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• CLINICAL RESEARCH •

Surgical management of esophageal strictures after caustic burns: A 30 years of experience

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Abstract

AIM: To analyze a 30-year historical series of patients treated in our hospital, who ingested corrosive substances, and to assess the effectiveness of surgical therapy administered in patients with strictures after caustic injury in esophagus during this period.

METHODS: A total of 79 cases of caustic burns in esophagus were treated in Tangdu Hospital from 1971 to 2001. Their clinical and pathological data were reviewed, and collected from the medical records of patients and interviews with them.

RESULTS: More men (n = 61) than women (n = 18) ingested caustic substances with a sex ratio of 3.4:1 during the 30-year period. The caustic materials were liquid lye and acids (54 cases and 25 cases, respectively). Sixty-eight patients were given esophageal replacement in more than three months after caustic injury with no postoperative death, of which 17 cases developed postoperative complications making a complication rate of 25%. The most common one was cervical anastomotic leakage. All patients had improvement in swallowing afterwards.

CONCLUSION: The presence and severity of injuries are correlated with the amount of caustic substances ingested. Surgical treatment is a good option in patients with severe strictures, and colonic interposition might be the best surgical process. The most important factors to guarantee a successful outcome for surgery are good vascular supply and absence of tension in the anastomosis.

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INTRODUCTION

Potentially catastrophic presentation and life long complications resulting from caustic ingestion make it one of the most challenging clinical situations in gastroenterology. Caustic material ingestion is most frequently encountered in children who accidentally swallowed caustic materials or in adults who ingested caustic materials for suicidal purposes[1,2]. Alkaline caustics and acids are the commonest chemicals implicated in caustic burns. Burns from ingestion of such agents may include the oral, pharynx, larynx, esophagus and stomach. Destruction of tissues or of these organs may lead to complications, of which respiratory compromise, esophageal and gastric perforation, septicemia, or even death might occur. Stricture formation with inability to swallow food after the injury is inevitable in some cases. Many different therapies have been recommended. The literature regarding the treatment of these patients is quite controversial and inconclusive. Repeated dilations to maintain an adequate lumen diameter were given in patients with chronic strictures. As for the complications and ineffectiveness of the dilation in more severe strictures, surgical replacement of esophagus may be required. The objective of this study was to analyze a 30-year historical series of patients treated in our hospital who ingested caustic substances, and to assess the effectiveness of surgical therapy administered in patients with strictures after caustic injury in esophagus as well as the best time for operation.

MATERIALS AND METHODS

Subjects

From 1971 to 2001, 79 cases of caustic burns in esophagus were treated in Tangdu Hospital. Their clinical and pathological data were reviewed, and collected from the medical records of patients and interviews with them. Sixty-one men and 18 women ingested caustic substances (sex ratio 3.4:1), respectively. Patients aged from 2 to 72 years (mean, 20.8 ± 2.5 years). The caustic materials for injuries were liquid lye and acids (54 cases and 25 cases, respectively). Ingestion was associated with suicidal intent in 70% of cases and accidental in 29% of cases. The amount of substances ingested ranged from 5-15 mL to as much as 40 mL, with the amount tending to be larger in the suicide attempts. To determine the amount of caustic substances ingested, patients or witnesses were asked to compare the amount ingested to the amount of water in a cup. The time intervals the patient came to our hospital after ingestion varied from several hours to several days. A total of 73 cases presented lesions of the esophagus. Two patients, who ingested a large amount of more than 60 mL caustic substances, died of stomach and esophageal perforation during the acute phase as a result of generalized infection and bleeding. Four patients, who ingested less than 15 mL, did not present severe complications. Esophageal strictures were found in 72 cases, the presence of stenosis was determined 2 wk after ingestion (chronic phase) by endoscopy and radiological signs.

