



Nutrición Hospitalaria



Trabajo Original

Pediatría

Nutritional status in children with esophageal stenosis and dysphagia associated with caustic ingestion

Estado nutricional en niños con estenosis esofágica y disfagia secundaria a ingestión de cáusticos

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Abstract

Introduction: Caustic ingestion (CI) in children and adolescents may lead to esophageal burns, esophageal stenosis and secondary dysphagia. These complications may limit the normal feeding process leading to malnutrition and growth impairment.

Aims: Our aim was to evaluate the nutritional status and its association with dysphagia and esophageal stenosis in children with CI.

Methods: Sixty-two patients with caustic ingestion treated at a pediatric referral hospital were included in this cross-sectional study. Independent variables were dysphagia/normal swallowing and esophageal stenosis/normal barium-swallow. The dependent variables were growth and nutritional status evaluated by anthropometry. Analysis: χ^2 test, OR, 95% CI, kappa test and Student's t-test.

Results: The average age at the time of CI was 39.7 months; 38.7% of the patients were girls. Endoscopy performed upon admission revealed erosive esophagitis (II-b, III-a, and III-b) in 46 (77.8%) of the patients, dysphagia in twenty-four (38.7%) and esophageal stenosis in forty (64.5%). Both complications occurred simultaneously in 20 children (32.3%, kappa = 0.3, p = 0.014).

The z-score of height-for-age was below -2 SD in five children (8.1%). The z score of body mass index (BMI) was < -2 SD in three children (4.8%) and it was above +1 SD in 24.2%. The z-score means of the arm anthropometric indicators of fat stores and muscle mass in both the dysphagia and esophageal stenosis groups were located in the negative area of the z-score curve and their values differed significantly from the z-scores of the non-dysphagia and non-stenosis groups.

Conclusions: The proportion of erosive esophagitis, esophageal stenosis and dysphagia was high. Children with dysphagia and/or esophageal stenosis associated with CI had lower fat stores and muscle mass than the cases without esophageal complications.

Key words:

Caustic ingestion.
Esophageal stenosis.
Dysphagia. Nutrition.

Resumen

Introducción: la ingestión de cáusticos (IC) en niños y adolescentes puede ocasionar esofagitis erosiva, estenosis esofágica y disfagia, entidades que pueden alterar el proceso de alimentación y originar desnutrición y retraso en el crecimiento.

Objetivos: evaluar el estado nutricional de niños con IC y su asociación con disfagia y estenosis esofágica.

Métodos: estudio transversal analítico en el que se incluyó a 62 niños atendidos en un hospital pediátrico de referencia que sufrieron IC. Las variables independientes fueron la presencia/ausencia de disfagia y/o estenosis esofágica; las dependientes fueron el crecimiento y el estado nutricional evaluados mediante antropometría. Análisis estadístico: χ^2 , OR, IC 95%, kappa y t de Student.

Resultados: la edad promedio fue 39,7 meses, el 39,7% eran niñas. Cuarenta y dos (77,8%) presentaron esofagitis erosiva (II-b, III-a, and III-b) en la endoscopia. En 24 (38,7%) ocurrió disfagia y en 40 (64,5%) estenosis esofágica. El puntaje z de la talla para la edad fue < -2 DE en cinco niños (8,1%) y el puntaje z del IMC < -2 DE en tres (4,8%). En 24,2% la z-IMC fue > +1 DE. El puntaje z de los indicadores del brazo relacionados a reservas de grasa y masa muscular tanto en el grupo de estenosis como de disfagia se localizó en el lado negativo de la curva y ambos fueron significativamente menores a los del grupo sin disfagia o estenosis.

Conclusiones: la proporción de esofagitis erosiva, estenosis o disfagia fue elevada. En los niños con disfagia o estenosis esofágica se identificaron reservas de grasa y masa muscular menores a las de los niños sin estas complicaciones.

Palabras clave:

Ingestión de cáusticos. Estenosis esofágica. Disfagia. Desnutrición.

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INTRODUCTION

Caustic ingestion (CI) is an unfortunate event that children and adolescents may suffer when living in homes with a poor injury prevention culture (1-3). Ingestion of acid or alkali substances frequently leads to upper gastrointestinal tract damage manifested in the short term as esophageal burns and later as esophageal stenosis. It can also result in acquired motility disorders and secondary dysphagia (4-12). These conditions may limit the normal feeding process leading to malnutrition and growth impairment, particularly in developing countries (12-15). Data related to the nutritional status in children with caustic esophageal burns are scarce. Therefore, our aim was to evaluate the nutritional status and its association with dysphagia and esophageal stenosis in children with CI.

