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ORIGINAL ARTICLE

Effectiveness of endoscopic balloon dilatation in grade 2a and 2b esophageal burns in children

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ABSTRACT

Purpose: To evaluate the predictability of the initial endoscopic evaluation of the effectiveness of endoscopic balloon dilatation (EBD) in childhood esophageal strictures caused by corrosive ingestion.

Material and methods: Medical records of 635 endoscopies caused by corrosive ingestion between January 2000 and December 2015 in children between the ages of 0 and 18 years were retrospectively analyzed. Among them, five children with grade 2a and 15 with grade 2 b who developed esophageal strictures were evaluated for the effectiveness of endoscopic balloon dilatation.

Results: The stricture rate was 5/136 (3.6%) in grade 2a and 17/25 (68%) in grade 2 b esophageal burns. Strictures with grade 2a burn had seven (1–10) EBD sessions, and grade 2 b had 8.8 (1–30) EBD sessions. For grade 2a burns, the treatment period was 15 months and 18.8 months for grade 2 b burns. Three patients with grade 2 b and two patients with grade 2a are still on the EBD program.

Conclusion: Initial endoscopy for caustic ingestion and esophageal injury grading may help to provide healthcare givers with information about future stricture formation and management.

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Corrosive; esophagus; strictures; dilatation; children

Introduction

Ingestion of corrosive substances is reported to be increasing in developing countries unlike in modern countries due to the lack of legislation, public awareness and easy accessibility of corrosive substances. Most serious injuries and chronic complications occur as a consequence of esophageal injury. Despite unremarkable symptoms or physical findings after ingestion, extensive tissue injury resulting in resistant esophageal strictures may occur (1). Dysphagia associated with esophageal strictures may not only lead to chronic malnutrition and related problems but also to educational and psychosocial problems due to repeated hospitalization of the affected children. Additionally, this condition may become a public health problem considering the economic and social burden to the families and national health sources (2).

The formation of a stricture is mainly affected by the depth of the esophageal injury. Upper gastrointestinal endoscopy can be used to evaluate the initial extent and degree of tissue injury and also for therapeutic purposes. Moreover, endoscopic esophageal injury grading may provide information that can be used to predict complications and facilitate clinical decisions for patients who have ingested corrosive substances (3). Different classification systems are used for esophageal injury according to the endoscopic view of the esophageal mucosa to predict stricture formation and clinical outcome. Although grade 1 injuries have good prognoses, grade 2 and grade 3 injuries may develop up to 15–90% stricture formation (2,4). Caustic agent related esophageal strictures are more complex with longer, angulated, tortuous and irregularly shaped esophagus. Hence, they are difficult to treat, show higher failure and complication rates than other benign esophageal strictures. Endoluminal dilatation therapy evolving from bougienage with rigid and semi-rigid materials to 'through-the-scope' (TTS) balloon catheters for esophageal strictures is the mainstay of the treatment (5). Surgical procedures such as esophagectomy or substitution with intestinal or gastric conduits are reserved for patients unresponsive to repeated dilatations due to long-term negative impact on the developing children. Although endoscopic balloon dilatation (EBD) therapy has been a primary method for treating benign esophageal strictures in adults there are only limited studies focusing on strictures

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Table 1. Staging of esophageal injury according to the endoscopic view.

Stage	Findings
Grade 0	Normal mucosa
Grade 1 (mucosal)	Edema, hyperemia of mucosa
Grade 2 (transmucosal)	Blisters, white in color membranes, hemorrhages, superficial erosions and exudates
Grade 2a	linear ulcerations
Grade 2b	With deep focal or circumferential ulcerations
Grade 3 (transmural)	Multiple ulceration and black-brown discoloration of mucosa suggesting necrosis
Grade 3a	Small scattered areas of ulceration and necrosis
Grade 3b	Extensive necrosis

caused by caustic agent ingestion in children. Additionally, studies about the dilatation of strictures with EBD include a combination of different etiological factors such as congenital stenosis or webs of the esophagus, stenosis or strictures after esophageal atresia repair, achalasia or strictures due to gastroesophageal reflux, which leads to variation in the effectiveness and safety of EBD (2,6–9).

The aim of this study was to evaluate the effectiveness and safety of EBD in caustic ingestion related esophageal strictures with initial endoscopic findings of grade 2 (mild) esophageal burns.

