

# Surgical revision of the postesophagectomy gastric conduit to address poor emptying



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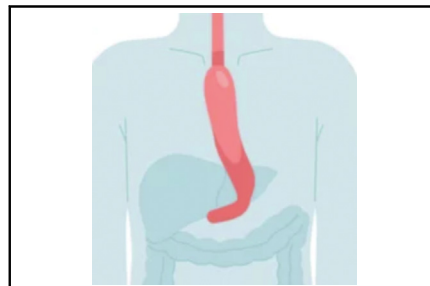
## ABSTRACT

**Introduction:** The configuration of the gastric conduit after esophagectomy can lead to chronic gastrointestinal and respiratory issues. Surgical revision of the gastric conduit has been described in small series but appears to be infrequently used. We investigated outcomes of revising dilated or redundant conduit in patients with severe quality-of-life issues.

**Methods:** We identified all patients from 2016 to 2022 at our institution who underwent gastric conduit revision after previous esophagectomy either at our or another institution. Chart review was performed to assess prerevision course and perioperative outcomes. Pre- and postrevision imaging was compared for all patients to assess the impact of surgery on anatomic configuration. Patient-reported gastrointestinal and respiratory issues before and after surgery were examined.

**Results:** The use of right thoracotomy combined with laparotomy to reduce redundancy and improve gastric emptying was performed in 8 patients. The symptoms necessitating reoperation included intolerance to oral intake and poor gastric emptying associated with both acute and chronic aspiration episodes. The median length of stay was 8 [4, 25] days, and there were no perioperative mortalities. Seven (87.5%) patients were tolerating oral intake at discharge. All patients had improvement in their prerevision symptoms on follow-up.

**Conclusions:** Gastric conduit revision can improve severe postesophagectomy gastrointestinal and respiratory symptoms in patients with dilated/redundant conduits with limited perioperative morbidity. (*JTCVS Techniques* 2024;23:132-40)



Gastric conduit dysfunction postesophagectomy.

## CENTRAL MESSAGE

Postesophagectomy gastric conduit dysfunction can severely affect patients' quality of life and surgical revision of the dilated or redundant conduit should not be delayed when clinically indicated.

## PERSPECTIVE

The symptoms necessitating surgical revision of the gastric conduit post-esophagectomy include poor nutrition and aspiration. The use of right thoracotomy and laparotomy with gastropexy and pyloroplasty to reduce conduit redundancy and improve gastric emptying is an effective revisional technique with limited perioperative morbidity that should be offered in a timely manner.

Most studies examining outcomes after esophagectomy focus on either perioperative morbidity or long-term survival when the surgery was performed for cancer resection. Studies examining quality-of-life issues are much less common. However, both improved perioperative outcomes as

well as better survival with therapies such as induction chemoradiation and adjuvant immunotherapy mean that more patients are living for more prolonged periods with their postesophagectomy anatomy.<sup>1,2</sup> All patients postesophagectomy will have to modify their lifestyle secondary to their reconstructed upper gastrointestinal tract in regard to eating habits and aspiration risks, but the expectation for all patients should be that they can maintain adequate nutrition with oral intake alone with no clinically significant aspiration events.

However, some patients can have particularly poor quality of life due to more extreme failure-to-thrive symptoms or recurrent or chronic aspiration episodes secondary to dilation and redundancy of their reconstructed esophagus.<sup>3</sup> Management of these patients can be difficult, as both patients and surgeons may be reluctant to consider another major

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surgery to address postesophagectomy mechanical issues, although endoscopic interventions are often insufficient to relieve severe symptoms. In particular, literature reports related to surgical management in these circumstances that could support surgeon and patient decision-making are very limited. We sought to investigate the safety and effectiveness of surgical treatment for postesophagectomy conduit dysfunction and evaluate the impact on preoperative symptoms.

## METHODS

All patients with a history of a previous esophagectomy who subsequently had a conduit revision from 2016 to 2022 at a single center were retrospectively evaluated. Chart review was performed to capture patient baseline characteristics, indications for conduit revision, and perioperative outcomes. Case details and minor statistics were descriptively summarized. Imaging of the esophagus and stomach anatomy as well as patient symptoms were compared before and after revisional surgery. This study was approved by the Stanford Institutional Review Board (protocol number: 72368; October 10, 2023).

