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Surgical outcomes of patients with corrosive ingestion: a retrospective analysis

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Abstract

Corrosive ingestion can cause severe complications, including perforation, stricture, and fistula, which often require surgical intervention to prevent further damage. This retrospective observational study analyzed surgical outcomes and gender differences in ingestion types (accidental vs. suicidal) and causative substances (acid, alkali, ammonia, detergent, or mixed) among 99 patients at a tertiary care hospital in Rawalpindi from January 2002 to January 2024. The average age of the patients was 30.36 ± 10.18 years, with 61.62% female patients and 38.38% male patients. Accidental ingestion was more common in males (94.74%), whereas suicidal ingestion was more common in females (21.31%, $p = 0.026$). Mixed substances were the most common substances ingested, particularly among females (60.66%, $p = 0.048$). All patients underwent upper gastrointestinal endoscopy, and diagnostic laparoscopy or feeding jejunostomy was the most common surgical procedure (57.58%). The esophagus (68.69%) was the most affected site. Surgical site infections (16.16%) and strictures (11.11%) were the most frequent complications, with a mortality rate of 4.04%. Our study concluded that timely surgical management could reduce the risk of complications and enhance patient outcomes. Corrosive ingestion often affects multiple areas of the gastrointestinal tract that require several surgical interventions. In certain cases, complex procedures, such as colon interposition and total laryngopharyngoesophagectomy (TLPO), which require skilled surgeons as well as advanced management centers, are performed to manage corrosive injuries. Therefore, improving these patients' outcomes via interventions focused on training in complex surgical procedures is crucial. However, more research is needed to identify the most effective approaches for the surgical management of corrosive ingestion.

Keywords

Corrosive ingestion; Surgical management; Complications; Retrospective analysis

1. Introduction

Corrosive ingestion refers to the intentional or accidental ingestion of corrosive substances, such as acids or alkalis, which can cause severe damage to the digestive tract. This can lead to serious complications, including perforation of the esophagus and stomach. Corrosive ingestion is a major public health issue globally [1,2]. It is more prevalent in developing countries, but it is also common in developed countries. Even in the United States, approximately 5,000–15,000 corrosive ingestions are reported annually [3]. Annually, more than 40,000 cases of corrosive ingestion are reported in England and Wales.

In developing countries such as Pakistan, it is very prevalent, although most cases are not reported due to cultural barriers [4]. The lack of safe "childproof" containers, un-

regulated access to corrosive agents, a culturally specific inclination to ingest corrosives for suicidal purposes, and the absence of standard medical care in rural areas [4,5,6]. The medical literature concerning the epidemiology and clinical presentation of corrosive ingesting patients is inadequate. The World Health Organization (WHO) reported that in the past 17 years, only 37 papers concerning corrosive ingestion in low- and lower-middle-income countries have been published [7].

Surgical intervention plays a crucial role in the management of corrosive ingestion patients, particularly in cases where severe damage to the gastrointestinal tract has occurred [8,9]. The type of surgical intervention depends on the damaged area, and multiple surgical approaches can be used in multiple affected areas [9]. Surgical evaluation is essential for assessing the extent of damage caused by corrosive substances [10]. This may involve various diagnostic procedures, such as endoscopy, imaging studies (e.g., CT scans), and clinical assessments, to determine the severity and location of the injury. Corrosive ingestion can lead to a range of complications, including perforation, stricture, and fistula in the gastrointestinal tract [11]. Surgical intervention may be necessary to address these complications, such as repairing perforations, dilating strictures, or performing bowel resections in severe cases. Surgical intervention aims to prevent further damage to the gastrointestinal tract and surrounding structures. Therefore, the present study was conducted to retrospectively analyze the surgical outcomes of patients managed surgically for corrosive ingestion. Moreover, sex differences in ingestion types (accidental and suicidal) and ingested causative substances (acid, alkali, ammonia, detergents, and mixed) were assessed in corrosive ingestion cases.

2. Methods

2.1. Study design

This was a retrospective observational study that assessed the surgical outcomes of patients who ingested corrosive substances.

2.2. Study duration

Data from January 2002 to January 2024 were retrieved from the database and patients' medical records at a tertiary care hospital in Rawalpindi.

2.3. Ethical considerations

The study adhered to ethical guidelines and received all necessary approvals. The study obtained ethical approval from the Ethical Committee/Institutional Review Board, Combined Military Hospital, Rawalpindi (No. 267).

2.4. Sample size

The sample size was calculated using the proportion of patients with corrosive ingestion injuries who underwent surgical procedures (6.2%) at a 95% confidence level and a 5% margin of error [12,13]. The final sample size was calculated as 90, which was further increased to 99 to strengthen the study findings.

2.5. Selection criteria

The study included admitted patients who underwent surgical intervention for corrosive ingestion and who were 5 years of age or older, with documented corrosive ingestion durations of 3 months or longer, and who were receiving surgical management. Patients who presented with malignant or other benign strictures were excluded. In addition, all patients whose medical records were incomplete were excluded from the study.