Material and methods

A retrospective study was designed to review the medical charts of 639 patients who were admitted to the emergency department for caustic agent ingestion from January 2000 to December 2015 after the approval of the institutional review board.

All patients had early upper gastrointestinal endoscopy within 48 h to the level of the first circumferential lesion and mucosal injury graded according to the method of Zargar et al. (Table 1). No complication occurred in the initial endoscopies, which may be attributed to avoiding performing endoscopy for hemodynamically unstable patients, in the presence of radiological suspicion of esophageal or gastrointestinal perforation or clinical signs of significant airway edema/obstruction (10). During their follow-up period, children with suspected symptoms of esophageal obstruction such as dysphagia, intolerance to swallow solids or liquids, regurgitation or emesis were assessed with upper gastrointestinal intestinal series with water-soluble contrast medium and/or endoscopy to evaluate formation of the stricture. Among them there were 20 children who developed esophageal strictures after caustic ingestion and underwent the endoscopic balloon dilatation (EBD) program. Patients who had surgery or retrograde dilatations were excluded from the study. Patients who had strictures were then divided into two groups according to their initial injury grade: grade 2a and grade 2 b. Age at presentation, sex, ingested substance, location of the stricture, number of strictures, number of dilatations, treatment period, recurrence, complications, failure (surgery after a minimum two-year period with the EBD program) and follow-up period were reviewed. If a patient had symptoms suggesting gastroesophageal reflux (GER) or when there were endoscopic signs of GER, 24-h pH monitoring was carried out to assess the GER, and anti-reflux medical treatment was initiated.

Technique of the balloon dilatation procedure

After obtaining informed consent from the parents or legal caregivers of each patient all endoscopic procedures were performed under general anesthesia with endotracheal intubation to provide a safe airway and all patients fasted for at least four hours to protect against aspiration. EBD procedures were performed under direct visualization via endoscopic view on a video system without fluoroscopic guidance.

Initially a pediatric rigid endoscope (Karl Storz, Tuttlingen, Germany) was introduced to the level of the stricture to evaluate the diameter of the narrowed lumen of the esophagus, which then would help to assess the balloon catheter size. CRE (Control radial expansion; Boston Scientific Corp., Microvasive, Cork, Ireland) wire-guided 8 cm in length, 6–18 mm in diameter balloon catheters were used. After reaching the stricture level, the balloon catheter was introduced through the accessory channel of the endoscope and advanced through the stricture area. In cases of too narrow stricture sites, warm saline was injected to identify the true esophageal lumen and if we were unable to pass the tip of the catheter a hydrophilic guide wire (Roadrunner® PC Wire Guide, Cook®, Limerick, Ireland) was used and advanced through the lumen. A balloon dilatator was passed over the hydrophilic guide wire. Under endoscopic visualization the middle part of the balloon was kept just in the narrowest part of the esophageal lumen. After correct positioning and stabilization of the catheter, the balloon was inflated via a syringe pressure system; Encore 26™ Inflation Device (Boston Scientific, Tullamore, Ireland) gradually from 1 to 5 atm pressures for 2–3 minutes and then deflated. The procedure was repeated twice until an effective balloon dilatation session was obtained. For multiple stenosis, stepwise dilatation was performed. We did not use fluoroscopy to check for the disappearance of the

hourglass deformity in order to reduce the radiation for the growing children in repeated balloon dilatation sessions. After the removal of the catheter, the esophagus was checked for bleeding, perforation or widening of the narrowed area and the endoscope was passed through the dilated esophagus. All patients were followed up for signs of esophageal perforation and mediastinitis and underwent chest X-ray to rule out any perforation. They were allowed to feed orally and were discharged home on the next day and antibiotics were not routinely used. Several dilatations were performed every three weeks but individualized according to the clinical signs of dysphagia or radiological signs of stricture relieved. Treatment success was defined as the clinical disappearance of dysphagia for at least one year and failure was classified as the need for operative intervention despite repeated dilatations. Recurrence was defined as occurrence of dysphagia symptoms after one year.

Results

From January 2000 to December 2015, a total of 635 endoscopic evaluations were performed on 639 children admitted to our department after the ingestion of caustic substances. We did not perform endoscopy in four patients with clinical findings of severe stridor and airway/epiglottis edema. The male to female ratio was 1.6:1. The ages ranged from 10 months to 15 years (median 48 months). Except for one of the affected adolescents who ingested to commit suicide, all the children were reported to have ingested the caustic agent accidentally. The characteristics of patients and EBD treatment are summarized in Table 2. Among 635 endoscopies, the caustic substance was unknown in 149 (23.4%), acidic agent in 138 (21.7%) and alkaline in 348 cases (54.8%).

