

## Original Research Article

# Colon interposition in the treatment of corrosive esophageal strictures: 100 patients in seven years

Praveen Sharma, Mukesh Pancholi\*

Department of Surgery, Government Medical College, Surat, Gujarat, India

**Received:** 17 August 2019

**Accepted:** 13 September 2019

**\*Correspondence:**

Dr. Mukesh Pancholi,

E-mail: [dr\\_mpancholi@yahoo.co.in](mailto:dr_mpancholi@yahoo.co.in)

**Copyright:** © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

### ABSTRACT

**Background:** The purpose of this study is to represent the change in our concept of principles and techniques of esophagocoloplasty (midcolon esophagocoloplasty) with repetitive performance of the operation and approach of early surgical intervention (within 4-6 month of corrosive ingestion) in place of repetitive trials of dilatations and medical management, provides early better quality of life with lesser period of suffering and saving expenditure of treatment.

**Methods:** This retrospective study comprises of consecutive 100 patients operated for colon interposition for corrosive stricture of esophagus done at two university linked government teaching hospitals during March 2011 to March 2018. Out of 100 patients, 77 female and 23 male (3:1), mean age 30.6 years (range from 21 to 47 years), mean hospital stay was 14.5 days (range 10 to 25 days) and mean operative duration was 4.5 hours (range 2.5 to 7 hours).

**Results:** The 30 day in hospital mortality rate was 9%. There were 14 instances of leak at the esophagocolic anastomosis (14%), graft necrosis occurred in 01 patient, 08 patients (8%) developed stenosis at the esophagocolic anastomosis. More than 90% patients (n=77) had 'Good' result, 06 patients had 'Fair' and 02 had 'Poor' result.

**Conclusions:** Midcolon graft is a solution for confusion in judgment of adequate length of graft and offer uniformity in procedure with effectively lesser operative time. Early (4-6 months after ingestion) operative intervention is advantageous to patients suffering from crippling dysphagia with repeated admission and expenditure from multiple endoscopic dilatations.

**Keywords:** Corrosive ingestion, Colon interposition, Midcolon esophagocoloplasty, Corrosive stricture

### INTRODUCTION

A million dollar smile of a patient, having first bite of food on 12<sup>th</sup> day of colon interposition procedure with normal swallowing after a long duration of frustrating dysphagia due to corrosive stricture of esophagus, was encouraging to us for doing this complicated reconstructive procedure. While in a number of instances immediate death results, yet most of the victims survive to suffer the disabling sequelae of stricture formation of the pharynx, esophagus or even the stomach whatever prompt is the therapy provided.<sup>1</sup> While endoscopic

dilatation is indicated in patients with short-length strictures, long or multiple strictures require surgical intervention in some form or other in long run.<sup>2</sup> Colon interposition for corrosive esophageal strictures has good results with freedom from debilitating dysphagia.

This is a study of 100 cases of corrosive stricture of esophagus managed with colon interposition within duration of seven years. With improved knowledge after review of literature and experience of more frequent procedures, we changed our technique of surgery with decreased operative time and better understanding of

pathology and complications.<sup>3-5</sup> The purpose of this study is to represent the change in our concept of principles and techniques of esophagocoloplasty (midcolon esophagocoloplasty) with repetitive performance of the operation; better understanding of complications and their subsequent management for better long term functional results.<sup>4,5</sup> Moreover, approach of early surgical intervention (within 4-6 month of corrosive ingestion) for long non-draining corrosive strictures of esophagus in place of repetitive trials of dilatations and medical management, provides early better quality of life with lesser period of suffering and saving expenditure of treatment.

## METHODS

This retrospective study of consecutive 100 patients operated upon with colon interposition for corrosive stricture of esophagus at two university linked teaching hospitals during March 2011 to March 2018. The data were collected from hospital records section and patients during their follow up visits. Statistical analysis of results was done with Microsoft Office - Excel 2013.