2.6. Statistical analysis

The data were analyzed via SPSS (version 27.0) by calculating frequencies, percentages, means, and standard deviations (SDs). The chi-square test was applied to assess the gender-wise comparison of ingestion types and causative substances in corrosive ingestion cases. The results were considered significant at $p < 0.05$.

3. Results

Table 1 shows that the average age of the patients was 30.36 ± 10.18 years, with 61.62% female patients and 38.38% male patients. Most of the cases (84.85%) were accidental, whereas 15.15% were suicidal ingestion cases. Among the 99 patients, 72.73% had no comorbidities. Among the ingested substances, a mixed combination (55.56%) was most common, followed by acid ingestion (25.25%).

Table 1. Sociodemographic indicators and medical history of corrosive ingestion cases (n = 99).

Variables		Frequency (%)	Mean ± Std. Deviation
Age (in years)		-	30.36 ± 10.18
Gender	Male	38 (38.38)	-
	Female	61 (61.62)	-
Comorbidity	Hypertension	15 (15.15)	-
	Diabetes	2 (2.02)	-
	Diabetes, hypertension	7 (7.07)	-
	Any other	3 (3.03)	-
	No comorbidity	72 (72.73)	-
Ingestion	Accidental	84 (84.85)	-
	Suicidal	15 (15.15)	-
Ingested causative substance	Acid	25 (25.25)	-
	Detergents	9 (9.09)	-
	Alkali	5 (5.05)	-
	Ammonia	5 (5.05)	-
	Mixed	55 (55.56)	-

Table 2 shows that accidental ingestion was more common among males (94.74%) than females (78.69%), whereas suicidal ingestion was significantly greater among females (21.31%) than males (5.26%) ($p = 0.026$). Moreover, compared with males, most of the females (60.66%) ingested mixed substances, while 29.51% ingested acid (47.37% and 18.42%, respectively), and these differences were statistically significant ($p = 0.048$).

Table 2. Sexwise comparison of ingestion types and causative substances in corrosive ingestion cases (n = 99).

Variables		Gender		Degree of Freedom (df)	Chi-Square Value (X^2)	*p* value *
		Male Frequency (%)	Female Frequency (%)			
Ingestion	Accidental	36 (94.74)	48 (78.69)	1	4.691	0.026 *
	Suicidal	2 (5.26)	13 (21.31)			
Ingested causative substance	Acid	7 (18.42)	18 (29.51)	4	9.577	0.048 *
	Alkali	3 (7.89)	2 (3.28)			
	Ammonia	4 (10.53)	1 (1.64)			
	Detergents	6 (15.79)	3 (4.92)			
	Mixed	18 (47.37)	37 (60.66)			

* Variables were compared using the chi-square test. ** Significant value ($p \leq 0.05$).

Table 3 shows that all patients underwent upper gastrointestinal endoscopy, whereas contrast studies were performed in 97.98% of patients. Moreover, diagnostic laparoscopy or feeding jejunostomy was the most common surgical procedure (57.58%), followed by complete esophagectomy with gastric pull-up (34.34%). Furthermore, complex surgeries, such as esophagogastrectomy with colonic interposition and Roux-en-Y, were performed in 21.21% of patients. The most affected site of injury was the esophagus (68.69%), followed by the pylorus (36.36%) and gastroesophageal junction (23.23%). Among the complications, surgical site infections or abscesses were the most common (16.16%), followed by stricture formation (11.11%) and respiratory complications such as empyema, pneumonia, or atelectasis (10.10%). Mortality was recorded in 4.04% of the 99 patients.

Table 3. Procedures, injuries, management, and complications in corrosive ingestion cases.

Variables		Frequency (%)
Evaluation procedures	Upper gastrointestinal endoscopy	99 (100.00)
	Contrast study	97 (97.98)
	Bronchoscopy	18 (18.18)
Injury location/extent	Esophagus	68 (68.69)
	Pylorus	36 (36.36)
	Gastroesophageal junction	23 (23.23)
	Proximal stomach	19 (19.19)
	Distal stomach	17 (17.17)
	Pharynx/hypopharynx	2 (2.02)
Surgical procedures	Diagnostic laparoscopy/feeding jejunostomy	57 (57.58)
	Complete esophagectomy with gastric pull-up	34 (34.34)
	Pyloroplasty	25 (25.25)
	Esophago-gastrectomy, colonic interposition, Roux-en-Y	21 (21.21)
	Gastrojejunostomy	7 (7.07)
	Partial esophagectomy with gastric pull-up	6 (6.06)
	Tracheoesophageal fistula repair	3 (3.03)
	Total laryngopharyngoesophagectomy	2 (2.02)
	Esophagectomy, colonic interposition, Roux-en-Y	1 (1.01)
Complications	Abscess/surgical site infections	16 (16.16)
	Stricture formation	11 (11.11)
	Empyema/pneumonia/atelectasis	10 (10.10)
	Cardiac arrythmias	8 (8.08)
	Recurrent laryngeal nerve injury	7 (7.07)
	Hemorrhage	5 (5.05)
	Anastomotic leak	4 (4.04)
	Mortality	4 (4.04)
	Conduit necrosis	3 (3.03)