### Prerevision Work-up

Patients who have symptoms of poor gastric emptying that manifest with gastrointestinal or aspiration issues will generally go through a series of evaluations before potentially having a conduit revision surgery. Although not necessarily formalized, the work-up typically starts with assessment of the appearance of gastric conduit on postoperative computed tomography scans. Even if patients have a very dilated conduit on cross-sectional imaging, our typical next step is an esophagram for a more dynamic assessment of the flow of orally ingested contrast through and out of the gastric conduit. Finally, we favor evaluation and endoscopy by a gastroenterology specialist who both focuses on motility issues and also has advanced endoscopic skills such as the ability to perform gastric-per oral endoscopic myotomies, so that any potential medical (such as erythromycin or metoclopramide) or endoscopic options are considered as an alternative to surgical intervention.

### Surgical Technique

The gastric conduit revision surgery generally involved esophagogastroduodenoscopy, right thoracotomy and laparotomy with adhesiolysis, conduit mobilization, gastropexy, and selective use of pyloroplasty. The important steps in operative preparation as well as thoracic and abdominal manipulation are described to follow. It should be noted that, in preparation for all cases, the potential need for resecting or plicating the gastric conduit based on intraoperative findings was considered and discussed preoperatively with the patients but was deemed to be not necessary in all cases in the series.

### Presurgical Preparation

Patient preparation before surgical intervention should involve careful planning for several potential issues (Table 1). An epidural is typically placed before anesthesia induction due to the planned open approach for both the chest and abdomen. Because these patients often have some chronic although potentially mild and subclinical respiratory issues, consideration for appropriate pharmaceutical deep venous thrombosis prophylaxis should be given whenever deemed safe relative to timing of epidural placement. The anesthesia team should be specifically reminded of the potential for aspiration on induction, given not only the previous esophagectomy but also the redundant and poorly emptying conduit.

Esophagogastroduodenoscopy should be initially performed, where the location of the esophagogastric anastomosis should be noted and any mucosal changes since previous endoscopies ruled out. In addition, the

**TABLE 1. Summary of the steps involved in patient preparation before surgery**

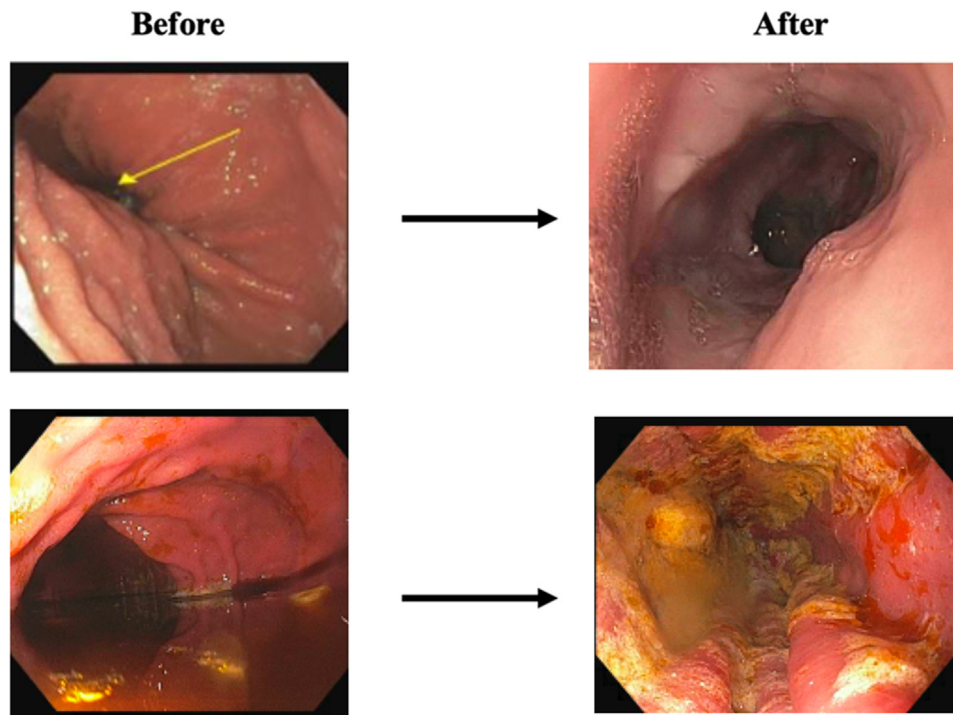
Step	Important considerations
Epidural is typically placed before anesthesia induction.	Optimize ability to participate in postoperative pulmonary toilet to minimize potential respiratory complications.
Careful consideration of aspiration risk during induction and the surgery.	Patients at greater risk due to not only the previous esophagectomy but also the presence of a chronically dilated and often full gastric conduit.
Careful consideration of thromboembolic risk during the perioperative period.	Patients can have at least mild and subclinical respiratory issues if they have been having chronic aspiration, such that the consequences of postoperative pulmonary emboli can be even more severe than typical.
Esophagogastroduodenoscopy before surgical intervention.	Confirmation of findings noted from previous endoscopies, with assessment for unexpected mucosal irregularities as well as the location of the previous esophagogastric anastomosis, and as much clearance of the gastric conduit as possible.

