Antesternal Colonic Interposition for Corrosive Esophageal Stricture

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Abstract Restoration of swallowing in a patient with dysphagia due to nondilatable corrosive stricture of esophagus remains a surgical challenge. Organs available for replacement are stomach, jejunum, or colon. Jejunum is useful to replace a small segment, whereas stomach and colon are required for a long-segment replacement. In cases where the stomach is also injured, colon remains the only option. The route of colonic interposition has also been a subject of debate over the years. Antesternal, retrosternal, or esophageal bed passage are the routes described. In the present series, the data of antesternal colonic interposition (ACI) performed for nondilatable benign esophageal strictures in 32 patients (1988–2011) have been retrospectively analyzed. The results indicate that ACI for corrosive strictures is a quick and simple procedure. Thoracotomy is avoided and anastomosis is easily performed in the neck, and mortality rate due to anastomotic failure or graft failure is diminished. This retrospective analysis discusses the ease, effectiveness, quality of life, morbidity, and mortality of ACI and compares the pros and cons of ACI with other procedures described in the literature.

Keywords Colonic interposition · Esophageal stricture · Corrosive

Introduction

Inability to swallow following a corrosive stricture of the esophagus is one of the most distressing symptoms that patients experience. Treatment of these benign esophageal strictures following corrosive ingestion has remained a

challenge. The treatment options include dilatations (blind, retrograde endless string, and endoscopic) or creating a new passage (replacement). While endoscopic dilatations are meant for patients with short-length strictures, long or multiple strictures require surgical intervention in some form or the other in the long run. Among the jejunal interposition, use of gastric or reversed gastric tube and colonic interposition, the result of the use of colon as the organ for replacement has been found to be satisfactory in most studies [1–4]. Controversy exists as to the route of colonic graft placement—antesternal, retrosternal, and esophageal bed. The aim of this retrospective analysis was to study the results of antesternal placement of the colon as replacement passage in patients with benign corrosive esophageal strictures not amenable to conservative dilatations and compare the merits and demerits with other routes of graft placement.

Material and Results

Data of all the patients who underwent antesternal colonic interposition (ACI) for nondilatable corrosive strictures of the esophagus between 1988 and 2011 were retrieved and reviewed. The data included the following factors:

1. Age and sex
2. Mode of corrosive injury
3. Corrosive agent responsible
4. Morphology of strictures
5. Perioperative management
6. Morbidity and mortality
7. Functional assessment—subjective and objective

Because the data included patients since 1988, pre- and postoperative management differed considerably over the years with advances in the field of surgery including nutrition but the surgical management did not change.

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The results were tabulated and analyzed. The merits and demerits of ACI in our series were compared with literature with particular reference to the patients treated with retro-sternal and esophageal bed routes.

Results

Data from 32 patients who underwent antesternal subcutaneous colonic transposition for nondilatable corrosive injuries of esophagus from 1988 to 2011 were reviewed. There were 20 males and 12 females ranging from 16 to 50 years (mean of 18 years). The mode and the nature of corrosive injury are listed in Tables 1 and 2.

Of the 32 patients, 21 patients were primary presentations of which 5 were acute. The acute injuries were subjected to the standard protocol management of corrosive injury of esophagus and stomach. They were subjected to feeding jejunostomy for the enteral nutrition. Definitive surgery was deferred for 3–4 months.

Patients with chronic injuries ($n=16$) were often in a state of poor hydration and nutrition. They were treated with hydration and feeding jejunostomy in the preparenteral nutrition era ($n=6$) and now with total parenteral nutrition ($n=10$) to build up their general condition before surgical intervention.

Eleven patients were referred to us. The patients at the time of referral had previous surgical intervention in the form of feeding gastrostomy ($n=6$), feeding jejunostomy ($n=2$), posterior gastrojejunostomy for pyloric stenosis ($n=2$), and anterior gastrojejunostomy for pyloric stenosis ($n=1$). The patients with feeding tubes were given enteral nutrition, while other patients were given parenteral nutrition.

