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Clinical Profile and the Outcome of Corrosive Injuries in Children

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Abstract: ***Background: Corrosive substances are common household substances that can be ingested either accidentally or intentionally with suicidal intent. Accidental ingestion is common among younger children of <5 years while suicidal ingestion is more common among adolescents. The severity of injuries depend upon the nature of corrosive, amount ingested and the site of exposure. Upper Gastrointestinal Endoscopy is an important investigation to decide on further management. Upper Gastrointestinal strictures are the most common long term sequelae and are managed by endoscopic bougie or endoscopic balloon dilatations. In case of resistant strictures, newer adjunctive therapies are available, such as intralesional steroids, stents. Surgery is the final resort for strictures resistant to dilatations and adjunctive therapy. Aims and objectives: To identify varied patterns of injuries and outcome following corrosive ingestion. Methodology: We conducted a retrospective cohort study of children aged between 1 year to 17 years admitted from January 2018 to June 2022, with history of corrosive ingestion and underwent Upper Gastrointestinal Endoscopy. Results: Out of 20 children, 80% were injuries due to accidental ingestion, 20% were suicidal.65% patients were under the age of 5 years.40% patients had esophageal strictures, 20% patients had both esophageal and stomach injuries, 10% patients had hollow viscous perforation as complication.20% patients developed gastric outlet obstruction subsequently.15.9% patients required gastric pull up surgery on follow up.10% required emergency laparotomy with total gastrectomy while 35% patients are on regular follow up for stricture dilatation. Conclusions: Accidental ingestion of corrosive is commonly observed in children, especially under 5 years of age. Upper gastrointestinal strictures were the common injuries requiring long term follow up and stricture dilatation. In order to prevent children from corrosive ingestion, importance must be given to preventive measures such as education of families, keeping and storing these agents out of the reach of children.***

Keywords: Corrosive ingestion, Upper Gastrointestinal Endoscopy, Esophageal stricture, Gastric outlet obstruction

1. Introduction

Corrosive ingestion remains a common problem in developing countries. Worldwide, children represent 80% of all corrosive substance ingestion cases. Children generally face higher risks than adults because they are unprotected and unaware of dangers. In developed countries, corrosive injuries have decreased significantly due to strong efforts like childproof containers and biohazard labelling. In developing countries, caustics are inexpensive, easily available, and often unlabeled for bio safety hazard. This problem is amplified by poor literacy and unawareness. It poses a significant management challenge due to a devastating effect on upper gastrointestinal tract in acute and chronic phases of the injury. Once acute complications are managed, strictures may develop at any site starting from oropharynx. The overall rate of esophageal stricture formation post corrosive ingestion is 2% - 63%. Endoscopic dilatation and surgery remains the mainstay for the management of strictures. While patients with established stricture are usually treated at tertiary centres, emergency management happens in the peripheral centres. There is paucity of literature on the management of corrosives in children. Therapeutic protocols or guidelines are not available so far.

Pathophysiology

Alkaline substances have higher viscosity hence remain in contact with esophageal mucosa for a long time, while acids have low viscosity, reach stomach faster, traverse along lesser curvature and reach pylorus where there will be physiological stasis. Alkali causes liquefactive necrosis and cause deeper ulcer, while acids causes coagulative necrosis and cause superficial ulcers. Emergency interventions such as usage of emetics and stomach wash causes repeated exposure of the caustic to esophageal mucosa. Following corrosive injury, an initial inflammatory response (lasts for about 4 - 7 days) in which there is thrombosis in arterioles and venules leading to necrosis followed by ulcer formation. Mucosal sloughing and bacterial invasion develop after four to seven days following ingestion, warranting use of anti microbials. Ulcers are covered by granulation tissue and fibrin. Ulcers extending beyond muscle layer causes perforation. Fibroblast appear on day four and repair of the damaged mucosa starts at day ten. Stricture usually develops by third week and completes over the next few months. Ascollagen deposition usually starts after two weeks, the strength of the injured tissue is poor in the initial three weeks, contraindicating any endoscopic procedures. From third week onwards, scar retraction commences leading to shortening of gastrointestinal tract. At this time, the pressure in the lower esophageal stricture decreases causing gastroesophageal reflux. Repeated acid exposure accelerated the stricture formation. Diverticular and deeper damage in the esophagus may lead to tracheoesophageal fistulae. Contraction of body of stomach results in decreased capacity and rarely fistulous opening into small or largeintestines. Antropyloric strictures cause gastric outlet obstruction. Proximal duodenal ulcers are rare. Compromise in nutrition causes dyselectrolytemia, cachexia, apathy and poor quality of life.

