

Nutritional status of children with esophageal stenosis secondary to burns by caustics, with gastrostomy management in the Civil Hospital of Guadalajara

Estado nutricional de niños con estenosis esofágica secundaria a quemadura por cáusticos, alimentados por gastrostomía en el Hospital Civil de Guadalajara

Martha del R. Cornejo-Villa*, Andrea Torres-Rojas, María A. Soto-Blanquel, and Juan L. Soto-Mancilla

Department of Clinical Nutrition and Pediatric Surgery, Organismo Público Descentralizado (OPD), Hospital Civil de Guadalajara Fray Antonio Alcalde, Guadalajara, Jalisco, Mexico

Abstract

Background: The ingestion of caustic substances constitutes a serious problem in the pediatric age that can cause injuries in the esophagus that may require oral feeding. Gastrostomy nutrition is a safe way to guarantee an adequate evolution of the nutritional status, as well patient's growth and development. **Objective:** The objective of the study was to evaluate the nutritional status of children with esophageal stenosis, secondary to caustic ingestion, after 6 months of gastrostomy placement as a feeding route. **Methods:** A descriptive, longitudinal ambispective study was carried out, with a sample of 20 patients. Nutritional status before and after gastrostomy placement; was obtained through anthropometric measurements and pediatric indexes. Statistical analysis: t-test. **Results:** The anthropometric indexes of W/A and BMI/A reflect a statistically significant improvement in nutritional status over 6 months of gastrostomy treatment, but not for H/A. **Conclusion:** The nutritional status evolves adequately from gastrostomy management in these patients.

Keywords: Caustic. Nutritional status. Esophageal stenosis. Gastrostomy.

Resumen

Antecedentes: La ingestión de cáusticos constituye un problema grave en la edad pediátrica que puede ocasionar lesiones en el esófago que imposibiliten la alimentación vía oral. La nutrición por gastrostomía resulta una vía segura para garantizar una evolución adecuada del estado nutricional, así como favorecer el crecimiento y el desarrollo del paciente. **Objetivo:** Evaluar el estado nutricional de niños con estenosis esofágica secundaria a ingestión de cáusticos, posterior a 6 meses de la colocación de gastrostomía como vía de alimentación. **Método:** Estudio descriptivo, longitudinal, ambispectivo, con una muestra de 20 pacientes. El estado nutricional previo y posterior a la colocación de gastrostomía se obtuvo mediante mediciones antropométricas e índices pediátricos. Análisis estadístico: t de Student. **Resultados:** Los índices antropométricos de peso para la edad (P/E) e índice de masa corporal para la edad (IMC/E) reflejan una mejoría estadísticamente significativa en el estado nutricional a lo largo de 6 meses de tratamiento con gastrostomía, no siendo así para la talla para la edad (T/E). **Conclusiones:** El estado nutricional evoluciona adecuadamente a partir del manejo con gastrostomía en estos pacientes.

Palabras clave: Cáustico. Estado nutricional. Estenosis esofágica. Gastrostomía.

Correspondence:

*Martha del R. Cornejo-Villa

Ejército Constitucionalista, 4017

C.P. 45120, Zapopan, Jalisco, México

E-mail: rocio.cornejov@hotmail.com

Date of reception: 14-10-2019

Date of acceptance: 02-04-2020

DOI: 10.24875/CIRUE.M22000188

Cir Cir (Eng). 2020;88(6):707-712

Contents available at PubMed

www.cirugiaycirujanos.com

2444-0507/© 2020 Academia Mexicana de Cirugía. Published by Permanyer. This is an open access article under the terms of the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

The esophagus is a tubular and longitudinal organ that extends from the pharynx to the stomach, the purpose of which is to transport the alimentary bolus. It begins and ends in two structures, the upper esophageal sphincter and the lower esophageal sphincter, which make it independent from the pharynx and stomach¹.

Mean length in adult individuals is 22-25 cm: 5-6 cm for cervical esophagus, 16-18 cm for the thoracic portion, and 3 cm for the abdominal segment. Esophageal length at birth is about 8-10 cm, and it measures about 19 cm at 15 years age².