Endoscopic grading of the patients is summarized in Table 3. No complication was encountered during the initial endoscopies of the patients. During their follow-up period, no stricture occurred in grade 0 and grade 1 patients. However, five patients (3.6%) with grade 2a and 17 patients (68%) from the group 2 b had esophageal strictures. A total of 470 patients with grade 0 and 1 esophagitis were fed orally and discharged within 24 h after endoscopy. Five patients from the grade 2a group and 17 patients from the grade 2 b group developed strictures and required balloon dilatations. Two patients with esophageal stricture from the grade 2 b group were lost to follow-up. A total of 20 patients requiring 149 EBD sessions were enrolled in this study (Figure 1).

The locations of the strictures were as follows: three upper, two lower with grade 2a and 11 upper, six middle and one lower with grade 2 b burns. The alkaline/acid ingestion ratio was 1:4 and 8:7 in grade 2a and grade 2 b burns, respectively. The mean number of dilatations was seven in grade 2a and 8.8 in grade 2 b burns. The treatment and follow-up period was 15 and 42.4 months in grade 2a and 18.3 and 44 months in grade 2 b, respectively. The ingested substance, stricture locations, the average number of

Table 3. Endoscopic grading of the patients.

Endoscopic grading	*n* (%)
Grade 0	167 (26.29)
Grade 1	303 (47.71)
Grade 2a	136 (21.41)
Grade 2b	25 (3.93)
Grade 3	4 (0.62)

Table 2. Characteristics of patients and EBD treatment.

Patient no.	Age (months)	Grade	Corrosive agent	Location of stricture	The number of EBD	Treatment period (months)	Follow up period (months)	Result/ achievement
1	48	2a	Alkaline	Upper	10	36	132	Recovery
2	72	2a	Acids	Upper	10	17	29	Recovery
3	36	2a	Acids	Lower	8	8	28	Recovery
4	72	2a	Acids	Upper	6	8	9	Continues
5	180	2a	Alkaline	Lower	1	1	14	Recovery
6	54	2b	Acids	Upper	13	18	74	Recovery
7	36	2b	Alkaline	Upper, middle	30	39	168	Recovery
8	10	2b	Acids	Upper	2	3	4	Recovery
9	60	2b	Acids	Lower	3	9	12	Recovery
10	60	2b	Acids	Upper	15	47	37	Recovery
11	60	2b	Acids	Middle	11	33	72	Recovery
12	24	2b	Acids	Upper, middle	4	23	50	Recovery
13	24	2b	Acids	Upper	3	6	11	Recovery
14	36	2b	Acids	Middle	9	19	20	Recovery
15	60	2b	Alkaline	Upper, middle	19	48	60	Recovery
16	12	2b	Alkaline	Middle	8	8	58	Recovery
17	24	2b	Alkaline	Upper	1	2	3	Continues
18	24	2b	Alkaline	Upper	4	6	48	Continues
19	24	2b	Alkaline	Upper	7	9	9	Continues
20	48	2b	Alkaline	Upper	4	5	36	Continues

