Original Article

Predictive Factors of Gastrointestinal Injuries after Exposure to Sodium Hypochlorite

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ABSTRACT

Background: Sodium hypochlorite is found in bleaching agents used to cleaning dishes and bleach laundry. The ingestion of sodium hypochlorite causes acute corrosive esophagitis and gastritis. In establishing the diagnosis and therapeutic approach of acute corrosive poisonings, the upper endoscopy has great importance. The aim of this study was to determine predictive factors of gastrointestinal injuries that mandate early endoscopy.

Methods: This study consisted of 65 patients presented to Loghman Hakim Toxicology Center, Tehran, Iran with history of sodium hypochlorite bleach exposure from 2010 to 2014. The post-corrosive damage classified according to Kikendal's grading.

Results: There were a total of 19 males and 46 females with a mean age of 34.21 yr old. In upper GI endoscopy, 20% of poisoned patients had abnormal findings. Male gender (*P*=0.029), presence of hoarseness (*P*=0.044), nausea and vomiting (*P*=0.007), sialorrhea (*P*=0.044) and higher age (*P*=0.05) were associated with the occurrence of gastrointestinal injuries, but only male gender (OR=5.04), nausea and vomiting (OR=8.97) were independent predictors of gastrointestinal injuries (*P*=0.03 and *P*=0.03, respectively).

Conclusion: We proposed five factors associated with gastrointestinal injuries, which could be important factors that mandate urgent endoscopy.

Keywords: Bleach, Corrosive Poisoning, Endoscopy, Gastrointestinal Injuries, Sodium Hypochlorite.

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INTRODUCTION

Sodium hypochlorite (NaOCl) is largely found in household bleaching agents. It is highly efficacious at disinfecting and cleaning hard surfaces, dishes and bleach laundry [1, 2] Its medical usages are not limited to disinfection of devices such as dialysis machines, tunneled catheters and surgical equipment, but it is used for wound cleaning, hand hygiene, and root canal sterilization [3, 4].

Victims may expose to NaOCl accidentally or intentionally [2]. Poisoning due to ingestion of sodium hypochlorite bleach usually results in a benign clinical course [1, 3, 5-8]. Few studies have reported severe complications such as esophageal stenosis or perforation [1]. Oral ingestion of sodium hypochlorite is accompanied with gastrointestinal symptoms and signs such as nausea, vomiting, esophageal burning, perforation, and strictures [9, 10]. Park et al. reported a case of esophageal perforation followed by acute mediastinitis [1]. Some other rare complications are hypernatremia, hypercholeremia, and metabolic disturbance [5, 11]. The aim of this retrospective study was to investigate the prognostic factors of gastrointestinal injuries in patients poisoned with sodium hypochlorite admitted to a university hospital in Tehran, Iran.

MATERIALS AND METHODS

Samples

We enrolled all patients with history of acute sodium hypochlorite bleach exposure

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referred to Loghman Hakim Toxicology Center in a convenience manner. All cases admitted to the Emergency Department (ED) of our university hospital within 4 years [Jan 1, 2010 to 31 Dec, 2013] were included if they underwent upper gastrointestinal endoscopy. The sample size included both adult and pediatric injured patients.

The study was approved by the institutional review board of Loghman Hakim Toxicology Research Center and the Ethics Committee of Shahid Beheshti University of Medical Sciences. All the participants or their legal proxies signed written informed consent. The authors promise to keep the information of patients confident and use them only in scientific articles.

Data Gathering

Patient demographics, presenting features, physical examinations, clinical management, laboratory data and outcomes were recorded for each patient. The time of ingestion and the ingested volume was recorded based on patients' or their attendance reports. We enrolled only patients who underwent urgent endoscopy in addition to supportive management. Inclusion criteria were acute intoxication with sodium hypochlorite and exclusion criteria were multiple drug intoxication. The post-corrosive damage classified according to Kikendal's grading. Kikendal [12] suggested a classification in four grades: I: edema and erythema of the mucosa, II A: hemorrhage, erosions, blisters, superficial ulcers, II B: circumferential lesions, III: deep grey or brownish-black ulcers, IV: perforation.

All patients received standard care. Airway management and intravenous fluid resuscitation were the priorities. Treatment with a proton pump inhibitor (pantoprazole) was initiated but the steroids and prophylactic antibiotics had not been administered because the evidences were not strong enough. 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 drown for arterial blood gas, complete blood count, serum electrolytes, blood urea nitrogen and creatinine.

Data Analysis

The statistical analyses were performed by SPSS 18.0 [SPSS Inc., Chicago, IL, USA]. To test the normality of the distribution of the continuous variables, the Kolmogorov-Smirnov test was performed. Descriptive statistics are given by means and 95% confidence intervals. Categorical data are subsumed by absolute and relative frequencies. In analytical statistics, nominal or ordinal variables were compared between groups by chi-square test and Fisher's exact test, depending on the expected cell counts of the corresponding crosstabs. In addition, unpaired Student t test and one way ANOVA were used because all the variables fulfilled the presumption of normal distribution. Statistical significance was considered $P<0.05$.

RESULTS

Totally, sixty-five patients including 46 females (70.8) and 19 males (29.2%) were studied. The mean age was 34.21±17.18 (range: 2-82) yr. The average dose of sodium hypochlorite intake was 190.85 ml (95% CI, 143/41-251/26). However, the exact dose of only 47 patients (72.30%) was known. In 42 patients (64.61%), the exact time of poisoning was reported by patients or their attendance. Average time since drug ingestion and arrival at ED was 4.37 hours (95% CI, 2.98-6.04).