surgeon should verify previously described findings if previous endoscopies were performed by other providers and confirm that the planned revision will address the suspected anatomic issues. In many cases, the endoscopy will reveal a large amount of fluid and food residue in the stomach. A typical prerevision endoscopic finding is a cavernous gastric lumen filled with pooling of fluid and food debris; the antrum typically has a sharp angulation in the area of the diaphragmatic hiatus (Figure 1, left panels). It will likely not be possible to navigate through the intrathoracic stomach to proceed distally under the diaphragm due to the redundancy of the conduit. The fluid in the stomach should be aspirated as thoroughly as possible, as manipulation of the conduit during surgery could lead to reflux into the pharynx and possible aspiration even with an endotracheal tube in place.

After the endoscope has been removed, an orogastric tube should be placed. The anesthesia team should also be aware that intraoperative manipulation of the gastric conduit can lead to residual gastric contents being refluxed more proximally and into the pharynx. The presence of an endotracheal tube can reduce but not eliminate the potential for aspiration of these contents into the airway, so the posterior pharynx should be manually cleared of secretions with suction at regular intervals throughout the case, particularly in the early part of the thoracic portion.

### Thoracic Component of Surgery

The initial portion of the surgery involves a right thoracotomy with the patient in the left lateral decubitus position (Table 2). Entry in the sixth intercostal space will allow for adequate visualization of the gastric conduit throughout its course in the chest. Although a minimally invasive approach could be attempted with conversion as necessary, our bias is that a minimally invasive approach could be particularly difficult as extensive adhesions of the lung to the posterior chest wall, mediastinum, and



**FIGURE 1.** Typical endoscopy findings of the gastric conduit before (*left panels*) and after (*right panels*). The yellow arrow in the *top left panel* shows the diaphragmatic hiatus.

diaphragm are the norm when patients have had previous esophagectomy, even when performed in a minimally invasive technique. The adhesions must be taken down completely off of the conduit to allow adequate mobilization, which can involve avulsing of the visceral pleural layer of the lung as care must err on the side of lung injury rather than conduit injury. Selective use of wedge resections in the area of particularly dense adhesions can limit early postoperative air leaks.

The conduit then is carefully mobilized from the diaphragm and then from the hiatus. The conduit is encircled at the hiatus. Extreme care is necessary in this area to avoid inadvertent injury to the gastroepiploic arcade that is vascularizing the conduit. Although not employed in this series, fluorescence imaging can be considered to identify the location of the conduit blood supply as well as to confirm preserved conduit perfusion through the surgery. It should be noted that injury to the blood supply that causes loss of the conduit would be a catastrophic complication. Although this event did not happen in our series, surgeons should have plans to manage the patient should that occur, and one option would be to perform resection of the conduit at that time with mobilization and diversion of the proximal esophagus and then a subsequent staged reconstruction with a jejunal or colon interposition.

The conduit can then be freed moving more proximally from the hiatus. This dissection should not extend to the level of the gastroesophageal anastomosis unless there is an anatomic abnormality in that area that must be specifically addressed, which was the scenario in one case in this series where the anastomosis had a twist that prevented passing of oral intake. The location of the anastomosis should have been carefully noted from previous imaging as well as the endoscopic examination.

