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Investigating the predictive factors of gastrointestinal lesions due to consumption of household sodium hypochlorite in pediatric and adult Rasht referral hospitals

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Abstract

Introduction: Sodium hypochlorite is a corrosive substance with an alkaline nature that can lead to intoxication. This study aimed to evaluate the demographic, clinical, and endoscopic findings of swallowing this substance and to investigate the predictive factors for the incidence of gastrointestinal lesions in these patients.

Materials and Methods: In a retrospective study, all records of patients who were admitted to Razi and 17 Shahrivar Hospitals in Rasht during the years 1386-96 were evaluated by Endoscopy. Subsequently, the results were analyzed by SPSS v21 software including age, sex, cause of ingestion, volume of fluid swallowing, referral time, clinical manifestations, and endoscopic findings.

Results: Of the 173 patients under study, there were 33 pediatric patients and 140 adult patients. 101 cases (58.4%) were female and 72 cases (41.6%) were male. As reasons of swallowing, 102 cases (59%) were deliberate and 71 cases (41%) were accidental. The most common treatment was proton pump inhibitor and anti-vomiting. The most common symptom was nausea, seen in 135 patients (78%). Coughing was the most common sign in 51 of the cases (29.5%). In adults, 51 cases were less than or equal to 0.5 glass, 64 cases were between 0.5 glass to 2 glasses and 25 were higher.

Conclusion: The results show that in volumes less than 1.5 glasses, damage has either not been present or mild. Therefore, in volumes of less than 1.5 glasses, it is not necessary to perform endoscopy, and medical treatment and patient monitoring are recommended.

Keywords: Caustics, Digestive system injuries, Endoscopy-digestive system, Endoscopy-gastrointestinal, Sodium hypochlorite

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Introduction

Sodium hypochlorite, known in Iran as the WHITEX brand, is a corrosive substance with an alkaline nature that can deliberately or accidentally lead to intoxication and damage to the digestive tract. Sodium hypochlorite poisoning is one of the more common causes of acute poisoning (1).

The damage done to the oral cavity as well as the gastrointestinal tract, following ingestion, is a major cause for concern as it can vary from mild inflammation of the esophagus to perforations or necrosis (2, 3). Endoscopic examinations are a routine part of assessing the damage done in the cases of corrosive agent ingestion since it can provide a better management plan as well as a treatment course for the physician (4-6). Among the sign and symptoms with which the patients are presented, nausea and vomiting are more common. Although, findings suggest that gastrointestinal damage may be present as well. These include but are not limited to, dysphagia, drooling, and epigastric pain (the latter indicates more severe damage). In extreme cases, shock and ARDS (Acute Respiratory Distress Syndrome) have been reported (7-11). Many authors and researchers believe that there is a rather weak correlation between clinical manifestations of the patients and endoscopic findings. Therefore, despite the fact that performing an endoscopic examination in patients with sufficient indications is recommended, it is not part of the routine management protocol (12-14).

The aim of this study was to evaluate the demographic, clinical, and endoscopic findings of swallowing of this substance and to investigate the predictive factors for the incidence of gastrointestinal lesions in these patients.

Materials and Methods

In this retrospective cross-sectional study, all documents of patients with Bleach poisoning admitted in Razi and 17 Shahrivar hospitals of Rasht from March 2007 to March 2017 were assessed. These included both adult and pediatric cases. This study was initiated after approval by the ethical committee of Guilan University of Medical Sciences. Variables such as age, gender, cause of exposure, estimated ingested volume, duration between exposure and admission, time of hospitalization, management, signs and symptoms (abdominal pain, tenderness, guarding, nausea, vomiting, drooling, skin burn, oral orifice burn, dysphonia, dyspnea, upper GIT complications, erythema, dysphagia, retrosternal pain, etc.) and endoscopic findings were extracted and surveyed. Inclusion criteria were clinical manifestations such as upper GIT burns or nausea, accompanied by a history of exposure to bleach during the past 24 hours. Zargar's classification was used to categorize the damage done to the esophagus, the stomach, and the duodenum.(13) In this classification, the grades are as follows: normal mucus is 0, edema and swollen mucus is 1, erosion, shallow ulceration, bleeding and a white membrane is 2a, should the findings of grade 2a be accompanied by deep or annular ulcerations it was labeled 2b, in cases of necrosis and multiple ulcerations it was 3a and lastly, massive necrosis was graded 3b.