Fourteen patients had long continuous stricture, and 18 had multiple strictures. None of these patients had associated pharyngeal involvement, and 16 had associated pyloric stenosis. In 3 patients of concurrent pyloric stenosis, gastrojejunostomy was already performed earlier. In the rest 13 patients, in addition to ACI, a posterior gastrojejunostomy was added.

Surgical Technique

The surgical technique of choice was a long, antiperistaltic colon interposition based on middle colic vessels. The colon was transected at hepatic flexure at one point and at the

Table 2 Nature of corrosive agents

Type of corrosive	No. of patient	Percentage
1. Acid		
Hydrochloric acid	19	60 %
Acetic acid	03	09 %
Nitric acid	03	09 %
2. Alkali		
Caustic soda (NAOH)	07	22 %

junction of descending colon and sigmoid colon at the other. In one case the middle colic artery was not well formed and the graft taken was isoperistaltic, and it was based on the ascending branch of the left colic artery. A subcutaneous antesternal tunnel was created with help of sharp and blunt dissection.

The proximal neck dissection was done, and the esophagus was dissected, looped, and transected for proximal anastomosis. We do not remove the entire native esophagus as it adds to additional morbidity in the form of bleeding and development of mediastinitis. It has been very well described in the literature that the long-term incidence of development of carcinoma in the remnant esophagus is low and that has been seen in all the follow-up cases of this study. The latent period for development of carcinoma on an average is 40 years after the injury [5–7]. The distal end of the transected esophagus in the neck was sutured closed with continuous suture.

The colonic segment was then delivered through antesternal space and positioned snugly avoiding any tension, twisting, or redundancy. The proximal esophagocolonic anastomosis was performed in the cervical region using hand suturing single-layer technique using 3–“0” delayed absorbable suture. The distal cologastric anastomosis was performed on the anterior wall of stomach, close to antrum. In cases where the patient had gastric outlet obstruction, distal continuity of alimentary tract was reestablished by posterior gastrojejunostomy ($n=13$).

The ascending colon was anastomosed to the sigmoid colon to complete the procedure. Feeding jejunostomy was performed in all the cases for immediate postoperative enteral feeding. The diseased esophageal segment was not resected and maintained in continuity with stomach in all our cases.

Morbidity and Mortality

The results of morbidity are shown in Table 3.

All cases of cervical salivary fistula were treated conservatively and closed spontaneously over an average period of 15 days. Of these, two cases developed anastomotic strictures in the neck which responded to dilatations.

Table 1 Mode of corrosive injuries

Mode of injury	No. of patient	Percentage
Suicidal	22	69 %
Accidental	09	28 %
Homicidal	01	03 %

Table 3 Morbidity

	No. of patient	Percentage
Cervical salivary fistula	06	18 %
Anastomotic site stenosis	02	06 %
Intestinal obstruction	01	03 %
Redundant colon with stasis and regurgitation	01	03 %
Poor alimentary function	01	03 %

One patient developed intestinal obstruction due to a kink at the site of feeding jejunostomy that required surgical intervention.

One patient had a redundant colon which formed a “C”-loop in the abdomen, resulting in stasis of food in this pouch with significant symptoms of regurgitation. This patient was reoperated and the most dependent part of the colon was anastomosed to a loop of jejunum.

Another patient had poor alimentary function due to impediment to progression of food bolus. The antiperistaltic loop was hyperactive and it led to persistent regurgitation. The contrast studies and upper endoscopy through the graft revealed no organic obstruction. He was treated conservatively and his nutrition was maintained through the feeding jejunostomy. The symptoms of regurgitation, nausea, and epigastric discomfort continued but tapered after 6 months and the patient improved thereafter.

We never experienced a case of necrosis of graft.

Follow-up CT scan was done in 5 patients. It showed that the remnant esophagus in thorax was unremarkable, and it showed no evidence of mucocoele formation or malignant transformation.

Operative mortality included 30-day mortality as well as any later death that occurred during initial postoperative hospital stay. There was no operative mortality. One patient who was operated for suicidal esophageal nitric acid injury attempted a repeat suicide 10 years later and died following ingestion of nitric acid, which caused perforation of the colon and stomach with severe hemorrhage.