MATERIALS AND METHODS

PATIENTS

Sixty-two children and adolescents diagnosed with CI that were treated at the Esophagus Clinic of the Unidad Médica de Alta Especialidad Hospital de Pediatría were included in the study. The period running from the time when the CI happened to inclusion in the study was longer than six months in all cases. The average age when the injury occurred was 39.7 months (31.5, DD). Twenty-four cases (38.7%) were girls.

PROTOCOL

In this cross-sectional study the assigned independent variables were: a) dysphagia/normal swallowing; and b) esophageal stenosis/normal barium swallow. The dependent variables were growth and nutritional status evaluated by anthropometrical indicators.

The complete X-ray and endoscopic charts had to be available for all patients included in the study. Children with genetic, chronic, or systemic diseases were not included. Swallowing data were obtained through a direct interview with the patients and their parents or guardians. Dysphagia was defined as difficulty swallowing solid or semi-solid foods that occurred after CI and was evaluated with the "Dysphagia Score" (16).

Data of the mucosal esophageal damage observed through endoscopy upon admission were classified according to Zargar's classification (17). Results were then expressed as a dichotomic variable: normal mucosa/non-erosive and mild erosive esophagitis (Zargar 0, I and II-a) and moderate-to-severe esophagitis (II-b, III-a, and III-b).

A barium swallow was performed 3 weeks after CI. Diagnosis of esophageal stenosis was established in the presence of narrowing of the esophageal lumen and lack of normal esophageal distension during fluoroscopy.

Anthropometry: Before the data were collected, the main author and two collaborators performed an anthropometrical standardization trial with 30 children under 6 years of age. Consistency (intra-group individual measurements) and validity (inter-group comparison with a gold standard) were evaluated with Pearson's bivariate correlations; when the correlation coefficient was below 0.85, the anthropometrical technique was reviewed and corrected until the desired (> 0.85) intra and inter-group correlation coefficients were achieved.

Weight: Study subjects were weighted without shoes and minimal clothing, using a movable weight platform-beam scale. Weight was recorded to the nearest 100 grams (18,19).

Height: Height was measured and recorded to the nearest 0.1 cm using a stadiometer with a movable block. The subjects were measured while standing, without shoes, heels together, back as straight as possible, and arms hanging freely. The head was positioned in the Frankfort horizontal plane and the movable block was brought down until touching the head (18,19).

Mid arm circumference (MAC): MAC was calculated with the right arm bent at the elbow at a 90° angle while the upper arm was held parallel to the side of the body. The distance between the acromion and the olecranon was measured with a fiberglass tape and the midpoint between these two spots was marked. The patient's right arm was hanging loosely and relaxed to the side of his or her body. A fiberglass metric tape was positioned at the marked midpoint and the circumference was recorded to the nearest 0.1 cm (19).

Triceps skinfold (TSF): The TSF was measured with a Lange skinfold caliper at the previously marked midpoint on the posterior portion of the right upper arm with the arm extended in the same relaxed position held in MAC. The examiner grasped a vertical pinch of skin and subcutaneous fat between the thumb and forefinger about 1 cm above the previously marked midpoint pulling away gently from the underlying muscle. The skinfold caliper was placed at the marked midpoint while keeping the skinfold grasped. Readings were taken in millimeters as soon as the caliper came in contact with the skin and the dial reading stabilized. Babies sat on their mothers' laps and children were measured standing up (19).

Total, muscle, and arm fat areas: Arm areas were calculated with MAC and TSF measurements according to the formulas described by Jelliffe, Gurney, and Frisancho (19-21). Results were expressed in square millimeters.

Body mass index (BMI): BMI was calculated as weight (kg) divided by height squared (m²).

Reference patterns and indicators of nutritional status: Height-for-age, weight-for-height, MAC, TSF, and arm areas-for-age z-scores were calculated with the 2006 WHO and Frisancho reference patterns (19,22). Definitions of thinness, overweight, and obesity were based on the BMI-for-age WHO z-score current criteria (22).

STATISTICS

Comparison of the quantitative values of the anthropometric indicators according to the presence of dysphagia/normal swallowing and

stenosis/normal esophagus on the barium swallow was performed with the Student's t-test for independent variables. Comparison of qualitative anthropometric variables according to the presence of dysphagia and stenosis was performed with the chi-square test; risk was estimated with OR and 95% CI. *Kappa* test was used to determine concordance between esophageal stenosis and dysphagia.

ETHICS

Informed consent was obtained from the parents or guardians. The study protocol was approved by the Hospital Research and Ethics Committee (#1302-167).