Out of 100 patients, 77 female and 23 male (3:1), mean age 30.6 years (ranges from 21 to 47 years), 87 have suicidal and 13 were accidental ingestion. Mean hospital stay was 14.5 days (range 10 to 25 days), mean operative

duration was 4.5 hours (range 2.5 to 7 hours). All patients with alleged history of corrosive ingestion followed by stricture of esophagus developed 4 to 6 months after injury were operated for colon interposition. The time interval from corrosive ingestion to the definitive procedure was less than 6 months in 57; between 7-12 months in 40; between 12-24 months in 02; and more than 2 years in 01 patient. After endoscopic and barium swallow evaluation of esophagus and stomach, patients with long narrow strictures, multiple strictures and non-dilatable strictures of esophagus or pharyngio-esophagus were selected for the procedure. The upper esophagus was involved in 74 patients- including pharynx in 04, hypopharynx in 22 patients and larynx in 02 patients; middle esophagus in 05, lower esophagus in 04 and multiple sites in 17. In addition to esophageal stricture pylorus of the stomach was strictured in 17 patients (Table 1). All patients were on feeding jejunostomy (priorly formed) assessed for nutrition and systemic wellness. All patients received antegrade esophageal dilations from 1 up to 15 times (mean 5.2) previously at other center.

The details of colon interposition in reference to type of colon and vessels used as a main pedicle with orientation of peristalsis placed substernally or in posterior mediastinum are as per mentioned in Table 2. Various operative options used according to level of stricture are as per Table 1.

**Table 1: Choice of procedure according to level of stricture in esophagus and pharynx.<sup>3</sup>**

| Level of stricture  | No. of patients | Surgical procedure   |
|---------------------|-----------------|--|
| Supraglottic        | 02              | Substernal colonic interposition with pharyngeocolostomy <sup>8</sup> and total laryngectomy with end tracheostomy |
| Subglottic          | 02              | Substernal colonic interposition with pharyngeocolostomy <sup>8</sup> and end tracheostomy                         |
| Hypopharyngeal      | 22              | Substernal colonic interposition with hypopharyngeocolostomy <sup>8</sup>  |
| Cervical esophagus  | 48              | Substernal colonic interposition with esophagocolostomy  |
| Thoracic esophagus  | 09              | Transthoracic Esophagectomy and Posterior mediastinal colonic interposition with cervical esophagocolostomy        |
| Multiple strictures | 17              | Substernal colonic interposition with esophagocolostomy  |
| <b>Total</b>        | <b>100</b>      |  |

**Table 2: Type of colon with pedicled vessels and peristaltic orientation.**

| Type of colon      | Pedicle vessels | Peristaltic orientation | No. of patients |
|--------------------|-----------------|-------------------------|-----------------|
| <b>Left colon</b>  | Left colic      | Iso-peristalsis         | 27              |
|                    | Middle colic    | Anti-peristalsis        | 06              |
| <b>Right colon</b> | Middle colic    | Iso-peristalsis         | 02              |
|                    | Ileo-colic      | Anti-peristalsis        | 01              |
| <b>Midcolon</b>    | Middle colic    | Iso-peristalsis         | 01              |
|                    | Left colic      | Iso-peristalsis         | 63              |
| <b>Total</b>       |                 |                         | <b>100</b>      |

### Surgical principles

The abdomen is opened through a full midline incision and cervical esophagus is approached via left oblique

neck incision. The author's preference for colon in reconstruction of esophagus lies due to favorable anatomic and physiologic features of colon; including its relatively straight mesentery, increased length that can be

mobilized on its vascular pedicle; its low incidence of diseases, resistance to chronic gastric reflux and long-term good functional results. Both right and left colon can be used however, left colon is more preferable and this preference lies on the near-invariability in anatomy of left colic artery in contrast with vascular pattern of right colon. When performed by experienced surgeons, sub sternal left iso-peristaltic colon reconstruction is the surgical procedure of choice to reconstruct the scarred esophagus with low mortality, acceptable morbidity and good functional results.<sup>6</sup> After experience in first 35 patients (Table 1), we uniformly adapted one procedure for all rest of 65 patients using colon from ascending to descending colon (midcolon graft) as a choice of graft with variation in vascular pedicles and orientation of graft in reference to peristalsis.<sup>4,5</sup>