Caustic refers to any substance that causes the destruction of exposed tissues by attacking cell membranes, causing necrosis. Caustic acids, with a pH < 2, such as muriatic acid and hydrochloric acid, will produce coagulative necrosis, while caustic alkalis, which have a pH between 11.5 and 14, such as sodium hydroxide (caustic soda) and ammonia, produce liquefactive necrosis. If these substances are ingested, serious injuries to the digestive system can be produced³. Alkali burns are more frequent than acid burns because their use is more common at home⁴. In this study, patients were admitted to the hospital due to sodium hydroxide ingestion.

Acids produce necrosis due to protein coagulation; there is water loss and a firm and protective eschar is formed that limits substance penetration, except at high concentrations⁵. Alkalis induce necrosis by liquefaction, with protein denaturation, fat saponification that allows deep penetration to submucosal and muscle tissues, which results in capillary thrombosis and tissue fibrosis or even perforation. Water retention increases hydration burn and this favors injury depth. Alkalis primarily injure the proximal gastrointestinal (GI) tract, including the mouth, pharynx, esophagus, and stomach⁶.

Since ingestion of acids causes severe oropharyngeal pain, they are generally consumed at small volumes compared to alkaline substances. Acids pass quickly through the esophagus, which results in a lower frequency and lower degree of esophageal injuries⁷.

Esophageal burns are injuries caused by ingestion of caustic substances and are among the most recurrent accidents at pediatric age⁴. In Mexico, around 5% of all domestic accidents are caused by ingestion of caustic substances, since it is easy for alkali and acid

solutions to be acquired for use at home, which has led to an increase in the frequency of burns and impairment for food consumption⁸.

Fifty percent of cases with severe esophageal burn (Grades IIB and IIIA)⁹ have a prognosis that involves developing esophageal stenosis with more than 90% involvement, which prevents oral feeding for long periods of time¹⁰. At *Hospital Civil de Guadalajara Fray Antonio Alcalde*, an average of 22 cases is cared for every year.

Treatment consists of esophageal dilations in order to recover the caliber and allow feeding. However, sometimes, when the degree of injury is significant and there are esophagogastric perforations or highly severe dysphagia, gastrostomy is contemplated, as well as when appropriate nutrition is not possible, with < 70% of energy requirements by oral route^{11,12}. Nutritional treatment is essential, since this way it is possible for the intake of the necessary energy requirement to be ensured in the most physiological way and thereby avoid caloric-protein malnutrition¹³.

Although it is a recurrent problem at pediatric age, there is scarce information regarding this pathology and its impact on nutritional status, as well as on patient prognosis. The vast majority of available data do not address this aspect, in addition to the fact that there is no established stress factor for this type of burn, and calculating the exact caloric requirement of these patients is therefore not possible.

The purpose of this study was to identify the nutritional status evolution of pediatric patients with esophageal stenosis secondary to caustic burn fed by gastrostomy at *Hospital Civil de Guadalajara Fray Antonio Alcalde* from 2014 to 2017.

Methods

This was descriptive, longitudinal, and ambispective study. The population we had access to were 20 pediatric patients diagnosed with esophageal stenosis secondary to caustic burn, fed by gastrostomy (surgical technique), who were cared for at *Hospital Civil de Guadalajara Fray Antonio Alcalde* from 2014 to 2017. To obtain the sample size, a non-probability sample by census-type expert judgment was considered. Data collection was from May 2017 to October 2018.

The general purpose of the study was to evaluate the nutritional status 6 months after gastrostomy placement as feeding route. The specific objectives were to know the incidence of caustic ingestion-secondary esophageal burn diagnosis in pediatric patients, to

identify the number of patients who received nutritional treatment and to know the incidence of the use of gastrostomy in this pathology.

