

Clinical and Endoscopic Features of Alkaline Toxicity in Children: A 5-year Retrospective Cohort Study

Shafiqa Alsharif

King Abdulaziz University Faculty of Medicine, Department of Emergency Medicine, Jeddah, Saudi Arabia

Abstract

Aim: Alkaline toxicity is a rare emergency condition that may result in substantial health issues in children with long-term morbidities. Our study aims to describe the clinical and endoscopic features of alkaline ingestion in children and to review the management.

Materials and Methods: A retrospective cohort analysis was conducted on 33 pediatric patients, who ingested weak or strong alkaline substance and presented to the emergency department in a single tertiary center.

Results: The mean patients' age was 24 ± 18.03 months with 17 (51.5%) boys and 16 (48.5%) girls. Twenty cases (60.6%) ingested strongly alkaline substances, and 13 cases (39.4%) ingested weakly alkaline substances. The common presenting symptoms were vomiting (63.6%), drooling (39.4%), hematemesis (12.1%), and stridor and chest wall burns (6.1%). Shortness of breath and oral stenosis were rare (3%). Esophagogastroduodenoscopy (EGD) was performed within 48 hours on children who had ingested a strong alkali. The endoscopic findings followed Zargar's classification. Suicide attempts or deaths were not reported in any cases. Clinical manifestations did not differ significantly between the exposure groups; however, endoscopic findings were not compared because EGD was performed only in children who had ingested strong alkali. Among the 20 children who underwent EGD, esophageal burns were identified in 8 (40%).

Conclusion: Our findings highlight the role of early endoscopic evaluation in identifying gastrointestinal injury after alkaline ingestion and guiding subsequent clinical management in affected children.

Keywords: Alkaline ingestion, clinical features, complications, endoscopy, children

Introduction

Unintentional ingestion of corrosives has been addressed in multiple guidelines and protocols over the past several years, particularly in the pediatric population. Several studies and case reports have demonstrated the catastrophic events that result immediately following the ingestion and over the long-term follow-ups (1). Morbidity outcomes vary depending on the type and quantity of corrosive ingested. The acidity of substances is determined by their pH. Substances with a pH above 7 are classified as alkaline, with those exceeding a pH of 11 requiring special attention due to potential human exposure (2). Alkaline toxicity is a rare health issue among adults and children; children have a higher incidence of alkaline than acidic ingestion. Males tend to have a higher frequency of ingesting alkaline substances than females (3,4). Common alkaline substances include

bleach, sodium hydroxide, potassium hydroxide, ammonia, and dishwashing detergents (5). Accidental ingestion of small amounts of these substances typically results in minimal health effects. However, intentional ingestion, or ingestion in large quantities, can lead to severe consequences, such as injuries to the eyes, skin, esophagus, and gastrointestinal tract (GIT). Those patients require comprehensive medical intervention and prolonged treatment.

In developed countries, the morbidity and mortality rates related to caustic ingestion have decreased due to stricter product regulations and increased public awareness about alkaline products (6). Despite these efforts, caustic substances continue to prompt numerous calls to control centers and visits to emergency departments (7). In Saudi Arabia, morbidity from caustic esophageal burns remains a significant health concern. The accessibility of these detergents varies by location, although



Corresponding Author: Asst. Prof. Shafiqa Alsharif, King Abdulaziz University Faculty of Medicine, Department of Emergency Medicine, Jeddah, Saudi Arabia

E-mail: halsharif@kau.edu.sa **ORCID ID:** orcid.org/0009-0006-4744-3599

Cite this article as: Alsharif S. Clinical and endoscopic features of alkaline toxicity in children: a 5-year retrospective cohort study. Eurasian J Emerg Med. 2026;25: 449-55

