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CAUSE OF MORTALITY AND MORBIDITY IN CAUSTIC INJURIES OF ADULTS

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ABSTRACT

Objective: corrosive ingestion leads in vast majority aero-digestive injuries. Injury severity depends on the agent type, concentration, form and amount of ingested substance. The aim of this study was investigation of the outcomes to promote management strategies and reduction of mortality. Materials and **Methods:** As a retrospective study, between six years, we investigated 112 patients with the history of caustic ingestion were referred to Loghman Medical Center surgery ward. Patients were treated with medical or surgical measures based on the physical exam and endoscopy results. After discharge, patients were followed and further mortality and morbidity recorded. **Results:** A total of 112 patients, analysis. (67%) underwent early surgical intervention during acute phase of injury and the rest managed with conservative measures. Gastrointestinal (22.3%) and respiratory (20.5%) complications were the most leading causes of death. Respiratory complications were the main causes of death during primary admission. Despite of multiple interventions, after mean 2 years of follow up, just 31% of patients have normal eating. **Conclusion**: In cases of caustic ingestion, airway protection and precise estimation of aero-digestive injury besides appropriate surgical intervention can reduce the mortality rate.

KEYWORDS: Caustic ingestion, Esophagealgastric caustic injury, Complication, Mortality.

1, INTRODUCTION

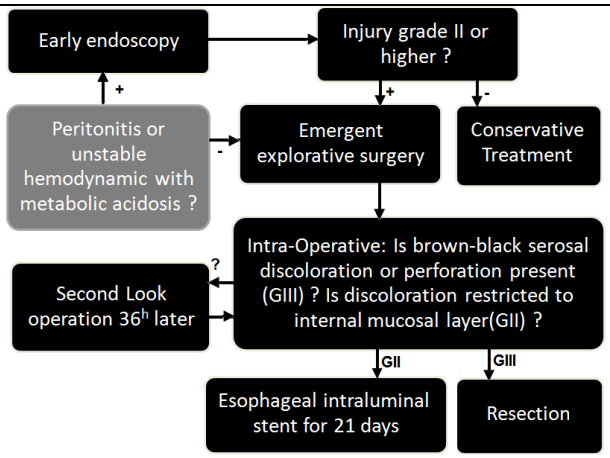
Corrosive ingestion, incidentally or intentionally, associates with broad spectrum of aero-digestive injuries.[1] Caustic agents can be alkaline in nature or acids.[2] Acids generally cause coagulation necrosis, with scar formation that may limit substance penetration and injury

depth. In contrast, alkalis cause liquefactive necrosis and saponification, and are classically taught to penetrate deeper into tissues. The severity of lesions produced by caustic substances on tissue depends on the type, form, quantity and concentration of the caustic substance ingested.[3] These factors vary according to available solutions and regional culture. Respiratory complications was stratified as early and delayed. Early respiratory complications occurred in acute phase during primary admission included acute upper airway obstruction (edema) and early aspiration syndrome (aspiration pneumonia and tracheobronchitis due to caustic aspiration) and delayed ones that occurred beyond 3th week after exposure included upper airway stenosis and delayed aspiration syndrome (chronic aspiration during swallowing due to impaired deglutition).Although there are many reports regarding corrosive agent ingestion over past half century, its best management, especially in adults, is still a major dilemma. The objective of the present study was to investigate the complications and causes of death observed in patients and their managements.

2. PATIENTS AND METHODS

Out of patients that were admitted to Loghman hospital toxicology ward due to caustic ingestion, at 6 years, a retrospective study on 112 patients that were referred to surgery ward was conducted. Their managements based on initial physical examination and early endoscopy results. Endoscopy was performed with least insufflations without sedation and retro-flexion. Patients who had unstable homodynamic with metabolic acidosis or acute medianstinitis or abdominal signs underwent emergent explorative surgery[4], and for the rest, endoscopy was performed for planning. Injury was graded according to Zargar's mucosal injury classification.[5] Emergent exploratory surgery, also, was performed for ones with endoscopic injury grade II or higher (table 1).

Table 1: Zargar's endoscopic mucosal injury grading scale[5] and study management.



