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Thoracolaparoscopic Esophagectomy for Severe Post-Corrosive Esophageal Stricture in a Young Adult: Implications for Minimally Invasive Surgical Practice

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Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
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Conflict of interest: None declared

Patient: Male, 21-year-old

Final Diagnosis: Severe post-corrosive esophageal stricture

Symptoms: Dysphagia •weight loss

Clinical Procedure: —

Specialty: Surgery

Objective: Rare disease

Background: Post-corrosive esophageal stricture (PCES) is a severe condition resulting from caustic ingestion that often leads to progressive dysphagia and requires surgical intervention after endoscopic treatment failure. Although minimally invasive esophagectomy is widely used in oncologic practice, its role in PCES remains limited due to the technical challenges posed by dense fibrosis and distorted anatomy.

Case Report: We present the case of a 21-year-old man with severe PCES after accidental ingestion of potassium permanganate ($KMnO_4$). The patient developed progressive dysphagia despite repeated bougienage. Thoracolaparoscopic esophagectomy with gastric conduit reconstruction was performed. The procedure was technically demanding because of dense periesophageal fibrosis, distorted anatomical landmarks, and collateral vascularization. Careful stepwise dissection and meticulous hemostasis enabled successful completion of the operation. The postoperative course was uneventful, and the patient was discharged on postoperative day 10. At the 3-month follow-up, normal oral intake had been restored, without evidence of anastomotic complications or reflux.

Conclusions: This case demonstrates the technical feasibility of thoracolaparoscopic esophagectomy with gastric conduit reconstruction in a carefully selected patient with severe PCES after failed endoscopic treatment. A minimally invasive approach may be considered in specialized centers with appropriate expertise. However, conclusions regarding safety, comparative effectiveness, or routine clinical use cannot be drawn from a single case.

Keywords: Esophageal Stenosis • Thoracoscopy • Minimally Invasive Surgical Procedures • Esophagoplasty

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Introduction

Post-corrosive esophageal stricture (PCES) is caused by the accidental or intentional ingestion of caustic substances. Chemical injury results in scar formation within the esophageal mucosa, progressively narrowing the esophageal lumen and impairing normal function. The incidence of PCES varies geographically and culturally. In the United States, an estimated 5000 to 15 000 cases of esophageal burns occur annually, more than 80% of which are unintentional [1]. The prevalence of esophageal stricture after caustic injury ranges from 50% to 80%, with a mortality rate of approximately 10% among adult patients [2]. Injury from caustic ingestion may involve the oral cavity, pharynx, larynx, esophagus, and stomach, leading to serious complications (eg, respiratory disorders, esophageal and gastric perforation, sepsis, and death) [1,2]. PCES requires surgical intervention when endoscopic treatment is unsuccessful. In patients with esophageal stenosis, surgical options include bypass procedures or esophageal resection followed by reconstruction using the stomach, colon, or jejunum [2]. According to contemporary reviews and large clinical series, esophagectomy for PCES is among the most technically demanding reconstructive procedures. Severe transmural fibrosis, loss of normal anatomical landmarks, dense mediastinal adhesions, and involvement of vital mediastinal structures substantially increase the risk of intraoperative complications during transthoracic and transhiatal esophagectomy [2,3]. A critical factor influencing surgical safety is the choice of operative approach. In patients with PCES, dense fibrosis and mediastinal adhesions often obscure normal anatomical landmarks, substantially complicating surgical orientation [2,3]. The transhiatal approach is performed without direct visualization of the thoracic esophagus and mediastinum, relying on blunt or limited guided dissection, which—under these conditions—increases the risk of uncontrolled bleeding and inadvertent injury to vital structures [4,5]. In contrast, the transthoracic approach (including thoracoscopic techniques) provides direct, magnified visualization of mediastinal structures, thus enabling more precise and controlled dissection, particularly when normal anatomical planes have been obliterated by fibrosis [6,7]. PCES is a severe consequence of caustic ingestion that leads to progressive dysphagia and functional impairment [1,2]. Despite advances in surgical techniques, its management remains challenging due to extensive fibrosis, obliteration of anatomical planes, and involvement of mediastinal structures [2,3]. Although minimally invasive esophagectomy has become widely adopted in oncologic surgery, its role in PCES remains limited; available evidence is restricted to small case series and isolated reports [7,8]. The objective of this case report is to demonstrate the technical feasibility and short-term functional outcomes of thoracolaparoscopic esophagectomy with gastric conduit reconstruction in a carefully selected patient with severe PCES after failed endoscopic treatment and to illustrate key intraoperative challenges encountered in a fibrotic mediastinum.

This clinical case was managed in the Department of Gastrointestinal and Endocrine Surgery at the A.N. Syzganov National Scientific Center of Surgery between June 2024 and February 2025.

This case report was prepared in accordance with the CARE (CAse REport) guidelines to ensure transparent and comprehensive reporting. Clinical, imaging, intraoperative, and postoperative data were prospectively collected and retrospectively analyzed.