All patients received standard care. Airway management and intravenous fluid resuscitation were the priorities. Treatment with a proton pump inhibitor (pantoprazole) was the most common method followed by the use of Metoclopramide (Plasil) but steroids and prophylactic antibiotics were used In a few of the cases as well. Pantoprazole was initiated at a dosage of 40 mg twice daily for all patients. If gastrointestinal bleeding occurred, the dosage would change to 80 mg bolus followed by 8 mg per hour. At the time of admission, ECG was taken and pulse oximetry was done, then blood samples were drawn for arterial blood gas, complete blood count, serum electrolytes, blood urea nitrogen, and creatinine. Frequency was used for descriptive statistics regarding the characteristics of the patients, clinical manifestations, and complications the patients faced. The severity of damage done based on the volume of Sodium Hypochlorite ingested, age and gender of the patients, as well as the duration of time spent prior to arrival in the hospital, were compared through the use of mean ± standard deviation. Kruskal Wallis test and Mann-Whitney U test were used to specify the most predictive factor in gastrointestinal damages following sodium hypochlorite ingestion. The Spearman correlation test and multiple logistic regression analyses were used to assess the necessity of endoscopic evaluation in every case. Collected data were analyzed with SPSS software (version 21) and

variables were presented as frequency and mean ± standard deviation (SD).

All the participants or their legal proxies signed written informed consent. The patient's identity as well as other information remains confidential and is not disclosed. The results of the research are reported in the form of groups and should there be a need for individual results, it is done without disclosing the patient's name. This study was approved by the Ethics committee of Guilan University of Medical Sciences with the ethics code of "IR.GUMS.REC.1396.522".

Results

In our study, 177 cases were evaluated (33 were pediatric cases). 72 (41.6%) of the cases were male patients and the rest (58.4%) were females. The most frequent age group with sodium hypochlorite poisoning were patients between 21-30 years of age (26.6%), followed by patients who were between the ages of 13-20 (23.7%). In the majority of cases (59.0%), Sodium hypochlorite was ingested with suicidal intent and the rest (41.0%) was accidental. All of the pediatric cases were accidental. The most frequent treatment option was the use of proton pump inhibitors (PPIs e.g. Pantoprazole) alongside anti-nausea agents such as Metoclopramide. PPIs were used in 161 of the cases (93.1%) and Metoclopramide (Plasil) was used in the treatment of 95 patients (54.9%). The most common symptom was nausea (135 of the cases or 78.0%), followed by vomiting in 120 patients (69.4%) and the third most common symptom was epigastric pain (56.6%). The most frequent signs observed in the cases of this study were coughing (29.5%), oral erythema (24.3%), hoarseness (3.5%), and hematemesis (2.9%). No other clinically significant sign was recorded.

The ingested volume was measured relative to a medium-size glass. 6 groups were devised to classify the patients on that basis. Ingested volumes of between 0.5 and 1 glass were the most frequent with 64 cases (37.0%), followed by ingested volumes less than 0.5 a glass with 51 (29.5%). In all the pediatric cases (33) the volume of ingestion was unknown. The volume of ingestion had a strong correlation ($p<0.001$) with 2+ grade damage in the esophagus as well as the stomach and the duodenum in which an increase in volume intensified the severity of tissue damage. Other than nausea, no other symptom had a statistically significant correlation with esophageal damage. Nausea, vomiting, loss of appetite, burning sensation in the mouth, and fatigue all had a connection to gastric damage. In the duodenum, nausea and vomiting were correlated with duodenal damage. Signs of hematemesis and oral erythema were also linked to the deterioration of the esophagus. Stomach injuries had a statistically significant correlation with coughing and oral erythema. There was also an association between hoarseness, oral erythema, and hematemesis, and duodenal tissue damage.

According to the statistics, referral time had no statistically significant effect on GI disturbances. On the contrary, the ingested volume crucially affected how severe the damage in the esophagus, stomach, and duodenum was ($p<0.001$, $p<0.001$, and $p<0.001$ respectively). Our data shows that the most frequent site of damage was the stomach (63.6%), followed by the esophagus (52.6%) and lastly the duodenum (9.2%). Tables 1 and 2 show the frequency and prevalence and the similarity of distribution, respectively. Furthermore, the correlation between the severity of damage done to each part and the signs and symptoms present was evaluated. The severity of damage in the esophagus was associated with nausea, vomiting, epigastric pain, and orodynia ($p<0.05$). The severity of damage in the stomach was correlated with nausea, vomiting, dysphagia, abdominal pain, and orodynia ($p<0.05$) and the duodenal damage intensity was statistically correlated with vomiting and orodynia. The more severe the damage, the more frequent the signs and symptoms became. Lastly, our data suggests that both hoarseness and oral erythema are associated with grade 2+ damage in all 3 parts of the gastrointestinal tube ($p<0.001$). However, hematemesis was only associated with grade 2+ damage in the stomach and duodenum ($p<0.001$), whilst coughing was exclusively associated with stomach damage ($p<0.001$).

