Original Research Article

Corrosive injury of the upper gastrointestinal tract and its outcome at 3 months: an observational study

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ABSTRACT

Background: Ingestion of corrosive substances can cause severe gastrointestinal (GI) tract damage, leading to life-threatening complications. The severity depends on the substance type, quantity, and intent behind ingestion. Early endoscopic evaluation is crucial for assessing injury extent and guiding management. This study aimed to evaluate the type and severity of upper GI mucosal injuries through early endoscopy, identify subsequent GI complications following corrosive ingestion, and assess patient outcomes three months post-ingestion.
Methods: This prospective observational study was conducted in the Department of Gastroenterology at Dhaka Medical College Hospital from January 2017 to December 2017. A total of 89 patients aged 18 years and above with a history of corrosive ingestion, presenting within 72 hours, were included. Data on the type of corrosive agent, quantity consumed, and ingestion intent were collected. All patients underwent upper GI endoscopy to assess mucosal injury severity.
Results: The study included 89 patients, predominantly young females (79.8% in the 18-27 age group) with a male-to-female ratio of 1:2.5. Most were Muslim (96.8%) and married (65.2%). Acid ingestion was reported by 78.7% of patients, with 71.9% ingesting household cleaners like harpic. initial symptoms included dysphagia and abdominal pain (both 56.2%). At three months, 80.9% had no complications, while 10.2% developed esophageal strictures, 12.4% had gastric outlet obstructions, and 2.2% died. Severe endoscopic mucosal injury (Zargar's grade 3) was a significant risk factor for complications.
Conclusions: Early endoscopic assessment is essential for predicting and managing the immediate and long-term complications of corrosive ingestion, significantly impacting patient outcomes.

Keywords: Corrosive ingestion, Complications, Oesophageal stricture, Outcome, Upper GI endoscopy

INTRODUCTION

Ingestion of corrosive substances, such as acids and alkalis, leads to significant and progressive injuries to the upper gastrointestinal (GI) tract, often resulting in considerable morbidity worldwide, with a particularly high burden in developing countries where corrosive agents are easily accessible as household items.[1] A study by the American Association of Poison Control Centers (AAPCC) reported that in 2014, 51,688 cases of corrosive ingestion occurred, representing 7.8% of all poisonings that year.[2] In India, the National Poisons Information Centre at the All India Institute of Medical Sciences documented 2,494 cases of poisoning from 1999 to 2002, with 3.1% attributed to caustic injury.[3] However, comprehensive data on corrosive injuries in Bangladesh are scarce. A hospital-based study in northeastern Bangladesh reported 441 cases of corrosive ingestion over four years, making up about 10% of all poisoning cases.[4]

In adults, corrosive ingestion is frequently intentional and associated with suicidal intent, often resulting in life-

threatening injuries.[5] This issue is particularly prevalent among young individuals, especially those in their teens and twenties.[6] The type of corrosive agent most commonly ingested varies by region; alkaline substances are more common in Western countries, whereas acid-related injuries are more prevalent in developing nations.[7] A study in Bangladesh found that out of 126 cases of corrosive injury, 51.6% involved Savlon ingestion, 31.8% involved Harpic, and 6.4% involved various acids.[8]

Corrosive ingestion can affect the entire GI tract, with the severity of injury depending on factors such as the nature of the caustic agent, the volume ingested, its concentration, the duration of mucosal exposure, and the intent behind the ingestion.[9] Solutions with a pH less than 2 or greater than 12 are considered highly corrosive.[10] Acute complications can include bleeding (haematemesis or melaena) and perforation of the esophagus or stomach, while late complications may include esophageal stricture and gastric outlet obstruction.[7,11] A remote but severe complication is the development of esophageal carcinoma, particularly squamous cell carcinoma, with a latency period of approximately 40 years after ingestion.[12]