Functional Assessment

Twenty-eight patients had been followed up regularly since surgery (4 months to 241 months). The patients followed up were interviewed for presence of foregut symptoms according to standard questionnaires similar to that given by Collard et al. [8] to patients who had undergone gastric interposition. The questions were as follows:

1. Do you have dysphagia?
2. How many meals are you able to take per day?

3. Are you disturbed after eating food (e.g., palpitations, sweating, early fullness or pain, regular regurgitation, and heart burn)?
4. Are you satisfied with weight gain after surgery?
5. Can you rate your current alimentary comfort if your condition before you began having esophageal problem was rated as 10 points?

Finally, the patient's alimentary function was graded as good if the patient could eat without gastrointestinal symptoms, fair if the patient complained occasionally of at least one of the major disabling symptoms (dysphagia, regurgitation, or vomiting), and poor if the patient had more frequent complaints. Alimentary function was good in 80 % of the patients ($n=22$), fair in 14 % ($n=4$), and was poor in 6 % ($n=2$).

Discussion

Corrosive esophageal injury is one of the most disastrous calamities that can occur to human race. It requires early recognition and treatment for lower morbidity and mortality. While most injuries are accidental in children, many in the adult group are due to suicidal or even homicidal causes. In the present review concerning only an adult group, the incidence of suicidal attempt was 69 %. With better management protocols available today, endoscopic or conservative dilations to maintain an adequate lumen of the esophagus is possible [9]. The incidence of complications such as perforation has been reported to be low after endoscopic dilatations [10], but Erdogan and Lew warn a significant increase in mortality if perforation has to occur [11, 12]. Requiring frequent admissions and anesthesia, endoscopic dilatations have been reported to have a high incidence (48 %) of recurrent stricture formation by Ogunleye et al. [13].

Surgery offers a one-time solution to a chronic problem of stricture-related symptoms. The timing of surgery is controversial. While reported best 6 months after initial injury [14], interval of 2–3 months was reported to be adequate by Munoz-Bongrand et al. [15]. In our study, the mean timing of intervention was 4 months.

Surgical restoration of swallowing in a patient with dysphagia due to nondilatable corrosive stricture of esophagus is a surgical challenge. Technique of bypassing the esophagus was first described by Roux [16] who used jejunum. Nowadays, jejunum is rarely used as vascular insufficiency can easily occur in situation of slight tension on anastomosis due to the size of supply vessels. Also, jejunal mucosa is not immune to acid of the stomach. Use of stomach was reported in the form of a nonreversed or reversed gastric tube made from the greater curvature [17]. Possibly a longer expected lifetime after surgery for corrosive strictures, inability to create a long tube due to concomitant corrosive

injury to stomach, coexisting pyloric affections, and previous surgery on the stomach (gastrojejunostomy) have deterred surgeons using the stomach tube as the organ of choice for replacement in corrosive strictures of the esophagus. Also, reflux, ulcerations, anastomotic narrowing, and propulsive dysfunction seem to be the major problems in the long term if gastric tube is used [4]. In our series, though only 28 % patients had previous surgery on the stomach, it was always our protocol to use the colon based on middle colic artery as the conduit for replacement. Kelling [18] and Vulliet [19] were one of the first few to suggest the use of colon as an alternate to esophagus. The major advantage of using colon for esophageal replacement is that a greater length of the viscus is available. The mobilization of colon is easy and acid regurgitation with anastomotic ulceration or stricture formation rarely occurs in colon [1, 2].

The issue of selection of route on interposition of the colon is controversial. Three approaches—esophageal bed approach after esophagectomy, the retrosternal tunnel, and antesternal which we propose—are described.

The esophageal bed approach requires significant mediastinal dissection for colon interposition often with a thoracotomy. Periesophageal inflammation and consequent fibrosis and adhesions can make dissection difficult, resulting in bleeding, inadequate space, and resultant morbidity [20]. Complications such as mucocele and malignancy [20] in nonresected esophagus are rare. These have not been seen often in literature [20] and support our data that leaving behind esophagus at the expense of reduced morbidity and mortality is justified.