Clinical presentation can vary from occasional asymptomatic to being moribund. Symptoms include pain, nausea, vomiting, dysphagia, refusal to swallow and drooling of secretions. Hemetemesis or malena, respiratory

distress should arise suspicion of complications. Rarely, patients who present late may show signs of end stage complications, such as shock, metabolic acidosis, DIC and vital organ hypoperfusion.

Upper Gastrointestinal endoscopy should be performed in first 24 - 48 hours in all patients following corrosive ingestion permitting more precise therapeutic regimens and for early discharge of the patients.

Commonly ingested corrosives in children:

Acid
Sulfuric acid: Batteries, industrial cleaning agents, metal plating, toilet cleaner
Hydrochloric acid: Solvents, metal cleaners, lime solvents, toilet and drain cleaners, muriatic acid, antirust compounds
Acetic acid: Pickling vinegar, vinegar spirit, wart solution
Phosphoric acid: Toilet cleaners
Oxalic acid: Paint thinners, metal cleaners, toilet cleaner

Alkali
Sodium hydroxide: Grease/oil cleaners, drain cleaners, sink openers, oven cleaners, oil removers
Potassium hydroxide: Oven cleaners, washing powders, paint remover
Sodium carbonate: Soap manufacturing, fruit drying on farms
Sodium hypochlorite: Household bleaches
Ammonium hydroxide: General cleaner and grease remover

Miscellaneous
Hydrogen peroxide: Surface and food cleaner
Potassium permanganate: Disinfectants, hair dyes