Given the diverse clinical presentations, symptoms, and signs are often unreliable indicators of the extent of GI damage. Radiological studies also lack sensitivity. Upper GI endoscopy is the gold standard for stratifying the severity of injury in patients with acute corrosive ingestion.[13] Several classification methods exist, including Zargar's grading system, which is particularly useful in predicting immediate and long-term complications and guiding therapy.[14] Although steroids have been considered for treating corrosive esophageal injuries, their effectiveness remains controversial, and current evidence does not strongly support their routine use in such cases.[15] Despite its utility, the indications, timing, and therapeutic implications of endoscopy remain subjects of debate. In Bangladesh, while a few studies have focused on the demographic profile of corrosive injury, research on the immediate GI complications and outcomes is limited. This study aims to assess the severity of upper gastrointestinal mucosal injury through early endoscopy, the complications following corrosive ingestion, and the short-term outcomes.

Objective

Primary objectives were to assess the severity of upper gastrointestinal mucosal injury by early endoscopy, to determine the gastrointestinal complications following corrosive ingestion and its outcome at 3 months. Secondary objectives were to study the socio-demographic profiles of patients with corrosive ingestion., to determine the nature of the ingested corrosive substances., and to see the association of severity of gastrointestinal injury at endoscopy following corrosive ingestion with short term outcome at 3 months.

METHODS

Study design

This research was a prospective observational study conducted in the Department of Gastroenterology at Dhaka Medical College Hospital in Dhaka, Bangladesh. The study spanned one year, from January 2017 to December 2017. It involved patients aged 18 years and above, regardless of sex, who had a history of corrosive ingestion and presented within 72 hours of the incident. The primary aim was to assess the type and severity of upper gastrointestinal mucosal injuries through early endoscopy and to evaluate the subsequent complications and outcomes over a three-month follow-up period.

Inclusion criteria

All patients aged 18 yrs and above irrespective of sex with history of corrosive ingestion presenting within 72 hours of ingestion.

Exclusion criteria

Patients taking other poisonous agents concomitantly with corrosive agents. Patients with relative contraindication of doing upper GI endoscopy. e.g., Ischaemic heart disease, severe anaemia, severe respiratory distress etc. pregnant patients with history of corrosive ingestion.

Sampling technique

Consecutive sampling was used in this study.

Sample size determination

Sample size was determined by following formula -

$$n = \frac{Z^2 p \times q}{d^2}$$

Where,

n = the desired sample size which would help to measure the different indicators; z = the standard normal deviate, usually set at 1.96 at 5% level which corresponds to 95% confidence level.

Here; p=0.10, q=1 − 0, 1 =0.9, d = allowable error (normally from 1 − 10%) = 0.06 (assumed 6.0%). So, the sample size for this study would be

$$n = \frac{(1.96)^2 \times 0.1 \times 0.9}{(0.06)^2} = 96$$

Due to time constraint, finally 89 consecutive patients with history of corrosives ingestion were enrolled.

Study procedure

This study was conducted at the Department of Gastroenterology, Dhaka Medical College Hospital. Written informed consent was obtained from all participants. Detailed histories focused on the type, concentration, amount, and intent (suicidal, accidental) of corrosive ingestion, along with presenting symptoms. Clinical evaluations included vital signs, oropharyngeal assessment, and chest and abdominal examinations. Chest and abdominal radiographs were performed for patients with suspected perforation to identify pneumoperitoneum or pneumomediastinum. Upper GI endoscopy, using Olympus CLV 180 and Pentax EPK 1000 endoscopes, was conducted within 72 hours for all patients without contraindications. Endoscopy was performed by experienced endoscopists without sedation, minimizing aspiration risk. Air insufflation and retroflexion were cautiously applied to prevent iatrogenic injury. Mucosal injuries in the esophagus, stomach, and duodenum were graded using the modified Zargar classification. Acute complications, such as hemorrhage or perforation, were managed promptly; perforations were confirmed by free air on radiographs, and patients were transferred for surgical care. Post-discharge, patients were followed up for 3 months, with symptoms like dysphagia and postprandial discomfort documented. Late complications, such as esophageal strictures and gastric outlet obstruction, were confirmed via endoscopy. Strictures were treated with endoscopic dilatation, and gastric outlet obstructions were referred for surgery. All complications were systematically recorded in the data collection form.

