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ORIGINAL PAPER

Surgical management of upper cervical esophagus stricture caused by ingestion of corrosive substances – a single-center experience

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ABSTRACT

Introduction and aim. Corrosive strictures of the upper cervical esophagus and hypopharynx are hard to treat in the operating room because there is a high chance of aspiration during swallowing after a high-up or proximal esophageal anastomosis. In this cases, we aimed to evaluate the role of intraoperative dilatation of the proximal hypopharyngeal and cervical esophageal stumps during surgery.

Material and methods. Patients who underwent surgery and had upper cervical esophageal and hypopharyngeal strictures from corrosive substance ingestion were included.

Results. Out of total 27 patients, 10 had a cricopharyngeal or proximal cervical esophageal stricture with a long segment thoracic esophageal stricture that was treated with intra-operative dilatation (IOD) of the proximal hypopharyngeal stump. IOD was done in two cases with Hegar's dilator and in three cases with wire-guided Savary Gillard dilators. In 74% (20/27) of the cases, the colon was frequently used as an esophageal substitute, while the stomach was only used in 10 cases. On follow-up, none of them developed repeated aspirations or required a tracheotomy.

Conclusion. IOD of the proximal hypopharyngeal and cervical esophageal stumps during surgery for corrosive upper cervical esophageal or cricopharyngeal strictures helps to save the proximal stump and avoid frequent hospital stays and multiple surgeries.

Keywords. corrosive injury of the esophagus, dilatation, esophageal replacement surgery, esophageal stricture

Introduction

Dysphagia, or difficulty swallowing, is a common symptom of an esophageal stricture, which is the abnormal narrowing of the esophageal lumen. It is a severe side effect of numerous disease processes and underlying causes. In developing nations, chronic strictures brought on by the consumption of corrosive substances are underreported. These strictures affect the upper cervical esophagus and hypopharynx.[1] Even though esophageal replacement surgery is the best option when multiple endoscopic dilations don't work, it is a very difficult procedure because the anastomoses at this high level are prone to anastomotic leakage, early postoperative stenosis, and disruption of the deglutition mechanism, which leads to repeated aspirations.[2-4] Additionally, maintaining the continuity of the upper digestive tract through esophageal substitution at healthy tissue margins compromises the strength of the swallowing mechanism and

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frequently necessitates performing a tracheostomy to ensure the avoidance of recurrent aspirations.

Aim

Here, we are presenting retrospective clinical information about patients who had corrosive-related esophageal and hypopharyngeal strictures that developed over time, along with our surgical approaches for treating them.

Material and methods

In this study, patient who went to the Department of Surgical Gastroenterology with chronic strictures of the upper cervical esophagus and hypopharynx from drinking corrosive substances and then had esophageal replacement surgery from 2009 to 2020 were included.

Patient-relevant information such as age, sex, duration of symptoms, radiological findings, and initial resuscitative measures was extracted from the hospital record. Preferred surgical approaches were done as per the patient's condition or clinical presentation. Prior to any management approaches, the planned route of reconstruction, its benefits, and the potential complications were explained to the patients, and informed consent (001/NEW/EC/INST/2023/15947) was obtained from the patient or their legal guardians. Prior to surgery, all patients were evaluated with an endoscopy.

A patient who had high stricture but normal lumen intraoperatively underwent intraoperative dilatation and esophageal reconstruction surgery.

Feeding jejunostomy was done in all cases in order to take care of nutrition prior to reconstruction surgery.

Surgical procedure

An oblique left cervical incision was made along the anterior border of the sternocleidomastoid muscle to access the cervical esophagus. The prevertebral fascia was found after the carotid sheath, and its contents were laterally retracted. The recurrent laryngeal nerve in the tracheoesophageal groove was carefully avoided by direct pressure. The upper thoracic esophagus was bluntly mobilized from the superior mediastinum, while the cervical esophagus was encircled by a No. 10 feeding tube and gently pulled upward.