The research was approved and reviewed by *Hospital Civil de Guadalajara Fray Antonio Alcalde* Ethics Committee, with registration number 277/17. The principles of the Declaration of Helsinki and the General Statute Health were followed. This research was considered free of risk because it only required information extraction from the pediatric clinical nutrition department databases, as well as from endoscopies carried out by the pediatric surgery department from 2014 to 2017, and obtaining informed consent was not necessary to carry out the research. However, parents or legal guardians previously granted consent to the corresponding departments for pertinent interventions.

Information was collected about patients with esophageal stenosis secondary to caustic ingestion with nutritional treatment by gastrostomy for 6 months. Those fed by oral route were not included, and those lacking the essential information for the study were eliminated.

Data were obtained from endoscopies carried out from January 2014 to December 2017 at *Hospital Civil de Guadalajara Fray Antonio Alcalde* pediatric surgery department, as well as information on nutritional status evaluation at hospital admission and at three subsequent visits (1, 3, and 6 months after the esophageal burn), and on the nutritional approach by the pediatric clinical nutrition department.

The following data were recorded: patient full name, hospital registration, date of hospital admission, date of birth, diagnosis at admission, date of the burn, date of gastrostomy placement and removal, date of the first three endoscopies with their respective endoscopic diagnosis, and medical plan to be followed. Similarly, age in months, weight, height, body mass index (BMI), and calories of the nutritional treatment started at hospital admission and at first three control visits were necessary in order for patient evolution to be evaluated.

Patient nutritional intervention started at hospital admission with parenteral nutrition and oral route fasting, until the moment gastrostomy was placed and, subsequently, transition was made to enteral nutrition until total energy requirement was reached. The nutritional treatment provided by the pediatric nutrition department was 20% higher than patient usual caloric intake. The energy intake provided to patients depends on their nutritional status, with approximately 100-200 kcal/kg/day being provided¹⁴, with a protein intake of 2.0-3.0 g protein/kg/day.

The WHO Anthro version 3.2.2 and WHO Anthro Plus version 1.0.4 programs were used to obtain the Z-scores corresponding to weight for age (W/A), height for age (H/A) and BMI for age (BMI/A). Descriptive statistics including the mean, standard deviation, minimum value, maximum value, and proportions were employed using Microsoft Office Excel 2013. Inferential statistical analysis was performed with the IBM SPSS statistical package, version 23. The statistical method employed was Student's t-test, with differences being considered significant when $p < 0.05$.

Results

During the period from January 2014 to August 2017, 92 patients were admitted with a medical diagnosis of esophageal burn secondary to caustic ingestion at *Hospital Civil de Guadalajara Fray Antonio Alcalde* pediatric surgery department, out of whom only 30 (32.6%) received nutritional treatment by the pediatric nutrition department and, among them, 26 (28.2%) required gastrostomy placement and six were eliminated since they did not comply with the information that was indispensable for the research.

The study group was made up of 20 patients with severe esophageal stenosis and esophageal burns of a degree higher than IIB and IIIA according to Zargar's endoscopic criteria, which prevented them from covering more than 70% of total energy requirement by oral route; two of them had IIA gastric burn on first endoscopy. As for gender, 75% were males and 25% were females. Mean age was 46 months (3.8 years), with an interval of 20.8 months (1.7 years) to 97.3 months (8.1 years).

Figure 1 shows the evolution of anthropometric indices Z-scores whereby nutritional status (W/A, H/A, and BMI/A) was evaluated at patient visits. Table 1 shows nutritional status indices results between hospital admission and last visit.

Initial W/A Z-score of 25% was within normal range and of 50% corresponded to underweight. A p-value of 0.037 was obtained when the means were compared. In comparison with final W/A, 60% indicated normality and 25% underweight. Initial H/A Z-score of 60% had a diagnosis of normality and on final indicator it was 65%. Initial BMI/A Z-score in 40% indicated normality, in 50% was wasting found, and in 10%, overweight. Final BMI/A Z-score in 65% was within normal range, 30% had wasting, and 5%, overweight. A p-value of 0.021 was obtained when the means were compared.