Received: 16.05.2026

Accepted: 05.09.2026

Published: 02.10.2026



©Copyright 2026 The Author(s). The Emergency Physicians Association of Turkey / Eurasian Journal of Emergency Medicine published by Galenos Publishing House. Licensed by Creative Commons Attribution-NonCommercial-NoDerivatives (CC BY-NC-ND) 4.0 International License

the manufacturers' containers are securely sealed. The severity of damage resulting from alkaline ingestion is influenced by the duration of contact with the affected surface, the amount ingested, and the titratable alkali reserve (TAR) (8). TAR represents the quantity of acid needed to neutralize an alkaline substance to a pH of 8.0. However, this information is often unavailable during emergencies. Alkaline substances with a pH above 7 can cause liquefactive necrosis, while those with a pH exceeding 11 are likely to result in severe injuries (9). Alkaline ingestion may cause esophageal damage including necrosis, proliferation, and stricture formation (4,10). It can also be reactive with the stomach hydrochloride causing alkaline gas that leads to gastric necrosis, and respiratory irritation (10). Direct contact with the alkaline substance can also result in skin burn and corneal injury (11). Patients who ingest alkaline substances may present with several symptoms including acute abdominal pain, vomiting, hematemesis, dysphagia, and rarely chest pain and shortness of breath (12). Stridor and saliva drooling are also reported symptoms (13). Patients presenting with alkaline ingestion, regardless of the amount taken, require proper care and management, starting with rapid assessment of the affected area, decontamination by flushing with copious amounts of water, and prompt medical attention. Blood tests may show leukocytosis, coagulopathy, lactic acidosis, or, rarely, renal or hepatic failure if the toxicity is severe. Radiological imaging may not help but sometimes can rule out a perforated viscus (9). Esophagogastroduodenoscopy (EGD) should be considered in children with suspected caustic ingestion who develop symptoms or signs suggestive of gastrointestinal injury, including vomiting, drooling, dysphagia, hematemesis, respiratory symptoms, abdominal pain, or oral lesions. In asymptomatic children without oral lesions, endoscopy may be withheld, provided that appropriate clinical observation and follow-up are ensured (1-3). The assessment of the esophagus in cases of alkali ingestion followed Zargar classification system (14).

Treatment always starts with airway protection (14). The placement of a nasogastric tube (NG tube) or the use of steroids in cases of caustic ingestion is still controversial. However, dexamethasone may reduce the airway inflammation and edema (15,16). Pain management and nutritional support are crucial, particularly for children and in long-term care. Generally, children with grade 1 injuries can safely be discharged home once they tolerate oral intake. Grade 2a injuries require close monitoring in the hospital until there is clinical improvement. Grade 2b/3 injuries necessitate admission to the intensive care unit (ICU) for appropriate management. Grades 2b and 3 burns have the potential to develop dense scar tissue and stricture formation, requiring long-term care involving dilations or stenting to maintain esophageal patency (17). Squamous cell

carcinoma of the esophagus can be a complication of grade 3 injuries (18).

Noting numerous children presenting to the pediatric emergency department with acute complications and occasionally, irreversible damage to multiple organ systems, we conducted a retrospective cohort study to examine these cases in terms of common presentations, grading features, and clinical management.

Materials and Methods

This retrospective cohort study included pediatric patients who presented to the Emergency Department of King Abdulaziz University Hospital following alkaline substance ingestion between 2012 and 2017. Patients were eligible if they were younger than 18 years, had a documented history of alkaline ingestion, and had sufficient clinical information in the medical record to confirm the exposure and initial clinical presentation. Patients who ingested non-alkaline corrosive substances or who lacked sufficient documentation to confirm alkaline exposure were excluded. Informed consent was obtained from the parents before performing the procedure. The study was conducted in accordance with the Declaration of Helsinki and was approved by the Biomedical Ethics Committee of King Abdulaziz University, Faculty of Medicine (approval no: 483-16. date: January 8, 2017). Informed consent was obtained from all parents before the procedure and the study.