Endoscopic Grade and Findings		Study Grade
I	Mucosal edema and hyperemia	I
IIa	Friability, hemorrhages, erosions, blisters and exudates	II
IIb	Deep or circumferential ulceration, in addition to 2a lesions	
IIIa	Small areas of necrosis	III
IIIb	Extensive necrosis	

According to intraoperative findings, patients with brown-black or grey serosal discoloration suggestive of transmural necrosis (grade III) were managed by resection[6-8] if restricted to second portion of duodenum. Patients with injury grade II underwent esophageal intraluminal stenting after taking posterior gastric wall biopsy.[9] If there were any uncertainty about the viability, a second-look operation was performed within 36 hours for decision making[10] (table 1) Patients that underwent surgery received supportive treatments included intravenous antibiotic and H2 blocker besides keeping intubated for 72 hour after operation. Patients who refused surgery and who candidate for nonsurgical therapy were managed with intravenous antibiotic and H2 blocker and keeping fast till dysphagia regressed. Intravenous steroid administered to some patients according to their respiratory conditions. Patients who survived from acute phase during primary admission followed for their swallowing and respiratory conditions and further surgical interventions and complications recorded. Data were analyzed using SPSS 17.0 and $P<0.05$ was considered significant.

3. RESULTS

A total of 112 patients consisting of 67 males (60%) and 45 females (40%) with a mean age of 38 ± 17 were included in our analysis. The intent was suicidal in 102 patients (91%). In past medical history, 42 (38%) of patients had prior psychiatric problems, mostly, major depressive disorder. Strong alkali including Drain cleaners (sodium hydroxide) were the most ingested agent (n=68; 61%). Other weak alkali included bleaches (sodium hypochlorite). Acidic agents included sulfuric acid (automobile batteries), choloridric acid agent. Mean arrival time to the emergency ward was 4.7 hours after exposure excluding 7 patients (6%) that referred from other centers with 3 to 7 days delay. In physical examination, manifestation relating to GI tract injury from the most frequent to the least frequent were dysphagia/odionphagia (n=97; 87%), epigastric tenderness (n=51; 46%), peritonitis (n=23; 21%). Manifestation relating to respiratory tract injury were tachypnea (n=76; 68%) and dysphonia (n=72; 64%). Other findings included sever oropharyngeal burns (n=69; 64% with 5 missed values), leukocytosis (n=73; 70% with 7 missed values), metabolic acidosis (n=64; 71% with 22 missed values). For upper airway protection emergent intubation and tracheostomy were performed in 26 patients (23%) and 3 patients (3%), respectively. Endoscopic evaluation was performed in 62 patients (55%), among which it revealed grade I, II and III in 5(8%), 26(42%) and 31(50%) patients, respectively. Total of 75 patients (67%) underwent exploratory surgery based on physical examination (n=35) or endoscopic findings (n=40) (table 2) and the rest managed conservatively.

Table 2: Operations list.

Operation	n	Mortality		normal deglutition survivors
Early operation (during primary admission)	75	26/15[1]	41	21
Intraluminal esophageal stent with posterior gastric wall biopsy + jejunostomy	28	4/4	8	14
Transhiatal esophagogasterectomy + jejunostomy[2]	33	13/10	23	4
Exploratory laparotomy[3]	6	4/0	4	1
Other[4]	8	5/1	6	2
Secondary operations (after primary admission)[5]	44	14		16
Gastrojejunostomy	12	1		8
Colon interposition	19	6		5
Gastric pull up	7	1		3
Tracheostomy[6]	5	3		1
Other[7]	3	3		-

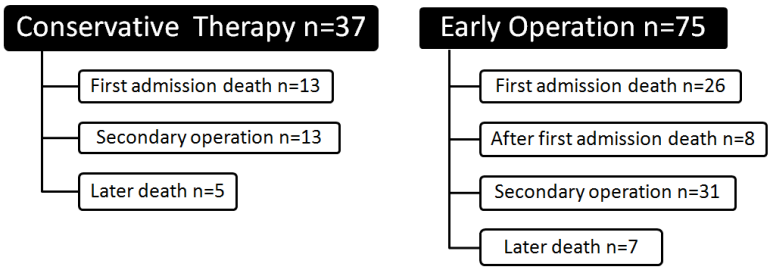
1-left number denotes death during primary admission and the right one death after primary admission. 2- Three patients primary underwent esophageal stenting but subsequently due to upper GI bleeding in one and GI perforation in two other, total esophagogastrectomy were performed. Also, one patient underwent primary total gastrectomy but due to anastomosis leakage subsequent esophagectomy was performed. 3- Operation terminated without further intervention in 4 patients due to extensive necrosis (all died) and in 2 patients with second look operation due to viability uncertainty. 4- including: isolated esophageal resection (n=1, died due to late upper respiratory obstruction), partial gastrectomy with esophageal stent (n=1, died due to peritonitis), feeding jeujenostomy (n=3, all died), pyloroplasty with vagutomy (n=1), total gastrectomy (n=1), laparatomy and thoracotomy due to massive GI bleeding (n=1, died). 5- Total of 46 operations for 44 patients due to tracheostomy in two patients who have GI operation also. 6- Due to delayed upper airway stenosis. 7- include: laparotomy due to perforation subsequent outpatient endoscopy in 14th day after exposure (n=1), total esophagogastrectomy due to delayed massive GI bleeding (n=1) and partial gastrectomy and segmental esophageal resection because stricture (n=1)