Treatment

All the patients were given early emergency managements including early administration of an appropriate neutralizing agent such as ingesting water or milk after the ingestion, although it did not seem to prevent stenosis[3], and antibiotics, as well as the correction of any apparent hydration deficiency or acid-base imbalance, and corticosteroid treatment to the patients with signs of esophagitis. Forty-eight patients of 77 cases underwent emergent endoscopy to assess the degree of damage after patients were stabilized, which was very important for the diagnosis and evaluation of the degree of injuries. Patients with ulceration, blisters, even areas of extensive

necrosis always tended to develop esophageal strictures[4,5]. Among the 79 patients, 72 might undergo a long period of dysphagia, and gastrostomy or jejunostomy was performed for feed routinely soon after the injury except 4 patients who were lucky enough to escape severe injury and suffered from only oral burn, and 1 patient refused for further treatment because of economical reasons. No emergency thoracotomy was performed for the esophagectomy or gastrectomy in this group. Sixteen patients were performed repeated dilations 1-2 mo after ingestion (Table 1).

Table 1 Previous management before esophagus replacement (n = 79)

Procedures	*n*	%
Gastrostomy	25	31.6
Jejunostomy and pyloroplasty	12	15.2
Jejunostomy	19	24.1
Repeated dilation after gastrostomy or jejunostomy	15	19.0
Dilation and stent placement after gastrostomy or jejunostomy	1	1.2
No surgery	7	8.8

Esophageal replacement

Sixty-eight patients, among whom 12 had been given repeated dilation with failure therapy, were performed esophagus replacement for diffuse or multiple caustic esophageal strictures and 3 patients were cured after corticosteroid treatment and repeated dilations, 1 patient was performed stent placement. Among the 68 patients, 65 underwent the operation 6 mo and 3 three months after the injury. Stomach, jejunum and colon were used for esophageal replacement (Table 2). The colon (63/68) was commonly used as an esophageal substitute in reconstruction, and all went through the substernal route.

Table 2 Operation procedure of esophageal replacement (n = 68)

Procedure	*n*	%
Colonic interposition	63	92.6
Esophagogastrostomy	3	4.4
Jejunal interposition	2	3.0

Surgical procedure of colonic interposition

As colonic interposition was mostly used in our study, the surgical procedure was prescribed. The operation was carried out through an upper abdominal incision and a cervical oblique incision along the inner border of the sternocleidomastoid muscle in 62 patients and in 1 patient with a right thoracotomy respectively. The cervical esophagus was explored. It was transected in the level that esophagus was normal. In case the cervical esophagus was thickened and stiff in consistency, indicating that the organ was too extensively injured, a hypopharyngocolostomy had to be performed. This was occurred in 7 cases in this series.

A sufficient colon segment for graft was mobilized from colonic mesentery. The middle and left colonic arteries were identified and freed respectively. The root of the vessels elected was clamped with bulldog clamps for about 15 min. In the same time, the estimated ends of graft were clamped with intestinal clamps and watched. If the colon acted as replacement expressed normal in color, peristalsis and marginal arterioles would be pulsating (especially those in both ends of the segment), it would be transected. The colonic segment used in this group consisted of left colon in 30 cases, right colon and transverse colon in 33 cases. The peristaltic orientation of graft consisted of isoperistalsis in 40 cases and antiperistalsis in 23 cases.

The substernal tunnel in 61 cases and the subcutaneous tunnel in 2 were prepared. The proximal end of graft was elevated gently from abdomen up to the neck through the tunnel. A proximal esophagocolic or hypopharyngocolic anastomosis was performed in an end-to-end or end-to-side fashion with hand-suturing single-layer technique in 56 and 7 cases, respectively.

Cologastric anastomosis was performed over the midportion of the anterior wall of the stomach without extensively injuring the stomach, and the anastomosis between the distal portion of graft and a Rouxeny loop of jejunum was performed.

Additional procedure included resection of upper portion of sternum in 5 patients in order to avoid or decrease compression on the proximal colonic graft at the level of the thoracic inlet.