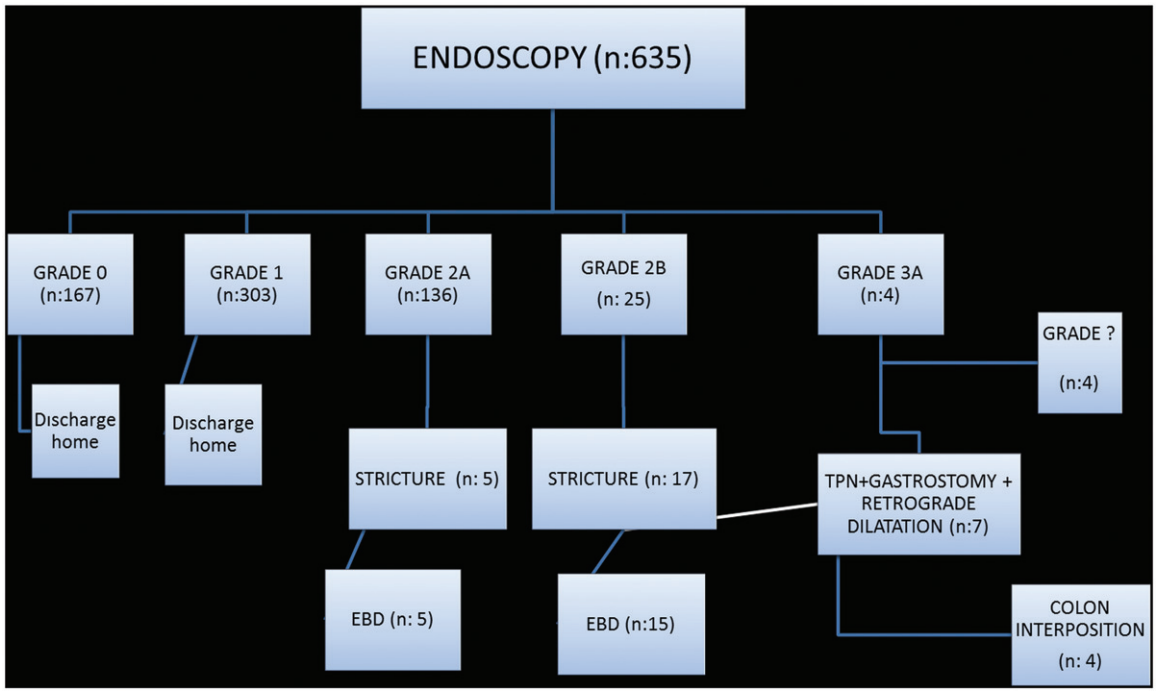

Figure 1. Endoscopy results with grading and management.

Table 4. The ingested substance, stricture locations, the average number of EBD, the mean treatment period and the mean follow-up period.

	Grade 2a	Grade 2b
Patient number	5	15
Boys/Girls	2/3	12/3
Age (month)		
Mean	81.6	37
Range	36–180	10–60
Corrosive agent		
Alkaline	1	8
Acids	4	7
Location of stricture		
Upper	3	11
Middle	0	6
Lower	2	1
No. of dilatation		
Mean	7	8.8
Range	1–10	1–30
Treatment period (month)		
Mean	15	18.3
Range	1–36	2–39
Follow up period (month)		
Mean	42.4	44
Range	9–132	3–168

EBD, the mean treatment period and the mean follow-up period are shown in Table 4. All EBDs were performed successfully and there was no major complication including esophageal perforation, pneumothorax, pneumomediastinum or subcutaneous emphysema in all patients. The EBD dilatation program is ongoing in four patients from the grade 2b group and in one patient from the grade 2a group. One stricture recurrence occurred in grade 2b patients with alkaline ingestion after 14 months.

Discussion

Esophageal stricture caused by ingestion of corrosive substances is a serious health problem mostly affecting toddlers. Initial endoscopic evaluation can provide information about the definite diagnosis and the severity of the esophageal injury. Esophageal strictures may occur in grade 2a and 2b esophageal injuries. Patients will require more dilatation sessions and a longer treatment period as the initial grade increases; however, they can be treated with endoscopic balloon dilatation effectively and safely.

Caustic esophageal injuries vary depending on the amount, the composition, the concentration of the ingested corrosive substance, the state of the substance (liquid, granular, paste, solid), and the state of gastric fullness (possible self-buffering by food). Two to four weeks after ingestion, remodeling of collagen deposition produces a scar formation which may thicken and contract the esophagus resulting in gastro-esophageal reflux, dysmotility and esophageal stricture. Among these long-term complications, esophageal stricture is the most serious because the necessity of long-term dilatation therapy with the need for repeated hospitalization and nutritional problems affects the quality of life of children and their caregivers (2,3,11).

Initial endoscopy is recommended for the definite diagnosis and evaluation of the extent of the injury to predict the morbidity and mortality following a suicidal attempt in adults and teens, but it is reported to

be questionable for accidental ingestion with small amounts of corrosive substance in children (12,13). However, initial endoscopy is crucial in children due to inaccurate correlation between physical signs and symptoms and the depth of the esophageal burn is the main predictor of stricture formation. In this study, all ingestions were reported to be accidental except for one patient, a 15-year-old-girl. The mean age was 48 months and the boy to girl ratio was 1.6:1. Literature findings were similar with a male/female ratio of 1.2:1 and a mean age of 36.2 months (14). The high incidence of caustic ingestion in early childhood may be explained by several factors including the increased mobility of the children in the oral period of life and using the oral route to explore the environment, lack of parenteral care-giving and also keeping the cleaning substances where children can easily reach them in the household. Another point for our country is marketing caustic substances in beverage bottles without any labels or safety locks, particularly in rural areas, which may be highly attractive for this age group of children.