Eligible cases were identified retrospectively from hospital medical records of children presenting to the emergency department with documented alkaline ingestion during the study period. Demographic characteristics, exposure history, presenting symptoms and signs, type and physical form of the alkaline substance, endoscopic findings, treatment, complications, and available follow-up information were extracted from the medical records. The 33 patients enrolled in this study were children <18 years of age and of both genders. All patients were evaluated at presentation by both emergency physicians and gastroenterologists. Clinical manifestations and physical examinations of the heart, lungs, and abdomen were performed. EGD was performed on 20 children with documented ingestion of a strongly alkaline substance who were clinically stable to undergo the procedure. Children with exposure to weak alkali and mild clinical manifestations were managed conservatively and did not routinely undergo EGD. Consequently, endoscopic outcomes were analyzed descriptively only among patients who underwent EGD; the outcomes were not statistically compared between the weak- and strong-alkali groups. Clinical information and patients' data used in this study, including age, sex, symptoms, history of ingestion, and the type of alkali (weak

or strong; fluid or granular), were retrieved from the hospital records.

Alkaline exposures were categorized as weak or strong according to the reported pH of the ingested substances. Substances with a pH >7 and ≤11 were classified as weak alkalis, whereas substances with a pH >11 were classified as strong alkalis. When available, the specific product and its documented composition or concentration were reviewed to support this classification. Based on the records, the endoscopic examination was performed under local anesthesia in those who had ingested a strong alkaline substance within 48h of admission.

Statistical Analysis

Given the small sample size and low frequency of several clinical events, the statistical analysis was primarily descriptive and exploratory. Data were described as values and percentages, including the mean and standard deviation (SD). Comparisons between weak- and strong-alkali groups were restricted to clinical variables assessed in both groups. Endoscopy-dependent findings were summarized for only the 20 patients who underwent EGD; no between-group hypothesis testing was performed. Fisher's exact test was used to compare categorical data among the study groups using Statistical Package for Social Sciences (SPSS) software version 22 (SPSS Inc., Chicago, IL, USA).

A p value<0.05 was considered statistically significant.

Results

A total of 33 children (age, mean ± SD: 24±18.03 months; Range: 12-96 months); 17 (51%) males and 16 (48.5%) females, were included in this study. All patients presented to the emergency department with ingestion of strong (n=20) or weak (n=13) alkaline solutions. All patients were admitted and managed appropriately during the study period. Accidental ingestion was documented in 19 patients (57.6%), while information regarding the intent of ingestion was unavailable for the remaining 14 patients (42.4%). No suicide attempts were reported (Tables 1, 2).

The number of substances ingested and the time elapsed after ingestion are summarized in Table 2. Presenting symptoms were evaluated in all 33 patients. Vomiting was one of the most frequently documented symptoms, occurring in 21 patients (63.6%) (Table 3).

As outlined in Table 4, ingestion of strong alkali often presented with symptoms such as vomiting, drooling, oral edema, and chest stridor, whereas ingestion of weak alkali showed no significant symptoms except mild vomiting and oral cutaneous edema. Because the majority of patients who ingested weak alkaline substances experienced minimal, non-serious symptoms, EGD

was performed only on patients who had ingested strong alkaline substances (n=20; 60.6%).

Ingestion of strongly alkaline substances was also associated with extensive mucosal involvement and complications. Clinical manifestations that were assessed in both exposure groups were compared using Fisher's exact test. Endoscopic findings were not compared between the weak- and strong-alkali groups because EGD was performed only in the strong-alkali group. Among the 20 children who underwent EGD, esophageal burns were identified in 8 (40%) children (Table 4). However, esophageal strictures and perforations were observed in 20% and 5% of patients who underwent endoscopy, respectively (Figure 1).