RESULTS

After early emergency management in these patients, 2 patients who ingested more than 60 mL of caustic substances died of stomach and esophageal perforation during the acute phase as a result of generalized infection and bleeding. Four patients, who ingested less than 10 mL, did not present complications in the present study. On this basis, we believed that the presence and severity of injuries were correlated with the amount of caustic substances ingested, which was similar with the result of Chien *et al*.[6]. Sixteen patients were performed repeated dilation 1-2 mo after ingestion in fear of perforation in earlier dilations and 12 patients needed further surgical treatment.

Sixty-eight cases were performed esophageal replacement because of the later stricture, which caused persistent dysphagia and weight loss in these patients. Results of operation were satisfactory with no postoperative death and improved swallowing ability, among which 17 cases developed postoperative complications making a complication rate of 25% (Table 3). The most common one was cervical anastomotic leakage, which occurred in 9 cases in this series. Postoperatively, swallow ability was considered good in 65 patients (95.7%) after an average of 22-mo follow-up (six months to eight years). The swallow ability was determined through the questionnaire about the sorts and amounts of food that could be swallowed compared with the condition before injury and operation in a general analysis.

Table 3 Postoperative complications (n = 17)

Complication	*n*	%
Cervical anastomostic leakage	9	52.9
Cervical wound infection	2	11.7
Anastomotic stenosis	3	17.6
Intestinal obstruction	1	5.8
Pneumothorax	1	5.8
Aspiration pneumonitis	1	5.8

DISCUSSION

A successful management of corrosive injury involves prompt recognition and early treatment. Unfortunately, it is sometimes not possible to maintain an esophageal lumen despite all the measures. Clinically apparent esophageal strictures occurred in 10-30% of patients with a caustic injury[7], even higher in some other reports[8,9]. In our study, 68 patients (85%) presented strictures that needed replacement, which might be due to the ingestion of relatively large amount of caustic substances for suicidal intent. Treatment of the strictures after esophageal injury was very difficult, and dilation has been used in many hospitals[10]. Even after many times of dilation, strictures were

found in about 48% cases[11], and although the danger of severe complications, such as perforation of the esophagus per procedure, was low (0.9-1.5%)[12,13], a significant number of people, especially children were at risk with a relatively high mortality[14,15]. Dilatation therapy, furthermore, required frequent admissions to hospital and multiple anesthetics with inherent risks. Surgical intervention, which is a good way to solve the problem of strictures, in the form of esophageal replacement, was carried out in more than half patients with established esophageal strictures[16].

Most beneficial time for surgery

The time for operation of esophageal replacement after corrosive injury is still under controversy. Certainly, emergency surgical exploration is indicated if perforation or penetration is demonstrated.

Bassiouny *et al*.[17] found in rats that collagen deposition peaked during the second week but continued for a long time after corrosive injury of esophagus. Scar retraction began as early as the end of the second week, and lasted for about six months. It took about 6-12 mo before full fibrosis stopped to develop after the injury[18], which showed that the edge of the stricture in the esophagus might not be confirmed until then. A too earlier operation, when the scar has not completely formed, may promote the risk of anastomostic stenosis. So, it is believed that the chance of successful surgical management is greater if the operation is carried out at least six months after the injury. In our study, 3 patients with strictures in the lower segment of esophagus, who developed severe dysphagia and refused gastrostomy, were performed partial esophagectomy and esophagogastrostomy about 90 d after caustic injury. However, anastomostic stenosis occured in 2 patients (67%) 2 mo after operation, a higher incidence of stenosis. The other 65 patients were performed operation 6 mo after injury with only one esophageal stenosis occured.

Although it was reported that esophageal replacement could be performed even 2-3 mo after injury[19], but many conditions must be met and the mucosa in the pharynx must be normal. So we think that the most beneficial time for surgery is no less than six months after the injury.

