Research article

Chemical burns of the esophagus in children of Kyrgyzstan: 10-year analysis of prevalence and cause

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ABSTRACT

Introduction and Aim: In Kyrgyzstan, there are still no studies on the prevalence of chemical burns of the esophagus in children, and there are also few studies aimed at studying the causative agents. The present study aimed to assess the prevalence of burns of the esophagus due to the accidental use of various chemicals by children and the chemical composition of cauterizing substances over a 10-year period of admission of children to the clinic.

Materials and Methods: An analysis of 1081 cases of chemical burns of the esophagus in children who received inpatient treatment for the period 2011–2020 is presented.

Results: In our study, caustic substances were used more often by boys (56.9%) than girls (43.1%), most of the children were under the age of 3 years. There is a tendency for an annual increase in chemical burns of the esophagus. Among the causal factors, there is an increase in the use of alkalis, which are part of the cleaning agents for dishes and plumbing pipes - Krot; recently, the cleaning agent for cauldrons - Aurora is gaining momentum.

Conclusion: The emerging situation indicates not only the need for further medical research in this area, but also the tightening of requirements for the packaging and use of household chemicals, and the solution of this problem at the state level.

Keywords: Children; chemical burns; prevalence; causative agents.

INTRODUCTION

In children, the ingestion of corrosive substances is a serious medical and social problem (1) which leads to injury of the esophagus, pharynx, larynx, mouth and death in severe cases or adverse effects on the gastrointestinal tract and respiratory tract (2). Most often, the ingestion of caustic substances occurs when children just start walking or crawling (3,4). Therefore, these accidents were major cause of death in children ≤ 5 years of age, with a peak incidence at 2 years of age. However, these incidents were also seen in children ≤ 1 year of age (5). In developed countries, the preventable problem of children swallowing caustic materials has long been resolved, but in most of the developing countries it persists (2,6). Families, industrial enterprises, government and medical personnel should play an important role in the control and management of these accidents, only their combined efforts can reduce the number of accidents or change the course of the disease (5,6). In the Kyrgyzstan, there are still no studies on the prevalence of chemical burns of the esophagus in children, and there are also few studies aimed at studying the causative agents. The present study aimed to assess the prevalence of burns of the esophagus due to the accidental use of various

chemicals by children and the chemical composition of cauterizing substances over a 10-year period of admission of children to the clinic.

MATERIALS AND METHODS

During the period from 2011 to 2020, 1,081 children with a confirmed clinical diagnosis of chemical injury of the esophagus admitted to the City Children's Clinical Hospital of the Emergency Medicine, Bishkek (Kyrgyzstan). Basically, a chemical burn of the esophagus was caused as a result of the accidental use of cauterizing substances, and only 2 children (14 and 16 years old) had a suicide attempt. The distribution of children by sex, age and place of residence is presented in detail in Table 1.

Table 1: Characteristics of children in the study by sex, age and place of residence

Indicators/factors	Value
Boys, n (%)	615 (56.9%)
Girls, n (%)	466 (43.1%)
Urban residents, n (%)	671 (62.1%)
Rural residents, n (%)	410 (37.9%)
Children under 3 years old, n (%)	895 (82.8%)
Children from 3 to 6 years old, n (%)	184 (17.0%)
Children 6 years and older, n (%)	2 (0.2%)

Upon admission to the hospital, all children were examined by a pediatric surgeon, an ENT doctor and a resuscitator; they underwent a comprehensive clinical and diagnostic examination, including endoscopic examination. Depending on the severity of the condition, the children were hospitalized in the intensive care unit or surgical department. Confidentiality of the patient data was maintained and parents or legal guardians provided informed consent. This study was approved by the I.K. Akhunbaev Kyrgyz State Medical Academy Bioethics Committee (Protocol No. 3 dated May 25, 2020).

Statistical data analysis and mathematical processing were performed using Microsoft Excel, Statistica Excel application package, and Statistica 8.0 application package. The Mann–Whitney U-test was used to assess the statistical significance of the differences. Differences were considered statistically significant at p -values < 0.05 .

RESULTS

All sick children were injured at home. The moment of injury in young children often took place

unattended when the child was left unattended. In our study, caustic substances were used more often by boys (56.9%) than girls (43.1%). The age of children varied from 7 months to 16 years, the majority of children (82.8%) were under the age of 3 years, while the average age was 2.3 ± 0.04 years. Most (62.1%) of children lived in the urban areas, the rest (37.3%) were residents of rural areas. The ratio of children with chemical burns of the esophagus in favor of urban residents is explained by the status of the hospital, which should serve the urban population, but despite this, children from rural areas enter the clinic.

The number of children with burns of the esophagus and their increase over the years is clearly shown in Figure 1. In 2020, their number decreased and amounted to 102 cases, which is most likely dictated by the epidemiological situation for Coronavirus disease 2019, the introduction of quarantine measures and home isolation, when parents were mostly sitting at home and there was time to deal with the child.

Fig. 1: The number of children with chemical burns of the esophagus according to the data of the City Children's Clinical Hospital of the Emergency Medicine, Bishkek

When studying causal agents, we carried out a comparative characteristic between the last two five years (2011-2015 and 2016-2020) in order to answer the question of whether the nature of chemicals has changed. From the data in the table 2, it is obvious that the nature of the cauterizing substances has changed significantly over the past 5 years. There was an increase in the incidence of alkalis ($p < 0.05$), which are part of the cleaning agents for kitchen utensils and plumbing pipes - Krot (Chemical composition [concentration]: Sodium hydroxide or caustic soda [40-60%], Potassium hydroxide [5-

10%], Surfactants [10%], and ethylenediaminetetraacetic acid [5-10%]). Caustic soda and cleaning agent for cauldrons - Aurora (Chemical composition [concentration]: Phosphoric acid [15%], non-ionic surfactants, perfume, dyes, purified water and sodium hydroxide [15% or 25%]) are gaining momentum, their share increased 1.9 and 5.0 times, respectively ($p < 0.05$). The number of injuries by acids ($p < 0.05$), potassium permanganate ($p < 0.05$), white spirit ($p < 0.05$) and other causative agents ($p < 0.05$) significantly reduced.

