Pediatric caustic ingestion in Minas Gerais – Brazil: an observational study at the university hospital of Uberlândia

Ingestão cáustica pediátrica em Minas Gerais – Brasil: um estudo observacional do hospital universitário de Uberlândia


ABSTRACT: Introduction: Children under five years old are the principal victims of accidents caused by the ingestion of caustics, so considering Brazilian epidemiology and the risks of exposure to these agents the importance of this study is emphasized. This study aims to carry out a descriptive analysis of cases of caustic accidents in pediatric patients treated in a university hospital in Minas Gerais. Methods: This is a descriptive cross-sectional study, with a quantitative character, based on data obtained from medical records of pediatric patients (0-13 years old) treated for ingestion of caustic agents at the Hospital of the Federal University of Uberlândia (Minas Gerais, Brazil). Results: We collected 132 medical records of children treated for ingestion of caustic substances from January 2011 to April 2018. The accidents affected children aged between 8 months and 12 years, with 82.60% of the cases occurring in the home environment. Among the main substances ingested are cleaning products, as for their chemical composition, caustic soda, sodium hypochlorite, and ammonia predominated. Upper digestive endoscopy (EGD) was performed in 104 patients. Almost 13% of the children had esophageal strictures and required esophageal dilation. During the study period, 296 dilatation procedures were performed, with an average of 17.4 procedures per patient. Discussion: Considering

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that caustic accidents are prevalent in children under five years of age and the home environment, the main substances ingested are those of an alkaline nature, which cause injury to the respiratory and gastrointestinal tract, the main consequence being esophageal stenosis. Furthermore, there are no well-defined protocols for the management of patients who have ingested these substances. The main limitations of the study were the incomplete filling of the medical records analyzed and the bureaucratic procedures for accessing them. Conclusion: Caustic accidents predominated in children under two years old in the home environment, which implies the need for educational and preventive actions.

Keywords: Caustic; Child health; Esophageal stenosis.

INTRODUCTION

Caustics are substances that affect cell membranes and cause lesions that can lead to necrosis on contact with body surfaces. These damages vary according to the acid or alkaline characteristic of the products. Currently, the main victims of accidental ingestion of these substances are children under 5 years old, generating health problems and the need for specialized medical follow-up, as well as the performance of numerous procedures such as Upper Digestive Endoscopy (EGD). In the epidemiological scope, a study carried out at the Toxicology Unit of Hospital João XXIII (a hospital of Minas Gerais Hospital Foundation) shows that of the 13,293 patients attended in 2015 due to caustic ingestion, 5,656 patients were children or adolescents.

In Brazil, countless household cleaning products are launched annually to be marketed, even without the appropriate legislation. These products generate risks of ingestion by children, since they have attractive labels or packages lacking safety seals. Also, in households, these products may be stored incorrectly, which can allow easy access to them. The reuse of food product packaging for storing chemical substances represents another factor favorable to the occurrence of caustic accidents with children.

Most of the products ingested are household products. They usually are cosmetics or cleaning products. In this context, many families still use industrial detergents and store them in containers originally made of other substances, such as soda bottles. As industrial detergents are more concentrated than common household detergents, they are more aggressive and have a greater potential to cause serious injury if ingested.

Regarding the severity of the injuries, one of the important factors is the physical state of the caustic ingested. Liquid substances usually cause greater harm, since they are ingested in larger quantities, being more likely to involve the stomach and duodenum. And also, they are more easily digested. Furthermore, the ingestion of alkaline substances is more common than acidic ones, since they are found in the composition of most cleaning products.

The lesions resulting from severe caustic accidents present two phases: the acute phase that occurs in the first hours after the accident and presents a great risk of esophageal perforation; and the chronic phase that can progress to narrowing and tortuosity of the organ. In these cases, quick assessments and procedures are required in order to minimize complications and improve the patient’s prognosis. However, there is no standardization of conduct and treatments, besides the fact that the cost of hospitalizations and morbidity are high and the multidisciplinary care of the patients occurs in the long term.

The clinical picture of an individual who has ingested a caustic product is diverse, ranging from asymptomatic to dysphagia, salorrhea, or even shock in the case of esophageal perforation. The costs of procedures and treatment for children and adolescents who have been
injured by caustic ingestion can be high, with the need for esophageal dilations, depending on the degree of the injury and the patient’s dysphagia. Therefore, endoscopic evaluation is necessary whenever there is a strong suspicion of caustic ingestion, 12 to 24 hours after the accident, allowing the evaluation of the lesions and the establishment of the therapeutic plan and subsequent follow-up.