Those patients each required esophageal balloon dilatation under general anesthesia more than five times (Figure 1). Pharyngeal and gastric erosions were each documented in 4

Table 1. Demographic data of the total patients included in the study (n=33)

Age at baseline, months (mean ± SD)	24±18.03
Age at baseline, months (range)	12-96
Age at baseline, months n (%)	
12	14 (42.4%)
13	0 (0%)
18	3 (9.1%)
19	0 (0%)
24	7 (21.1%)
36	5 (15.2%)
48	2 (6.1%)
60	1 (3%)
96	1 (3%)
Sex, n (%)	
Male	17 (51.5%)
Female	16 (48.5%)

Table 2. Data shows the alkali amount ingested the time elapsed after ingestion all children involved in the study (available data, n=21)

Substance	n (%)
Weak alkali	13 (39.4%)
Strong alkali	20 (60.6%)
Time elapsed since ingestion	
Minutes	4 (19%)
1 hour	8 (38.1%)
2 hours	2 (9.5%)
3 hours	2 (9.5%)
>24 hours	5 (23.8%)
*Available data, n=21	

of the 20 patients who ingested a strongly alkaline substance (20.0%), Gastrostomy tube placement was required in 2 of 20 patients who ingested a strongly alkaline substance (10.0%).

Additional complications resulting from the ingestion of strong alkaline substances and from severe morbidities are outlined in Table 4. While no fatalities were reported among the patients, three individuals required admission to the pediatric ICU for mechanical ventilation; this subsequently led to complications, including mediastinitis and airway fistula.

Discussion

The incidence of corrosives substances ingestion, including acids and alkalis, has decreased in developed countries due to safety

precautions levied on hazardous products(19), while it is still a major burden in developing countries where the living environment can be unsafe. Nevertheless, some developed countries continue to face challenges, including a few cases that have not been reported in the literature. Our study focused on Saudi children under the age of 14 who presented to the emergency department of our hospital following alkaline ingestion. Accidental ingestion was documented in 57.6% of patients; however, information regarding the intent of ingestion was unavailable for 42.4% of patients. Accidental ingestion implies that children were not adequately prevented from accessing locations where these corrosive substances were stored. Rafeey et al. (19) observed that children who were just beginning to walk or crawl were particularly susceptible and experienced significant morbidity and mortality, with the highest

Table 3. Common presentations of patients ingested weak or strong alkalis

Symptom at presentation	Total (n=33)	Weak alkali (n=13)	Strong alkali (n=20)
Vomiting	21 (63.6%)	3 (23.1%)	18 (90%)
Cyanosis	1 (3%)	0 (0%)	1 (5%)
Shortness of breath	1 (3%)	0 (0%)	1 (5%)
Saliva drooling	13 (39.4%)	0 (0%)	13 (65%)
Hematemesis	4 (12.1%)	0 (0%)	4 (20%)
Oral edema	21 (63.6%)	3 (23.1%)	18 (90%)
Stridor	2 (6.1%)	0 (0%)	2 (10%)

Percentages in the total column were calculated using the overall cohort denominator (n=33), whereas percentages in the weak- and strong-alkali columns were calculated using their respective subgroup denominators (n=13 and n=20)

Table 4. Morbidities and complications according to the type of alkaline substance ingested

		Weak alkali (n=13)	Strong alkali (n=20)
ENT system	Burns of oropharynx	0 (0%)	4 (20%)
	Air way edema	0 (0%)	3 (15%)
	Tracheostomy	0 (0%)	1 (5%)
Respiratory system	Mechanical ventilation	0 (0%)	2 (10%)
	Air way fistula	0 (0%)	1 (5%)
	Mediastinitis	0 (0%)	1 (5%)
Gastrointestinal system	Oral edema	0 (0%)	5 (25%)
	Tongue edema	0 (0%)	3 (15%)
	Pharyngeal erosions	Not assessed	4 (20%)
	Esophageal burns	Not assessed	8 (40%)
	Gastric erosions	Not assessed	4 (20%)
Maxillofacial system	Oral fibrosis and stricture	0 (0%)	4 (20%)
	Reconstruction surgery	0 (0%)	1 (5%)
Plastic surgery	External chest wall burns	0 (0%)	1 (5%)
	Facial burns	0 (0%)	2 (10%)
Nutrition	Gastrostomy tube	0 (0%)	2 (10%)

Data are presented as n (%), with percentages calculated using the corresponding subgroup denominators: weak alkali, n=13; strong alkali, n=20. P values were calculated using Fisher's exact test based on the observed frequencies. Clinical complications are presented by study cohort. Endoscopic findings are illustrated separately, with percentages calculated from only those patients who underwent EGD (n=20), EGD: Esophagogastroduodenoscopy