Case Report

Patient Presentation

A 21-year-old man presented to the emergency department with progressive dysphagia to solid food and weight loss. According to the patient, these symptoms had begun 10 months before presentation (January 2024) following accidental ingestion of a potassium permanganate ($KMnO_4$) solution, which resulted in a chemical burn to the esophagus (**Figure 1**).

Six months after the injury (July 2024), the patient's dysphagia progressively worsened. Consequently, in September 2024, 3 sessions of esophageal bougienage were performed under fluoroscopic guidance at our institution. A guidewire was inserted, and sequential dilation was performed using 27-Fr and 33-Fr bougies. However, dysphagia recurred within 15 days.

In October 2024, esophagogastroduodenoscopy revealed a patent esophagus with a pale pink, smooth mucosa extending to approximately 30 cm from the incisors. A cicatricial stricture with a luminal diameter of approximately 0.3 cm was identified (**Figure 2**). The gastroscope could not be advanced beyond the stricture. Subsequent contrast esophagography using barium sulfate (Vips-Med, Russia) diluted 1: 2 with 0.9% sodium chloride solution demonstrated narrowing of the esophageal lumen in the middle third of the thoracic esophagus (**Figure 2**).

Thoracoscopic Stage

Thoracoscopic esophagectomy was performed after induction of general anesthesia with 1-lung ventilation using a double-lumen endotracheal tube. The patient was initially positioned supine for induction and intubation, then repositioned to the prone position. Four trocars (Karl Storz SE & Co. KG, Germany) were placed in the right hemithorax between the middle and posterior axillary lines at the fifth, seventh, ninth, and eleventh intercostal spaces. After deflation of the right lung, the

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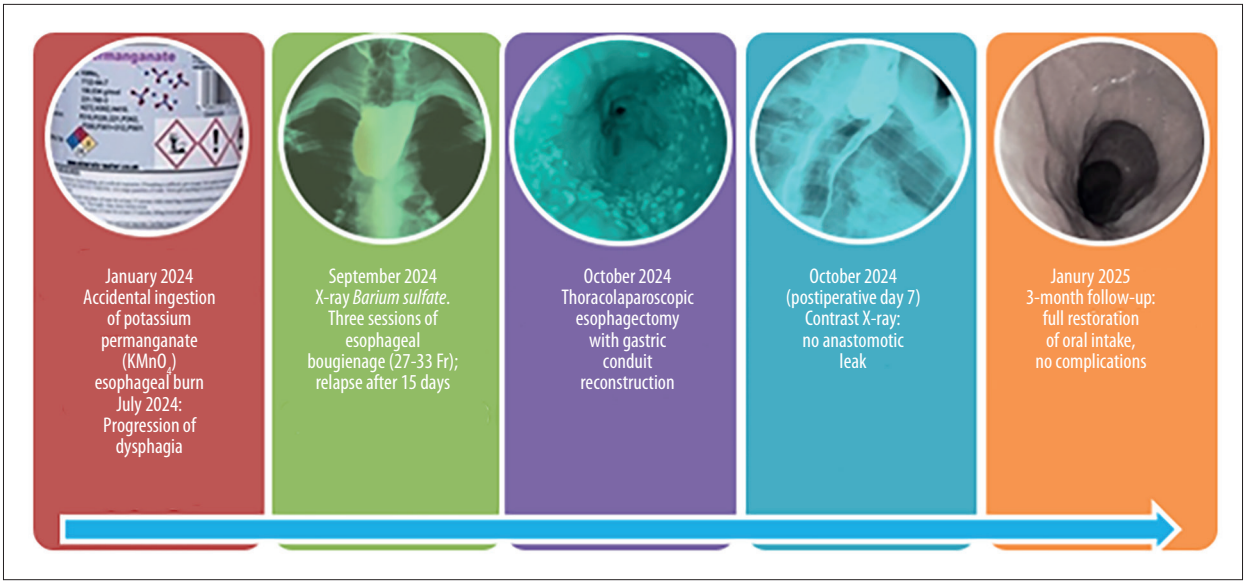

Figure 1. Timeline of the clinical course from caustic ingestion to the 3-month postoperative follow-up.

posterior mediastinum and esophagus were explored to identify the stenotic segment.