Table 2: Causative agents of esophageal burns in children (comparative data for every five years since 2010)

Causative agents	2010-‘15 n=486 (%)	2016-‘20 n=595 (%)	p
Acetic acid	173 (35.6)	118 (19.8)	< 0.05
Caustic soda	79 (16.2)	155 (31.9)	< 0.05
Dish cleaning products, including Aurora	25 (5.1)	126 (21.8)	< 0.05
Pipe cleaners, including - Krot	44 (9.0)	77 (12.9)	<0.05
Sodium permanganate	91 (18.7)	61 (10.3)	<0.05
White spirit	42 (8.6)	39 (6.5)	<0.05
Office glue	10 (2.1)	2 (0.3)	<0.05
Other reagents	22 (4.5)	17 (2.8)	<0.05

Patients with esophageal burns were admitted within 2 hours to 12 days from the moment of using cauterizing agents. The largest number of victims after taking acetic acid was noted in September, which is obviously associated with the process of seasonal home canning of vegetables. Children with corrosive esophageal burns from household chemicals have been reported throughout the year.

DISCUSSION

According to the literature, widespread use, easy availability, and low cost of cleaning and detergents, especially in Asian countries (7), have led to an increase in the incidence of swallowing products among children. This conclusion is also supported by the results of our study, which showed an annual and stable increase in the number of children with chemical burns of the esophagus.

Demographic studies have shown that the group with the highest risk of accidental ingestion of caustic substances included preschool children (mean age = 1.74 (3.38) years), and boys were predominantly involved in such incidents. A Turkish study showed that 58% of children who used caustic substances were boys, and 42% were girls, with an average age of 3.6 (2.8) years (8) and even other related studies have yielded similar results (9,10). Children, especially boys, have well-developed skills, they are interested in studying substances and drinking them. However, they lack knowledge of substance tolerance. This means that boys of preschool age (3-4 years) need more attention and care from their parents to avoid such swallowing incidents. The same analogy with regard to the gender distribution of children with burns can be traced in our study, as boys accounted for 56.9%, and girls - 43.1%.

CONCLUSION

The number of people who have admitted to the City Children's Clinical Hospital of the Emergency Medicine in Bishkek with a chemical burn of the esophagus is increasing from year to year due to the increased use of aggressive chemicals in everyday

life. Over the past ten years (2011-2020), the nature of cauterizing substances has changed in our country, the number of children with burns of the esophagus is increasing as a result of the accidental use of cleaning agents for dishes and pipes, especially the cleaning agent for cauldrons - Aurora. The results obtained indicate not only the need for further medical research in this area, but also the tightening of requirements for packaging and the use of household chemicals, and the main solution to the problem at the state level. As a primary prevention, it is recommended to use programs of constant care for the health of children, since it is from the increased attention of parents that a decrease in the number of burns in children depends.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest

REFERENCES

- Mamede, R. C., De Mello Filho, F. V. Treatment of caustic ingestion: an analysis of 239 cases. *Dis Esophagus*. 2002; 15(3): 210-213.
- Turner, A., Robinson, P. Respiratory and gastrointestinal complications of caustic ingestion in children. *Emerg Med J*. 2005; 22(5): 359-361.
- Lee, H. J., Lee, J. H., Seo, J. M., Lee, S. K., Choe, Y. H. A single center experience of self-bougienage on stricture recurrence after surgery for corrosive esophageal strictures in children. *Yonsei Med J*. 2010; 51(2): 202-205.
- Bicakci, U., Tander, B., Deveci, G., Rizalar, R., Ariturk, E., Bernay, F. Minimally invasive management of children with caustic ingestion: less pain for patients. *Pediatr Surg Int*. 2010; 26(3): 251-255.
- Hockenberry, M. J., Wilson, D. Wong's Nursing Care of Infants and Children Multimedia Enhanced Version. 9th ed. United States: Mosby; 2013.
- Ekpe, E. E., Ette, V. Morbidity and mortality of caustic ingestion in rural children: experience in a new cardiothoracic surgery unit in Nigeria. *ISRN Pediatr*. 2012; 2012: 210632.
- Previtera, C., Giusti, F., Guglielmi, M. Predictive value of visible lesions (cheeks, lips, oropharynx) in suspected caustic ingestion: may endoscopy reasonably be omitted in completely negative pediatric patients? *Pediatr Emerg Care*. 1990; 6(3): 176-178.
- Otçu, S., Karnak, I., Tanyel, F. C., Senocak, M. E., Büyükpamukçu, N. Biochemical indicators of caustic ingestion and/or accompanying esophageal injury in children. *Turk J Pediatr*. 2003; 45(1): 21-25.
- Doğan, Y., Erkan, T., Cokuğraş, F. C., Kutlu T. Caustic gastroesophageal lesions in childhood: an analysis of 473 cases. *Clin Pediatr (Phila)*. 2006; 45(5): 435-438.
- Ciftci, A. O., Senocak, M. E., Büyükpamukçu, N., Hiçsönmez, A. Gastric outlet obstruction due to corrosive ingestion: incidence and outcome. *Pediatr Surg Int*. 1999; 15(2): 88-91.