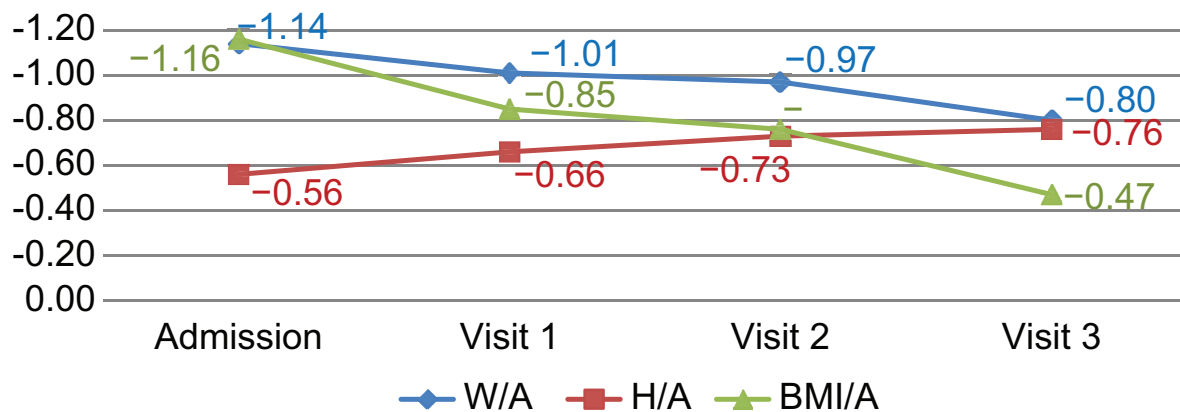


Figure 1. Anthropometric indices Z-scores at nutritional visits. BMI/A: body mass index for age; H/E: height for age; W/A: weight for age.

Table 1. Classification of anthropometric indices Z-score at hospital admission and at visit 3

SD	W/A		H/A		BMI/A	
	Admission (%)	Visit 3 (%)	Admission (%)	Visit 3 (%)	Admission (%)	Visit 3 (%)
+3.0 and higher	0	0	0	0	0	65 (n = 13)
+2.0 to +2.99	0	0	5 (n = 1)	0	5 (n = 1)	30 (n = 6)
+1.01 to +1.99	5 (n = 1)	0	5 (n = 1)	5 (n = 1)	5 (n = 1)	0
+1.0 to -1.0	25 (n = 5)	60 (n = 12)	55 (n = 11)	60 (n = 12)	40 (n = 8)	0
-1.01 to -1.99	50 (n = 10)	25 (n = 5)	20 (n = 4)	15 (n = 3)	20 (n = 4)	5 (n = 1)
-2.0 to -2.99	10 (n = 2)	10 (n = 2)	10 (n = 2)	15 (n = 3)	30 (n = 6)	0
-3.0 and lower	10 (n = 2)	5 (n = 1)	5 (n = 1)	5 (n = 1)	0	0

BMI/A: body mass index for age; H/A: height for age; SD: standard deviation; W/A: weight for age.

As for the nutritional approach with gastrostomy, average duration was observed to be 14.4 ± 10.5 months. The time elapsed between gastrostomy placement and burn occurrence depends on the degree of esophageal stenosis, clinical findings, evolution, and follow-up of each patient. In this study, gastrostomy placement is observed to have been resorted to within the first 10 days in those who had a stenosis percentage higher than 80%.

Discussion

In Mexico, accidents are among the main causes of mortality in children younger than 5 years, which reflects a poor culture with regard to their prevention¹⁵. At present, there is no information related to caustic substances ingestion epidemiology in our country, even though the number of reported cases is relatively high, which can be corroborated in different studies.

In a study on sociodemographic factors associated with caustic substances ingestion in children and adolescents during 2006 carried out at a pediatric hospital in Guadalajara, Mexico, 94 patients with an average age of 3.2 years were studied, with 59 of them (62.8%) being children. The sociodemographic variables that were significantly associated were found to be age younger than 6 years, the male gender, mothers younger than 30 years, maternal low educational level, mothers working away from home and children with divorced parents¹⁶. Similarly, 2012 ENSANUT describes that, at the national level, there is a higher prevalence of accidents in boys than in girls (5.3 and 3.4%, respectively)¹⁷. In the present study, a similar trend was observed for the risk males have of accidentally ingesting a caustic substance.

