doi: 10.67071/3093-9038-2026-3-3-106-109

CHEMICAL BURNS OF THE ESOPHAGUS IN CHILDREN: TREATMENT TACTICS FOR CICIAR STENOSIS DEPENDING ON THE TIME OF APPLICATION.

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Annotation. Aim. To assess the impact of the timing of seeking medical care after a chemical burn of the esophagus on the frequency and severity of cicatricial stenosis in children.

Materials and methods. A retrospective analysis of 34 cases of post-burn esophageal strictures in children treated at a children's hospital in the western region of Kazakhstan from 2016 to 2024 was conducted. All cases were associated with the ingestion of caustic substances. Patients were divided into two groups based on the length of hospitalization. Diagnostics included endoscopic and radiocontrast studies. For decompensated stenosis, gastrostomy with thread bougienage was used, while for subcompensated stenosis, bougienage under endoscopic or radiographic guidance was used.

Results. Patients admitted 35–48 days after injury required a greater number of bougienage procedures and had a higher incidence of complications (restenosis, esophagitis, perforation); one death due to mediastinitis was recorded. Patients admitted earlier (20–25 days) had less severe strictures, did not require gastrostomy, and required minimal bougienage procedures. The technique of bougienage through a gastrostomy with thread insertion proved effective for severe stenosis.

Conclusion. Early referral of patients to specialized surgical hospitals significantly reduces the severity of esophageal cicatricial changes and improves treatment outcomes.

Keywords: *chemical burn of the esophagus, stenosis, bougienage, gastrostomy, children, complications, esophagitis, perforation.*

Introduction. Chemical burns of the esophagus in children are among the most severe types of household injuries, occurring primarily through accidental ingestion of aggressive chemicals such as vinegar, alkalis, household cleaning products, etc. [1,2]. In the early stages, clinical assessment of the depth of damage to the esophageal mucosa and submucosa is generally difficult and rarely objective [3].

One of the most common and severe consequences of a chemical burn is the development of cicatricial esophageal stenosis. According to literature, this complication develops primarily 3–4 weeks after injury (days 21–25), during the tissue organization and remodeling phase [4]. Late hospitalization, inadequate initial management, and the lack of uniform protocols significantly increase the risk of severe stenosis that is resistant to conservative therapy [5].

Currently, there are no clearly defined guidelines defining the optimal timing, frequency, and methodology for bougienage in children with post-burn esophageal strictures. This significantly complicates the standardization of treatment measures and highlights the need for further study of this issue.

This study is based on many years of experience at a regional specialized hospital and is devoted to evaluating the effectiveness of the current treatment strategy for patients with post-burn esophageal strictures.

Purpose of the study. To analyze the dependence of the frequency and severity of cicatricial stenosis of the esophagus in children on the timing of seeking medical help after a chemical burn.

Materials and methods. The study included data from 34 children with post-burn cicatricial esophageal stenosis treated at the Aktobe Regional Children's Hospital between 2016 and 2024. The average age was 3.1 years (range, 1 to 9 years); boys predominated (73.5%). The primary cause of burns in 24 cases (70.6%) was the ingestion of alkaline substances, and in 10 cases (29.4%), it was acids, primarily acetic acid.

All patients were admitted with signs of decompensated or subcompensated esophageal stenosis, the severity of which depended on the time of presentation. For diagnostic purposes, all children underwent fibroesophagoscopy (FES) to assess the severity of the stenosis and its centricity. The extent of the lesion was determined using X-ray esophagoscopy with water-soluble contrast.

Table 1. Comparative characteristics of two groups of patients depending on the time of admission to hospital

Indicator	Group I (late treatment n=23)	Group II (timely treatment n=11)
Average time of admission (days)	41,2	22,7
Cause of burn: alkali/acid	18 / 5	6 / 5
History of chemical burn of the esophagus (according to Zargar)	IIb-III A	IIb-III A
Stage of stenosis at admission	Decompensation	Subcompensation
Kader gastrostomy (%)	100%	0%

Twenty-three patients hospitalized 35–48 days after injury were diagnosed with decompensated forms of stenosis with severe narrowing in the upper or middle third of the esophagus, with no visible lumen beyond the narrowing zone. These patients primarily resided in the surrounding regions of Western Kazakhstan. There was no history of hormonal therapy, and feedings were initiated on the first or second day without prior assessment of burn depth. All children in this group underwent a Kader gastrostomy—both for nutrition and for thread insertion with subsequent esophageal bougienage.

Calibration bougienage was performed on the 10th day after gastrostomy to determine esophageal patency and diameter, after which dilation was performed using increasingly larger bougies. Each procedure was accompanied by endoscopic monitoring before and after the procedure. After reaching the age-appropriate diameter, the patient was transferred to outpatient treatment.

The remaining 11 children were hospitalized 20–25 days after injury with clinical signs of subcompensated stenosis. In five cases, the burn was caused by vinegar essence, and in six cases, by alkaline cleaning agents. Most (8 patients) were referred to our clinic early. According to endoscopy data, the stenosis in this group was less severe, allowing for bougienage under endoscopic or radiographic guidance without the need for a preliminary gastrostomy. Bougies of an age-appropriate diameter or 2–4 Fr smaller were used, taking into account the lower wall rigidity and a narrowing of the lumen of no more than one-third.