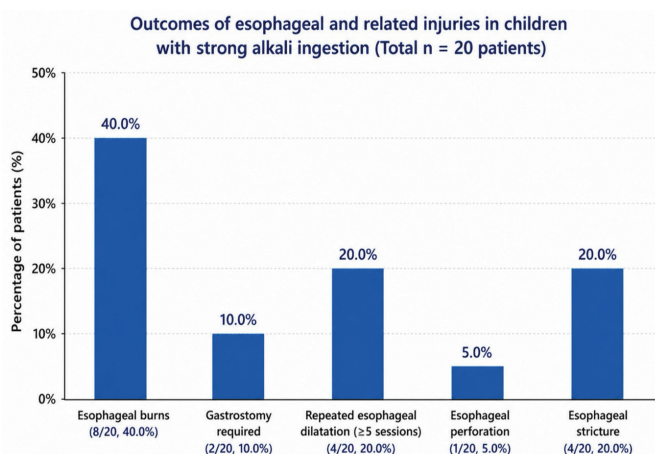


Figure 1. Endoscopic findings among children with strong alkaline ingestion. Percentages are calculated using only the 20 patients who underwent upper gastrointestinal endoscopy esophagogastroduodenoscopy as the denominator

incidence occurring at 2 years of age. The presentation of these children to the emergency department depends on the amount of alkaline substance ingested, the pH of the substance, and the time elapsed since ingestion. Household detergents and degreasers containing high concentrations of alkalis, with a pH as high as 11, are commonly found in lye-based products such as sodium hydroxide and potassium hydroxide drain cleaners, detergent powders, and granules (3,20). Ingestion of small amounts of weak alkalis or alkalis at low concentrations typically results in minor medical issues, such as mild vomiting and oral mucosal edema. Therefore, EGD is not always necessary in these patients, and close observation for a few hours is sufficient. Ingestion of a strong alkaline substance with a high pH is always associated with serious health consequences. Our current research highlighted the harmful effects of strong alkaline substances on multiple body organs. We observed that strong alkaline substances were ingested in 20 cases, while weak alkaline substances were ingested in 13 cases.

The pathophysiology of injuries caused by alkalis differs from that of acids. Alkalis can induce mucosal liquefactive necrosis, leading to submucosal destruction and deeper injuries that penetrate the muscularis propria. Alkalis become soluble upon forming soaps with fat, resulting in edematous tissue loosening and deep alkali diffusion into the tissues (3,20). This profound tissue damage results from the deep diffusion of alkalis and their edematous spread within the organs. Within 48 hours of ingestion, fibroblast proliferation and collagen synthesis commence, with peak weakening of the esophageal wall occurring between 1 and 3 weeks. The need for endoscopic evaluation should be determined based on clinical presentation and assessment by the treating pediatric gastroenterologist. Symptomatic children

with suspected caustic gastrointestinal injury should undergo timely EGD, whereas routine endoscopy may not be necessary in asymptomatic children without oral lesions when adequate follow-up can be assured (21).

The most common serious complications of strong alkaline ingestion occur in the GIT. A solution of 30% sodium hydroxide can result in full-thickness injury within seconds (5). In a rat model of esophageal injury, the concentration of sodium hydroxide was found to be crucial in terms of damage capacity as 2-15% was sufficient to result in epithelial necrosis and adventitial necrosis while 34% result in damages to the lung, trachea and esophageal perforation within 10 minutes to two hours (22). Other complications documented in our study included oropharyngeal burns, esophageal burns, and gastric erosions.