The population of the city of Uberlândia - Minas Gerais, Brazil - and the city region suffers from accidents related to the ingestion of caustics. However, there is a lack of studies on the epidemiological profile and the prevalence of these accidents. Therefore, this study aims to perform a descriptive analysis of the cases of caustic accidents in pediatric patients treated at a regional reference hospital in Uberlândia. In this way, this study seeks to identify the main risk groups, the stages of presentation of the lesions, the conducts and treatments carried out, enabling the development of preventive strategies, investments in inspection, and public policies. It is expected that prevention and better management of patients who are victims of caustic accidents can reduce morbidity, mortality, health problems, and the cost of hospitalizations and procedures.

**METHODS**

For this research, a descriptive cross-sectional study of a quantitative nature was carried out, based on data obtained from medical records of pediatric patients (0-13 years old) treated for ingestion of caustic substances at the Hospital de Clínicas of the Federal University of Uberlândia (HC-UFU), Minas Gerais, Brazil. The hospital is a regional reference and the cases analyzed come from patients received from the entire Health Macro-region of the Northern Triangle, comprising 86 municipalities. The period analyzed was from January 2011 to May 2018. According to the last census survey (2010) conducted by the Brazilian Institute of Geography and Statistics (IBGE), the number of inhabitants of up to 13 years old in the municipality of Uberlândia is 116,119 and the number in the Health Macro-region of the North Triangle is 229,127. In the present study, all patients up to 13 years old who were admitted to the Hospital de Clínicas of the Federal University Uberlândia between January 2011 and May 2018, registered with ICD-10 T54.3 (Toxic effect of caustic agents) were included. Patients with illegible or incomplete records were excluded.

The variables analyzed were: sex [male, female]; year of accident [2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018]; month of accident [January, February, March, April, May, June, July, August, September, October, November, December]; patient’s age in years and months; place of occurrence [home, out of home, unknown]; product or substance ingested [bleach, detergents, ammonia, homemade soap, batteries, unidentified]; chemical substance ingested [sulfonic acid, ammonia, sodium hypochlorite, oxalic acid, caustic soda, sulfuric acid, unidentified substance]; pre-endoscopic measures [vomiting, gastric lavage, antacid, analgesic, water, milk, antiemetic, none]; average time until endoscopy in hours; number of upper digestive endoscopies performed; evolution to death [yes, no].

The esophageal injuries found were classified based on Zagar classification, as presented in Table 1, below. Gastric lesions were classified according to the adapted Zagar classification, according to Table 2, in sequence.

**Table 1:** Zagar’s Endoscopic Classification of Esophageal Injury revised by Zagar

<table>
<thead>
<tr>
<th>GRADE</th>
<th>Endoscopic description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Normal Mucosa</td>
</tr>
<tr>
<td>1</td>
<td>Edema and hyperemia</td>
</tr>
<tr>
<td>2a</td>
<td>Friability, bleeding, erosions, blisters and superficial ulcers</td>
</tr>
<tr>
<td>2b</td>
<td>2a + Circumferential Lesion</td>
</tr>
<tr>
<td>3a</td>
<td>Focal areas of erosion; areas of necrosis are rare</td>
</tr>
<tr>
<td>3b</td>
<td>Extensive Necrosis</td>
</tr>
</tbody>
</table>

**Source:** Zargar et al., 1989

**Table 2:** Zagar’s endoscopic classification adapted for gastric injury

<table>
<thead>
<tr>
<th>Classification</th>
<th>Endoscopic Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>No change</td>
<td>Normal Mucosa</td>
</tr>
<tr>
<td>Mild</td>
<td>Edema or mucosal hyperemia</td>
</tr>
<tr>
<td>Moderate</td>
<td>Friability, bleeding, erosions, blisters, whitish membranes, superficial ulceration or exudate or circumferential ulceration</td>
</tr>
<tr>
<td>Severe</td>
<td>Small areas with erosions and rare areas of necrosis or extensive necrosis</td>
</tr>
</tbody>
</table>

**Source:** Zargar et al., 1989

The total number of pediatric endoscopies performed in the hospital in the analyzed period was obtained by the Hospital Statistics and Information sector of the Hospital de Clínicas of Uberlândia. The data was used in the percentage analysis of endoscopies by caustic accidents in relation to the total number of endoscopies performed.