The colon is completely mobilized, from caecum to right and then left flexure, and finally descending and sigmoid colon. Once the colon is fully mobilized, arterial vascularization is identified using transillumination. The left colic vessels are seen, forming an arch from descending colon up to left flexure under the spleen. With bull dogs applied on right colic artery, middle colic artery and collateral arcades at both ends except ascending left colic artery for at least ten minutes, allow us to check the correct arterial outflow in colon graft, and to detect previously masked occlusion of inferior mesenteric artery.<sup>7</sup> The length of graft and venous outflow is also checked simultaneously, verifying that there is no congestion.

We usually perform a hand-sewn wider proximal esophago-colic anastomosis, with single layer interrupted suturing using PDS 3-0 suture. In 22 patients with stricture of the hypopharynx, proximal anastomosis was done to the lateral wall of the hypopharynx<sup>8</sup>. The distal end to side colo-gastric anastomosis was done at the anterior surface of antrum and side to side colocolic anastomosis with GIA staplers in all patients.

In all except 09 patients of thoracotomies, bypass of strictured esophagus was performed through substernal tunnel. The tunnel was created by dividing the diaphragmatic attachment to sternum strictly in the midline outside the endotheracic fascia. With careful dissection, pleura were pushed laterally. A wide opening was made superiorly at the back of the manubrium till the fingers of surgeon meet along the tunnel easily without any restricting tissues. In no instance a part of manubrium and sternal end of left clavicle needed to be resected. The graft was pulled through the tunnel with great care to avoid twisting of its mesentery.

Postoperative nutrition in all of our patients was maintained by feeding jejunostomy which were usually started in small amounts with peristalsis. Oral feeding was began at about 12<sup>th</sup> post-operative day in absence of cervical leak, otherwise, feeding jejunostomy continued till leak healed.

### Follow-up

Barium swallow study was routinely carried out to evaluate patency of conduit and condition of anastomosis 10 days after reconstruction of esophagus. After discharge from the hospital, patients were monitored in outpatient clinic. The ability to swallow, body weight, and activity were recorded. The length of follow-up ranged from 1 month to 7 years. Data for the follow-up study was obtained through clinic visits and questionnaires. Complications developed post operatively or during follow-up were considered operative morbidity and death within one month after operation was defined as operative mortality.

## RESULTS

### Complications

**Table 3: Complications or morbidity.**

| Complications                             | No. of patients |
|---|-----------------|
| <b>Early</b>                              |                 |
| Cervical anastomotic leak                 | 14              |
| Surgical site infection in cervical wound | 02 <sup>#</sup> |
| Abdominal anastomotic leak                | 08              |
| Graft rejection                           | 01              |
| <b>Late</b>                               |                 |
| Cervical anastomotic stricture            | 08 <sup>#</sup> |
| Vomiting or reflux                        | 06              |
| Redundancy of colon graft                 | 03              |
| <b>Total</b>                              | <b>32</b>       |

<sup>#</sup>Out of those 14 patients who had cervical anastomotic leak.

### Early

There were 14 instances of leak at the esophagocolic anastomosis (14%), all occurred within first 2 weeks following reconstruction. All leaks healed spontaneously with drainage, restriction of oral feeding within 2-3 weeks except two patients who required re-exploration and redo-anastomoses, recovered later without complications. In 8 patients abdominal colocolic anastomosis leaked, required re-exploration and recovered well. Graft necrosis occurred in 01 patient; managed with removal of necrosed graft, cervical esophagostomy and feeding jejunostomy; lost in follow up later. Cervical wound infection developed in 2 patients out of those who developed cervical anastomotic leak.

### Late

We had 96 patients in regular follow up from 1 month to 7 years after surgery; 08 patients (8%) developed stenosis at the esophagocolic anastomosis; all of these followed leakage at same anastomoses. Revision of the proximal anastomosis was done for 01 patients with eventual good results and 07 responded well to endoscopic dilatations.

Reflux or vomiting was common complaint for 3-4 weeks postoperatively in 06 patients of antiperistaltic coloesophageal anastomosis.