Management should be initiated and performed only in hospitals where they have facilities for pediatric emergency services and pediatric gastroenterology services. The common practice in alkali ingestion whether strong or weak begins in the emergency room, with priorities to support airway, breathing, and circulation and to ensure hemodynamic stability. Treatment attempts in the acute stages of alkali ingestion by children are aimed at preventing the development of strictures (23). Children who have ingested weak alkalis may be monitored in the emergency room and provided with oral fluids as part of management. While endoscopy is not typically required for such patients, routine blood tests can be conducted. In our study, 13 individuals had a history of ingesting weak alkalis and presented with minimal vomiting or mild oral cutaneous edema. However, for those who have ingested strong alkalis, prompt management is crucial to safeguard the GIT and respiratory systems. Among our patients who ingested strong alkalis, 90% received intravenous dexamethasone as part of the initial treatment, although the use of steroid injections remains controversial. All patients were administered proton pump inhibitors and antibiotics. These treatments work together to mitigate further damage from acidic reflux, which could be detrimental in a compromised GIT, and to prevent secondary bacterial infections that may arise in necrotic tissue, potentially worsening the prognosis by leading to stricture formation.

The European Society of Gastrointestinal Endoscopy and European Society for Pediatric Gastroenterology Hepatology and Nutrition recommend EGD in children with suspected caustic ingestion who exhibit signs or symptoms, such as oral lesions, vomiting, drooling, dysphagia, hematemesis, dyspnea, or abdominal pain. In asymptomatic children without oral lesions, EGD may be withheld when adequate follow-up can be ensured (21). EGD is considered an essential procedure for grading cases and selecting the best management for patients with strong

alkaline ingestion. Previous research has raised doubts about the necessity of performing routine EGD in all suspected cases of caustic ingestion (24-26), arguing that significant injury is unlikely if symptoms do not manifest following alkaline ingestion. Crain et al. (27) examined the relationship between the presence or absence of three symptoms and signs (vomiting, drooling, and stridor) and the EGD findings, indicating that the presence of ≥ 2 signs or symptoms is a reliable predictor of esophageal injury. Although severe esophageal lesions have been observed in children who were initially asymptomatic, significant lesions at endoscopy have not been reported when symptoms are absent following ingestion of weak corrosives (28). Moreover, the need for EGD in children should be determined by a pediatric gastroenterologist. If EGD is required, it should be performed within 48 hours to prevent further organ damage. In our study, individuals who ingested strong alkalis underwent EGD within 48 hours of ingestion. We posit that children with a mild clinical presentation who ingested weakly alkaline substances and were assessed by a pediatric gastroenterologist may not require an EGD. Instead, close monitoring is deemed essential.

The majority of complications in our study affected the GIT and the respiratory tract. Other injuries involved the oral cavity, including the oropharynx, and the glottic and subglottic structures, with some lesions extending into the larynx. In cases where oropharynx and larynx are affected, flexible laryngoscopy is necessary to estimate the extent of injuries (29). In our study, respiratory involvement ranged from mild to severe, with two cases requiring admission to the pediatric ICU and intubation. Esophageal injury is considered the most critical and life-threatening complication of alkaline toxicity. These complications impose a socioeconomic burden on developing countries, where access to repeated interventions, such as esophageal dilatation, may be challenging. Patients may also experience significant nutritional depletion, requiring the use of a nasogastric tube (NGT) for long-term management. The tube serves as both a feeding route and a stent. In advanced esophageal injuries, stenting the damaged segment with an NGT may provide a route for enteral nutrition for a couple of weeks. In certain instances, such as those observed in our study, an esophageal stricture can develop. The incidence of stricture formation was higher in children who vomited after alkaline ingestion. These strictures are typically identified in the third week post-injury, and early dilatation may enhance the outcomes of esophageal injuries (28). Consequently, all patients with minimal esophageal damage should undergo follow-up endoscopy within three weeks of the initial detection of esophageal injury to exclude the possibility of stricture formation (16). In our study, esophageal stricture developed in 4 of the 20 children who underwent EGD (20%). Some

researchers have reported that the rate of esophageal stricture formation can be as high as 40% or more in pediatric patients with moderate injuries following alkali ingestion (30). Regular esophageal dilatations should be performed to achieve an adequate esophageal caliber; however, the optimal frequency for esophageal balloon dilatation is not well-defined in the literature and is currently guided by the patient's symptoms.