In this study, 635 endoscopies were performed for evaluation of caustic agent ingestion related injury. The overall esophageal stricture formation was 4.5%. The incidence of pediatric esophageal strictures is reported to be 2–90% according to the grade of injury (4,15,16). The accident of caustic substance ingestion usually occurs unintentionally within a very short time without certainty of ingestion in children. The low incidence of stricture formation in this series may be due to performing endoscopy to all suspected children. Among 136 grade 2a burns five (3.6%) patients and among 25 grade 2 b burns 17 (68%) patients developed strictures and required endoscopic balloon dilatations. Although there is no study indicating any stricture formation of grade 2a burns it is reported to be 15–32 in grade 2 (32% in grade 2 b) and 75–90% in grade 3 esophageal burns (2,4). Gastrostomy and retrograde dilatations are performed for grade 3 and more severe esophageal burns because severe caustic agents are reported to be unresponsive to dilatations. Because of the increased risk of injury, esophagoscopy is not recommended in patients with evidence of esophageal or gastrointestinal perforation, significant airway edema and in those who are hemodynamically unstable. In this series, we did not perform initial endoscopy in four patients with severe airway edema and unstable hemodynamic conditions.

Although many kinds of substances cause caustic injury, the most common agent is alkaline substance such as sodium hydroxide or potassium hydroxide, used in household detergents and leaching ashes. Highly acidic substances, such as acetic acid, hydrochloric acid, sulfuric acid, and phosphoric acid, are used frequently to remove rust in bathrooms and for establishing pickles in our region. Acids have low viscosity which causes rapid transit to the stomach. It is known that acids and alkalis produce different types of tissue damage. Acids cause coagulation necrosis, with eschar formation that may limit substance penetration and injury depth. Conversely, alkalis combine with tissue proteins and cause liquefactive necrosis and saponification, and penetrate deeper into tissues, helped by a higher viscosity and a longer contact time through the esophagus (17,18). In this study, alkaline ingestion was 54.8%, acidic ingestion was 21.7% and unknown in 23.4%. Among 2a burns, the acid/alkaline ratio was 4:1 and among grade 2 b burns the acid/alkaline ratio was 8:7. Children often tend to drink a larger amount of alkaline because alkalis are usually odorless and tasteless; however, acidic substances have a sour taste which makes children spit them out. In this series, most of the children had upper esophageal strictures. The mostly affected part of the esophagus is reported to be the proximal and middle part of the esophagus due to natural narrowing of the esophagus. In grade 2a burns three patients had upper and one patient had lower strictures. In grade 2 b burns 11 had upper and six had middle esophageal strictures. Uygun et al. reported that 22% of their series had upper and 62% had middle esophageal strictures (19).

EBD was first used in children with anastomotic strictures seen after esophageal repair. But there are increasing reports that endoluminal balloon dilatation can be used safely in corrosive induced strictures, whereas some reveal that complications are more frequent in corrosive induced strictures compared with anastomotic strictures and the failure rate after pneumatic dilatation is higher in caustic ingestion-related strictures than in other benign strictures (20–23). The choice of dilator and technique depends on many factors, the most important being stricture characteristics. It is also based on other factors, including patient tolerance, operator preference, and experience. It is reported that dilation therapy should be tailored individually (24). There is no standardized protocol for technical details of endoscopic balloon dilatation by means of fluoroscopic or endoscopic guidance, size/diameter of the catheter, time for inflation, increasing the diameter in each session, maximum pressure or the frequency of dilatation (16,25). Endoscopic balloon dilatation has the advantage of radial shearing force as compared to the longitudinal shearing force

of bougienage that reduces the perforation of the esophagus with a high success rate of 76–100% (22,23). The success of dilatation therapy is reported to be different according to 'technical or clinical success'. The relief of dysphagia one year after the last session of dilatation is reported to be a success. In the literature, the success rate differs from 14–100%, which may be attributed to the definition of success (26). In this study, we performed balloon dilatation under endoscopic visualization of the esophagus, which led us to find the correct lumen in inserting the tip of catheter and even in cases of too narrow strictures we used warm saline to identify the correct lumen and then passed a hydrophylic guide-wire which led us to find the correct path and advanced the balloon catheter over hydrophilic wire without any perforation in the esophagus. The esophageal dilatation can be performed either endoscopically or fluoroscopically, both were reported to have high success rates and low complication rates. Although EBD with fluoroscopic guidance allows the operator to see the widening of the waist of the balloon, in multiple dilatations under radiation, harmful effects of radiation to growing children should be considered.