All variables were analyzed using descriptive statistics and they were presented using raw numbers and frequency measures, including percentage, average, mode, and median. The Microsoft Windows Excel system was used for statistical analysis. The study was approved by the Research Ethics Committee of the Federal University of Uberlândia, and it did not identify any of the patients evaluated.
RESULTS

For the compilation of results, 132 medical records of children treated for ingestion of caustic substances were collected from January 2011 to April 2018, at HC-UFU. Of these, only one record was excluded due to incomplete filling and lack of information. Evaluating the distribution of cases over time, although the curve shows an oscillating pattern, an increase in the number of cases in recent years can be observed, as noted in Graph 1, below. In addition, there was no specific pattern of involvement between the different months, even though January has a higher incidence.

Graph 1: Number of cases and prevalence in relation to the pediatric population who suffered accidents by ingestion of caustic substance, by year, from 2011 to April 2018, at HC-UFU

Accidents involving caustic ingestion predominantly affected children aged between eight months old and 12 years old, being 44.3% in the first two years of life, according to Graph 2, below. Most of the children were under the age of five years old. There was a slight predominance of males (55.73%). The place where the accident occurred was possible to be verify in only 46 medical records (35,10%), whereby most of the accidents occurred at home (82.60%). In 93 (71%) of the medical records, the caustic substance ingested was possible to be verified, all of them were household cleaning products (bleach, detergents, ammonia and homemade soap). Regarding the classification in terms of chemical composition, the substances predominated were caustic soda, sodium hypochlorite and ammonia. Among the measures taken before the performance of the first upper digestive endoscopy, the administration of antacids, analgesics and induction of vomiting predominated. Gastric lavage was performed in some cases. Of the total number of accidents, 72 (54.96%) had no record of taking any measure prior endoscopy.

Graph 2: Distribution of cases of accidents by ingestion of caustics according to age group and sex among pediatric patients admitted to Hospital das Clínicas of Uberlândia, Minas Gerais, Brazil, between January 2011 and April 2018

Source: The authors.
Upper GI endoscopy (EGD) was performed in 104 (84.7%) patients. Among those who underwent EGD, 86.53% were examined within the first 24 hours after the caustic accident. The median time until the exam was performed was 16 hours. A total of 350 EGDs were performed, an average of 3.36 EGDs per patient. The amount corresponds to 7.51% of the total EGDs performed and to 16.85% of the total spent on this procedure in the hospital during the period of study for pediatric patients.

Endoscopic findings range from minimal or no oropharyngeal lesions to transmural lesions with a large area of necrosis. The medical records of 10 individuals did not contain a description of the endoscopic findings. The analyzed data show that in 287 endoscopies (82%) it was possible to classify the injury. Furthermore, more than half of the children had some degree of esophageal injuries. The milder injuries, classified as grade 1 or 2a, corresponded to 30.2% and 14%, respectively, as shown in Table 3, below. It is also noted that 11.3% of the children had moderate to severe esophageal injuries (grades 2b, 3a and 3b). Most of these injuries were caused by caustic soda. The only grade 3a injury was caused by ingestion of sodium hypochlorite. All children with grade 4 esophageal injuries were male, with a mean age of 28.5 months old at the time of the accident. Patients with grade 4 esophageal injuries totaled 79 EGDs performed (22.5% of the total), an average of 19.75 EGDs per patient, 5.87 times higher than the overall average of the analyzed patients.

Table 3: Clinical and epidemiological findings of children who ingested caustics, according to age group, sex, chemical ingested (each child may have been exposed to more than one agent), endoscopies performed, degree of endothelial injury according to Zagar Classification, and esophageal dilations performed, from January 2011 to May 2018, according to HC-UFU data

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Age - minimum-maximum (average)</th>
<th>≤ 5 years old - n (%)</th>
<th>Sex - n (%)</th>
<th>Chemical products - n (%)</th>
<th>Endoscopies</th>
<th>Esophageal injury</th>
<th>Esophageal dilation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age Group</td>
<td></td>
<td></td>
<td>M</td>
<td>F</td>
<td>Total number of endoscopies</td>
<td>Number of children submitted to endoscopy (%)</td>
<td>Average number of endoscopies per patient</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>73 (55,7%)</td>
<td>58 (44,3%)</td>
<td>350</td>
<td>104 (84,7%)</td>
<td>3,3</td>
</tr>
<tr>
<td>Grade 0</td>
<td></td>
<td>47 (44,3%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 1</td>
<td></td>
<td>32 (30,2%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 2a</td>
<td></td>
<td>15 (14,2%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 2b</td>
<td></td>
<td>7 (6,6%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 3a/3b</td>
<td></td>
<td>5 (4,7%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No data</td>
<td></td>
<td>25 (19,1%)</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Finally, only 9 of the 131 medical records had information about gastric lesions. Among these, two medical records had no alterations, four were classified as mild, two as moderate, and one as severe. Almost 13% of the children had esophageal strictures and they required esophageal dilation. During the study period, 296 dilation procedures were performed, with an average of 17.4 procedures per patient. Children with severe injuries...
(3a or 3b) had a greater number of endoscopic procedures and they had a more significant number of dilatations, as shown in Table 4, below. The only death occurred 13 days after the accident of ingestion of caustic soda, in a female individual, aged 39 months old, in a rural home, whose esophageal injury was classified as grade 2.