RESULTS

CLINICAL VARIABLES

Endoscopy performed upon admission revealed that four children (6.4%) had normal esophageal mucosa or erythematous esophagitis; twenty-three cases (37.1%) had II-a degree burns; twenty-nine (46.8%) II-b; four (6.5%) III-a; and two cases (3.2%) III-b. No cases of esophageal perforation (Zargar IV) were found. Dysphagia with solid or semi-solid foods occurred two to three weeks after the CI in 24 (38.7%) cases. Barium swallows revealed esophageal stenosis in 40 cases (64.5%). The odds ratio of having dysphagia in the presence of stenosis was 4.5 (1.3-15.7, 95% CI). Esophageal strictures and dysphagia occurred simultaneously in 32.3% of the patients; the concordance determined by the *kappa* test between these two complications was 0.3 ($p = 0.014$). Moderate-to-severe erosive esophagitis (II-b, III-a, and III-b) identified within 24 hours from CI was associated with esophageal stenosis ($p = 0.017$), but not with dysphagia ($p = 0.280$). Most of the stenoses were located in the mid esophagus; in four cases (6.5%)

they were located at more than two sites. Sixteen cases (25.8%) underwent esophageal dilatations during the study period.

ANTHROPOMETRICAL VARIABLES

Height-for-age: The z-score of height-for-age was below -2 SD in five children (8.1%). Overall, height-for-age was located in the negative area of the z-score curve in 41 cases (66.1%). The mean z-score in the 40 cases with stenosis was -0.5 SD and it was -0.2 SD in the 22 cases without stenosis ($p = 0.317$). The mean z-score in 24 children with dysphagia was -0.5 SD and was -0.4 SD in 38 patients without this symptom ($p = 0.777$). No statistical difference was observed in height-for-age among children with and without esophageal stenosis and/or dysphagia.

Body mass index (BMI): BMI z-score values according to the current WHO criteria are presented in table I. The BMI z-score was below -2 SD (severe thinness) in three children (4.8%). Twenty-one (33.9%) were below the cut-off point of -1 SD (thinness). Overweight plus obesity (z-score above 1 SD) was identified in 30 children (48.4%). The proportion of children with esophageal stenosis and BMI z-score values below -1 SD was higher compared with those without stenosis ($p = 0.006$). The proportion of children with overweight plus obesity was significantly lower in the presence of dysphagia ($p = 0.033$) or stenosis ($p = 0.038$).

Arm anthropometrics: The mean z-scores of the arm anthropometric indicators were compared according to the presence or absence of dysphagia or esophageal stenosis (Table II). Arm indicators of the children with both dysphagia and esophageal stenosis were all located in the negative area of the z-score curve. In all cases, z-score values were significantly lower in the children with dysphagia or stenosis when compared with the cases without these complications. Arm muscle area z-scores showed the same trend; the mean difference was significant only in the group with dysphagia ($p = 0.038$), but not in that with stenosis ($p = 0.074$).

Table I. Classification of body mass index (BMI) z-scores in 62 children that suffered caustic ingestion and their distribution in relation to the presence of dysphagia ($n = 24$) or esophageal stenosis ($n = 40$). Data are reported as frequencies and percentages. Percentages correspond to the overall subgroups of dysphagia or stenosis. Statistical tests: chi-square test

BMI z-score	Dysphagia				Esophageal stenosis			
	Yes		No		Yes		No	
	<i>n</i>	(%)	<i>n</i>	(%)	<i>n</i>	(%)	<i>n</i>	(%)
-1 to 1 SD	18	(29)	18	(29)	25	(40.3)	11	(17.1)
> 1 SD	2	(3.2)	13	(21)	5	(8.1)	10	(16.2)
< -1 SD	4	(6.5)	7	(11.3)	10	(16.2)	1	(1.6)

Dysphagia: BMI -1 to 1 SD versus < -1 SD $p = 0.839$. BMI -1 to 1 SD versus > 1 SD $p = 0.033$; *Esophageal stenosis:* BMI -1 to 1 SD versus < -1 SD $p = 0.244$. BMI -1 to 1 SD versus > 1 SD $p = 0.038$.