Table 1. Frequency and prevalence of endoscopic findings in the upper gastrointestinal tract.

		Grade 0	Grade 1	Grade 2A	Grade 2B	Grade 3A	Grade 3B	Total
Esophagus	Frequency	82	73	18	0	0	0	173
	Percentage	47.4%	42.2%	10.4%	0.0%	0.0%	0.0%	100.0%
Stomach	Frequency	63	73	31	5	1	0	173
	Percentage	36.4%	42.2%	17.9%	2.9%	0.6%	0.0%	100.0%
Duodenum	Frequency	157	11	5	0	0	0	173
	Percentage	90.8%	6.4%	2.9%	0.0%	0.0%	0.0%	100.0%

Table 2. The similarity of distribution of the upper gastrointestinal endoscopic findings in patients with bleach poisoning.

Duodenal endoscopic findings				Gastric endoscopic findings					Total
				Grade 0	Grade 1	Grade 2A	Grade 2B	Grade 3A	
Grade 0	Esophageal endoscopic findings	Grade 0	Frequency	41	31	9	0		81
			Percentage	50.6%	38.3%	11.1%	0.0%		100.0%
			Percentage of all	26.1%	19.7%	5.7%	0.0%		51.6%
		Grade 1	Frequency	21	33	9	1		64
			Percentage	32.8%	51.6%	14.1%	1.6%		100.0%
			Percentage of all	13.4%	21.0%	5.7%	0.6%		40.8%
		Grade 2A	Frequency	1	2	8	1		12
			Percentage	8.3%	16.7%	66.7%	8.3%		100.0%
			Percentage of all	0.6%	1.3%	5.1%	0.6%		7.6%
	Total		Frequency	63	66	26	2		157
			Percentage	40.1%	42.0%	16.6%	1.3%		100.0%
			Percentage of all	40.1%	42.0%	16.6%	1.3%		100.0%
Grade 1	Esophageal endoscopic findings	Grade 1	Frequency		7	0	1		8
			Percentage		87.5%	0.0%	12.5%		100.0%
			Percentage of all		36.6%	0.0%	9.1%		72.2%
		Grade 2A	Frequency		0	2	1		3
			Percentage		0.0%	66.7%	33.3%		100.0%
			Percentage of all		0.0%	18.2%	9.1%		27.3%
	Total		Frequency		7	2	2		11
			Percentage		36.6%	18.2%	18.2%		100.0%
			Percentage of all		36.6%	18.2%	18.2%		100.0%
Grade 2A	Esophageal endoscopic findings	Grade 0	Frequency			1	0	0	1
			Percentage			100.0%	0.0%	0.0%	100.0%
			Percentage of all			20.0%	0.0%	0.0%	20.0%
		Grade 1	Frequency			1	0	0	1
			Percentage			100.0%	0.0%	0.0%	100.0%

			Percentage of all			20.0%	0.0%	0.0%	20.0%
		Grade 2A	Frequency			1	1	1	3
			Percentage			33.3%	33.3%	33.3%	100.0%
			Percentage of all			20.0%	20.0%	20.0%	60.0%
	Total		Frequency			3	1	1	5
			Percentage	60.0%	20.0%	20.0%	100.0%		
			Percentage of all	60.0%	20.0%	20.0%	100.0%		
Total	Esophageal endoscopic findings	Grade 0	Frequency	41	31	10	0	0	82
			Percentage	50.0%	37.8%	12.2%	0.0%	0.0%	100.0%
			Percentage of all	23.7%	17.9%	5.8%	0.0%	0.0%	47.4%
		Grade 1	Frequency	21	40	10	2	0	73
			Percentage	28.8%	54.8%	13.7%	2.7%	0.0%	100.0%
			Percentage of all	12.1%	23.1%	5.8%	1.2%	0.0%	42.2%
		Grade 2A	Frequency	1	2	11	3	1	18
			Percentage	5.6%	11.1%	61.1%	16.7%	5.6%	100.0%
			Percentage of all	0.6%	1.2%	6.4%	1.7%	0.6%	10.4%
	Total		Frequency	63	73	31	5	1	173
			Percentage	36.4%	42.2%	17.9%	2.9%	0.6%	100.0%
			Percentage of all	36.4%	42.2%	17.9%	2.9%	0.6%	100.0%