Intraoperative assessment of the middle and lower thirds of the esophagus revealed dense periesophageal fibrous adhesions and pronounced dilation of the upper thoracic esophagus. These findings indicated severe post-burn deformity with substantial distortion of the normal anatomical landmarks, which greatly complicated the procedure. The mediastinal pleura was carefully opened longitudinally along the esophagus. Esophageal mobilization was performed under conditions of extremely limited visualization and obscured tissue planes. A combination of blunt and sharp dissection was used with an endoscopic swab and Innolcon ultrasonic scissors (Panther Healthcare Medical Equipment Co. Ltd., China). Dissection toward the upper thoracic esophagus was performed with extreme caution given the high risk of injury to the trachea, bronchi, and major mediastinal vessels. The upper third of the esophagus was moderately dilated. Beginning in the middle third, a particularly stenotic esophageal segment approximately 15 cm in length was identified, surrounded by dense, extensive periesophageal fibrous adhesions. Mobilization of this segment was technically challenging because of the pronounced scarring; despite the dense fibrotic tissue, no clinically significant bleeding occurred during adhesion dissection. Upon mobilization of the lower third of the esophagus, bleeding occurred from the paratracheal tissue near the tracheal bifurcation, where prominent collateral vessels were observed, likely due to chronic inflammatory and cicatricial remodeling. Hemostasis was successfully achieved using an ultrasonic dissector and electrocautery. Total blood loss during the thoracoscopic stage was 150 mL. The azygos vein was identified and mobilized via gentle lateral retraction (**Figure 3**). This stage was technically demanding because of extensive cicatricial adhesions that distorted the normal anatomical relationships. Intermittent episodes of diffuse bleeding further impaired visualization, requiring meticulous stepwise hemostasis and restoration of a clear operative field before each subsequent stage of dissection.

A tape was placed around the esophagus for subsequent passage of the gastric conduit to the neck. The esophagus was then transected at the middle thoracic level using a 45-mm linear stapler with Tri-Staple™ Technology (CADD-45 ENTS Purple; Panther Healthcare Medical Equipment Co. Ltd., China). A 24-Fr single-lumen silicone chest drain was placed in the pleural cavity, and the trocar incisions were closed.

Abdominal Stage

For the abdominal stage, the patient was positioned supine with legs apart in the Trendelenburg position. A 5- to 12-mm VersaPort trocar (Covidien, Medtronic, Ireland) was placed paraumbilically; 2 metal trocars (5 mm each; Karl Storz SE & Co. KG, Germany) were inserted along the right and left anterior axillary lines at the level of the costal margin. Two additional 5- to 12-mm VersaPort trocars (Covidien, Medtronic, Ireland) were then placed along the right and left midaxillary lines above the umbilicus.

The left lobe of the liver was retracted using a Nathanson Liver Retractor (Karl Storz SE & Co. KG, Germany). After thorough exploration of the abdominal cavity, the stomach was carefully mobilized along the greater and lesser curvatures by dividing the greater omentum, gastrocolic ligament, and gastrosplenic ligament while preserving the right gastroepiploic artery (**Figure 4**). The abdominal esophagus was then mobilized and

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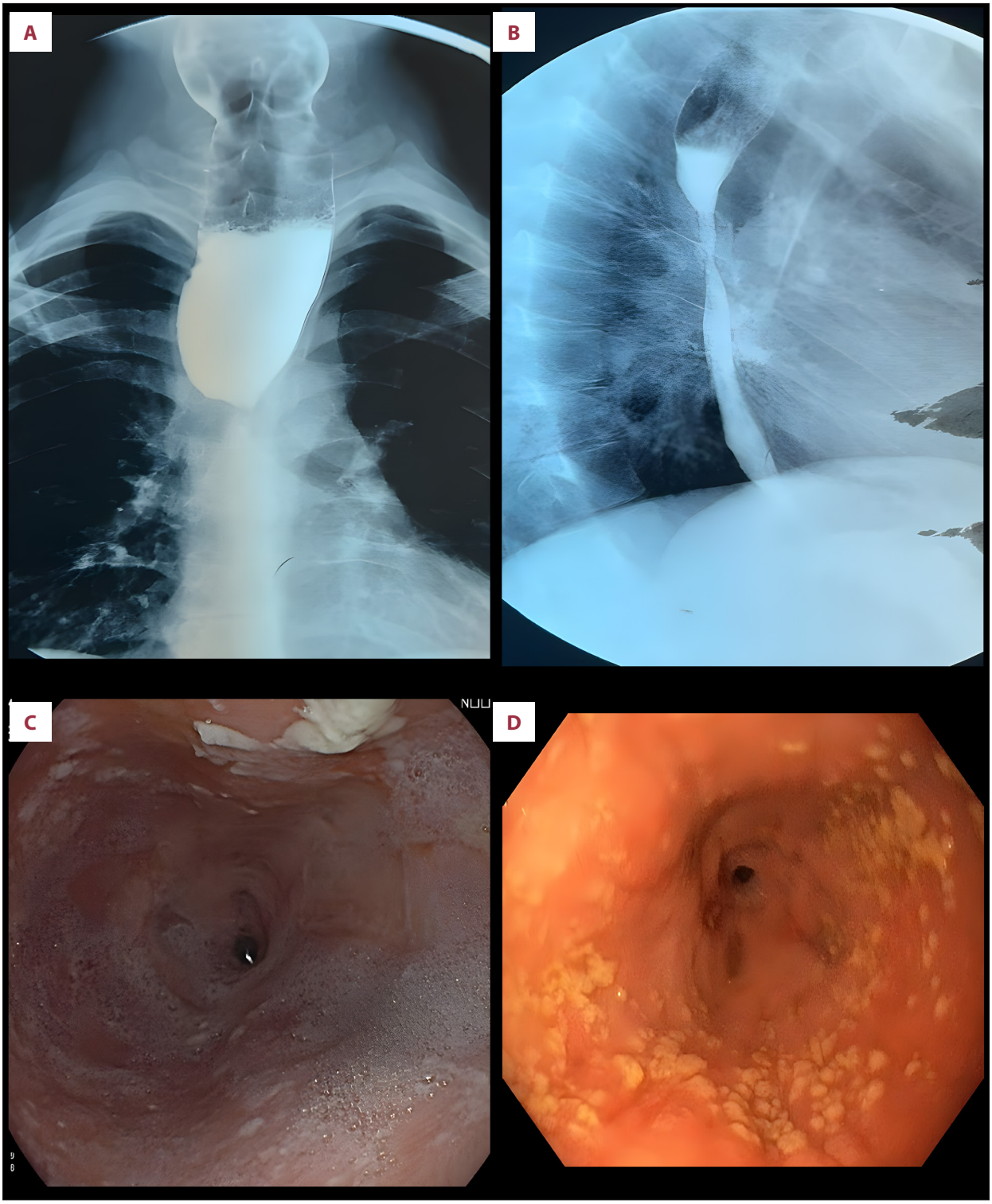