The patients were divided into two groups based on the timing of presentation:

Group I (late presentation) – 23 children;

Group II (timely presentation) – 11 children.

The groups were comparable in age, type of chemical agent, and degree of esophageal damage according to the Zargar classification.

The study compared treatment outcomes in both groups. The following were outcome measures: length of hospital stay, incidence of erosive esophagitis during bougienage, incidence of esophageal restenosis, complications (including microperforations and bleeding), and mortality.

Table 2. Comparative assessment of the effectiveness of treatment of two groups of patients depending on the time of admission to hospital

Indicator	Group I (late treatment n=23)	Group II (timely treatment n=11)	p-value
Average number of inpatient bougienage procedures	24	7	< 0,01
Duration of hospitalization (bed days)	32-45	15-22	< 0,01
Restenosis rate	10	2	0,04
The incidence of esophagitis	6	1	< 0,01
The need for further outpatient bougienage	20	2	0,18
Esophageal perforation	2	0	0,30
Mortality	1 case (4.3%)	0%	< 0,01

**Statistical significance was calculated using the χ^2 or t-test; differences were considered significant at $p < 0.05$.*

Results. Hospitalization times in the late-presentation group ranged from 32 to 45 days and depended on the severity of the stenosis and the presence of complications. The average number of bougienage procedures in this group was 3.4 times higher than in the second group, where treatment was initiated promptly.

The most common complications in the first group were esophageal restenosis (in 10 of 23 cases) and two perforations, one of which was fatal (mortality rate was 4.3%). In the second group, restenosis was observed in two cases, with no perforations or fatalities.

The need for further outpatient bougienage occurred in 20 of 23 patients in the first group, compared to only two in the second. Detailed data are presented in Table 2.

Discussion. The length of inpatient treatment in the late-presenting group was determined by the need for repeated bougienage, beginning with the smallest diameter bougies. Achieving the age-appropriate esophageal lumen (38–42 Fr) required 18 to 25 days, with bougienage frequency up to three times per week under general anesthesia. Once the target diameter was achieved, bougienage continued on an outpatient basis or in the hospital, twice per week.

Esophageal restenosis was observed in 10 children in this group and developed during both inpatient and outpatient periods. Its development was associated with the initial rigidity of scar tissue, poor nutrition, and failure to comply with the recommended frequency of bougienage.

Esophagitis was also more frequently diagnosed in patients in the late presentation group, occurring in six cases. Clinically, it manifested as persistent hyperthermia (up to 39–40 °C), increased salivation, dysphagia, and retrosternal pain. In many cases, episodes of esophagitis coincided with the transition to a larger caliber bougie, suggesting that the inflammation was triggered by microtrauma to the mucosa, followed by infection of the deeper layers of the esophagus.

Perforations occurred in two cases, despite the use of a guidewire during bougienage. The causes were an inappropriately chosen bougienage, forced dilation, and bougienage performed against the background of developing esophagitis. Both patients underwent emergency surgery with esophageal dissection, creation of a cervical esophagostomy, and distal dissection. One child died of mediastinitis despite treatment..

In contrast, in the second group, gastrostomy was not required in any case. Moderate lumen narrowing and lesser wall rigidity allowed for safe bougienage under esophagoscopic or fluoroscopic guidance using a guidewire.

It should be noted that the majority of patients in the first group had decompensated stenoses with severe narrowing of up to two-thirds of the lumen, inability to visualize the distal sections, and the presence of pseudodiverticula in the affected area. In such cases, the technique of gastrostomy bougienage with thread insertion significantly improved the safety of the procedure. Direct bougienage without a guidewire in the presence of severe stenosis was associated with a high risk of perforation.

Thus, an increase in the interval between the onset of stenosis symptoms and the start of bougienage contributes to increased tissue rigidity and the transformation of the mucosa into dense fibrous connective tissue—a natural outcome of the reparative phase of a burn [5]. These morphofunctional changes reduce the effectiveness of bougienage and increase the risk of complications.

Conclusion. The timing of seeking specialized medical care for chemical burns of the esophagus in children directly affects the severity of cicatricial stenosis and subsequent treatment tactics.

In children with late admission (on the 35th–48th day), decompensated forms of stenosis predominate, requiring the formation of a gastrostomy and multiple bougienage sessions with a gradual increase in the diameter of the bougies, which prolongs the hospitalization period and increases the risk of complications.

The technique of esophageal bougienage through a gastrostomy with the passage of a thread has proven itself as an effective and technically safe method in cases where endoscopic bougienage cannot be performed due to severe obstruction of the lumen.

In the late-admission group, the complication rate was significantly higher: esophageal restenosis was observed in 43.5% of patients, esophagitis in 30.4%, perforation in 8.7%, and mortality was 4.3%. Meanwhile, in children hospitalized within the optimal timeframe (20–25 days), bougienage could be performed under endoscopic or fluoroscopic guidance without the need for gastrostomy, with a significantly lower rate of restenosis, complications, and readmissions.

The obtained data emphasize the need for early diagnosis, adherence to the conservative treatment protocol in the acute period of esophageal burns, as well as timely referral of patients to specialized surgical hospitals that have the capabilities of both endoscopic and gastrostomy bougienage.

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