Intraoperative dilatation protocol

The cervical esophagus was divided at the thoracic inlet in all cases, and the lower cut end was transfixed with a silk suture. Ten patients with a cricopharyngeal or proximal cervical esophageal stricture and a long-segment thoracic esophageal stricture were treated with intra-operative dilatation of the proximal hypopharyngeal stump. Intra-op dilatation was done in the initial 4 cases with Hegars dilators (1 for gastric pull-up and 3 for colon pull-up) and in the subsequent 6 cases with wire-guided Savary Gillard dilators (all for colon pull-up). Of these 3 cases, in two, the guide wire was directly passed to the cervical esophagus under laryngoscope guidance, and in one, the guide wire was placed under the guidance of a pediatric endoscope. In all 10 cases, one finger was used by the assistant at the lower cut end of the cervical esophagus (Fig. 1 and 2). After dilatation of the proximal esophageal stump, the esophagus is anastomosed to the terminal ileum in an end-to-end fashion with interrupted 4-0 monofilament sutures (PDS). All knots were placed on the inside, with the exception of the final three or four sutures placed on the anterior surface. After being pulled straight, the graft was stitched to the left crus using several 2-0 silk sutures in order to prevent late redundancy and abdominal visceral herniation. For the colo-gastric anastomosis, the distal end of the colon graft is transected about 10 cm distally from the hiatus. To enable the colo-colonic anastomosis, the divided colon's two ends were moved. The two-layer technique was used to perform both a cologastric (and colo-jejunal, in the event that the stomach was severely damaged) and a colo-colostomy.

In all cases, a midline incision was made in the abdomen, from the xiphisternum to 5cm below the umbilicus. The omentum was dissected free from the transverse colon, and the ascending colon, hepatic flexure, and cecum, along with the ileocecal junction, were fully mobilized from the retroperitoneum. The colon graft's vascular supply is then evaluated. The middle colic vessels and their arcade with the right colic and ileocolic vessels are checked under trans illumination by lifting the whole mobilized right colon vertically. Vascular supply through this arcade and in the marginal vessels was again checked after clamping the illeo-colic, right colic, and ileal (if required) arteries with a vascular bulldog clamp (before its division). The middle colic vessels served as the graft's foundation. Utilizing an umbilical tape that had been cut to the length between the left ear and the xiphoid, the necessary length of the colon was determined. The site on the terminal ileum (up to 7-8cm in all cases) where the umbilical tape reaches was marked with a silk stitch. An appendectomy was done. In all of our cases, the graft (right colon or stomach) was brought up substernally in the anterior mediastinum up to the left neck. In all the cases, we enlarged the thoracic inlet by removing the medial aspect of the left clavicle from the sternoclavicular joint. To prevent diaphragmatic obstruction of the graft, the diaphragm was resected laterally for several centimeters on each side of the midline at the lower end of the retrosternal route. Although prior coronary artery bypass surgery may make the creation of a substernal window hazardous and a relative contraindication, we have not encountered any such situation in our series.

Postoperative follow-up was done. The quantitative variables were summarized using the mean and standard deviation, while the qualitative variables were summarized using frequencies and percentages.

Results

A total of 27 cases were included, out of which 16 were male and 11 were female. Our study population's mean ± SD age was 27±7.12, with a range of 17–37 years. Twenty patients had ingested acids, and only seven had a history of alkali ingestion. Suicidal intent was associated with ingestion in 17 (63% of cases) and accidentally in 10 (37% of cases).