Figure 2. Contrast esophagography with barium sulfate. (A) Anteroposterior radiograph showing an elongated stricture in the middle to lower thoracic esophagus. (B) Lateral radiograph demonstrating the elongated stricture in the middle to lower thoracic esophagus. (C) Endoscopic image showing cicatricial stenosis that involves the middle third of the esophagus, with a luminal diameter of approximately 0.3 cm. (D) Endoscopic image demonstrating severe cicatricial stenosis approximately 30 cm from the incisors, preventing passage of the gastroscope.

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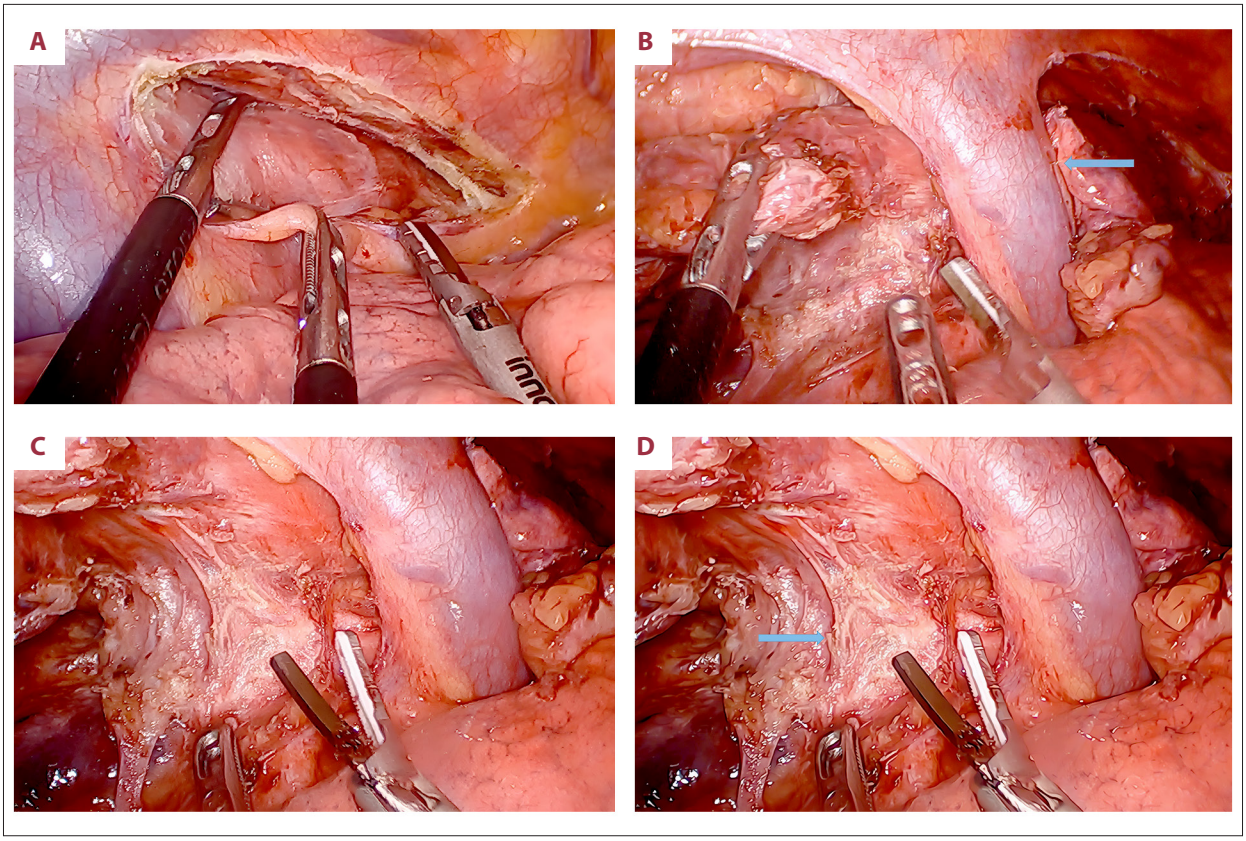