After full conduit mobilization, the conduit should be manually placed in a much straighter configuration, and there should be a significant amount of redundant stomach that can be reduced to the hiatus. Endoscopy should then be repeated, and the scope should be able to enter the gastric conduit more easily and manipulated through the pylorus into the proximal duodenum with no difficulty. The gastric conduit should have a much more tubular appearance, with clear resolution of the redundancy that had

been apparent on the prerevision endoscopy (*Figure 1, right panels*). If the endoscopic examination does not show this, a combination of inspection in the surgical field and on endoscopic examination should be used to facilitate additional surgical mobilization to achieve a better gastric configuration, which should optimally support postoperative emptying. The pylorus should be carefully inspected at this point—if the pylorus is not widely patent and allows passage of an adult-sized endoscope into the proximal duodenum, pyloroplasty during the abdominal portion of the procedure should be planned. Four stitches should be placed on the conduit to mark the amount of stomach that needs to be reduced from the chest. This will ensure that the ultimate location and configuration of the gastric conduit is ideal for optimal emptying.

### Abdominal Component of Surgery

The patient is turned supine when the chest has been closed for the abdominal portion of the operation (*Table 3*). If a patient has had previous laparoscopy, the lack of adhesions is often a pleasant finding, especially when compared with the dense adhesions often found in the chest. Even so, we favor an open abdominal approach via an upper midline incision for this portion of the procedure. Although a minimally invasive approach may facilitate better visualization of the conduit and the hiatus, our bias is that an open approach facilitates optimal dissection of the abdominal part of the gastric conduit such that blood supply manipulation or injury is avoided. In addition, somewhat vigorous manual reduction of the gastric conduit from the chest can be necessary to ensure that the desired location and configuration of the gastric conduit is achieved. In our experience, manual handling of the gastric conduit allows balancing of appropriate gastric reduction without causing gastric injury such as serosal tears or worse.

The stomach around the hiatus must be carefully mobilized, then reduced according to the amount determined during the thoracic portion of the surgery. All the stitches placed in the chest should be visible a few centimeters below the hiatus as desired. The stomach should then be

**TABLE 2. Important consideration during thoracic manipulation of the gastric conduit**

Step	Important considerations
Right thoracotomy with entry into the sixth space.	This location will allow adequate mobilization of the gastric conduit from the hiatus and away from other posterior mediastinal structures and intrathoracic structures to the desired proximal location.
Takedown all adhesions of the conduit and lung to the posterior chest.	Facilitate visualization and subsequent mobilization of the gastric conduit, with erring to leave the visceral pleural layer of the lung on the conduit rather than any conduit injuries.
The conduit then is carefully mobilized from the diaphragm, and then from the hiatus, to the desired proximal location. Extreme care is necessary in this area to avoid inadvertent injury to the gastroepiploic arcade that is vascularizing the conduit.	This dissection should not extend to the level of the gastroesophageal anastomosis unless noted to have been necessary based on preoperative and intraoperative assessment, as both the gastric and particularly the esophageal tissue in this area can be susceptible to inadvertent injury.
The conduit should be placed in a straighter configuration than it was in before the case. Endoscopy should then be repeated, and the scope should be observed to be more easily able to be placed into the gastric conduit and manipulated through the pylorus into the proximal duodenum with no difficulty.	Four stiches should be placed on the conduit to mark the amount of stomach which needs to be reduced from the chest from the subsequent abdominal approach, to ensure that ultimate location and configuration of the gastric conduit is ideal for optimal emptying.

secured to the adjacent crura and diaphragm with several nonabsorbable sutures.

Endoscopy should be repeated for the third time to verify that the scope easily passes through the gastric conduit and distal stomach with no twisting or angulation. The pylorus should be again assessed. Pyloroplasty should be performed if preoperative evaluations via either endoscopy or contrast studies showed pyloric narrowing or spasm to be an issue. If the preoperative work-up had not suggested that pyloric dysfunction was present, pyloroplasty can be deferred if the postrevision endoscopy shows a widely patent pylorus that can be easily traversed with an adult-size endoscope. If the pylorus appears narrow or there is any difficulty traversing the pylorus with the scope, then pyloroplasty should be performed. A nasogastric tube should now be placed and verified to extend into the stomach below the diaphragm before abdominal closure.