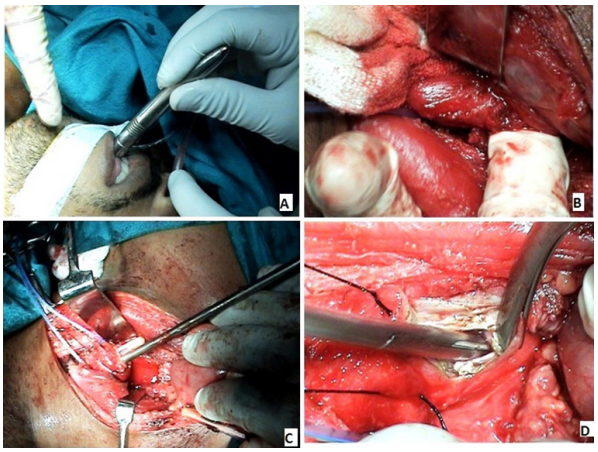

Fig. 1. A: Ante grade Dilatation with Hegar's dilator, B: Finger guidance at lower end, C and D: Esophageal stricture, stomach normal, whole stomach gastric pull up, retrosternal route

Fig. 2. A and B: Upper esophageal stricture, C: Upper GI endoscopy showing esophageal stricture

All of the patients, with the exception of one (a 32-year-old woman), had not undergone surgery while their injuries were still acute. During the acute stage of the injury, she had undergone surgical treatment (a feeding jejunostomy). For all patients, there was an average delay of 4 to 14 months between the injury and the reconstruction. The time frame was between 6 and 9 months in the vast majority of cases (79%). There were 4.3±1.5 hours of operating time on average. After clinical evaluation, a total of 22 patients underwent esophageal replacement surgery (Fig. 1 and 2).

In 74% (20/27) of the cases, the colon was frequently used as an esophageal substitute, whereas in 26% of the cases, the stomach was used. All of them took the substernal route.

In this study, 17 people only had esophageal reconstruction surgery, while 10 people with a cricopharyngeal or proximal cervical esophageal stricture and a long segment thoracic esophageal stricture were treated with a single-stage approach, such as intra-operative dilatation of the proximal hypopharyngeal stump and then esophageal reconstruction surgery (Fig. 3).

Fig. 3. A and B: Single-stage approach such as intra-operative dilatation of the proximal hypopharyngeal stump by wire-guided Savary Gillard dilators and subsequent esophageal reconstruction surgery of a 32 years old lady, C: Post operative period was uneventfull

Intra-op dilatation was done in 4 cases with Hegars dilators (1 for gastric pull-up and 3 for colon pull-up) and 6 cases with wire-guided Savary Gillard dilators (all for colon pull-up). The clinical management details of corrosive esophageal stricture are shown in Table 1.

From the post-operative day onward, enteral feeding was initiated in every patient through a feeding jejunostomy. A contrast study on post-operative day 10 revealed no anastomotic leakage. So all were started on both a semi-solid and liquid diet on post-operative day 10. But one patient developed a minor leak after

two days of starting an oral diet, which subsided spontaneously within seven days with only external compression. None of our patients developed pulmonary aspiration or required a tracheostomy in the post-operative period. The condition of all the patients at the time of discharge was stable and satisfactory.

Table 1. The clinical management details of corrosive esophageal stricture

Clinical parameters	Esophageal reconstruction surgery only	Intraoperative dilatation+esophageal reconstruction surgery
Total numbers	17	10
Male:female	10:7	6:4
Ingestion (acid:alkaline)	13:4	7:3
Intention (suicide:accident)	11:6	6:4
Time range (injury to surgery)	4–14 months	5–13 months
Intraoperative dilator used		
Hegars dilator	–	4
Savary Gillard	–	6
Post-operative complication (minor leak subsided with extrinsic compression only)	1	0
Post operative dysphagia	5/17	2/10
Dilatation frequency		
Once	1	1
Two time	2	–
Three time	1	1
>3 time	1	–
Dilatation duration	7–24 months	8–24 months

During the follow-up period (2.6 months to 12 years), one patient required endoscopic dilatation of the proximal esophageal stump three times over a 24-month period; another patient required dilatation only once after an 8-month period, but neither developed repeated aspirations nor required a tracheotomy.