Figure 3. Thoracoscopic stage. (**A**) After opening the mediastinal pleura, the upper third of the esophagus is exposed, demonstrating pronounced esophageal dilation. (**B**) Mobilization of the azygos vein, which was technically challenging due to extensive cicatricial adhesions. (**C**) Mobilization and dissection of dense periesophageal fibrous adhesions in the middle third of the esophagus. (**D**) A severely diseased esophageal segment approximately 15 cm in length, surrounded by dense periesophageal fibrous adhesions that formed a large adhesive conglomerate.

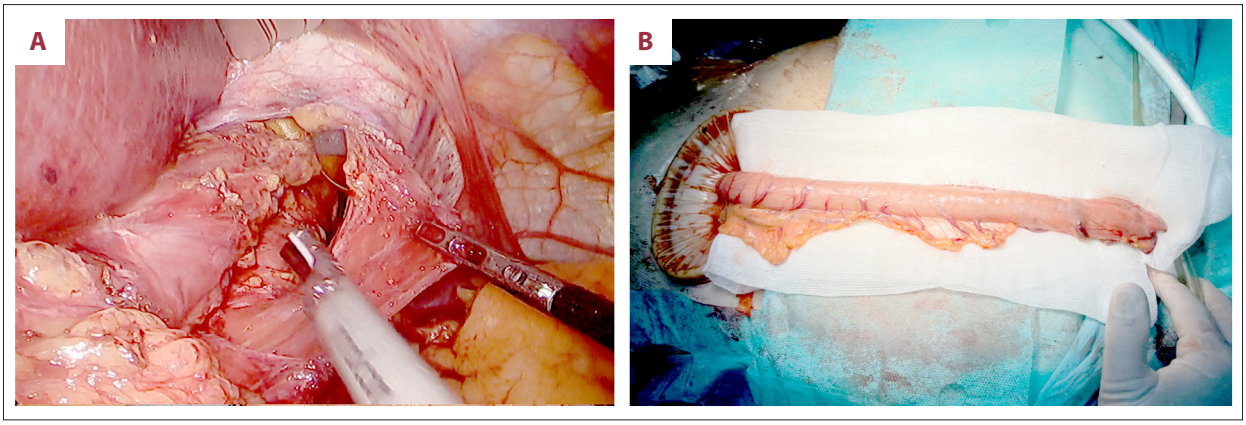

Figure 4. Abdominal stage. (**A**) View after mobilization of the abdominal esophagus and stomach. (**B**) Tubular gastric conduit created from the greater curvature of the stomach.