## Postoperative Care

Depending on the patient's early perioperative recovery and the amount of intraoperative dissection performed, we typically obtain an esophagram between postoperative day 2 and 5 before starting and advancing oral intake. Patients are typically advanced to a full liquid diet before discharge and subsequently advanced to soft and regular diets over the next 2 to 4 weeks depending on their progress.

## RESULTS

### Patient Characteristics and Prerevision Presentation

Table 4 shows a summary of the patients included in the series. There were 8 patients who met inclusion criteria, with a median age of 78 (52, 87) years. The majority of the cohort was male and of White race (6, 75%). Malignancy was the indication for esophagectomy in 7 (87.5%) patients, with the remaining patient undergoing esophagectomy for end-stage achalasia. Similarly, minimally invasive Ivor Lewis esophagectomy was performed in 7 (87.5%) patients, whereas 1 patient underwent a McKeown esophagectomy. One patient (12.5%) had a pyloroplasty performed at the time of their esophagectomy. Median age at time of esophagectomy was 73 (49, 84) years, and median time from primary surgery to revision surgery was 16 (3, 55) months. The patient who underwent revision only 3 months after the initial esophagectomy had evidence of a poorly emptying and dilated conduit on the first postoperative esophagram early after surgery, and then had 3 hospital readmissions for respiratory issues related to the poorly emptying conduit before the revision.

The predominant issue leading to poor gastric emptying in all patients was considered to be excessive and redundant conduit in the chest. Three patients were dependent on tube feeds, and 1 patient was dependent on total parenteral nutrition before the revision. Typical endoscopic images before and after the gastric conduit revision are illustrated in Figure 1, whereas radiologic images are shown in Figures 2 and 3. Prerevisional endoscopic and radiologic images consistently demonstrated significant conduit redundancy with or without acute angulation, which correlated with the severity of their symptoms.

The most common postesophagectomy symptoms were dysphagia, regurgitation, vomiting, aspiration, gastroparesis, and delayed gastric emptying, which led to inability to tolerate oral intake and subsequent dependence on tube feeding. All patients underwent numerous attempted endoscopic interventions such as dilation and botulinum toxin injections with minimal improvement. Two of the patients had surgeries at other institutions. Those patients were instructed by their esophagectomy surgeons to have postsurgical follow-up with their local gastroenterologist despite persistent and long-term reliance on jejunostomy tube feedings for postesophagectomy nutrition. Those patients were ultimately referred for gastroenterology evaluation at a tertiary center, and surgical revision was subsequently recommended after multidisciplinary evaluation.

**TABLE 3. Steps in the abdominal portion of gastric conduit revision**

Step	Important considerations
Upper midline abdominal approach.	An open approach facilitates optimal dissection of the abdominal part of the gastric conduit such that blood supply manipulation or injury is avoided. In addition, somewhat vigorous manual reduction of the gastric conduit from the chest can be necessary to ensure that the desired location and configuration of the gastric conduit is achieved.
The stomach in the area of the hiatus must be carefully mobilized, and the amount of stomach expected to be reduced from the chest based on the initial thoracic approach should be actually reduced.	All of the stitches placed in the chest should be visible a few centimeters below the hiatus as desired.
The stomach should then be secured to the crura and diaphragm with several non-absorbable sutures.	Endoscopy should be again repeated, to again verify that the scope can easily be placed through the gastric conduit and then to the distal stomach with no difficulty.
Pyloroplasty if indicated.	Based on both preoperative and intraoperative endoscopic and manual palpation evaluations of the pylorus.

### Perioperative Outcomes

The gastric conduit revision surgery involved esophagogastroduodenoscopy, right thoracotomy and laparotomy with adhesiolysis, conduit mobilization, and gastropexy. Pyloroplasty was also performed in 2 patients. None of patients had gastric or vascular injury or required reoperations. The median postoperative length of stay was 8 (4, 25) days. One half (4, 50%) of the patients had no notable postoperative issues and were discharged from postoperative day 4-8. The length of stay for these patients was typically related to adequate physical activity, resumption of adequate oral intake, return of gastrointestinal activity, and adequate pain control with oral medications.

