Complex esophageal reconstruction after esophagogastrectomy with non-supercharged right colon interposition for the treatment of lye ingestion

Paige Finkelstein, Omar Picado, Elizabeth Paulus, Janeth Ng, Gabriel Ruiz, Danny Yakoub

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Introduction: Lye injury to the esophagus often produces necrotic injury, but gastric injury is less common; subsequently, gastric pull-up surgery can be performed to reconstruct the esophagus. Herein, we present a case where the stomach was destroyed and had to be removed, forcing alternative reconstruction to be performed.

Case Report: A 67-year-old male requiring total esophagogastrectomy after lye ingestion presented for reconstruction where gastric pull-up surgery was no longer a viable option. We performed a novel right-colonic interposition leaving the cecum in place, combined with a Roux-en-Y procedure to replace both the esophagus and stomach. The patient made a full recovery, experiencing few complications after the reconstructive surgery.

Conclusion: Complex esophageal reconstruction using a non-supercharged colon bypass in the retrosternal route can be used in esophageal replacement in cases with esophagogastrectomy for lye ingestion or otherwise. This can be done with leaving the ileocecal valve in place.
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Keywords: Caustic injury, Colon interposition, Colonic interposition, Esophagogastrectomy, Lye ingestion

INTRODUCTION

Lye injury to the esophagus is well recognized, producing rapid and extensive liquefaction necrosis due to active trans-cellular Na+ transport that is both time-dependent and concentration-dependent when above pH 11.5 [1]. Gastric injury from lye ingestion is less common, due to the inherent gastric acidity that counteracts the mostly alkaline pH of caustic agents [2]. The management of digestive caustic injuries is challenging; prevention of stricture formation on the stable patient is a primary goal, but often surgery is necessary if severe burns have been identified [3]. For esophagectomy, if the stomach is viable, gastric pull-up is preferred for reconstruction [4].

Colon interposition is another attractive treatment option for total esophageal replacement due to its length and functional capabilities; nonetheless, it has been accustomed to be attached to the stomach. Replacing
the esophagus with a segment of the colon was first recorded in 1911 [5], and since, it has become a standard reconstruction method for patients who have previously undergone esophagectomy [6]. Here, we report the utilization of colon interposition surgery for successful delayed reconstruction of excised necrotic esophagus and stomach following lye ingestion. A segment of the right and transverse colon was used without resecting the cecum, and colocolic anastomosis was done. The distal part of the colon conduit was anastomosed to a Roux-en-Y jejunal loop as the stomach had been previously excised due to severe burn.

CASE REPORT

A 67-year-old male was brought to the hospital via emergency medical services in mild distress with the inability to speak, sore throat, congestion, and hematemesis. Past medical history was unclear due to altered mental status. It was reported that the patient had ingested lye just prior to his arrival to the hospital.

Initial examination showed stable vital signs, mild confusion and a moderately-tender, non-distended abdomen, with normal intestinal sounds and no organomegaly; at this point he did not develop peritoneal signs yet. Initial fluid resuscitation was started, and proton pump inhibitors were given followed by steroids. Computed tomography scan of the head without contrast was negative for acute cerebrovascular accidents. Findings from X-ray, followed by CT scan of the chest (Figure 1) indicated a thickened esophagus consistent with esophagitis, and moderate left pleural fluid. Computed tomography scan of the abdomen and pelvis (Figure 2) without contrast revealed pneumatosis of the gastric wall, free intraperitoneal air and ascites consistent with suspected perforation.

About four hours after admission, the patient rapidly deteriorated and developed severe abdominal pain/rigidity, tachycardia, anuria, and hypotension despite adequate fluid resuscitation. The decision to operate was made, and exploration of the peritoneal cavity showed a necrotic stomach with evident necrosis of the distal esophagus up into the lower mediastinum. Furthermore, a large gastric perforation with full thickness necrosis of the entire body of the stomach was found, and there were large amounts of caustic fluid in the lesser sack. The whole gastric mucosa was grey and non-viable, with signs of ulceration and general sloughing. At this point, a total gastrectomy and transhiatal esophagectomy was performed with a diverting cervical esophagostomy. The abdominal cavity was washed out with 13 L of normal saline. A feeding jejunostomy was inserted. The patient tolerated the procedure well and was admitted to the ICU.