Choice of replacement organs

The organs used for esophageal replacement in patients after caustic injuries included stomach, jejunum and colon in previous studies[20,21]. Stomach has the disadvantages of long-term gastroesophageal reflux, possible ulceration, anastomostic stenosis and progressive dysfunctional propulsion[22]. The stomach is always not long enough to reestablish a continuity of esophagus when anastomosis had to be performed in the neck because the diffused injuries of esophagus, when patients had to be given partial gastrectomy after caustic injuries. In our study partial esophagectomy and esophagogastrostomy were performed only in 3 patients on the condition that strictures were located in the lower segment of esophagus. Jejunal interposition is seldom used because of the difficulty for operation since blood vessels of jejunum are too thin and easier to be affected after anastomosis. Furthermore, the jejunum is fragile to the erosion of acid in a long run, so the jejunum should not be the first choice. In our study, only 2 cases of jejunal interposition were performed, because the patients had undergone abdominal operation before and the stomach and colon were unable to be mobilized. With good blood supply and improved somatic growth, colon is long enough for esophageal replacement, and it causes fewer late complications of esophagitis and stricture because of the resistance to acid. So colon could offer potential advantages over other organs[20,23], and is believed to be an ideal organ for the replacement. We used colon for replacement in 63 cases, and the result was satisfactory. Our experiences support the idea that colon interposition is the best process for reconstruction of esophagus in caustic injury strictures.

Choice of colon segment as a graft is also a key point for reconstruction of esophagus. The left colon has been considered by many surgeons to be a preferable conduit for several reasons. But left colon interposition could always be used in an antiperistalic fashion, which may cause inflammation of the anatomosis, and affect the healing process. In our study, leakage of cervical anastomosis appeared in 7 cases of the antiperistalic anastomosis group, which was much higher than the isoperistaltic groups. So, it is suggested that the reversed peristalsis might cause more complications of anastomosis than isoperistalsis. The choice of a colon segment for substitution in our study was also affected by the supply of blood vessels during operation, and the color of intestine, and pulsation of marginal arteries after the supplying artery of colon was clamped. The mortality and morbidity in the literature after colonic interposition was very high[24]. The most severe complication was complete necrosis of the transplanted colon. When it happened, a more complex reconstruction procedure should be considered. We had no experience in facing such a catastrophy. In 1 case, local necrosis in the proximal end of transplanted colon was observed when anastomotic leakage was diagnosed 3 d after the procedure. The anastomotic leakage was the most common complication in 9 of 63 cases, making an incidence as high as 13.3%. Considering the fact that most patients in whom esophageal disease was caused by caustic injury accompanied with bad nutritional status, this rate of postoperative complication after colon interposition is acceptable. Anastomotic leakage of the patients was managed by opening the cervical wound, and it seemed to have no effect on the late swallow ability of patients after anastomotic leakage compared with the patients without leakage in the follow up interviews. There was no death in the group. The outcome was favorable when compared with published literature[24].

Residual esophagus

It is still a subject of a controversy whether the residual esophagus should be resected after colonic interposition. Many studies have focused on the relation between esophageal injury and carcinoma. Although the scarred and damaged esophagus might have an increased incidence of carcinoma[25,26], there is no evidence that has been reported. In our study, esophagectomy was only performed in the esophagogastrostomy and jejunal interposition groups, and no residual esophagus was resected in the colonic interposition group. In our follow-up study, no carcinoma of residual esophagus occurred even 8 years after operation. In our experience, an additional thoracotomy or esophagectomy to resect the injuried esophagus is a big burden for patients, when an abdominal incision is enough in colonic interposition procedure. Adhesion and inflammation of the residual esophagus after long time caustic injuries may be a great strike for patients to receive esophagectomy, with a higher risk of complications, even death than expected. It is therefore suggested that a long term follow-up and observation for the residual esophagus may be a preferable option for the treatment of caustic injuries of esophagus. Resection of the residual esophagus should be seriously considered anyhow.

Keys for success of surgical procedure

Certainly good nutrition and careful peri-operation treatment are important for the healing process of anastomosis. Gastrostomy or jejunostomy must be performed for the nutrition of patients. In addition to an effective nutritional support, the pivotal keys for a successful surgical procedure are the adequate and good vascular supply for the esophageal replacement, as well as the absence of tension at the anastomosis. Thus, an

enough length of substitutes must be prepared. Resection of parts of the sternum should be considered for colonic interposition to allow a spacious room for the graft colon, if the sternum exerts pressure upon the graft colon .

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