Four of the patients had a more prolonged postoperative stay of 10 days or more. Two of these patients had a postoperative ileus that required a longer hospitalization. The

patient with a 21-day length of stay had prolonged chronic and regular aspiration issues before the revision surgery. This patient experienced early respiratory failure and discovery of new pulmonary emboli necessitating prolonged ventilatory support and anticoagulation. This patient was noted at a 7-month follow-up visit to have returned to work and essentially her preoperative lifestyle.

### Long-Term Outcomes

All patients noted improvement or resolution of their significant preoperative symptoms postoperatively. All patients progressed to solid oral intake. All patients but one were completely weaned from tube feeding by the time of their follow-up visit. Two patients who had required hospitalizations prerevision related to aspiration events or failure to thrive due to respiratory issues did not have any more hospitalizations postrevision. Radiologic imaging for all patients pre- and postoperatively showed dramatic changes in conduit anatomy which correlated with symptomatic improvement (Figures 1 and 2, Table 4). One patient died from brain metastasis 5 years after his revision surgery.

### DISCUSSION

Surgery is associated with cure for resectable esophageal cancer and end-stage achalasia. However, esophagectomy can significantly affect basic activities of daily living such as swallowing and eating and predispose patients to aspiration events. Although patients often express gratitude for surviving through cancer care, their postesophagectomy anatomy can lead to significant impacts on quality of life. Our case series of a limited number of patients postesophagectomy showed that patients with symptoms ultimately related to conduit dysfunction can endure long periods of diagnostic evaluation and attempted nonsurgical management. The described technique of right thoracotomy with gastric conduit revision, lysis of adhesions, and laparotomy with gastropexy and pyloroplasty in this series was effective in relieving symptoms in all 8 patients. The perioperative course was generally uneventful in one half of the patients. Patients with a more prolonged hospital stay ultimately recovered well. There were no catastrophic complications, including injury to the blood supply and loss of conduit. One of the most important lessons learned from our experience was the tendency to delay surgical revision, which leads to long periods of poor quality of life for patients. We therefore propose this revisional surgery as a high-yield and low-morbidity solution to be performed a timely manner, including in the early postoperative period, if signs and symptoms point toward a very dilated or poorly emptying conduit.

As shown in our cohort, patients undergo many endoscopic interventions before a more invasive management strategy is even considered. One reason for this may be

TABLE 4. Summary of patients

Diagnosis	Postesophagectomy symptoms	Management before revision	Time between index operation and revision, mo	Summary of postoperative course	Postrevision symptoms
End-stage achalasia	Dysphagia, regurgitation, aspiration events	>5 EGDs with esophageal balloon dilation and pyloric Botox	36	No complications; discharged on POD 6	Regular oral intake, no dysphagia, reflux, or vomiting
Esophageal squamous cell carcinoma s/p neoadjuvant CRT	Did not tolerate oral intake: dysphagia, vomiting, and excessive mucus after eating	>5 endoscopies with repeat dilations.	17	Admitted to ICU for hypotension—self-resolved; large pleural effusion necessitating chest tube drainage; discharged on POD 14	Regular oral intake without difficulties, no dysphagia
Adenocarcinoma in gastroesophageal junction s/p neoadjuvant CRT	Dyspnea, cough, aspiration pneumonia, pleural effusion, and reflux	5 EGDs and balloon pyloric dilation	15	No complications; discharged on POD 6	Regular oral intake with intermittent episodes of reflux, vomiting, cramping, and dumping syndrome; no aspiration events
Early-stage adenocarcinoma in distal esophagus	Gastroparesis, aspiration pneumonia	EGD with removal of fluid in conduit, pyloric dilation was not possible	3	No complications; discharged on POD 8	Regular oral intake without nausea, vomiting, cough attacks, or GERD symptoms; no aspiration-related admissions
Adenocarcinoma in esophagus s/p neoadjuvant CRT	Did not tolerate any oral intake, became TPN dependent, which led to J-tube re-siting	Endoscopic and laparoscopic interventions	48	Ileus; J-tube dislodged and replaced multiple times; discharged on POD 25	No longer required TPN, continued tube feeding with intermittent and selective oral intake
Early-stage mid-esophageal squamous cell carcinoma and	Vomiting and poor emptying of the gastric conduit, weakness, did	4 EGDs with pyloric dilation and Botox injections	12	No complications; discharged on POD 4	Regular oral intake without aspiration