The patient remained in the hospital for six months, during which he had multiple complications including pneumonia with pleural effusion and development of left upper quadrant colocutaneous fistula (resulting from the original caustic injury damaging a small area the colon), which eventually healed. He also had complications of malnutrition, where subsequently he recovered his nutritional status after months of appropriate enteral tube feeding. Finally, he was deemed ready for esophageal reconstruction. Preoperative preparation included mechanical bowel preparation and CT angiography of the abdomen to ensure integrity of mesenteric and pericolic vessels. Colonoscopy was done and showed no other abnormalities other than the site of the healed fistula by the splenic flexure.

At the time of the reconstruction procedure, the abdomen was opened and adhesions were noted and carefully divided. Inflammation was noted in the area of the splenic flexure as a result of the previous fistula that had developed there. Trials for mobilization of the

Figure 1: Computed tomography scan of the chest showing esophageal thickening and left pleural effusion.

Figure 2: Computed tomography scan of the abdomen showing pneumatosis of gastric wall and free intraperitoneal air.
splenic flexure failed. The decision was made to use the right colon as the conduit to reconstruct the esophagus. First, the right colon was mobilized with identification and preservation of the right ureter. A Cattell–Braasch maneuver was performed, as well as a Kocher maneuver with division of adhesions between the transverse mesocolon and the inferior aspect of the pancreas to achieve full mobilization of the right and transverse colon. The middle colic vessels were identified at their origin from the superior mesenteric vessels just below the neck of the pancreas. The middle colic pedicle would provide the blood supply to the interpositioned colon; test bulldog clamps were placed on the ileocolic and right colic vessels (planned to be divided) to confirm ability of middle colic vessels to supply the whole length of conduit via the artery of Drummond. Umbilical tape was used to measure the length of the colon, and determine how much would need to be mobilized to bring it up into the neck. The esophagostomy and proximal cervical esophagus were then mobilized, and its edge trimmed to normal esophagus. Owing to the fact the posterior mediastinum was obliterated by fibrosis due to previous inflammation, a retrosternal tunnel was created from the neck above and hiatus below using blunt finger dissection. To widen the thoracic inlet allowing easy passage of the colon conduit, the left half of the manubrium sterni and the head of the left clavicle were removed with a bone saw, avoiding injury to the underlying vessels.

When the colon vessel clamps were rechecked, the colon remained pink and viable. The colon was divided just distal to the cecum at the beginning of the ascending colon. The ileocolic and right colic arteries were divided; the marginal artery was left intact. The proximal end of the right colon was then brought up to the neck in an isoperistaltic manner by placing the colon segment in a laparoscopic sleeve bag, guiding a Foley catheter through the retrosternal tunnel, securing the Foley into the bag containing the conduit then pulling it into the neck to avoid excessive handling of the conduit or its twisting along its longitudinal axis. The conduit was brought into the neck; pulse in the vessels of the conduit was demonstrated by Doppler examination of the mesocolon in the neck. The proximal esophagocolic anastomosis was performed using a stapled triangulated technique [7].

The transverse colon was then subsequently divided, taking care to preserve the marginal artery of Drummond. The previous jejunostomy feeding tube was disassembled. A Roux-en-Y jejunostomy loop was brought up to the conduit to create the colojejunal, stapled anastomosis. A stapled colocolic anastomosis was performed between the cecum and the distal transverse colon. Appendectomy was also performed to avoid potential future issues.