The severity of esophageal damage secondary to burns by caustic agents is reflected on the incidence of severe esophageal stenosis that entails the

impossibility of feeding by oral route, for which gastrostomy placement is necessary in 28.2% of patients.

BMI/A Z score in 30% of patients was below -2 standard deviations (SD), in 20%, below -1 SD, 10% were found with overweight and 30% had short stature (10% with -2 SD), which contrasts with the study by Sánchez-Ramírez et al.¹⁸ carried out in 2016 with 62 children treated at the Esophagus Clinic of the High Specialty Medical Unit (UMAE – *Unidad Médica de Alta Especialidad*), Children's Hospital, Mexico, which had a higher percentage of children with wasting, lower percentage with overweight and 40% of patients with normal nutritional status. Furthermore, more than half the patients were below average on arm anthropometric indicators, which reflect a loss of fat and muscle reserves. This can be considered to be nutritional status chronic deficit. In comparison with the figures reported by 2012 ENSANUT, there is a disparity with regard to national percentages of wasting (1.6%) and short stature (13.6%)¹⁷. This suggests that the studied population had lower food safety prior to the accident, since short stature is a reflection of negative effects accumulated over time.

Regarding nutritional status evolution after gastrostomy treatment implementation, in a study carried out at Children's Hospital UMAE in Mexico City, 97 patients with severe esophageal injury by caustics occurred at around 3 years of age were studied. Less than 50% were found to restore and maintain nutritional status with the use of gastrostomy or oral feeding with polymeric or handmade formula administration¹⁸. However, significant differences were observed in our study for W/A ($p = 0.037$) and BMI/A ($p = 0.021$). At hospital admission, 25% of patients were within normal ranges, and by the end of the study, 60% were found to be within normal weight, despite the fact that an unconventional form of feeding was used, but by means of which, nutritional requirement of the child can be appropriately covered. Comparing both studies, although the burns are of the same type, the study variables were different. However, in this research, treatment duration and energy intake are specified and, therefore, the difference in nutritional status restoration may be due to the continuity of patient visits for 6 months, the emphasis on nutritional education offered to the mother and to the provision of a homemade polymeric formula with 20% more calories than usual dietary intake.

In a study carried out in 2006 at different children's hospitals from Jalisco, 94 patients with caustic-related

stenosis were studied, out of whom 18 received enteral nutrition, with 50% having favorable results with gastrostomy¹⁶; also in this research, there was an improvement in BMI in 25% and in body weight in 35%, which corroborates that nutrient intake by gastrostomy is important in this type of patients.

Ingestion of caustic substances at pediatric age is alarming, given that recurrence of this accident reflects the lack of information specifically aimed at parents and caregivers, which could be avoided by raising awareness about the importance of corrosive substances appropriate storage.

As for the nutritional approach, calculation of requirements is complex because there is no specific stress factor for esophageal burns, since it is difficult for a single value to be determined due to the severity of the pathology and the type of treatment. However, by increasing patient usual dietary intake, long-term improvement in nutritional status is accomplished.

It is important to underscore that, in the present study, the provided treatment was with homemade polymeric formulas and no commercial formula of any type was used for an evolution in nutritional status to be accomplished.

At present, there are still few bibliographic references that address the nutritional approach or prognosis of children with esophageal stenosis after caustic substances ingestion, which invites to continue with research to learn more about the situation in the country.

Conclusion

There is scarce information on esophageal stenosis secondary to caustic substances ingestion, as well as about nutritional treatment with gastrostomy and its evolution.

Caustic ingestion is a serious and relatively common problem, which especially affects the male gender aged between 2 and 8 years. In the period from 2014 to 2017, 92 patients with a diagnosis of esophageal burn secondary to caustic ingestion were found, out of whom 30 (32.6%) received were approached by the pediatric nutrition department; 26 (28.2%) required the use of gastrostomy for an average time of 14.4 months.