(Continued)

TABLE 4. Continued

Diagnosis	Postesophagectomy symptoms	Management before revision	Time between index operation and revision, mo	Summary of postoperative course	Postrevision symptoms
T1bN0 RUL lung cancer	not tolerate oral intake				
Early-stage esophageal adenocarcinoma	Cough, wheezing, regurgitation, intermittent dysphagia primarily to solids, frequent belching, gassiness, and abdominal distention	>5 EGDs with dilation and Botox.	57	Early reintubation for respiratory failure; altered mental status; deep venous thrombosis; discharged on POD 22	Regular oral intake without dysphagia but reported intermittent regurgitation at night
Adenocarcinoma in distal esophagus s/p neoadjuvant CRT	Worsening reflux symptoms and dysphagia.	3 EGDs with balloon dilation	10	Mild ileus; discharged on POD 10	Regular oral intake with occasional reflux and regurgitation

EGD, Esophagogastroduodenoscopy; POD, postoperative day; s/p, status post; CRT, chemoradiotherapy; ICU, intensive care unit; GERD, gastroesophageal reflux disease; TPN, total parenteral nutrition.

due to the temporary bouts of relief that can be achieved with pyloric balloon dilation. Although balloon dilation has been shown to treat gastric outlet obstruction with

success rates as high as 95%, studies have shown that approximately 30% of patients require repeat dilations, which questions the long-term durability of the

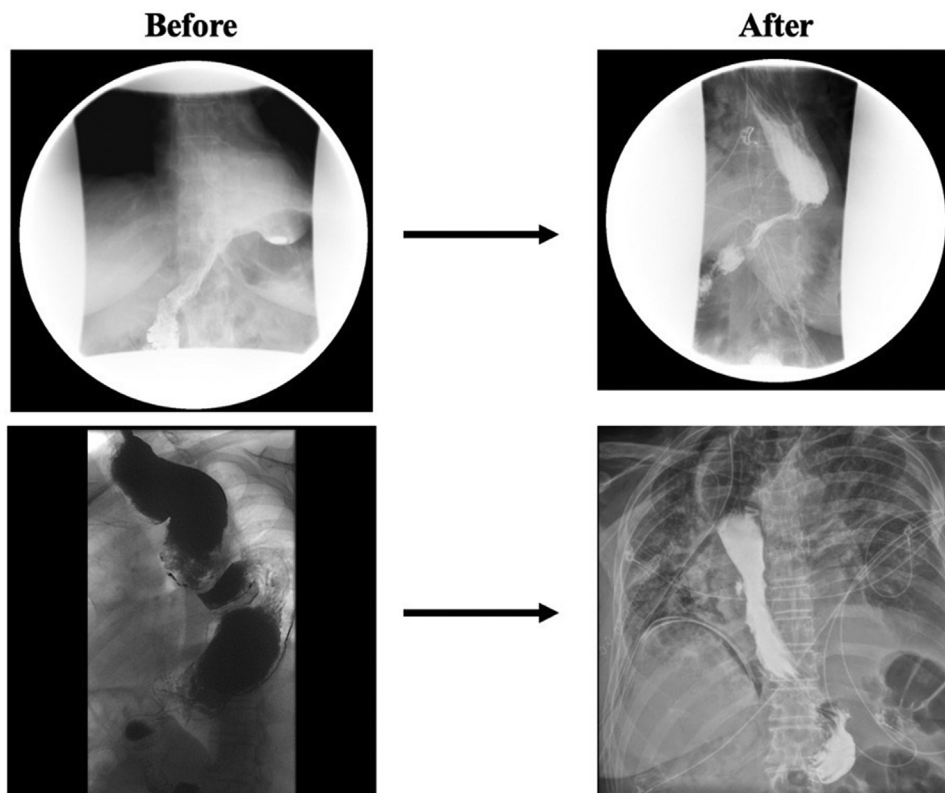
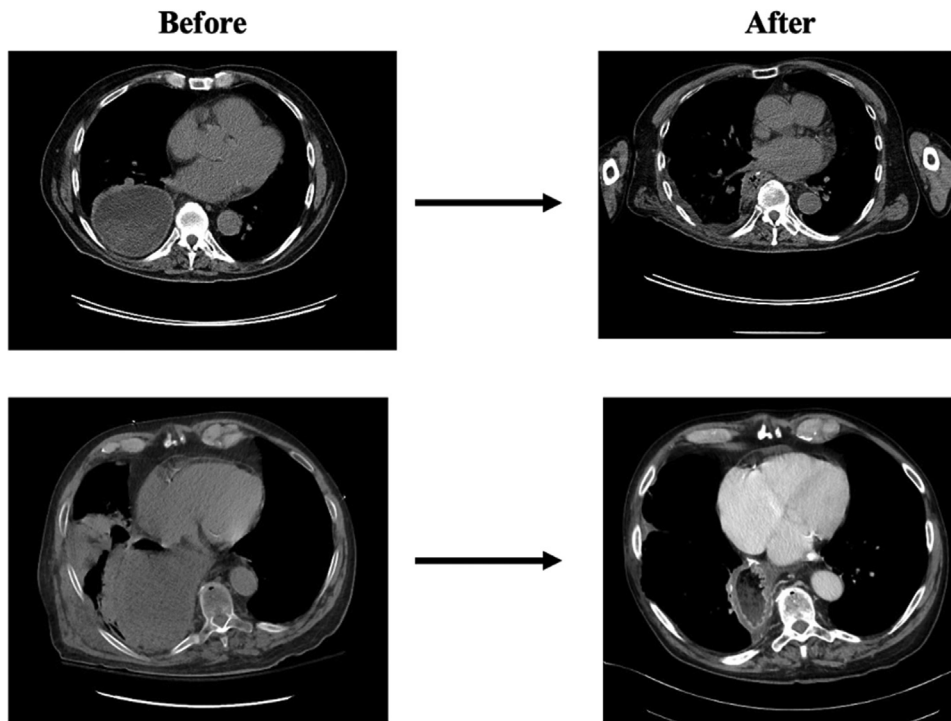