Finally, a new feeding jejunostomy tube was placed distal to the jejunocolonic anastomosis via Witzel technique [8] and secured to abdominal wall. Nasogastric (Nasocolic in this case) tube was left in place. Drains were placed in the neck and in the upper abdomen near the colo-jejunal anastomosis. The neck and abdomen were inspected to ensure adequate hemostasis and then closed in layers in the standard fashion. Overall, the patient tolerated the procedure well with no intraoperative complications. Operative time was 436 min, estimated blood loss was 200 cc.

The patient’s postoperative course was unexpectedly smooth without any major complications. DVT prophylaxis was started on day-2, oral diet was resumed on day-5 after a barium swallow confirmed absence of leakage. The patient experienced minor diarrhea which subsided, and was discharged home day-9. At 4th week postoperative, the feeding tube was removed as he had adequate oral intake. The patient was subsequently seen at 6th and 12th months with no reported dysphagia or other complications. Artistic rendition of the reconstructive surgery is seen in Figure 3.

![Figure 3](image_url)

**Figure 3:** The left image demonstrates the status of the gastrointestinal tract after esophagogastrectomy with spit and feeding jejunostomy, but before any reconstruction. The right image demonstrates the gastrointestinal tract after reconstruction with reversed colon bypass and Roux-en-Y colojejunalostomy with feeding jejunostomy.

**DISCUSSION**

To avoid post-surgical reconstruction stenosis of the esophagus, it is recommended to delay the date of surgery up to three months in the absence of pharyngeal injury and up to six months in case of pharyngeal injury [9]. Additionally, the selection of right versus left colon for interposition has been controversial [10]. The choice of right colon versus left colon usually depends on the preference of the surgical team [6]. Right colic interposition benefits include prevention of pharyngeal reflux with preservation of the ileocecal valve, congruence of the esophagus and the ileum at the cervical level, ease of anastomosis, and ability to use the left colon for rescue.
transplant in the case of right colon necrosis (the reverse is not always feasible) [10]. Opponents to right colonic interposition argue that right colon vascular anatomy can be exceedingly variable, compared to more consistent left colon vasculature [11]. In this scenario, the ascending and transverse colon segment, which was supplied by the marginal and middle colic artery, was used as the primary reconstruction organ due to the inflammation that remained on the left colon from the patient’s earlier fistula. While the right colon may be preferred because pharyngeal reflex can be prevented by preservation of the ileocecal valve [9], here, the decision was taken to leave the cecum in place so as the patient may have an appropriate quality of life with less diarrhea. Enlargement of the upper thoracic inlet by resection of a part of the manubrium and the head of the left clavicle is associated with a lower rate of cervical fistulae [6]. This was our preference as well and it succeeded in our case. Another point, the importance of the preoperative preparation by CT mesenteric angiography and colonoscopy to ensure the colon and its vascularity will be adequate to sustain the conduit, cannot be over emphasized enough.

Colon bypass has classically been described as a method for esophageal replacement with the distal part getting anastomosed to the indwelling preserved stomach [12]. In this case, the stomach had to be excised in the initial procedure due to burns, and similar cases could be encountered, for instance, if a stomach had to be excised for extensive tumors. Thus, gastrectomy should not discourage doing reconstruction using Roux-en-Y jejunal loop.

**CONCLUSION**

Complex esophageal reconstruction using a non-supercharged colon bypass in the retrosternal route can be used in esophageal replacement in cases with esophagogastrectomy for lye ingestion or otherwise. This can be done with leaving the ileocecal valve in place.

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**Author Contributions**

Paige Finkelstein – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published

Omar Picado – Analysis and interpretation of data, Revising it critically for important intellectual content, Final approval of the version to be published

Elizabeth Paulus – Analysis and interpretation of data, Revising it critically for important intellectual content, Final approval of the version to be published

Janeth Ng – Analysis and interpretation of data, Revising it critically for important intellectual content, Final approval of the version to be published

Gabriel Ruiz – Analysis and interpretation of data, Revising it critically for important intellectual content, Final approval of the version to be published

Danny Yakoub – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published

**Guarantor**

The corresponding author is the guarantor of submission.

**Conflict of Interest**

Authors declare no conflict of interest.

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