Table 4: Total number of endoscopies, total number of patients who underwent esophageal dilation, and total number of esophageal dilations according to the degree of esophageal injury according to the Zagar Classification, for the cases of children who ingested caustics, from January 2011 to May 2018, according to HC-UFU data

<table>
<thead>
<tr>
<th>Zagar Classification</th>
<th>Total number of endoscopies (%)</th>
<th>Total number of patients submitted to esophageal dilation (%)</th>
<th>Total number of esophageal dilations (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 0</td>
<td>60 (20,9%)</td>
<td>1 (2,1%)</td>
<td>5 (3,6%)</td>
</tr>
<tr>
<td>Grade 1</td>
<td>71 (24,7%)</td>
<td>1 (3,1%)</td>
<td>23 (16,8%)</td>
</tr>
<tr>
<td>Grade 2a</td>
<td>59 (20,6%)</td>
<td>5 (33,3%)</td>
<td>37 (27,0%)</td>
</tr>
<tr>
<td>Grade 2b</td>
<td>17 (5,9%)</td>
<td>2 (28,6%)</td>
<td>2 (1,5%)</td>
</tr>
<tr>
<td>Grade 3a/3b</td>
<td>80 (27,9%)</td>
<td>4 (80%)</td>
<td>70 (51,1%)</td>
</tr>
</tbody>
</table>

Source: The authors.

DISCUSSION

The accidental ingestion of corrosive substances during childhood remains an important public health problem in developing countries, and it is related to socioeconomic factors, educational issues and deficiency in preventive actions. However, it is difficult to know the real prevalence of these accidents when considering the underreporting of cases. Since 1966, the World Health Organization has demonstrated high rates of injuries from ingestion of caustics in children under 5 years old. In the study carried out, the vast majority of children were younger than 5 years old, with a predominance of males, as shown in the literature. Children under 3 years old corresponded to a significant part, since, in this age group, children begin to explore the environment and are very curious, which can increase the accidental risk of ingesting corrosive substances if these are present in easily accessible locations. In addition, the habit of conditioning cleaning products in unmarked containers that attract the child’s attention is common, which favors this type of accident. Therefore, accidents usually happen at home. A study showed that about 86 to 90% of the accidents occur in home environment or in the surroundings, which corroborates the data found by the present research.

The most commonly ingested chemical compounds are alkaline substances, with caustic soda being the main agent involved in caustic accidents. In the present study, caustic soda represented the main agent of accidents, followed by sodium hypochlorite. These substances can be found in household cleaning products, especially in bleaches and detergents. In the region analyzed in this study, it is customary to manufacture soap in households using caustic soda. Despite the National Health Surveillance Agency (ANVISA) formulating technical regulations that provide requirements for labeling commercialized products containing caustic compounds, the information contained on the label is sometimes neglected or it does not effectively promote consumer awareness. It is mandatory, for example, that the labels of bleaches based on sodium hypochlorite contain the warning “store out of the reach of children” in a visible way to the consumer. However, information such as what to do in case of accidental exposure is provided in smaller and barely visible letters, as well as the consequences when ingesting the product, which are not even mandatory.

Accidental ingestion of alkaline or acidic substances can cause injuries to the mouth, oropharynx, airways, esophagus and stomach and less commonly to the duodenum. Thus, caustic agents when ingested can cause cellular necrosis by coagulation (acids) or liquefaction (alkalis), with varying degrees of involvement of the upper gastrointestinal tract depending on the amount of product ingested, the time of exposure, and the extent of the involvement. The endoscopic findings can be classified into several forms and the presentations can range from minimal or no oropharyngeal lesions to transmural lesions with extensive necrosis. A study with Mexican children showed that, in the endoscopic examination of the digestive tract, the most common esophageal injuries corresponded to grades 1, 2a and 2b for caustic soda, and 20% of the children had esophageal stricture. In relation to the present study, most children presented lesions 1, 2a and 2b, as already reported. The rapid performance of endoscopy, mostly in less than 24hs after exposure, may have contributed to the predominance of milder lesions. A review study showed that the average endoscopy time after caustic ingestion was 30 hours. This time is longer than that one found in this research. However, there are no well-established protocols for the management of caustic accidents that establish conducts when these substances are ingested.