Data processing and analysis

Statistical analysis was conducted using SPSS-16 (SPSS Inc, Chicago, IL, USA). Quantitative data were presented as mean ± standard deviation, while qualitative data were expressed as frequency and percentage. Chi-square tests were used for categorical variables, and unpaired t-tests for continuous variables. Factors associated with complications at 3 months post-ingestion were analyzed using univariate and multivariate logistic regression. A two-sided p value <0.05 was considered statistically significant. Data were systematically recorded, summarized, and presented using tables and charts.

Ethical consideration

The study adhered to ethical standards, with approval obtained from the ethical review committee. Patients and their relatives were fully informed of the study's scope and limitations, and written consent was secured. Confidentiality of patient information was strictly maintained, and participants were assured of their right to withdraw at any time without penalty. The study was designed to avoid any physical, mental, or social harm beyond the inherent risks of the procedures involved, with measures in place to minimize complications. All endoscopic procedures were performed by expert gastroenterologists, and medico-legal considerations were carefully addressed.

RESULTS

Table 1 showing the demographic profiles of the patients demonstrates that the mean age of the patients was 24.4 years and most of the patients were in the age group of 18-27 years (79.8%). Females were more affected than male with a sex ratio of male: female =1:2.5. Most of the patients in our study population were Muslims (96.8%). The educational background of the patients was mostly class VI-X (49.4%). Most of the patients were married (65.2%). The incidence was more common in housewife (44.9%) and the next common group was student 55 (33.7%).

Table 1: Demographic profile of the patients (n=89).

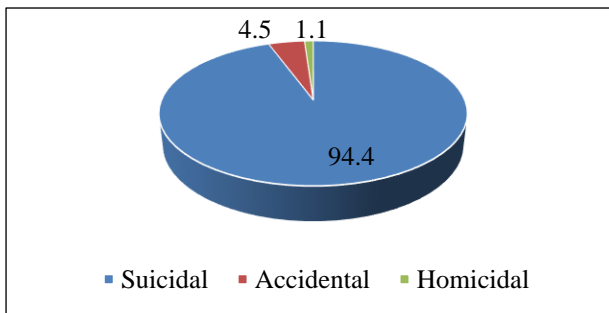| Demographic	Frequency (N)	Percentage (%)
Age (years)		
18-27	71	79.8
28-37	12	13.5
38 and above	6	6.7
Mean±SD (min-max)	24.4±7.6 (18-52)	
Gender		
Male	25	28.1
Female	64	71.9
Religion		
Islam	87	97.8
Hindu	2	22.2
Education		
Upto class V	5	3.2
Class VI-X	18	11.6
Class XI and above	45	29.0
Marital status		
Married	58	65.2
Unmarried	31	34.8
Occupation		
Housewife	40	44.9
Student	30	33.7
Others	19	21.4

Table 2 shows characteristics of corrosive agents. Most of the patients ingested acids (78.7%). However, 14 (15.7%) patients chemically unspecified corrosive agents. The amount of ingested corrosive agents ranged from 20 ml to 250 ml which was estimated based on the history given by the patient or family member. Most of the patients in our study ingested household toilet cleaner (Harpic, 71.9%) and disinfectant substance (Savlon, 11.2%) was the next common corrosive agent.

Figures 1 showed that ingestion intent was primarily attributed to suicide (94.4%) in our study population, while

4.5% cases were accidental and only 1.1% cases were homicidal.