Table II. Arm anthropometrical indicators performed in 62 children that suffered caustic ingestion. The cases of children with dysphagia (n = 24) or stenosis (n = 40) were compared with children without these complications. Data are reported as z-score means and SD. Statistical test: Student's t

Arm anthropometrical indicators	Dysphagia				p	Esophageal stenosis				p
	Yes		No			Yes		No		
	Mean	(SD)	Mean	(SD)		Mean	(SD)	Mean	(SD)	
Mid arm circumference	-1.04	(0.9)	-0.2	(1.4)	0.006	-0.9	(1.1)	0.1	(1.4)	0.010
Triceps skinfold	-0.3	(0.8)	0.3	(1.2)	0.035	-0.3	(0.9)	0.7	(1.3)	0.003
Total arm area	-0.8	(0.9)	-0.03	(1.3)	0.007	-0.7	(1.05)	0.2	(1.4)	0.006
Arm fat area	-0.4	(0.8)	0.3	(1.3)	0.016	-0.3	(1.7)	0.7	(0.13)	0.002
Arm muscle area	-1.1	(0.8)	-0.6	(1.1)	0.038	-0.9	(0.9)	-0.5	(1.1)	0.074

SD: Standard deviation.

DISCUSSION

The clinical impact of a single event of CI is underlined in the current study: more than one-half of the children presented esophageal stenosis and one-third complained of daily dysphagia. The diagnosis of erosive esophagitis in more than 50% of the children in the 24-hour post-injury admission endoscopy highlights the severity of the initial esophageal damage.

The observation that one-half of the patients with stenosis did not complain of dysphagia and that some patients with dysphagia had no esophageal stenosis points to the underlying complexity of the functional and anatomical esophageal damage induced by the chemical agent, as well as to the individual variation in visceral sensitivity. Given the severity of the esophageal damage that usually occurs in children with CI, it is surprising that there is very little published information regarding their nutritional status. In France, Ganga-Zandzou et al. found that the nutritional status in 34 children with esophageal stenosis was not affected, whereas in Egypt, Hamza et al. recorded 15% malnutrition (7,8).

The comparison of body composition with anthropometrical indicators of children with dysphagia and/or esophageal stenosis with those cases without these disorders showed interesting results. In most cases, children with dysphagia or esophageal stenosis were located in a negative position in the z-score curve area and their values were significantly lower than their counterparts without dysphagia and/or stenosis. This was particularly true for the arm indicators of fat stores, such as TSF, arm fat area, and BMI. These findings may be interpreted as loss of fat stores and may be considered as impaired nutritional status (23). The arm muscle area showed significant differences in the same direction as the fat stores, but this was observed only in the children with dysphagia. The clinical significance of these findings should be weighed within the framework of a symptom (dysphagia) and an anatomical abnormality (stenosis), which may have a chronic outcome and in many cases will not be entirely resolved. If the changes in body composition persist for years, they could possibly

result in a more severe impairment in fat stores, muscle mass and eventually in linear growth.

In the current series we found a low proportion of height-for-age below -2 SD, which is comparable to its prevalence in the 2012 National Health and Nutritional Survey performed in Mexico (24), and it may reflect a population prevalence rather than an effect of the CI. However, in most cases, anthropometric indicators related to fat stores and muscle mass of children with dysphagia or stenosis were significantly lower than those of the children without these complications. Unfortunately, we could not compare these results with the 2012 National Health and Nutritional Survey performed in Mexico to determine whether the nutrition rates found in the population with stenosis or dysphagia due to CI represented a population subset or a true diseased population, since the survey did not include arm anthropometry in the population studied.

Moderate or severe secondary malnutrition is frequently associated with gastrointestinal diseases affecting the liver, the pancreas and the small intestine, all of which share impaired digestion and absorption mechanisms. In contrast, the main function of the esophagus is to transport the food contents from the mouth to the stomach, without any digestive or absorptive functions (25), which may account for the low frequency of malnutrition found in our series. However, besides the anatomical evidence of esophageal narrowing, children may have esophageal dysmotility. Esophageal manometry has revealed hypoperistalsis, with normal upper and lower esophageal sphincter, in children with CI (26,27). Rana et al. showed that patients with corrosive injury have prolonged oro-cecal transit time using the lactulose hydrogen breath test method, even in the absence of any gastric symptoms. Transit time was maximally prolonged in patients with lower third esophageal scars (6). Gastric emptying time assessed by radionuclide scintigraphy after a CI event was significantly prolonged in patients with esophageal stenosis, even in the absence of gastric symptoms (28). Another study reported that esophageal transit time, assessed by scintigraphy, was prolonged in one-third of patients with corrosive-induced esophageal stenosis, despite having achieved adequate dilatation. They found that the prolongation of esophageal

transit time correlated with the length of the stricture and that the severity of dysphagia correlated with the prolongation of total esophageal transit time (29).

In summary, the findings of our study highlight the differences in body composition between children with stenosis and/or dysphagia and those without these complications, underlining the potential value of arm anthropometry, a technique which is validated in infants and children for evaluating body composition, in assessing nutritional status (23,30,31).

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