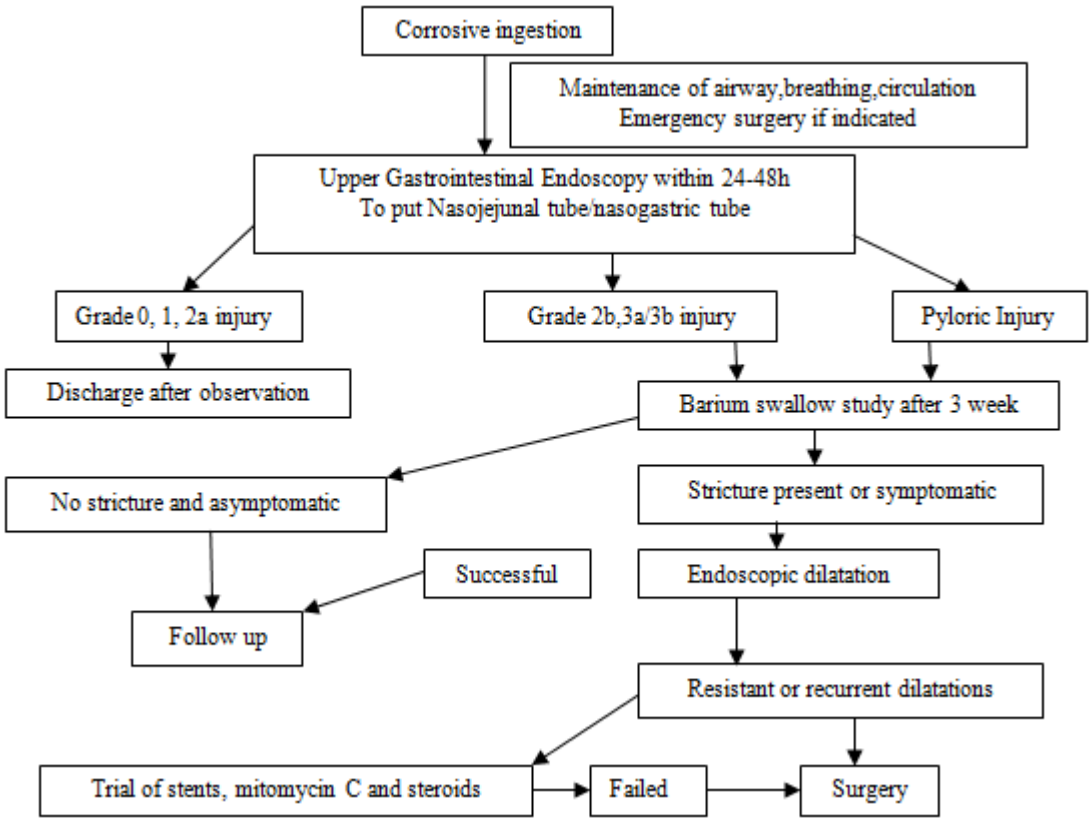

Figure: Flowchart for management of corrosive ingestion and upper gastrointestinal strictures

Endoscopic findings as graded using classification proposed by Zargar et al:
Grade I: only erythema and edema
Grade II: haemorrhage, erosion, blisters and ulcers with exudates
Grade II b: circumferential esophageal ulceration
Grade III a: scattered deep ulcers with brown, black, and gray discolouration
Grade III b: extensive deep ulcers with brown, black, and gray discolouration.
Grade IV: an esophageal perforation

2. Methodology

Aretrospective study was conducted at our Institute, Indira Gandhi Institute of Child Health, Bengaluru, between January 2018 to June 2022. Demographic characteristics, presenting symptoms, laboratory details, upper GI endoscopy results and outcome were extracted from hospital records. Children aged between 1month to 18 years were included in the study who had history of corrosive ingestion.
All patients admitted with history of corrosive ingestion underwent upper gastrointestinal endoscopy after thorough history taking and detailed physical examination and stabilisation of airway, breathing and circulation. History regarding type of corrosive, duration since consumption, upper GI endoscopy findings and they were correlated with outcome.

Statistical Analysis
SPSS (Statistical Package for Social Sciences) version 20. (IBM SPASS statistics [IBM corp. released 2011] was used to perform the statistical analysis. Data was entered in the

Excel spread sheet. Descriptive statistics of the explanatory and outcome variables were calculated by mean and standard deviation for quantitative variables, frequency and percentage with qualitative variables. The level of significance was set to 5%.

3. Results

Table 1: Demographic details

Sex	Male	11 (55%)
	Female	9 (45%)
Age	<5 years	13 (65%)
	5 - 10 years	2 (10%)
	>15 years	5 (25%)
Socio - Economic Status*	Lower middle	10 (50%)
	Higher middle	10 (50%)
Place	Rural	3 (15%)
	Urban	17 (85%)

*Socio - Economic status considered according to modified Kuppuswamy classification

Table 2: Clinical details, course in the hospital and complications:

Mode of ingestion	
Accidental	16 (80%)
Suicidal	4 (20%)
Time of presentation to the hospital	
Within 24 hours	
After 24 hours	8 (40%)
	12 (60%)
Type of corrosive	
Acid	15 (75%)
Alkali	5 (25%)
Oropharyngeal Ulcers	3 (15%)
Odynophagia	3 (15%)
Chest pain	5 (25%)
Epigastric Pain	6 (30%)
Nausea	10 (50%)
Vomiting	16 (80%)
Dysphagia	19 (95%)
Refusal to swallow	12 (60%)
Upper GI Bleeding	1 (5%)
Respiratory distress	3 (15%)
Hollow viscus perforation	2 (10%)
Shock	3 (15%)
Metabolic acidosis	3 (15%)
Sepsis	5 (25%)
DIC	0

Table 3: Upper Gastro intestinal Endoscopy:

Underwent within	
24 hours of ingestion	2 (10%)
24 - 72 hours of ingestion	3 (15%)
After 2 weeks of ingestion	15 (75%)

Table 3: Upper Gastro Intestinal Endoscopy findings

Normal	1 (5%)
Esophageal injuries	8 (40%)
Gastric injuries	7 (35%)
Both esophageal and gastric injuries	4 (20%)

In our retrospective cohort study, we analysed 20 children admitted to our Institute during the defined study period (December 2018 to January 2022) who had history of corrosive ingestion. Out of 20 children, 13 children (65%) were <5 years of age, 2 (10%) children were between 5 - 10 years of age and 5 (25%) were above 10 years of age. Average age of presentation was 6.5 years. Male to female ratio was 1.2: 1.