Table 2: Characteristics of corrosive agents (n=89).

| Corrosive agent	Frequency (N)	Percentage (%)
Type of corrosive agent		
Acid	70	78.7
Alkali	5	5.6
Others	14	15.7
Trade name of corrosive agent		
Harpic	64	71.9
Savlon	10	11.2
Dettol	3	3.4
Vixol	3	3.4
Lizol	2	2.2
Battery water	2	1.1
Gold Smith's solution	1	1.3
Others	4	4.5
Amount of ingested corrosive agent (min-max) (ml) (Amount estimated by a standard measuring cup)	80.0±54.2 (20-250)	

Figure 1: Reason for ingestion of corrosive agents by the study subjects (n=89).

Table 3: Clinical symptoms of the study subjects at admission (n=89).

Symptoms	Frequency (N)	Percentage (%)
Dysphagia/odynophagia	50	56.2
Abdominal pain	50	56.2
Chest pain	38	42.7
Heartburn	36	40.4
Oropharyngeal pain	26	29.2
Sialorrhoea	22	24.7
Drooling	20	22.5
Hoarseness of voice	1	1.1
Dyspnoea	1	1.1

Table 3 showed clinical symptoms of the study subjects at admission. It shows most common initial symptoms of the patients at admission are dysphagia/odynophagia (56.2%),

abdominal pain (56.2%), chest pain (42.7%), heartburn (40.4 %) and oropharyngeal pain (26%).
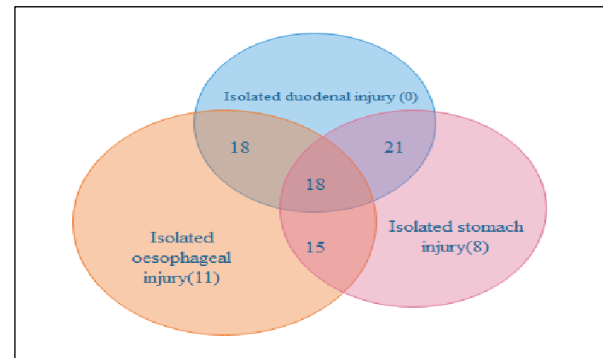
Figure 2: Venn diagram showing different sites of mucosal injury revealed at initial endoscopy.

Figure 2 venn diagram showed that out of 116 patients who undergone initial endoscopy, 14 (12.1%) and 11 (9.5%) patients had isolated oesophagus and stomach involvement respectively. No patient had isolated duodenal involvement. However, 45 (38.8%) patients had both oesophageal and gastric injury.

Table 4: Grading of stomach injury according to different types of corrosive agent (n=89).

Grading of stomach injury	Acid (n=70) (%)	Alkali (n=5) (%)	Others (n=14) (%)
Grade 0	17 (24.3)	2 (40.0)	8(57.1)
Grade 1	6 (8.6)	0 (0.0)	4 (28.6)
Grade 2a	14 (20.0)	1 (20.0)	2 (14.3)
Grade 2b	8 (11.4)	0 (0.0)	0 (0.0)
Grade 3a	18 (25.7)	1 (20.0)	0 (0.0)
Grade 3b	7 (9.0)	1 (20.0)	0 (0.0)

Figure within the parenthesis indicates percentage

Table 4 showed grading of stomach injury according to different types of corrosive agent demonstrates that out of 70 patients who ingested acids majority had Zargar's grade 3a (25.7%) stomach injury and 7 (9.0%) cases had severe grade 3b injury.

Table 5: Presenting symptoms at follow up (n=89).

Presenting symptoms at follow up	Frequency (N)	Percentage (%)
Weight loss	27	30.3
Dysphagia	11	12.4
Vomiting	10	11.2
Regurgitation	8	19.0
Post prandial abdominal discomfort	4	4.5

Table 5 showed the presenting symptoms of the patients at follow up. During follow up most common presenting symptom was weight loss (30.3%). Other common presenting symptoms of the patients were dysphagia (12.4%) and vomiting (11.2%).