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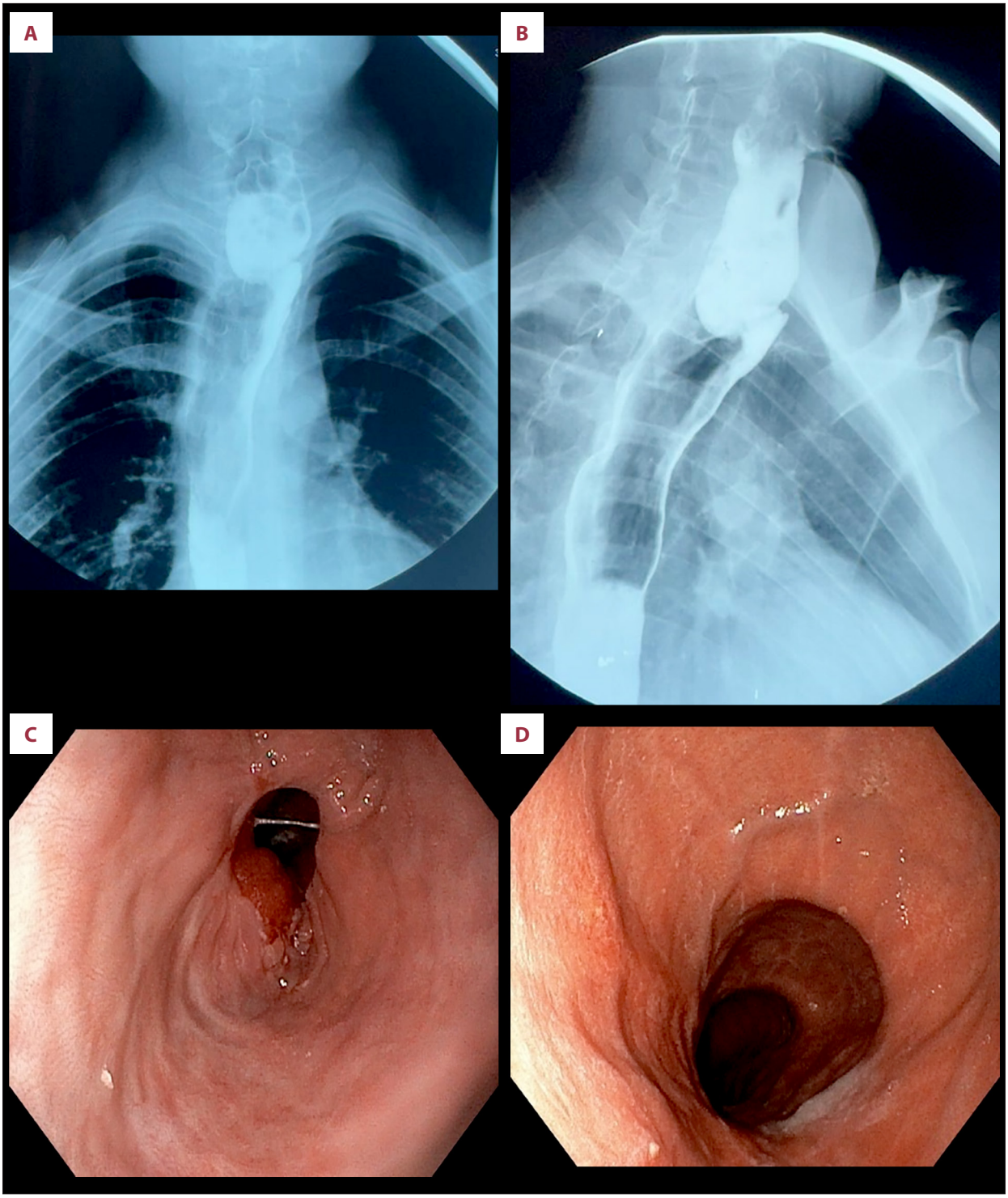

Figure 5. Follow-up contrast esophagography and endoscopic findings at 3 months. (A) Anteroposterior radiograph demonstrating an anastomotic diameter of 20 mm. (B) Lateral radiograph showing satisfactory anastomotic patency. (C) Endoscopic image demonstrating a widely patent esophagogastric anastomosis. (D) Endoscopic image of the gastric conduit.

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gently delivered into the abdominal cavity using the previously placed tape. A tubular gastric conduit was created from the greater curvature of the stomach using a 60-mm linear stapler with Tri-Staple™ Technology (CADD-60 ENTS Purple; Panther Healthcare Medical Equipment Co. Ltd., China). A 24-Fr 4-channel silicone drain was placed in the abdominal cavity and secured with CARDIOXYL 2-0 suture material (Peters Surgical, France).

A cervical incision was made along the medial border of the left sternocleidomastoid muscle, and the cervical esophagus was mobilized. After completion of esophageal mobilization, the cervical esophagus with the attached tape was delivered through the cervical incision, followed by passage of the gastric conduit into the neck by traction on the tape. The cervical esophagus was then transected to complete the esophagectomy. An end-to-end esophagogastric anastomosis was constructed via double-layer interrupted 3-0 PDS sutures (Ethicon US, LLC, USA). A nasogastric tube was inserted for decompression and advanced into the duodenum. The gastric conduit was secured at the level of the jugular notch of the sternum. A 10-Fr polyvinyl chloride drain was placed adjacent to the anastomosis on the left side of the neck and secured with CARDIOXYL 2-0 suture material (Peters Surgical, France). The cervical incision was then closed in layers. Total intraoperative blood loss was approximately 300 mL, and the operative time was 340 minutes. The abdominal stage proceeded uneventfully, without technical difficulties or complications.

Morphological examination of the resected specimen (pathology and histology reports No. 22169-22174, dated October 14, 2024) confirmed a post-burn cicatricial esophageal stricture. Histologic evaluation demonstrated pronounced fibrosis with dense fibrous connective tissue proliferation, epithelialization of the stenotic segment, and focal chronic inflammatory infiltration, consistent with a long-standing cicatricial inflammatory process.

The postoperative course was uneventful. The cervical drain was removed on postoperative day 3. On postoperative day 7, contrast esophagography was performed after oral administration of barium sulfate (Vips-Med, Russia) diluted 1: 2 with 0.9% sodium chloride solution. The study demonstrated an intact esophagogastric anastomosis without evidence of contrast leakage.