Study Limitations

Only a few limitations have been acknowledged. As this was a retrospective medical-record review, some variables were not available for all patients. No statistical imputation was performed. The extent of missing data was reported where applicable. Furthermore, non-standardized clinical follow-up may have resulted in incomplete ascertainment of delayed complications.

Conclusion

This study describes the clinical and endoscopic characteristics of alkaline ingestion in children and highlights the spectrum of associated short- and long-term complications. Early endoscopic evaluation can assist in identifying and grading gastrointestinal injury and may support subsequent management decisions in appropriately selected patients. Given the retrospective design and absence of a comparison group based on endoscopy timing, the present study cannot determine whether early endoscopy reduces morbidity or mortality.

Ethics

Ethics Committee Approval: The study was conducted in accordance with the Declaration of Helsinki and was approved by the Biomedical Ethics Committee of King Abdulaziz University, Faculty of Medicine (approval no: 483-16. date: January 8, 2017).

Informed Consent: Informed consent was obtained from all parents before the procedure and the study.

Availability of Data and Material: The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflict of Interest: No conflict of interest was declared by the author.

Financial Disclosure: The author declared that this study received no financial support.

References

1. Cheng HT, Cheng CL, Lin CH, Tang JH, Chu YY, Liu NJ, et al. Caustic ingestion in adults: the role of endoscopic classification in predicting outcome. *BMC Gastroenterol.* 2008;8:31.