Discussion

The ingestion of caustic agents may be life-threatening depending on the type of corrosive agents ingested (NaClO vs other corrosives), clinical manifestations (hoarseness, orodynia, dysphagia, skin burns, drooling, hematemesis, retrosternal pain, and epigastric pain), and high-grade endoscopic findings (15). Based on the information obtained from this study and statistical analysis; A significant correlation was found in the esophagus, stomach, and duodenum between the degree of injury and the volume of WHITEX consumed ($p < 0.001$). According to the findings, larger consumption volumes of WHITEX were directly linked to the more detrimental damage in all three areas. As in consumptions larger than 1.5 cups, gastrointestinal damage was grade A2 or worse which was consistent with the findings of a study by Kim et al. (16) in 2006 in South Korea. Based on the aforementioned retrospective study, consuming less than 100 ml. was significantly related to low degree findings in endoscopy. Overall, the study suggested follow-up during hospitalization in patients who consumed less than 100 ml. of WHITEX because there were few signs or symptoms. The study found emergency endoscopy unnecessary in such cases.

In the study conducted by Nikpour et al. (17), the correlation between the volume of consumption and the endoscopic findings wasn't significant which can be attributable to studying the effects of both acidic and basic solutions. According to the statistics, there was a significant correlation between esophageal injury and the sign of vomiting ($p < 0.023$). Yet, other signs weren't significantly correlated. In other words, of all the signs, only vomiting is related to the severity of damage to the esophagus. Nausea, vomiting, loss of appetite, heartburn, weakness, and lethargy were significantly associated with the injury in the stomach.

Nausea, vomiting, and abdominal pain were associated with the injury to the duodenum ($p < 0.05$). In the study of Ghoochani et al.(18), a significant correlation was found between signs and the degree of injury, which was consistent with the results of the present study in this regard. Furthermore, they reported a statistically meaningful connection between the endoscopic findings and frequency of hoarseness ($p = 0.04$), nausea and vomiting ($p = 0.007$), and sialorrhea ($p = 0.044$). A significant correlation was found between the severity of damage to the esophagus and the signs of nausea, vomiting, epigastric pain, and mouth burning in the aforementioned study. The higher the degree of damage, the more frequent appearance of these signs ($p < 0.05$). Also, a significant connection was found between the severity of the gastric injuries and signs of nausea, vomiting, Dysphagia, abdominal pain, and heartburn in the statistical analysis ($p < 0.05$). There was a significant relationship between the degree of duodenal injury and vomiting and heartburn ($p < 0.05$). The symptom hoarseness was also significantly associated with the degree of injury in all three areas ($p < 0.001$). This means that in patients with hoarseness, the frequency of grade 2 injury or worse is higher than the patients without hoarseness. Also, coughing was significant only in the severity of gastric injuries ($p < 0.002$). The presence of oral erythema was also significantly associated with the degree of damage in all three areas ($p < 0.001$). Hematemesis was also associated with the degree of gastric and duodenal damage ($p < 0.001$). Ghoochani et al. (19) in a study in 2014 in Tehran on patients with sodium hypochlorite poisoning reported a finding consistent with the present study. The correlation between hoarseness ($p = 0.04$), nausea and vomiting ($p = 0.007$), and sialorrhea ($p = 0.044$) were also reported to be significant in this study.

In the present study, a significant relationship was found between the volume of fluid consumed and the severity of the damage, as in volumes of 1.5 glasses or above, gastrointestinal damage was graded A2 or worse in most of the patients. In a study conducted by Quingking et al. (20) in 2013, they also reported a significant connection between the volume of consumed fluid and the degree of injury, as well as the frequency of signs and symptoms in 36 patients with sodium hypochlorite poisoning which was consistent with the results of the present study. Besides, they reported that there was no significant correlation between the degree of damage grading and leukocytosis. According to this study, there was no significant connection between the severity of injury and referral time in any of the areas investigated. In other words, the referral time did not affect the severity of complications. This finding is consistent with the 2017 study by Nikpour et al. (17) as they also did not report a significant link between the referral time and the degree of injuries.

Conclusion

For patients without clinical symptoms, emergency endoscopy is not required due to the lack of severe complications in the study. In patients with clinical symptoms (at least three), upper endoscopy and further examination are recommended. In patients with a history of consuming more than 1.5 glasses, upper endoscopy and further examinations are recommended. It is recommended that in all patients with a history of ingestion of caustic agents, fixation with the time interval between swallowing and referral should be avoided and more attention should be paid to clinical signs, the volume ingested, and patient history. It is suggested that a similar study be performed in a higher statistical population and a wider age range on different types of acidic or alkaline corrosives. Also, in an accurate history taking, the history of neurological problems, as well as a more detailed examination of the signs and symptoms should be noted.

Author contributions

AB, **MRT**, **MSA**, **SM**, **EKL**, **EB**, and **MKh** wrote and completed the article. **HMK** designed and edited the manuscript. All authors confirmed the final edited version.

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Conflict of interest

The authors declare that they have no conflict of interest.

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