16 children (80%) were admitted with history of accidental consumption of corrosive, and 15 (75%) children admitted were due to acid consumption. Dysphagia was the most common presentation (95%), while 80%of children presented with complaints of vomiting. Only 8 (40%) were admitted within 24 hours, among which two of them developed complications such as hollow viscus perforation requiring emergency surgical intervention.5 (25%) children underwent upper gastrointestinal endoscopy within 72 hours of ingestion. All children were subjected to upper gastrointestinal endoscopy after 2 weeks of ingestion and on subsequent follow up.1 child showed normal findings with no subsequent development of dysphagia. Out of 19, 8 children (40%) had esophageal strictures, 7 (35%) had gastric involvement, 4 (20%) had both esophageal and gastric lesions. Overall, 17out of 19 children were submitted to dilatation, with a mean of 5.2 procedures per child. Recurrent strictures were experienced in 7 of 19 children (35%). A feeding gastrostomy was performed on 4 (20%) of 19 children.5 children are still on a continuous dilatation programme. In 3 (15%) patients it was not possible to overcome strictures and gastric pull up surgery was done. Successful dilatations were obtained in 7 children (35%).

4. Discussion

Children constitute 80% of all corrosive ingestion cases and the majority of this burden is contributed by developing countries. Corrosive ingestion is a common and preventable cause of esophageal and gastric injury in children. Development of stricture in the upper gastrointestinal tract is associated with long term morbidity, need for long term therapy and procedure related complications affecting the quality of life of children. The clinical outcome following endoscopies is generally rewarding. Even after the resolution of symptoms, the patients should be kept on long term follow up.

The mean age in our study was 6.49 years. The youngest age was 1year 3 months and the oldest was 17 years. There was no significant difference in the outcome among different age groups. The male: female ratio was approximately 1.2: 1. Ingestion of acids (75%) was more common than alkali ingestion (25%). The reason is attributed to the easy availability of acids when compared to the alkalis. In our study accidental consumption was the most common cause for corrosive ingestion accounting for 80% of the cases. The most common clinical features were dysphagia followed by vomiting.

Oropharyngeal ulcers were present only in 15 % of the patients. The incidence of significant esophageal and gastric injury as well as stricture was higher in the patients with normal physical examination at presentation. This correlates with studies which have shown poor predictive nature of oropharyngeal injuries in predicting the occurrence of esophageal or gastric injury following corrosive ingestion.

The upper Gastro Intestinal endoscopy revealed esophageal injuries (40%) to be most common followed by gastric injuries (35%). Many injuries do recur as observed in our study with 35% of children exhibiting recurrent strictures requiring continuous dilatations. Unfortunately long term dilatation programmes are very challenging in low income countries. Repeated hospital visits cost money, the parents may get exhausted and start feeling frustrated. These socioeconomic and psychological factors should be taken into account in the long term follow up. Furthermore, in our study we observed that children are admitted when the strictures are already well established. Late dilatations are difficult and are associated with significant recurrence rate.

In some patients, gastrostomy was necessary. However, feeding through gastrostomy or after dilatation may be followed by progressive malnutrition due to inability to nourish children properly and lack of appropriate feeding solutions. Mothers should be trained and helped in feeding techniques.

When evaluating the outcome of treatment, improvement in both the nutritional status and sustained esophageal patency, with an adequate lumen for normal food intake for growth and development, should be the reference points for successful dilatations.

In conclusion, immediate and late sequelae of corrosive ingestion requiring numerous diagnostic and interventional procedures put a significant social and economic burden on the family and healthcare system. As it is preventable, active measures should be taken to reduce the incidence of corrosive ingestion and its consequences. The decreasing incidence of corrosive ingestion in developed countries suggest that strict laws and regulatory measures can prevent corrosive ingestion. Stringent legislation is necessary for developing countries to curtail the sales of caustics in unlabeled containers and limit unrestricted access. The packaging of these agents ahouldbe made child proof. Parents needs to be educated to keep household corrosives safely away from children.

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