and precise examination of the respiratory system are the key points in estimating the proper time and preventing the complications. Maintaining good nutritional intake in critically ill patients is of the great concerns, we couldn't place a nasogastric tube, and the central line couldn't prepare enough amounts of calories, and the patient lost weight significantly. Fortunately at the follow-ups of the patient, he didn't have significant stenosis, and there wasn't any need for invasive procedural treatments.

Lack of protective measures and legislations in the society, and the absence of community education campaign through social media are the main reasons for such events.

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