Among the measures taken before the first endoscopy was performed, the administration of drugs such as analgesics and antacids was observed. In contrast, induction of vomiting is still observed, although proscribed in these cases, as is gastric lavage, administration of water, milk, or anti-emetics. This shows the lack of information from parents and even health professionals.
The indication of endoscopy is also controversial, although it helps to define the anatomical location and severity of the lesion. The National Poisons Information Service (NIPS) recommends that endoscopy should be performed within the first 24 hours, even in asymptomatic patients, and its indication is independent of the presence of oral lesions. The European Society of Paediatric Gastroenterology, Hepatology, and Nutrition (ESPHAN) and Endoscopy (ESGE), recommends close monitoring of these children and endoscopy, depending on the symptoms, within the first 24 hours. In addition, it may be necessary to repeat the exam to evaluate the appearance of complications and with a therapeutic objective. Some services advocate performing endoscopy after 2 to 3 weeks in symptomatic patients who sought late care (after 48 hours of exposure) to assess possible complications such as strictures.

Caustic ingestion is the most common cause of esophageal stenosis in children, and is therefore its most frequent late complication. The incidence rates of esophageal stenosis can range from 2 to 49% and predominantly affects the mid to distal portion of the organ. In the present study, the incidence was 13%. The most used therapy for esophageal strictures are endoscopic dilatation sessions that should start after 3 weeks of exposure and continue weekly until the desired caliber is reached. Most children who develop stenosis will require dilations initially twice a week for about 3 months, with an average of 12 dilations per patient. Although the number of dilations can be unpredictable and much higher than this.

The activities carried out by the Information and Toxicological Assistance Centers (CIATOX) in Brazil are very important in cases such as caustic accidents. This is because these centers are able to provide information regarding which products present the greatest risk to health and what measures should be taken after a caustic accident. However, it was only in 2015 that the Brazilian Ministry of Health recognized the CIATOX as health facilities that are part of the Emergency Care Network of the Unified Health System. Therefore, this information is still poorly disseminated to both health professionals and the general population.

The use of protocols for care in health units is a tool that enables the agility and effectiveness of treatments. In addition, educational actions for the prevention and adequate management of patients, aimed at both family members and/or guardians of the child and health professionals, are essential for early diagnosis and appropriate therapeutic measures. In this way, long-term complications can be avoided, including perforation and esophageal stricture, as well as the development of neoplasms.

There were potential limitations to this study. First of all, the fact that some medical records analyzed were not filled out completely and legibly, making it difficult or impossible to analyze certain variables, including the total number of accidents that occurred. In addition, bureaucratic procedures cause delays in accessing inactive records of patients who have not been seen in the hospital for more than five years or who have died. These facts made it difficult to analyze the data. In view of this, the importance of encouraging the proper filling of medical records by the responsible professionals is highlighted, as well as creating measures within the institutions that facilitate access to medical records, since this is an extremely useful tool for future research.

The results obtained in this study are not dependent on the analyzed sample or on a particular research situation, because although only medical records of children who suffered accidents with caustics were analyzed, the data were analyzed randomly, in order to obtain a representative sample of the child population. Finally, it should be considered that this research has external validation.

**CONCLUSION**

Esophageal injuries caused by caustic ingestion remain a major public health problem in underdeveloped and developing countries. Accidentally ingested substances mostly affect children under 5 years old and can cause harm to their health, with great impact on their quality of life. In addition, expenses with procedures such as dilations, when necessary, and interventions, such as EGD, significantly burden the health system.

In this context, based on the descriptive analysis carried out in the present study, a better epidemiological understanding of caustic accidents in children is possible, which is extremely important to establish effective measures for prevention and adequate management.

The ingestion of caustics was predominant in children under 2 years old in their own homes, which explains the need for actions to protect this risk group within their home environment. Furthermore, the early approach by the EGD resulted in the appearance of less serious injuries, a fact that demonstrates the importance of services that know how to deal with cases of caustic accidents and services that provide both endoscopic technology and trained professionals.

In addition, the study reinforces the importance of access to information regarding ways to prevent accidents for parents and health agents. And the study helps in the elaboration of public policies. In this way, this allows the prevalence of caustic accidents and their damage to be reduced. Finally, it is the university’s duty to produce research that brings positive results to the community, which strengthens the responsibility of public education to society.
2. Urganci N, Usta M, Kalyoncu D, Demirel E. Corrosive

1. Mencias, E. Intoxicación por cáusticos. In: Anales del

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