Enteral nutrition was initiated at 500 mL/day and gradually increased to 2000 mL/day. Intravenous therapy included 0.9% sodium chloride solution, adrenaline, Remaxol (Polysan NTFF LLC, Russia), Ringer's solution, and glucose solution. The abdominal drain was removed on postoperative day 6, and the patient was discharged on postoperative day 10. At the 3-month follow-up, normal oral intake had been restored, without evidence of gastroesophageal reflux, hoarseness, or choking during swallowing (**Figure 5**).

Discussion

Esophagectomy preserves the natural anatomical position of the gastric conduit while reducing the risk of complications associated with retaining the diseased esophagus. This procedure is widely accepted and commonly used to treat esophageal malignancies; it can be performed using either open or minimally invasive techniques [3]. The incidence of corrosion-induced esophageal carcinoma is high, ranging from 10% to 30% among patients with corrosive esophageal injury, and is associated with substantial morbidity and mortality. To minimize the risk of malignant transformation in the remaining esophagus, total esophagectomy is generally recommended during reconstructive surgery rather than bypass procedures [3].

The incidence of esophageal carcinoma is substantially higher in patients with PCES than in the general population. The risk of developing carcinoma is estimated to be at least 1000-fold greater than that of the general population [9].

Bielecki et al reported that chronic corrosive injury causes transmural destruction of the esophageal wall and dense periesophageal fibrosis, making surgical mobilization technically demanding and hazardous [1]. Similarly, the World Society of Emergency Surgery consensus emphasizes that management of severe corrosive esophageal injury requires an individualized approach because extensive fibrosis and scarring substantially complicate surgical dissection and increase perioperative risk [2].

In a "frozen mediastinum," the normal anatomical planes are completely obliterated, whereas partial preservation of tissue planes may be present in oncologic esophagectomy. This obliteration results in complete loss of surgical landmarks and greatly increases the risk of injury to vital mediastinal structures, including the trachea, aorta, pleura, pericardium, and thoracic duct. Consequently, these procedures require advanced surgical expertise, extensive experience in complex esophageal surgery, and intraoperative adaptability. Management in high-volume centers with multidisciplinary teams and rigorous perioperative risk management is strongly recommended [6,7].

An additional important consideration is the steep learning curve associated with minimally invasive esophagectomy for PCES. In contrast to standard minimally invasive esophagectomy for esophageal cancer, PCES is characterized by dense transmural fibrosis, obliteration of normal tissue planes, distorted anatomical landmarks, and close involvement of vital mediastinal structures. These factors make thoracoscopic mobilization substantially more difficult and less predictable.

In such cases, safe dissection requires proficiency in minimally invasive esophageal surgery and extensive experience in complex benign esophageal reconstruction. Surgeons must

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be able to perform slow, stepwise dissection, maintain spatial orientation despite distorted anatomy, control diffuse bleeding from collateral vessels, and recognize when conversion to an open procedure is warranted. Thus, the technical success achieved in this case should not be considered readily reproducible across all surgical settings.

This experience suggests that thoracolaparoscopic esophagectomy for severe PCES should be performed in carefully selected patients and preferably carried out in high-volume specialized centers with multidisciplinary perioperative support. The steep learning curve, risk of injury to mediastinal structures, and need for intraoperative adaptability remain important barriers to broader implementation of this approach.

Accordingly, future studies should report not only postoperative outcomes but also surgeon experience, institutional case volume, conversion criteria, and management of intraoperative complications to better define the reproducibility of minimally invasive esophagectomy in this complex patient population.

Chronic corrosive stricture is also associated with increased risks of esophageal dysplasia and carcinoma, further complicating surgical decision-making. Careful preoperative evaluation is essential; radical resection is often preferred to eliminate all potentially premalignant mucosa [3,9]. Long-standing inflammation and fibrosis can obscure early malignant changes, underscoring the importance of thorough histopathologic assessment.

Esophagectomy can be performed through either a transhiatal or transthoracic approach. Although the transthoracic approach provides excellent exposure, it is more invasive and carries a risk of serious pulmonary complications. In contrast, the transhiatal approach is performed without direct visualization of the mediastinum; it carries an increased risk of injury to adjacent structures, including the trachea, pleura, aorta, pericardium, and thoracic duct [6].

Esophagectomy remains the definitive treatment for patients with severe PCES after failed endoscopic management, particularly given the increased long-term risk of malignancy associated with chronic corrosive injury [3,9].

Unlike esophageal cancer, PCES is characterized by dense transmural fibrosis and complete obliteration of normal tissue planes, creating a so-called “frozen mediastinum” that substantially increases operative complexity and risk [2,3].

The choice between transhiatal and transthoracic approaches remains controversial. Although the transhiatal approach avoids thoracotomy, it is performed without direct visualization and may be unsafe in the presence of dense fibrosis [6]. In contrast, thoracoscopic access provides magnified visualization and enables controlled dissection in a hostile mediastinal environment, potentially reducing the risk of injury to vital structures [6,7].

From a technical perspective, successful completion of this procedure relied on several key intraoperative strategies, including stepwise dissection with meticulous hemostasis, combined use of blunt and energy-based dissection techniques, and careful progression through areas of dense adhesions. These principles may provide practical guidance for managing similarly complex cases.