Table 6: Clinical outcome of the study subjects at the end of 3 months according to different types of corrosive agent (n=89).

Clinical Parameters	Acid (n=70) (%)	Alkali (n=5) (%)	Others (n=14) (%)	Total N (%)
No complication	56 (80)	2(40.0)	14 (100.0)	72 (80.9)
Oesophageal stricture	7 (10.1)	2 (40.0)	0 (0.0)	9 (10.2)
Gastric outlet obstruction	10 (14..3)	1 (20.0)	0 (0.0)	11 (12.4)
Both oesophageal stricture and gastric outlet obstruction	4 (5.7)	1 (20.0)	0 (0.0)	5 (5.6)
Expired	1(1.4)	1 (20.0)	0 (0.0)	2 (2.2)

Table 7: Univariate analysis of the individual variable associated with development of complications at 3 months (n=89).

Variables	Complications at 3 months		P value
	Complications present	Complications absent	
Age (Mean ± SD) (years) [a]	24.1±7.4	24.4±7.6	0.890
Gender [b]			
Male	5 (29.4)	20 (27.8)	1.0
Female	12 (70.6)	52 (72.2)	
Type of corrosive agent [c]			
Acid	14 (82.4)	56 (77.8)	0.013*
Alkali	3 (17.6)	2 (2.8)	
Others	0 (0.0)	14 (19.4)	
Intent of ingestion[c]			
Suicidal	16 (94.1)	68 (94.4)	0.849
Accidental	1 (5.9)	3 (4.2)	
Homicidal	0 (0)	1 (1.4)	
Amount of ingested corrosive agent (Mean±SD) (ml)[a]	114±46	72±53	0.003*
Endoscopic grade 3 injury[c]			
Present	15 (88.2)	13 (18.1)	<0.001*
Absent	2 (11.8)	59 (81.9)	

[a]Student's t test was done to measure the level of significance; [b]Fisher's exact test was done to measure the level of significance; [c]Chi-square test was done to measure the level of significance; *p<0.05 considered significant

Table 6 showed clinical outcome of the study subjects at the end of 3 months according to different types of corrosive agent. Out of 89 patients, 72 (80.9 %) patients developed no long term complication at the end of 3 months and 9 (10.2 %) cases developed oesophageal strictures, 11 (12.4 %) cases developed gastric outlet obstructions and 5 (5.6%) patients developed both oesophageal strictures and gastric outlet obstructions. The rate of mortality rate was 2.2 % (as 2 patients expired during the study period of 3 months).

Table 7 showed univariate analysis of different factors associated with development of complications at 3 months revealed that type of the corrosive agents (p=0.013), number of ingested substances (p=0.003) and grade 3 endoscopic mucosal injury (<0.001) to the oesophagus or stomach or duodenum were the significant risk factors for the development of complications at 3 months.

Table 8 showed multivariate analysis by logistic regression of individual variables associated with development of complications at 3 months which revealed that severe endoscopic mucosal injury i.e., Zargar's grade 3 injury was significantly [p=.002,OR=32.920, 95% CI (3.611-300.146)] associated with development of complications.

Table 8: Multivariate regression model of the individual variables associated with development of complications at 3 months.

Variables	P value	Odds ratio (OR)	95%CI (Lower-upper)
Age	0.318	0.952	0.865-1.048
Sex (male)	0.688	0.716	0.140-3.656
Amount of corrosive agent	0.183	1.012	0.994-1.030
Type of corrosive agent			
Acid	0.999	6.109E7	0.000
Alkali	0.998	2.370E9	0.000
Others	0.085		
Endoscopic grade 3 injury	0.002	32.920	3.611-300.146