In this study, we defined success as the relief of dysphagia and eating solid food without interruption while swallowing. The success rate of balloon dilatation was 100% but four patients are still on the dilatation program. The high success rate may be due to low initial low-grade injury with short size of strictures. It is reported that strictures that are long and secondary to corrosive ingestion seemed to require more dilatation sessions (16,19,22). Additionally, it has been shown that the diameter of the stricture at the beginning of each procedure is important for the success of the EBD program. Cases of too narrow esophageal strictures, where hydrophilic guides where used to insert the balloon catheters, were much more resistant to the EBD program. In this series, the mean number of dilatation was seven times [1–10] for grade 2a burns and 8.8 times [1–30] for grade 2 b burns. The treatment period was 15 months for grade 2a burns and 18.3 months for grade 2 b burns. Some authors reported that dilatation should be avoided after 7–21 days after ingestion due to the risk of perforation, tough early prophylactic dilatation from 5 to 15 days after caustic ingestion should be performed. The interval between dilatations for sufficient results is reported to be less than one to two to three weeks; however, it was preferred to perform EBD every two and three weeks until clinical relief of dysphagia while swallowing solid foods in this series due to decreased risk of esophageal perforation (18,21).

Esophageal perforation is one of the important early complications after EBD. However, the perforation rate differs according to the primary cause of stricture and is reported to be higher in corrosive substance induced esophageal strictures. Caustic agent related strictures are longer, requiring more dilatation sessions than anastomotic strictures. It is also known that radiologically intramural or transmural ruptures occur in 30% of balloon dilatation procedures (27). The esophageal perforation rate is reported to be 0–32.0% after balloon dilatation of caustic agent related strictures (8,12,28). Endoscopically placed balloon catheters have the advantage of circumferentially shearing force to the stricture area with the operator controlled gradual dilatation. In this series, the perforation rate was 0%, which may be attributed to obeying some suggestions to prevent the risk of perforation such as 'rule of 3' or selecting the catheter size according to the thump of children or not increasing the diameter of balloon more than 1 mm in each session (20,23,24).

Conclusions

Initial endoscopy for caustic ingestion and esophageal injury grading may give information about future stricture formation and management for healthcare givers. Parents can be informed particularly for grade 2 b esophageal burns which will develop more stricture formation and require more dilatation sessions. However, corrosive injuries complicated with esophageal strictures can be effectively and safely treated by EBD.

Declaration of interest

Dr. Hakan Taşkınlar, Dr. Gökhan Berktuğ Bahadır, Dr. Doğakan Yiğit, Dr. Cankat Erdoğan, Dr. Dinçer Avlan and Dr. Ali Naycı report no conflict of interest. The authors alone are responsible for the content and writing of the paper.The authors declared that this study has received no financial support.

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References

1. Bassiouny IE, Bahnassy AF. Transhiatal esophagectomy and colonic interposition for caustic esophageal stricture. J Pediatr Surg 1992;27:1091–5.