Radiographic follow-up of our patients revealed free passage of contrast through the colon graft into the stomach within seconds in most of cases. Redundancy of thoracic colon transplant was found in 03 of our cases, yet marked functional obstruction or feeding problems were not encountered.

### Mortality

The mortality rate was 9% in our study; 03 deaths resulted from postoperative pulmonary complications, 03 from sepsis, 01 patient died due to chylous ascites and 01 from DIC (disseminated intravascular coagulopathy)

developed immediate postoperatively; aspiration played a major role in development of these complications. One patient died due to multidrug resistant military tuberculosis presented 2 weeks after discharge.

According to criteria of Hanna and colleagues results were graded as 'good', 'fair' and 'poor'. Patients graded 'good' when they were symptom free, capable of swallowing a regular diet and gaining weight accordingly.<sup>9</sup> When patients could swallow but with regurgitation and had decrease in daily activities graded as 'fair'. Those who had dysphagia, regurgitation and aspiration were graded as 'poor'. In our study, excluding 15 patients of less than six months of follow up, 1 patient lost in follow up and 9 deaths, out of remaining 75 patients more than 90% patients (n=68) had 'good' result, 06 patients had 'fair' and 01 had 'poor' result.

**Table 4: The comparison of various parameters of quality of life in different timings of surgery after corrosive ingestion.**

| Quality of life                                   | Timings of surgery after corrosive ingestion |                       |                        |                    |
|---|--|-----------------------|------------------------|--------------------|
|   | <6 months<br>(n=57)                          | 7-12 months<br>(n=40) | 12-24 months<br>(n=02) | >2 years<br>(n=01) |
| No. of hospitalizations (mean)                    | 1.56   | 2.72                  | 4.5                    | 5                  |
| Total days of hospitalization* (mean)             | 11.7   | 17                    | 22                     | 27                 |
| No. of preoperative endoscopic dilatations (mean) | 0.17   | 1.9                   | 5.5                    | 9                  |
| Days of return of swallowing (mean)               | 14.26  | 15                    | 15.5                   | 15                 |
| <b>Prognostic grading (n=75)**</b>                |  |                       |                        |                    |
| Good (n=68)                                       | 34   | 32                    | 01                     | 01                 |
| Fair (n=06)                                       | 03   | 02                    | 01                     | 00                 |
| Poor (n=01)                                       | 01   | 00                    | 00                     | 00                 |

\*Including all previous hospitalizations; \*\*Excluding patients who lost in follow up and died.

### Quality of life

On comparing various parameters of quality of life (as mentioned in Table 4) according to timings of surgery after corrosive ingestion, those who were operated upon after 6 months of corrosive ingestion had nearly same results in form of swallowing and grading of results, but sufferings of more duration and days as well as number of hospitalizations with more financial and days of productivity losses.

## DISCUSSION

Corrosive esophageal injury is one of the most disastrous calamities that can occur to human race. It requires early recognition and treatment to lower morbidity and mortality. While most injuries are accidental in children, many in the adult age group are due to suicidal or even homicidal intentions. We did esophagojejunoplasty (EGJ) - a surgical innovation - in a 4 years old girl presented with history of accidental ingestion of battery acid.<sup>10</sup> Indian data regarding corrosive agent used, are strikingly different; majority of ingestions are due to acids used as toilet cleaner as these are more easily available and cheaper than alkalis.<sup>11</sup>

With better management protocols available today (e.g. endoscopic dilatations), to maintain an adequate lumen of esophagus is possible.<sup>12</sup> Requiring frequent admissions and anaesthesia, endoscopic dilatations have been reported to have a high incidence (48%) of recurrent stricture formation by Ogunleye et al.<sup>2,13</sup> Surgery offers a one-time solution to a chronic problem of stricture-related symptoms. Historically the first coloplasty was realised by Kelling, and the first successful use of a colon after esophagectomy in by Hacker.<sup>7,8</sup> The timing of surgery is controversial. While reported best 6 months after initial injury, interval of 2-3 months was reported to be adequate by Munoz-Bongrand et al.<sup>14</sup> In our study, more than 50% of patients were operated before 6 months of ingestion of corrosive with good to fair results comparable to those patients operated between 6 months to more than 2 years post corrosive ingestion but with advantage of early normal swallowing, return to work and effectively lesser cost of treatment and sufferings out of hospitalizations as well as repetitive dilatations with its morbidities (Table 4).