Based on intraoperative findings, resection was performed for 36 patients among which pathologic examination revealed transmural necrosis in 25 patients (69%). 39 patients died during primary admission (14±12 days) (table 3) and dealing causes from the most frequent to the least frequent were: acute upper airway obstruction (n=13), multi-organ dysfunction syndrome (MODS) due to extensive injury (n=7), MODS after operation (n=5), upper GI

bleeding (n=4), early aspiration syndrome (n=3) and peritonitis due to anastomosis leakage or duodenal stamp blow out after early operation (n=3) (table 4).

Table 3: Patient's management and mortality.

First 48 hour mortality	16%
First admission mortality	35%
Crude mortality	52%



Seventy three survivors followed for mean 2 years. During this period 44 patients underwent secondary operation most because of reconstruction or stricture formation (table 2) and additional 20 patients (17%) died. Dealing causes of death from the most frequent to the least frequent were: delayed aspiration syndrome (n=5), post-operative complications (n=5), delayed upper airway stenosis (n=2), second successful suicide attempt (n=2) (table 4). Investigation of 53 survivor patients after this follow up revealed normal swallow in 35 patients (31%).

Table 4: Complications and causes of death.

Complications	Cause Death		Incidence
	n	%	
GI Complications (total)	7	6.3	42
Esophageal Stricture	-	-	13
Pyloric Stenosis	-	-	10
Both Pyloric and Esophageal Stricture	-	-	2
Tracheoesophageal Fistula	-	-	1
Upper GI Bleeding	5	4.5	10
Internal Bleeding	1	0.9	1
Mediastinitis	1	0.9	4
Pancreatitis	-	-	1
Respiratory Complications (total)	23	20.5	80
Early Upper Airway Obstruction	13	11.6	34
Early Aspiration Syndrome	3	2.7	36
Delayed Upper Airway Stenosis	2	1.8	5
Delayed Aspiration Syndrome	5	4.5	5
Post-Operation Complications (total)	11	9.8	37
MODS	5	4.5	5
Anastomosis leakage or duodenal stamp blow out (early operation)	4	3.6	5
Cervical Anastomosis Leakage (delayed operation)	5	-	-
Cervical Anastomosis Stricture	-	-	9

Others[1]	2	1.8	13
Mortality (total)	59	52.6	
Mortality relating to GI Injury or Complication[2]	25	22.3	
Mortality relating to Respiratory Injury[3]	23	20.5	
Mortality relating to other cause[4]	11	9.8	

1-included: fascia dehiscence (n=4), recurrent nerve paralysis (n=1), post-operative bleeding (n=1), left colon necrosis during colon interposition (n=1), inferior epigastric artery pseudoaneurysm due to feeding jejunostomy (n=1) and post-operative ARDS (n=1). 2-Included: MODS due to extensive injury (n=7), GI Bleeding (n=5), early post-operative MODS (n=4), GI leakage (n=4), malnutrition (n=3), early post-operative bleeding (n=1) and massive internal bleeding (n=1). 3- Included: early upper airway obstruction (n=13), delayed aspiration syndrome (n=5), early aspiration syndrome (n=3) and delayed upper airway stricture (n=2). 4- Included: unknown cause (n=4), second successful suicide (n=2), cardiac event (n=2), GI perforation secondary to endoscopy at 14th day of exposure due to food intolerance (n=1), mediastinitis (n=1) and post-operative ARDS (n=1).

4. DISCUSSION

Corrosive injury, comparing manifestations (dysphonia 64%, dysphagia 87%), complications (42 GI cases, 80 respiratory cases) and mortality (GI 22%, Respiratory 20%), is a true aero-digestive injury and management concentration on GI injury accompanies unsatisfactory results. Caustic agent exposure injures glottis and supra-glottis leading to inflammation and edema in acute phase. This injury manifests as dysphonia or chocking, if sever enough.[12]

Moreover, variable amounts of the agent are aspirated leading to tracheobronchitis and pneumonitis.[13,14] High incidence of dysphonia (64%), tachypnea (68%), early aspiration syndrome (32%) and need for emergent airway protection (26%), all show this respiratory injuries. Early upper airway obstruction was leading cause of death in 11.6% patients, and most were occurred during first 12 hour after exposure and related to delay in airway protection.[11]