4. Discussion

The current study reported the surgical management of patients who ingested corrosive substances. Most of the cases were accidental, and mixed substances were reported as the most commonly ingested materials. The majority of the patients did not have comorbidities. Moreover, sex differences were significant in terms of ingestion patterns as well as the types of substances ingested. All patients underwent upper gastrointestinal endoscopy, and diagnostic laparoscopy or feeding jejunostomy was the most frequently performed surgical procedure. The esophagus was the most affected site of in-

jury, followed by the pylorus and gastroesophageal junction. Furthermore, postoperative complications were common, with surgical site infections and strictures being the most commonly reported, whereas mortality and anastomotic leaks were rare.

Corrosive ingestion triggers full-thickness esophagogastric necrosis, which represents the most severe form of injury to the alimentary tract. The degree of severe damage is typically associated with the ingestion of large quantities of concentrated corrosive agents, often in cases of suicidal intent, as observed in most cases in our study. The injuries are generally confined to the esophagus and stomach, with the duodenum being relatively spared. This sparing is likely owing to pyloric spasm triggered by the corrosive substance or the alkaline environment of the duodenum. Severe metabolic complications, including acidosis and dehydration, often accompany such injuries. Furthermore, disruption of the gut mucosal barrier, in addition to contamination of the peritoneal and mediastinal spaces, often leads to life-threatening sepsis.

The management of corrosive ingestion requires immediate resuscitation to correct fluid, electrolyte, and acid–base imbalances, along with the administration of broad-spectrum antibiotics and timely surgical intervention. Significant differences in mortality rates were observed between the surgical group (67%) and the supportive treatment group (100%) in a comparative study involving 27 patients [14]. In contrast, our study reported a mortality rate of 4%, which may be attributed to effective management strategies, the extent of injury, and the retrospective design of our study, which did not include long-term patient follow-up. In such cases, surgical treatment generally focuses on excising nonviable tissue and ensuring effective peritoneal and mediastinal drainage. There is a dearth of literature on the management and outcomes of severe esophagogastric injuries owing to corrosive ingestion. Cattan et al., in their review, reported immediate postoperative mortality in 2 out of 9 patients, with further deaths occurring in the months after surgical resection [15]. Moreover, a review on the outcome of gastric perforation resulting from corrosive ingestion revealed that patients with gastric necrosis and perforation had poor survival outcomes, whereas those with isolated perforation that was repaired primarily experienced improved survival [16].

Higher mortality rates have been reported when a thoracoabdominal approach is employed for esophageal resection following severe corrosive injuries. In a study by Lai et al., 18 patients who underwent emergency surgery were recruited, and the overall mortality rate was reported to be 66.7%, with four deaths occurring among patients who underwent esophagectomy and stomach resection via the thoracoabdominal method [14]. In contrast, mortality was lower (37.5%) in patients who underwent esophageal stripping with stomach resection through the abdominal route. These findings suggest that esophageal stripping is a safer alternative to the thoracoabdominal approach in such cases.

Despite the severity of injuries and the extensive surgical resection often needed, the perioperative mortality rate reported in the literature is relatively low [17]. Factors associated with improved outcomes include aggressive resuscitation, timely surgical intervention to limit further injury, complete excision of necrotic tissue, transhiatal esophageal resection, and postoperative nutritional support provided through jejunostomy feeding [18]. Additionally, corrosive-induced periesophageal edema has been suggested to aid in transhiatal resection by reducing procedural complexity and minimizing morbidity [19].

Our study findings revealed significant gender-based differences in patterns of substance ingestion. Accidental ingestion was more prevalent among males, which may be linked to occupational or environmental exposures associated with male-dominated activities [20,21,22]. Conversely, suicidal ingestion occurs more frequently among females,

which may be due to psychological and sociocultural factors, as females may experience higher levels of emotional distress and societal pressures that contribute to self-harm [23,24]. Additionally, females were more likely to ingest mixed substances, whereas males were more likely to ingest acid. These findings highlight the need for tailored prevention strategies, such as promoting workplace safety for males and providing targeted mental health support for females, to address the specific needs and underlying factors associated with these behaviors [25,26]. To explore related qualitative factors and determine the contributing sociodemographic parameters unaddressed by the current study, further research is needed, which is a potential weakness of this study.

5. Conclusions

Our study concluded that timely surgical management could reduce the risk of complications and enhance patient outcomes. Corrosive ingestion often affects multiple areas that require several surgical interventions. In certain cases, complex procedures, such as colon interposition and total laryngopharyngoesophagectomy (TLPO), which require skilled surgeons as well as advanced management centers, are performed to manage corrosive injuries. Therefore, improving these patients' outcomes via interventions focused on training in complex surgical procedures is crucial. Further research is needed to identify the most effective approaches for the surgical management of corrosive ingestion.

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