There is no study in the literature proving pre-operative angiography achieves better results as anatomical variations are dealt with intra-operatively. Thus, in our

opinion, it should be indicated for selected patients: in cases of previous abdominal surgery with potential involvement of the colon vessels, previous surgery of the abdominal aorta, or in case of lower extremity claudication.<sup>1</sup> In our study none of the patient was subjected to angiography.

There is controversy concerning the removal of the strictured esophagus with substitute interposition in the mediastinum or simple bypass of the esophagus. We did a retrosternal colon bypass without esophagectomy (91 patients), so as to decrease the mortality and morbidity of this major reconstructive surgery in these high risk patients and because of anticipation of difficulty in trying to remove the scarred esophagus that usually associated with dense periesophagitis making excision difficult or hazardous. Complications such as mucocele and malignancy in nonresected esophagus are rare.<sup>13</sup> These have not been seen often in literature and support our data that leaving behind esophagus at the expense of reduced morbidity and mortality is justified.<sup>2,13</sup>

The stomach is deliberately kept intact for functional outcomes. In this situation, a functional reservoir is created and the patient has less acid and bile reflux then when performing the gastric pull up procedure. These two conditions are considered as two main factors in the

quality of life of young patients with a long life expectancy and especially in a benign disease setting.<sup>1</sup>

In literature, the reported post-operative mortality of the procedure ranges from 0 to more than 16%, with an associated risk of graft necrosis going from 0 to 10%, and anastomosis leak from 0 to 15%.<sup>7</sup> When faced with a colon graft necrosis, as much viable conduit should be preserved in view of future reconstruction. Associated measures such as control of the sepsis, limitation of the inflammation surrounding the bed of the conduit, and performing an optimal nutritional resuscitation, are mandatory to improve the outcome.<sup>7</sup>

After experience of 35 patients using isolated left or right colon with transverse colon, for getting optimal length of graft and uniformity, we started doing midcolon graft with support of literature based on various pedicle and orientation of graft as needed.<sup>4,5</sup> Outcome in form of symptoms is also comparable, more than 90% patients have symptom free life after follow up of 1 month to 07 years (Table 5).<sup>9</sup> However, comparison of our results to those of other studies that used the midcolon as an esophageal substitute is limited because of differences in patients, in type of surgery or in time period in which the data were generated.<sup>15-20</sup>

**Table 5: Comparing operative mortality and morbidity with other studies.**

| References                           | Year of study | No. of patients | Mortality (%) | Morbidity (%) |
|--------------------------------------|---------------|-----------------|---------------|---------------|
| Wilkins et al <sup>12</sup>          | 1980          | 100             | 09            | 40            |
| Knezevic et al <sup>21</sup>         | 2007          | 336             | 09            | 40            |
| N.Ananthakrishnan et al <sup>4</sup> | 2014          | 105             | 2.9           | 46.6          |
| <b>Our study</b>                     | 2018          | 100             | 09            | 32            |

## CONCLUSION

Early (4-6 months after ingestion) operative intervention in corrosive esophageal stricture is advantageous to patients suffering from crippling dysphagia with repeated admission and expenditure from multiple endoscopic dilatations providing temporary relief and minimal chances of permanent solution. Midcolon graft is a solution for the confusion in judgment of adequate length of graft and offer uniformity in procedure with effectively lesser operative time.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: Not required*

## REFERENCES

1. Bahnassy AF, Bassiouny IE. Esophagoplasty for caustic stricture of the esophagus: changing concepts. *Pediatr Surg Int.* 1993;8(2):103-8.
2. Gvalani AK, Deolekar S, Gandhi J, Dalvi A. Antesternal colon interposition for corrosive

esophageal strictures. *Indian J Surg.* 2014;76(1):56-60.