The retrosternal approach is technically very demanding and involves removing left half of the manubrium, medial end of the first rib and sternal head of left clavicle to increase the size of thoracic inlet. This at times requires an extrapleural dissection. All these factors contribute to increase chances of pneumothorax and postoperative respiratory complications [21]. A series of 38 children who underwent esophageal replacement at Children's Hospital of Philadelphia showed that leakage rate was significantly higher among patients with retrosternally placed grafts. The high incidence of anastomotic leakage associated with retrosternal graft was possibly because of long length of vascular pedicle, tension on cervical anastomosis, and possibly arterial obstruction or venous congestion at thoracic inlet [22].

The antesternal reconstruction without esophagectomy is relatively easier, quicker, and does not require a thoracotomy (Fig. 1). The dissection is minimal when compared to other two routes. Necrosis of the graft, anastomotic leaks in the neck, delayed stricture, redundancy issues with the graft, and alimentary dysfunction are morbidities common to all these three routes of colonic interposition.

Huguier et al. [23] compared the mortality in 117 patients undergoing colonic interposition by all three routes. The

Fig. 1 Coloplasty patient immediate post operative period

mortality rate was 20.5 % for antesternal, 25 % for retrosternal, and 50 % for esophageal bed placement. The high mortality rate reported in this series was because of intrathoracic leakage of anastomosis leading to mediastinitis and pyopneumothorax. This shows that antesternal placement of esophagus is a much safer procedure than other routes used. The disadvantage of this route is the cosmesis, but over a period as patients start putting up weight the graft gets hidden behind the bulk of subcutaneous fat and it has not been a matter of concern for the patients in this study. However, recent studies on colon interposition report a much lower rate of mortality [5]. This is possibly due to betterment in investigative technology, antibiotics, and intensive care management. We have not experienced any postoperative mortality in our series of 32 cases though one patient died late due to suicidal attempt.

In a collective series of 2,067 patients [24], studied by Postlethwait, the most prominent cause of death was necrosis of colon, which occurred in about 8 % of patients.

As shown in our series, ACI with antiperistaltic transplant in the neck without esophagectomy seems to be a safe procedure. The advantages of this procedure are obvious. It is simple, dissection is minimal as compared to other routes, and it is quicker. Thoracotomy is avoided and risks of pneumothorax are minimal. Necrosis of the graft if it happens is

Fig. 2 Coloplasty patient 2 years post operative period

picked up early and corrective surgery can be done at the earliest. The mortality rate due to esophageal anastomotic failure, which is the main cause of death in patients with intra-abdominal or intrathoracic anastomosis, is reduced [25].

In the collected series of 2,067 surgeries, studied by Postlethwait [24], 77.4 % had good swallowing function, 15.6 % had acceptable results (fair), and only 7 % had poor results. These results are comparable with our experience. In this study alimentary function was good in 80 % of the cases ($n=25$), it was fair in 14 % of the cases ($n=5$), and it was poor in 6 % of the cases ($n=2$).

Huguier et al. [23] reported that leakage of anastomosis in the neck was the most frequent nonfatal complication and was estimated to occur in as many as 25 % of patients. In our group, 6 patients (18 %) developed temporary cervical salivary fistula, which healed spontaneously. These results are comparable with the literature. Majority of cervical leaks resolve with conservative management, as was also the case in our series.

Conclusion

Antesternal colonic transposition graft for esophageal corrosive stricture is a safe, and effective method of restoring esophageal continuity with fewer days of hospital stay, especially in a developed country like us where functional outcome of a procedure for a disease gets more weightage than cosmesis (Fig. 2).