2. Temiz A, Oguzkurt P, Ezer SS, Ince E, Hicsonmez A. Long-term management of corrosive esophageal stricture with balloon dilation in children. Surg Endosc 2010;24:2287–92.
3. Chiu HM, Lin JT, Huang SP, Chen CH, Yang CS, Wang HP. Prediction of bleeding and stricture formation after corrosive ingestion by EUS concurrent with upper endoscopy. Gastrointest Endosc 2004;60:827–33.
4. Lebeau R, Coulibaly A, Kountélé GS, Gnangoran MK, Kouakou B, Yapo P, et al. Isolated gastric outlet obstruction due to corrosive ingestion. J Visc Surg 2011;148:59–63.
5. Spiess AE, Kahrilas PJ. Treating achalasia: from whalebone to laparoscope. Jama 1998;280:638–42.
6. Doğan Y, Erkan T, Cokuğraş FC, Kutlu T. Caustic gastroesophageal lesions in childhood: an analysis of 473 cases. Clin Pediatr (Phila) 2006;45:435–8.
7. Zhang C, Zhou X, Yu L, Ding J, Shi R. Endoscopic therapy in the treatment of caustic esophageal stricture: a retrospective case series study. Dig Endosc 2013;25:490–5.
8. Gürpinar A, Dogruyol H. Endoscopy-guided balloon dilatation of oesophageal strictures in children. Minim Invasive Ther Allied Technol 2003;12:98–100.
9. Antoniou D, Soutis M, Christopoulos-Geroulanos G. Anastomotic strictures following esophageal atresia repair: a 20-year experience with endoscopic balloon dilatation. J Pediatr Gastroenterol Nutr 2010;51:464–7.
10. Zargar SA, 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.
11. Soyer T, Ayva Ş, Somuncu S, Atasoy P, Kanmaz T, Çakmak M. Caustic esophageal injury decreases the number of interstitial cells of Cajal in the rat esophagus. Turk J Med Sci 2010;40:599–604.
12. 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;26:251–5.
13. Kay M, Wyllie R. Caustic ingestions in children. Curr Opin Pediatr 2009;21:651–4.
14. Boskovic A, Stankovic I. Predictability of gastroesophageal caustic injury from clinical findings: is endoscopy mandatory in children? Eur J Gastroenterol Hepatol 2014;26:499–503.
15. Hawkins DB, Demeter MJ, Barnett TE. Caustic ingestion: controversies in management. A review of 214 cases. Laryngoscope 1980;90:98–109.
16. Cakmak M, Boybeyi O, Gollu G, Kucuk G, Bingol-Kologlu M, Yagmurlu A, et al. Endoscopic balloon dilatation of benign esophageal strictures in childhood: a 15-year experience. Dis Esophagus 2016;29:179–84.
17. Jung IS, Kim JS. A case of corrosive gastritis caused by salt-fermented Northern Sand Lance. Korean J Gastrointest Endosc 2011;42:366–8.
18. Contini S, Scarpignato C. Caustic injury of the upper gastrointestinal tract: a comprehensive review. World J Gastroenterol 2013;19:3918–30.
19. Uygun I, Arslan MS, Aydogdu B, Okur MH, Otcu S. Fluoroscopic balloon dilatation for caustic esophageal stricture in children: an 8-year experience. J Pediatr Surg 2013;48:2230–4.
20. Said M, Mekki M, Golli M, Memmi F, Hafsa C, Braham R, et al. Balloon dilatation of anastomotic strictures secondary to surgical repair of oesophageal atresia. Br J Radiol 2003;76:26–31.
21. Lew RJ, Kochman ML. A review of endoscopic methods of esophageal dilation. J Clin Gastroenterol 2002;35:117–26.
22. Alshammari J, Quesnel S, Pierrot S, Couloigner V. Endoscopic balloon dilatation of esophageal strictures in children. Int J Pediatr Otorhinolaryngol 2011;75:1376–9.
23. Lan LC, Wong KK, Lin SC, Sprigg A, Clarke S, Johnson PR, Tam PK. Endoscopic balloon dilatation of esophageal strictures in infants and children: 17 years' experience and a literature review. J Pediatr Surg 2003;38:1712–15.
24. Chang CF, Kuo SP, Lin HC, Chuang CC, Tsai TK, Wu SF, et al. Endoscopic balloon dilatation for esophageal strictures in children younger than 6 years: experience in a medical center. Pediatr Neonatol 2011;52:196–202.
25. Tiryaki T, Livanelioğlu Z, Atayurt H. Early bougienage for relief of stricture formation following caustic esophageal burns. Pediatr Surg Int 2005;21:78–80.
26. Youn BJ, Kim WS, Cheon JE, Kim WY, Shin SM, Kim IO, Yeon KM. Balloon dilatation for corrosive esophageal strictures in children: radiologic and clinical outcomes. Korean J Radiol 2010;11:203–10.
27. Doo EY, Shin JH, Kim JH, Song HY. Oesophageal strictures caused by the ingestion of corrosive agents: effectiveness of balloon dilatation in children. Clin Radiol 2009;64:265–71.
28. Siersema PD, de Wijkerslooth LR. Dilation of refractory benign esophageal strictures. Gastrointest Endosc 2009;70:1000–12.