3. Sharma P, Pancholi M, Patel G, Sharma A, Modi H. Colon interposition in corrosive stricture of esophagus: experience in 35 patients. *Gujarat Med J.* 2016;12(2):24-9.
4. Ananthakrishnan N, Subbarao KS, Parthasarathy G, Kate V, Kalayarsan R. Long term results of esophageal bypass for corrosive strictures without esophageal resection using a modified left colon esophagocoloplasty- a report of 105 consecutive patients from a single unit over 30 years. *Hepato-Gastroenterol.* 2014;61:1033-41.
5. Ananthakrishnan N. Esophageal bypass using the midcolon: A modified technique for corrosive esophageal strictures. *World J Surg Proced.* 2012;2(1):1-4.
6. Abdelkader B. Esophageal replacement of caustic stricture- a brief review. *Adv Res Gastroentero Hepatol.* 2017;3(5):555623.
7. Kelling GE. Oesophagoplastik mit Hilfe des Querkolons. *Zentralbl Chir* 1911;38:1209-12.

8. Von Hacker V. Uber Oesophagoplastik in Allgemeinen und uber den Ersatz der Speiserohre durch antethorakale Hautdickdarmschlauchbildung im Besonderen. *Arch Klin Chir.* 1914;105:973.
9. Hankins JR, Cole FN, McLaughlin JS. Colon Interposition for Benign Esophageal Disease Experience with 23 Patients; *Ann Thorac Surg.* 1984;37:192-6.
10. Sharma P, Pancholi M, Patel G, Sharam A. Surgical techniques and innovations- Side to side esophagogastrorjejunoplasty in post-corrosive stricture of distal esophagus and proximal stomach; *Indian J Surg.* 2015;77(S3):S1469-72.
11. Laxmi CP, Vijayahari R, Kate V, Ananthkrishnan N. A hospital based epidemiological study of corrosive alimentary injuries with particular reference to the Indian experience. *Natl Med J India.* 2013;26(1):31-6.
12. Wilkins EW. Long segment colon substitution for the esophagus. *Ann Surg.* 1980;192:722-5.
13. Temiz A. Caustic Ingestion, *Pediatric and Neonatal Surgery* Joanne Baerg, Intech Open. Available at: <https://www.intechopen.com/books/pediatric-and-neonatal-surgery/caustic-ingestion>. Accessed on 3 June 2019.
14. Munoz-Bongrand N, Gornet JM, Sarfati E. Diagnostic and therapeutic management of digestive caustic burns. *J Chir.* 2002;139:2-6.
15. Furst H, Hartl WH, Löhe F, Schildberg FW. Colon Interposition for Esophageal Replacement An Alternative Technique Based on the Use of the Right Colon. *Ann Surg.* 2000;231(2):173-8.
16. Belsey R. Reconstruction of the esophagus with left colon. *J Thorac Cardiovasc Surg.* 1965;49:33-53.
17. Glasgow JC, Cannon JP, Elkins RC. Colon interposition for benign esophageal disease. *Am J Surg.* 1979;137:175-9.
18. Keenan DJM, Hamilton JRL, Gibbons J, Stevenson HM. Surgery for benign esophageal stricture. *J Thorac Cardiovasc Surg.* 1984;88:182-8.
19. Curet-Scott MJ, Ferguson MK, Little AG, Skinner DB. Colon interposition for benign esophageal disease. *Surgery.* 1987;102:568-74.
20. Mansour KA, Hansen HA, Hersh T, Miller JI Jr, Hatcher CR Jr. Colon interposition for advanced non-malignant esophageal stricture: experience with 40 patients. *Ann Thorac Surg.* 1981;32:584-91.
21. Knezevic JD, Radovanović NS, Simić AP, Kotarac MM, Skrobić OM, Konstantinović VD, et al. Colon interposition in the treatment of esophageal caustic strictures: 40 years of experience. *Dis Esophagus.* 2007;20:530-4.

**Cite this article as:** Sharma P, Pancholi M. Colon interposition in the treatment of corrosive esophageal strictures: 100 patients in seven years. *Int Surg J* 2019;6:3727-32.