Also, significant difference was observed in died patients with higher RR and need for upper airway protection (P=0.00, 0.01). Early aspiration syndrome was leading cause of death in 2.7% patients and its occurrence directly affected by primary intubation duration (P=0.00). Intubation impair respiratory toilet, so may be exacerbate primary chemical injury with supper-infection. According to these findings, evidences, support to lower intubation

threshold.[14,15], even if the cast of higher risk by supper-infection. Extubation must perform as soon as possible. Similar to GI tract, if injury sever enough, healing process in glottis and supra-glottis region can lead in granulation formation and scar retraction, both manifesting as delayed upper airway stricture.[12] In this series, incidence of stricture was 9.5% (7patients out 73 survivors) and most occurred during 4-8 weeks after exposure leading in two deaths. In this study relation between this stricture formation and endoscopic GI injury grade, oropharyngeal sever burn, GI stricture formation or early aspiration syndrome (P=0.84, 0.69, 0.64, 0.50) cannot be established. Just statistically significant relation can observed in need for emergent upper airway protection (intubation or tracheostomy) with this stricture formation (P=0.01). So, these findings guide to need for delayed direct examination of supra-glottis region, in patients who have proved caustic injury, with any degree of injury in oropharynx or esophagus.[11,16] Evidences supports laryngoscopy or bronchoscopy may be lifesaving after acute phase of injury (after 3th week) to early detection and proper intervention for upper airway stricture. Hypopharyngeal caustic injury, especially with concomitant epiglotic injury, impairs airway protection during deglutition leading in aspiration.[17] This aspiration was evident in some patients in barium swallow. This chronic aspiration via delayed aspiration syndrome was leading cause of death in 4.5% overall and 13% patients which were undergone esophageal replacements in this study. So currently, if significant symptomatic aspiration exists, permanent tracheostomy or laryngectomy can be advisable.[17] In this series, GI caustic injury was most frequent cause of death (22.3%) and most leading causes were MODS secondary to extensive injury or early post-operative MODS (48%), GI bleeding (20%), post-operative GI suture line breakdown (16%) and chronic malnutrition (12%). Deep and extensive GI tract necrosis causes death by MODS, either secondary to perforation and sepsis or severe dehydration and metabolic acidosis. Metabolic acidosis occurs due to significant water loss as edema in stasis injury zone. Patients with metabolic acidosis were 12 times more likely at risk of death (Relative Risk=12, P=0.00), in this study. In patients with extensive injury that abandoned resection and those who died during first 48 hour after operation, significant metabolic acidosis was sole prominent finding. So, our recommendation in this setting is aggressive hydration. In other word, patients who candidate for emergent surgery or patients with metabolic acidosis may benefit from hydration maintaining 100cc/hr urine output for minimizing volume depletion and preventing necrosis in stasis injury zone. Early resection is a lifesaving modality in transmural necrosis and some authors perform resection when extend of injury restricted to second portion of duodenum,[6,7,9,18-21] Our experience not supports partial resection because

of low accuracy in selecting non-viable boundary in tissue organ (69%), progressive nature of injury[22] and high rate of suture line breakdown in inflammatory environment (leading to 2 deaths and one reoperation). However some successful management even in extent of whipple procedure or partial resections had been reported.[21] GI bleeding with incidence of 15% was leading cause of death in 4.5% patients. In this study, life threatening GI bleeding was occurred mean 9th day after exposure. Besides stress ulcers, mucosal sloughing and exposure of deep vessels are known causes of GI bleeding in deep injuries.[3] In our setting, definitive causes of GI bleeding was include unrecognized transmural necrosis in patient managed with intraluminal esophageal stent (n=3) and stress ulcer (n=1). GI bleeding was controlled with conservative measures within 24 hour in 4 patients. These four patients developed GI strictures, later, denoting deep injury. So, concerning to contraindication of endoscopy in caustic patients within 5 to 15 days after exposure[5] and high rate of mortality, GI bleeding in caustic injury background needs specific management. Evidences in this study supports early surgical intervention for diagnostic and therapeutic propose. GI bleeding was leading cause in 10 patients out of 65 patients who did not undergo total esophagogastrectomy during first 48 hours. At the end with 52.7% mortality rate and acceptable outcome just in 31% patients.

CONCLUSION

According to the obtained results caustic injury is still a major dilemma. So, market restriction to strong caustic agents is a sole mean for damage control. In cases of caustic ingestion, airway protection and precise estimation of aero-digestive injury besides appropriate surgical intervention can reduce the mortality rate. Evidences in this study supports early surgical intervention for diagnostic and therapeutic propose. GI bleeding was one of common cause in patients who did not undergo total esophagogastrectomy during first 48 hours. However further studies with larger sample should be carried out to attain more definite results for consideration in diagnostic approaches and management in caustic ingestion cases.

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