Discussion

Due to the relative ease of access to caustic chemicals, ingesting them and the accompanying corrosive damage to the aero digestive tract are common occurrences in developing countries.[5-6]

Acids, or alkalis, are often the caustic chemicals that are consumed. Most caustic ingestions occur in Western nations where alkaline materials predominate, whereas acid-related injuries are more frequent in some developing nations like India, where sulfuric and hydrochloric acids are readily available.[7]

Acids and alkalis can cause a variety of tissue injuries. Coagulation necrosis and liquefactive necrosis are the underlying mechanisms of acidic and alkaline damage, respectively. Corrosive injuries may only affect the stomach or esophagus. In 20% to 62.5% of cases, esophageal and stomach injuries coexist.[6] For a very long time, it was thought that the esophageal mucosa was more susceptible to injury from alkalis than the stomach mucosa was, which was more susceptible to harm from acids.[8-9]

However, in this study, both alkali and acid were found to be associated with upper gastrointestinal injuries. Unlike the previous report, we also found that the vast majority of caustic ingesting cases were suicidal, as opposed to accidental occurrences, and almost all fatal results occurred in individuals who had that purpose.[10-11] The majority of the patients in this study were young adults, and 63% of the cases involved suicidal intent. Accidental consumption of corrosive substances was also noted.

Recognition and treatment of corrosive injuries must occur quickly for success. Sadly, despite all efforts, maintaining an esophageal lumen is not always possible. The most severe side effect of corrosive oesophageal injury is esophageal stricture, which is even higher in some other accounts, developing in between 10 and 30% of individuals who eat caustic substances.[12-14]

Consuming caustic compounds can cause damage ranging from modest mucosal erythema to stomach and esophageal transmural necrosis with viscous perforation. Esophageal strictures may develop after the primary damage has healed. The cornerstone of treatment for established strictures is therapeutic dilatation after the initial damage or until fibrosis stops developing. Yet, a lot of these individuals are either resistant to dilation or need it frequently, which seriously impairs their quality of life. Replacement surgeries are the next step in management when recurrent dilatation fails to reduce symptoms or when the patient refuses to undergo repeated dilatations.[9]

Even though esophageal replacement surgery is the best way to treat upper cervical esophageal and hypopharyngeal strictures caused by drinking caustic substances, it is a very hard procedure because high-up or proximal esophageal anastomoses are prone to anastomotic leakage, early postoperative stenosis, and disruption of the deglutition mechanism, which can lead to recurrent aspirations.[3,11,15] Also, replacing the esophagus at healthy tissue boundaries to restore the continuity of the upper digestive tract affects the integrity of the swallowing mechanism and often requires a tracheostomy to keep the person from aspirating again and again.

Several surgical treatments are available, depending on the specific circumstances. The location of the stricture, the time since the corrosive injury, its proximity to the laryngeal inlet, the condition of the larynx and airway, the length of the stricture, and the existence or absence of strictures further downstream all affect the treatment method.

Ananthakrishnan et al. discussed their experience managing pharyngoesophageal strictures in 51 patients.[16] Based on the severity of the pharyngeal stricture and the degree of related distal esophageal involvement, they separated the patients into groups and established treatment recommendations for each group. After inhaling air, they

used computed tomography to examine the stricture distal to the throat. For patients with pharyngoesophageal strictures, an esophago-coloplasty was then performed to achieve distal continuity after a cervical esophagostomy was first performed on the right side and repeatedly dilated to obtain appropriate dilatation.

They advised that for a reconstruction to be successful, there must be a precise hypopharyngeal opening, a wide anastomosis, a suitable esophageal substitute, a patent esophageal route, and an airway. A decent esophageal substitute must have the following characteristics: isoperistalsis, a sufficient blood supply, an appropriate size and length, and little or no surrounding fatty tissue. Moreover, the swallowing mechanism's anatomical and functional integrity ought to be kept close to normal.