The W/A and BMI/A anthropometric indices reflect a statistically significant improvement over 6 months of treatment with gastrostomy, which did not occur with H/A.

For all the above, it is concluded that nutritional status evolves satisfactorily with gastrostomy management in these patients.

Funding

The authors declare that there were no funding sources.

Conflicts of interest

The authors declare that they have no conflicts of interest related to this manuscript.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this research.

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained informed consent from the patients and/or subjects referred to in the article. This document is in the possession of the corresponding author.

References

1. Sociedad Española de Otorrinolaringología y Patología Cérvico-Facial. Otorrinolaringología. Madrid: Médica Panamericana; 2011.
2. Viswanatha B. Esophagus anatomy. Medscape. 2015 Jul. Disponible en: <https://emedicine.medscape.com/article/1948973-overview>.
3. Mencías E. Intoxicación por cáusticos. An Sist Sanit Navarra. 2003;26:191-207.
4. Millar AJ, Cox SG. Caustic injury of the oesophagus. Pediatr Surg Int. 2011;31:111-21.
5. Asociación Española de Pediatría. Protocolos de gastroenterología, hepatología y nutrición. 2.ª ed. Madrid: Ergón; 2011.
6. Kurowski JA, Kay, M. Caustic ingestions and foreign bodies ingestions in pediatric patients. Pediatr Clin North Am. 2017;64:507-24.
7. Contini S, Scarpignato C. Caustic injury of the upper gastrointestinal tract: a comprehensive review. World J Gastroenterol. 2013;19:3918-30.
8. Asociación Española de Gastroenterología. Esofagitis por cáusticos. En: Montoro MA, García JC, editores. Gastroenterología y hepatología: problemas comunes en la práctica clínica. 2.ª ed. Madrid: Jarp-vo; 2011. p. 221-8.
9. Zargar S, Kochhar R, Mehta S, Mehta SK. The role of fiberoptic endoscopy in the management of corrosive ingestion and modified endoscopic classification of burns. Gastrointest Endosc. 1991;37:165-9.
10. Donatone J. Urgencias endoscópicas digestivas en pediatría. Rev Med Clin Condes. 2009;20:869-77.
11. García A. Estenosis esofágica por ingestión de sustancias cáusticas. Rev Cub Cir. 2007;46:1-6.
12. Pedrón C, Benlloch C, Navas-López VM, Gómez-López L, Redencillas-Ferrero S, Moreno-Villares JM, et al. Documento de consenso SENPE/SEGHNP/ANECIPN/SECP sobre vías de acceso en nutrición enteral pediátrica. Nutr Hosp. 2011;26:1-15.
13. Parra-Gómez L, Reyes J, Escobar C. La desnutrición y sus consecuencias sobre el metabolismo intermedio. Rev Fac Med UNAM. 2003;46:32-6.
14. Toussaint G, García-Aranda J. Desnutrición energético-proteínica. 3.ª ed. Ciudad de México: Médica Panamericana; 2015. p. 263-96.
15. Instituto Nacional de Estadística y Geografía. México: Estadísticas de mortalidad. Disponible en: <http://www3.inegi.org.mx/sistemas/cni/esenario.aspx?idOrden=1.1&ind=6300000011&gen=146&d=n>
16. Sánchez-Ramírez C, Larrosa-Haro A, Vásquez-Garibay EM, Macías-Rosales R. Socio-demographic factors associated with caustic substance ingestion in children and adolescents. Inter J Ped Otorhinolaryngol. 2012;76:253-6.
17. Gutiérrez JP, Rivera-Dommarco J, Shamah-Levy T, Villalpando-Hernández S, Franco A, Cuevas-Nasu L, et al. Encuesta Nacional de Salud y Nutrición 2012. Resultados nacionales. Cuernavaca, México: Instituto Nacional de Salud Pública; 2012.
18. Sánchez-Ramírez CA, Larrosa-Haro A, Vásquez-Garibay EM, Rodríguez-Anguiano AK, Cámara-López ME. Nutritional status in children with esophageal stenosis and dysphagia associated with caustic ingestion. Nutr Hosp. 2016;33:26-30.