Initial vital signs of the patients were as follows: Mean systolic blood pressure in patients was 127.07 mmHg (123.80-131.10, 95% CI) and mean diastolic blood pressure was 83.46 mmHg (81.84-85.47, 95% CI). Average respiratory rate and heart rate were 15.23 (14.56-15.93, 95% CI) and 84.20 (82.77-85.75, 95% CI), respectively. The mean body temperature at the time of arrival was 37.20 centigrade (37.11-37.29, 95% CI). The mean of S_pO2 saturation of the patients was 88.40% (84.5-98.2%, 95% CI). On arrival, all of the patients were fully alert. The most common chief complaints of the patients were dysphasia (27 patients, 41.5%) followed by nausea and vomiting (20 patients, 30.8%). Table 1 shows the symptoms and signs of victims by details.

The upper GI endoscopy had been performed in all cases and 20% (95% CI, 10.8-29.2) of patients had abnormal findings. Erythema (grade I) was seen in 9 victims (13.8%; 95% CI, 6.2-23.1), grade IIa in 1 (1.5%; 95% CI, 0-4.6) and grade III in 3 (4.6%; 95%CI, 0-10.8). The locations of injuries were in esophagus in 7 victims and in stomach in others. The majority of our victims had taken the sodium hypochlorite

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accidentally and only 7 patients (10.8%) had intended to suicide.

In bivariate analysis, the male gender (*P*=0.029), presence of hoarseness (*P*=0.044), nausea and vomiting (*P*=0.007), sialorrhea (*P*=0.044) and advanced age (*P*=0.05) were associated with the occurrence of gastrointestinal injuries.

In multivariate analysis, the male gender (OR=5.04; 95% CI, 1.08-23.45) and nausea and vomiting (OR=8.97; 95% CI, 1.96-41.3) were independent predictors of gastrointestinal injuries (*P*=0.03 and *P*=0.03, respectively)

Table 1. The symptoms and signs of patients admitted to emergency department after sodium hypochlorite ingestion.

Symptoms or Signs	Frequency	Percent (95% CI)
Dysphagia or Odynophagia	27	41.5 (30.8-53.8)
Nausea & Vomiting	20	30.8 (20-41.5)
Epigastric Pain	15	23.1 (13.8-33.8)
Mouth Erythema	14	21.5 (12.3-32.3)
Retrosternal Pain	12	18.5 (9.2-27.7)
Dyspnea	8	12.3 (4.6-21.5)
Respiratory Distress	7	10.8 (3.1-20)
GI Bleeding	3	4.6 (0-10.8)
Sialorrhea	1	1.5 (0-4.6)
Cough	1	1.5 (0-4.6)
Hoarseness	1	1.5 (0-4.6)

DISCUSSION

The production of sodium hypochlorite is occurred when chlorine gas passed into cold dilute sodium hydroxide solution. When it dissolved in water , it forms hypochlorous acid (HOCl) that generates superoxide radicals. So sodium hypochlorite is a potent oxidizer and exhibit antimicrobial or pathogen activity [13]. NaOCl is the frequently used as a disinfectant and an active ingredient in household bleach due to its alkaline nature [14, 15]. Household bleach is a solutions containing 1–6% of NaOCl [15].

The ingestion of NaOCl induces acute corrosive esophagitis and gastritis [16]. The degree of gastrointestinal injury and alkaline esophagitis due to NaOCl ingestion is variable and the findings of endoscopic abnormalities within 48 hours of ingestion are associated with poor prognosis [17]. NaOCl poisoning, results in minor transient adverse effects with rare permanent sequel [2]. Satar and colleagues reported 24 patients who orally ingested NaOCl. The mean time interval after ingestion of NaOCl and admission to emergency department was 5.4±5.6 h, which was a little longer than our result. The endoscopic results were as follows: grade 0 (21.6%, n=8), grade 1 (45.9%, n=17), grade 2a (13.5%, n=5) and grade 2b (18.9%, n=7) patients. The authors stated “early signs and symptoms after caustic substance ingestion are not consistent with the extent of damage, and endoscopy is the only reliable method to assess the severity of injuries” [18]. The quantity and concentration of ingested bleach were not as important as the symptoms and signs of patients and the clinical manifestations were more reliable for prediction of GI lesion [19]. In a 15 years retrospective cohort study in a tertiary medical center, 50 cases of caustic ingestion were identified. The most common caustic agent ingested was alkaline (42%) followed by acidic (32%) and chlorine bleach (26%). The most frequent cause for ingestion was accidental (67%) as opposed to attempted suicide (33%). The adult victims who ingested sodium hypochlorite intentionally had poor outcome and higher rate of adverse effects (9). Chlorine bleach is usually stored inappropriately in home and children reach it easily [20].

Caustic agents are responsible for the most serious cases of poisoning, which are usually emergency cases [18].

As limitations of this study, although our study was conducted in one center but to our knowledge near all poisoned cases were transferred by Emergency Medical Service (EMS) or referred by other hospitals to our toxicology center (Loghman Hakim, Tehran, Iran), so these results may not be representative of the general population in Tehran.

CONCLUSION

Ingestion of sodium hypochlorite is usually benign, leading most poison centers to implement conservative cares. There are no known antidotes to NaOCl and currently most authorities recommend endoscopic examination of the upper gastrointestinal tract due to the poor correlation between clinical presentations and the degree of injury. Others suggest that patients require endoscopy only if they are symptomatic. We proposed five factors associated with gastrointestinal injuries, which could be important factors that mandate urgent endoscopy.

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