In our study, we did intraoperative dilation of the proximal hypopharyngeal and cervical esophageal stumps during surgery for upper corrosive strictures. We did this to avoid problems with swallowing and breathing after surgery, as well as frequent hospital stays and multiple surgeries. All of the people in our study did well with the surgery, which is the same as what Yannopoluset al. said about their study.[15] Both problems with deglutination and problems with breathing were prevented, and normal esophageal function was restored.

In a different study, Karunkar et al. stated about their experience with how to treat 15 patients with difficult pharyngoesophageal strictures that affected the larynx.[11] In their investigation, five patients received further colonic interposition, and ten patients were recovered with dilatation using end-less string insertion. A remarkable case was reported involving an 82-year-old female patient with a corrosive esophageal stricture. For over 40 years, she successfully managed her condition through home self-bougienage. This prolonged self-dilation therapy resulted in a maintained good quality of life, manageable symptoms, and excellent nutritional status. The authors concluded that self-dilation, with proper patient training, can be a safe and effective treatment option, obviating the need for frequent and costly hospital admissions for endoscopic esophageal dilation.[17]

The timing of an esophageal replacement operation after a corrosive injury is still being debated. A study found that scarring continued for 6 months after a corrosive event in the esophagus. To avoid the risk of anastomotic stenosis caused by an operation performed too soon, when the scar has not fully formed, surgical intervention must be performed nearly 6 months after the acute event.[11,18] In this study, in the majority of cases (79%), the surgery was performed 6–9 months after the acute event. In this study, we did not find anastomic stenosis.

Although the stomach, colon, and jejunum have all been used in esophageal substitution, we preferred the colon because the colon is long enough to replace the esophagus, and because of its resistance to acid, it is less likely to develop late complications like esophagitis and stricture. A study has shown that although the liberal blood supply of the stomach makes it the most reliable organ for esophageal replacement, in most cases, the stomach is not a suitable candidate for esophageal substitution because it is usually moderately or severely injured by caustic agents.[9] Long-term gastroesophageal reflux, the potential for ulceration, anastomotic stenosis, and progressive dysfunctional propulsion are all drawbacks. When an anastomosis is done in the neck because of diffused oesophageal injuries, the stomach is never long enough to reconnect the esophagus. Instead, many patients have to have a partial gastrectomy or gastric bypass because the stomach was damaged by acid.[18,19] In our study, five patients underwent gastric pull-ups, provided that they had strictures in the lower esophageal segment and that their stomachs were all healthy.

Whether the residual esophagus should be removed following colonic interposition is still up for debate. On the connection between esophageal injury and carcinoma, numerous studies have been conducted. There has been no evidence to suggest that the esophagus that has been scarred and damaged has a higher incidence of carcinoma.[20,21] In our study, we did not remove any of the patients' remaining esophagus, and we detected no incidence of carcinoma during the 12-year follow-up.

Conclusion

During surgery for upper corrosive strictures, dilatation of the proximal hypopharyngeal and cervical esophageal stumps was found to help keep the proximal stump, which stops problems with swallowing and breathing after surgery. This single-stage approach, such as intraoperative dilatation and esophageal reconstruction, will help to avoid frequent hospital admissions and multiple surgical sessions. Further study is needed to substantiate its role.

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Author contributions

Conceptualization, H.C.M.; Methodology, H.C.M. and J.R.M.; Validation, S.D.; Formal Analysis, S.B.D.; Resources, S.B.D. and S.D.; Writing – Original Draft Preparation, S.B.D. and S.D.; Writing – Review & Editing, H.C.M., J.R.M., S.B.D. and S.D.

Conflicts of interest
The authors have no conflicts of interest to declare.

Data availability
Data available on request from the authors.

Ethics approval
All subjects gave their informed consent for inclusion before they participated in the study (001/NEW/EC/INST/2023/15947). The study was conducted in accordance with the Declaration of Helsinki.

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