*P<0.05 considered significant

DISCUSSION

This study aimed to evaluate the sociodemographic profile, characteristics of corrosive ingestion, the severity of mucosal injury, and the clinical outcomes of patients at 3 months. The findings provide important insights into the patterns and consequences of corrosive ingestion, particularly in a setting where such incidents are prevalent yet underreported. The study population predominantly consisted of young adults, with a mean age of 24.4 years, and a significant majority (79.8%) were within the 18-27 age group. This aligns with previous studies indicating that young adults are more likely to ingest corrosive substances, often due to impulsive behavior or socio-economic pressures.[17] The higher prevalence among females, reflected in a male-to-female ratio of 1:2.5, is consistent with existing literature, which suggests that women, particularly housewives, are at greater risk of corrosive ingestion in some regions due to factors like domestic stress and easy access to household cleaning agents.[18,19]

The majority of the patients were Muslims (96.8%), which corresponds to the dominant religion in the region but does not necessarily indicate religious predisposition, given the small sample size.[20] The data highlight the predominance of acid ingestion (78.7%), with household cleaning agents such as Harpic and Savlon being the most commonly ingested substances. This trend is consistent with findings from other studies in similar settings, where acids are more frequently involved due to their availability and low cost.[21,22] The majority of cases were intentional, with 94.4% of patients reporting ingestion as a suicidal attempt. This underscores the need for mental health interventions and stricter regulation of the sale of such substances to prevent their misuse.[23]

Endoscopic evaluation revealed that a significant portion of the study population suffered from severe mucosal injury, particularly in the esophagus and stomach. The use of Zargar's classification showed that 25.7% of patients had grade 3a stomach injury, while 9.0% had severe grade 3b injury. These findings are comparable to previous studies, indicating that the extent of mucosal damage is directly related to the type and volume of the corrosive agent ingested.[24,25] The study also found that isolated duodenal involvement was rare, but combined esophageal and gastric injuries were common, affecting 38.8% of patients.

The follow-up data revealed that the most common long-term symptoms were weight loss (30.3%), dysphagia (12.4%), and vomiting (11.2%). These symptoms are likely related to the development of complications such as esophageal strictures and gastric outlet obstruction (GOO), which were observed in 10.2% and 12.4% of patients, respectively. The findings are consistent with existing literature, which suggests that these complications are significant contributors to morbidity following corrosive ingestion.[26, 27]

Univariate analysis identified the type of corrosive agent, the amount ingested, and the presence of grade 3 mucosal injury as significant risk factors for the development of complications at 3 months. This is in line with previous studies that have identified these factors as critical determinants of patient outcomes.[28,29] The multivariate analysis further established that severe endoscopic mucosal injury (Zargar's grade 3) was the most significant predictor of complications, with an odds ratio of 32.920, highlighting the critical role of early endoscopic evaluation in predicting long-term outcomes.[30]

This study has few limitations. The study period was short and sample size was small. It was not possible to follow up the patients for long period of time. The study was done in a single centre, so it does not represent the whole population of the country. It was difficult to ascertain the absolute chemical nature of some ingested corrosive agents as it was not provided by the manufacturer.

CONCLUSION

In conclusion, this study reveals that corrosive ingestion predominantly affects young adults, with females being more affected than males. Suicidal intent was the primary reason for ingestion, and acids were the most common corrosive agents. Endoscopic assessment showed that two-thirds of patients had mucosal injury, with the majority presenting as Zargar's grade 2a. Acute complications were

primarily bleeding, while long-term issues included esophageal strictures and gastric outlet obstructions. The severity of mucosal injury, as assessed by endoscopy, was a critical predictor of both immediate and long-term complications, highlighting the importance of early endoscopic evaluation in managing these cases.

Recommendations

A multi-center study with large sample size may be undertaken to make representation of the whole country population. Hospital based management protocol should be developed to maintain the uniformity in managing these patients. Systematic reporting is necessary to generate a national database which will be useful to estimate the actual magnitude and burden of corrosive injury that can serve as a motivator for legislation to tightly control the availability of these chemicals.

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