Importantly, the present case should be considered illustrative—rather than definitive—evidence. It represents the experience of a single patient treated at a specialized center with only short-term follow-up and should not be generalized to all patients with PCES.

Nevertheless, this report adds to the limited body of evidence suggesting that minimally invasive esophagectomy may be feasible in carefully selected patients with severe fibrotic disease when performed by experienced surgical teams [8,10].

Studies assessing quality of life after esophageal reconstruction have shown that esophagectomy with immediate esophagogastroplasty is an effective reconstructive approach associated with substantial improvements in postoperative quality of life [7].

Use of the stomach as the reconstructive conduit offers several physiological advantages, including the need for only a single anastomosis, thereby reducing operative complexity and anastomotic failure risk. For cases of lower esophageal stricture, gastric conduit reconstruction remains the preferred approach.

Minimally invasive esophagectomy has become widely adopted for the treatment of esophageal malignancies but is rarely used for PCES. Most available data regarding minimally invasive esophagectomy are derived from oncologic series; limited evidence specifically addresses PCES. Published experience in this patient population is restricted to isolated case reports and small case series [8].

Thoracoscopic esophagectomy offers multiple potential advantages, including improved cosmetic outcomes, reduced postoperative analgesic requirements, and lower intraoperative blood loss. Favorable perioperative outcomes have also been reported in selected studies, primarily among patients with esophageal cancer [8].

According to the available literature, thoracolaparoscopic esophagectomy for PCES remains limited to a small number of highly specialized centers. The principal limiting factors are severe transmural fibrosis, loss of normal anatomical landmarks, and dense mediastinal adhesions, all of which substantially increase

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the risk of intraoperative complications relative to esophagectomy for malignant disease. Thus, a minimally invasive approach to PCES should be considered on a case-by-case basis, with careful preoperative patient selection and substantial surgical team experience [2].

Luketich et al reported the largest series of patients undergoing minimally invasive esophagectomy to date. Their findings suggest that minimally invasive esophagectomy can be performed safely in experienced centers, with an operative mortality of 1.68%, median intensive care unit stay of 2 days, and median hospital stay of 8 days. Overall, minimally invasive esophagectomy demonstrated perioperative outcomes comparable to or better than those reported in trials of open esophagectomy [10].

The primary contribution of the present report is the technical demonstration of thoracolaparoscopic esophagectomy in a patient with severe cicatricial deformity after failed endoscopic management. This case highlights key intraoperative challenges, including dense periesophageal adhesions, distorted anatomical landmarks, and collateral vascularization; it suggests that minimally invasive reconstruction is technically feasible in carefully selected patients when performed in specialized centers.

Clinical Takeaways

This case illustrates that minimally invasive esophagectomy may be technically feasible in carefully selected patients with severe PCES when performed by experienced surgical teams [8]. Management of a "frozen mediastinum" requires advanced surgical expertise, meticulous stepwise dissection, and careful intraoperative decision-making due to dense fibrosis and distorted anatomy [2,3]. Compared with blind transhiatal dissection, the thoracoscopic approach provides direct visualization of mediastinal structures and may facilitate safer dissection in complex cases [3,6]. Careful patient selection and treatment in high-volume specialized centers remain critical factors for achieving favorable outcomes [7,10].

Limitations

This report has some important limitations. It describes a case in which a single patient with short-term follow-up was treated at a high-volume specialized center with substantial expertise in minimally invasive esophageal surgery. The case involved severe cicatricial fibrosis after failed endoscopic treatment and thus may not be representative of all PCES cases. Accordingly, the present findings should be interpreted cautiously without generalization to broader patient populations or lower-resource settings.

Conclusions

This case report demonstrates that thoracolaparoscopic esophagectomy with gastric conduit reconstruction is technically feasible in a carefully selected patient with severe PCES after failed endoscopic management. The procedure was associated with favorable short-term postoperative recovery and restoration of normal oral intake. These findings support the potential utility of a minimally invasive approach in highly selected patients treated at specialized centers with substantial surgical expertise. Broader conclusions regarding safety, comparative effectiveness, or routine clinical application require validation in larger cohorts with long-term follow-up.

Department and Institution Where Work Was Done

Department of Gastrointestinal Tract and Endocrine Surgery, Syzganov National Scientific Center of Surgery, Asfendiyarov Kazakh National Medical University, Almaty, Kazakhstan.

Patient Consent

Written informed consent for publication and any accompanying images was obtained from the patient. The study was approved by the local ethics committee of the Syzganov National Scientific Center of Surgery, Almaty, Kazakhstan (Local Ethics Committee Protocol No. 2, dated April 24, 2025).

Declaration of Figures' Authenticity

All figures submitted have been created by the authors who confirm that the images are original with no duplication and have not been previously published in whole or in part.

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