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References

1. Erdogan E, Emir H, Eroglu E, Danismend N, Yeker D (2000) Esophageal replacement using the colon: a 15-year review. *Pediatr Surg Int* 16:546–549
2. Deschamps C (2000) History of esophageal surgery for benign disease. *Chest Surg Clin N Am* 10:135–144
3. Hirschl RB, Yardeni D, Oldham K, Sherman N, Siplovich L, Gross E, Udassin R, Cohen Z, Nagar H, Geiger JD, Coran AG (2002) Gastric transposition for esophageal replacement in children: experience with 41 consecutive cases with special emphasis on esophageal atresia. *Ann Surg* 236:531–539
4. Helardot P (2003) Caustic burns of the esophagus, esophagectomy and replacement with gastric tube: comparative study with other procedures. *Saudi Med J* 24:S39
5. Chirica M, de Chaisemartin C, Munoz-Bongrand N, Halimi B, Celerier M, Cattani P, Sarfati E (2009) Colonic interposition for esophageal replacement after caustic ingestion. *J Chir (Paris)* 146 (3):240–249
6. Sikorszki L, Horváth OP, Papp A, Cseke L, Pavlovics G (2010) Colon cancer after colon interposition for oesophageal replacement. *Magy Seb* 63(4):157–160 [article in Hungarian]
7. Szabó M, Pavlovics G, Papp A, Horváth OP (2009) Development of scar cancer after subtotal oesophagectomy for corrosive injury. *Magy Seb* 62(2):71–74 [article in Hungarian]
8. Collard JM, Tinton N, Malaise J, Romagnoli R, Otte JB, Kestens PJ (1995) Esophageal replacements: gastric tube or whole stomach? *Ann Thorac Surg* 6:261–267
9. Shao YX, Chen ZH, Ning JW (2002) Treatment of esophageal stricture and leakage with dilation stents. *Shijie Huaren Xiaohua Zazhi* 10:249–251
10. Poddar U, Thapa BR (2001) Benign esophageal strictures in infants and children: results of Savary-Gilliard bougie dilation in 107 Indian children. *Gastrointest Endosc* 54:480–484
11. Erdogan E, Eroglu E, Tekant G, Yeker Y, Emir H, Sarimurat N, Yeker (2003) Management of esophagogastric corrosive injuries in children. *Eur J Pediatr Surg* 13:289–293
12. Lew RJ, Kochman ML (2002) A review of endoscopic methods of esophageal dilation. *J Clin Gastroenterol* 35:117–126
13. Ogunleye AO, Nwaorgu GB, Grandawa H (2002) Corrosive oesophagitis in Nigeria: clinical spectrums and implications. *Trop Doct* 32:78–80
14. Bassiouny IE, Al-Ramadan SA, Al-Nady A (2002) Long-term functional results of transhiatal oesophagectomy and colonic interposition for caustic oesophageal stricture. *Eur J Pediatr Surg* 12:243–247
15. Munoz-Bongrand N, Gornet JM, Sarfati E (2002) Diagnostic and therapeutic management of digestive caustic burns. *J Chir* 139:72–76
16. Roux CL (1907) Esophago-jejuno-gastrotome nouvelle operation pour retroussement infranchissable del esophagi. *Semaine Med* 27:37
17. Anderson KD, Rouse TM, Randolph JG (1992) Long term follow up of children with and gastric tube interposition for esophageal atresia. *Surgery* 111:131–136
18. Kelling G (1911) Oesophagoplastik mit Hilfe des Querkolon. *Zentralblatt Chir* 38:1209–1212
19. Vuillet H (1911) De l' Esophagoplastie et des diverse modifications. *Semaine Med* 31:529–532
20. Han Y, Cheng QS, Li XF, Wang XP (2004) Surgical Management of esophageal strictures after caustic burns: a 30 years experience. *World J Gastroenterol* 10(19):2846–2849
21. De Meester TR, Johnson KE, Franze J et al (1998) Indications, surgical technique, and long term functional results of colon interposition or bypass. *Ann Surg* 208:460–474
22. Ahmad SA, Sylvester KG, Hebra A, Davidoff AM, McClane S, Stafford PW, Schnauffer L, O' Neill J (1996) Esophageal replacement using the colon: is it a good choice? *J Paediatr Surg* 31:1026–1031
23. Huguier M, Gordin F, Maillard JN et al (1970) Results of 117 esophageal replacements. *Surg Gynaecol obstet* 130:1054–1058
24. Postlethwait RW (1983) Colonic interposition for esophageal substitution. *Surg Gynaecol Obstet* 156:377–383
25. Yannapoulos PA (1985) Subcutaneous transposition of the proximal esophagus in esophagoplasty. *Thorax* 40:936–939