2. Brent J. Water-based solutions are the best decontaminating fluids for dermal corrosive exposures: a mini review. *Clin Toxicol (Phila)*. 2013;51:731-6.
3. Arévalo-Silva C, Eliashar R, Wohlgelernter J, Elidan J, Gross M. Ingestion of caustic substances: a 15-year experience. *Laryngoscope*. 2006;116:1422-6.
4. Dehghani SM, Bahmanyar M, Javaherizadeh H. Caustic ingestion in children in South of Iran: a two-year single center study. *Middle East J Dig Dis*. 2018;10:31-4.
5. Lupa M, Magne J, Guarisco JL, Amedee R. Update on the diagnosis and treatment of caustic ingestion. *Ochsner J*. 2009;9:54-9.
6. Contini S, Swarray-Deen A, Scarpignato C. Oesophageal corrosive injuries in children: a forgotten social and health challenge in developing countries. *Bull World Health Organ*. 2009;87:950-4.
7. Gummin DD, Mowry JB, Beuhler MC, Spyker DA, Brooks DE, Dibert KW, et al. Annual report of the American Association of Poison Control Centers' National Poison Data System (NPDS): 37th Annual Report. *Clin Toxicol (Phila)*. 2020;58:1360-541.
8. Hoffman RS, Howland MA, Kamerow HN, Goldfrank LR. Comparison of titratable acid/alkaline reserve and pH in potentially caustic household products. *J Toxicol Clin Toxicol*. 1989;27:241-6.
9. Karnak I, Tanyel FC, Büyükpamukçu N, Hiçsönmez A. Pulmonary effects of household bleach ingestion in children. *Clin Pediatr (Phila)*. 1996;35:471-2.
10. Günel E, Çağlayan F, Çağlayan O, Akillioğlu I. Reactive oxygen radical levels in caustic esophageal burns. *J Pediatr Surg*. 1999;34:405-7.
11. Schrage NF, Langefeld S, Zschocke J, Kuckelkorn R, Redbrake C, Reim M. Eye burns: an emergency and continuing problem. *Burns*. 2000;26:689-99.
12. Chen RJ, O'Malley RN, Salzman M. Updates on the evaluation and management of caustic exposures. *Emerg Med Clin North Am*. 2022;40:343-64.
13. Shcherbaeva T, Muallem Kalmovich L, Shalem T, Broide E, Gavriel H, Pitaro J. Caustic ingestion in children: the otolaryngologist perspective. *Pediatr Emerg Care*. 2022;38:e1541-e4.
14. Zargar SA, Kochhar R, Mehta S, Mehta SK. The role of fiberoptic endoscopy in the management of corrosive ingestion and modified endoscopic classification of burns. *Gastrointest Endosc*. 1991;37:165-9.
15. Khan S, Orenstein SR. Ingestions. In: Kliegman RM, Stanton BF, Geme JW, Schor NF, Behrman RE, eds. *Nelson Textbook of Pediatrics*. 20th ed. Philadelphia: WB Saunders; 2016:1794-6.
16. Gharib B, Mohammadpour M, Yaghmaie B, Sharifzadeh M, Mehdizadeh M, Zamani F, et al. Caustic agent ingestion by a 1.5-year-old boy. *Acta Med Iran*. 2016;54:465-70.
17. Tiryaki T, Livanelioğlu Z, Atayurt H. Early bougienage for relief of stricture formation following caustic esophageal burns. *Pediatr Surg Int*. 2005;21:78-80.
18. Chirica M, Bonavina L, Kelly MD, Sarfati E, Cattani P. Caustic ingestion. *Lancet*. 2017;389(10083):2041-52.
19. Rafeey M, Ghojzadeh M, Mehdizadeh A, Hazrati H, Vahedi L. Intercontinental comparison of caustic ingestion in children. *Korean J Pediatr*. 2015;58:491-500.
20. Riffat F, Cheng A. Pediatric caustic ingestion: 50 consecutive cases and a review of the literature. *Dis Esophagus*. 2009;22:89-94.
21. Tringali A, Thomson M, Dumonceau JM, Tavares M, Tabbers MM, Furlano R, et al. Pediatric gastrointestinal endoscopy: European Society of Gastrointestinal Endoscopy (ESGE) and European Society for Paediatric Gastroenterology Hepatology and Nutrition (ESPGHAN) Guideline Executive summary. *Endoscopy*. 2017;49:83-91.
22. Emoto Y, Yoshizawa K, Shikata N, Tsubura A, Nagasaki Y. Autopsy results of a case of ingestion of sodium hydroxide solution. *J Toxicol Pathol*. 2016;29:45-7.
23. Karaman İ, Koç O, Karaman A, Erdoğan D, Çavuşoğlu YH, Afşarlar ÇE, et al. Evaluation of 968 children with corrosive substance ingestion. *Indian J Crit Care Med*. 2015;19:714-8.
24. Thomson M, Tringali A, Dumonceau JM, Tavares M, Tabbers MM, Furlano R, et al. Paediatric gastrointestinal endoscopy: European Society for Paediatric Gastroenterology Hepatology and Nutrition and European Society of Gastrointestinal Endoscopy Guidelines. *J Pediatr Gastroenterol Nutr*. 2017;64:133-53.
25. Gorman RL, Khin-Maung-Gyi MT, Klein-Schwartz W, Oderda GM, Benson B, Litovitz T, et al. Initial symptoms as predictors of esophageal injury in alkaline corrosive ingestions. *Am J Emerg Med*. 1992;10:189-94.
26. Nuutinen M, Uhari M, Karvali T, Kouvalainen K. Consequences of caustic ingestions in children. *Acta Paediatr*. 1994;83:1200-5.
27. Crain EF, Gershel JC, Mezey AP. Caustic ingestions. Symptoms as predictors of esophageal injury. *Am J Dis Child*. 1984;138:863-5.
28. Boskovic A, Stankovic I. Predictability of gastroesophageal caustic injury from clinical findings: is endoscopy mandatory in children? *Eur J Gastroenterol Hepatol*. 2014;26:499-503.
29. Cowan D, Ho B, Sykes KJ, Wei JL. Pediatric oral burns: a ten-year review of patient characteristics, etiologies and treatment outcomes. *Int J Pediatr Otorhinolaryngol*. 2013;77:1325-8.
30. Elshabrawi M, A-Kader HH. Caustic ingestion in children. *Expert Rev Gastroenterol Hepatol*. 2011;5:637-45.