FIGURE 2. Swallow studies of patients before and after conduit revision.



**FIGURE 3.** CT scans of patients before and after conduit revision. *CT*, Computed tomography.

intervention.<sup>4,5</sup> In addition, the use of intrapylorus botulinum toxin injections is debatable. Although it is common practice, studies have demonstrated that patients who receive Botox injections instead of standard drainage procedures like pyloromyotomy or pyloroplasty experience more reflux symptoms and require greater use of pro-motility agents.<sup>6</sup> To investigate the reflux issue further, Loo and colleagues<sup>7</sup> published a meta-analysis that showed better gastric emptying with pyloric drainage without increased postoperative complications such as reflux, aspiration, and pneumonia. Although we do not necessarily advocate for performing upfront pyloroplasty for all esophagectomies, this case series does indicate that it should be an important step in the revisional surgery. The transition from consideration of endoscopic to operative pyloric drainage lies within the patient and physician relationship and the willingness of both parties to proceed with revisional surgery. However, we would advocate for earlier consideration of revisional surgery for patients with severe symptoms and limited palliation with medical or endoscopic therapies. Patients with longer periods of chronic aspiration can be particularly susceptible to perioperative respiratory issues, and earlier rather than later intervention may be associated with smoother recovery periods.

There is limited existing literature describing the long-term results of patients who receive esophagectomy and eventually undergo complete surgical revision of their

conduit, as this severity of presentation is relatively rare. This lack of literature may lead to surgeons being reluctant to consider revisional surgery after esophagectomy. In fact, we did not pursue this intervention in our patients until Rove and colleagues<sup>8</sup> gave a presentation at the 2016 Western Thoracic Surgical Association annual meeting and subsequently published a case series of 7 patients who underwent thoracotomy and/or laparotomy for conduit revision. The authors advocated for an open approach to ensure full circumferential mobilization of the conduit, which corresponds with our techniques and intraoperative findings of dense adhesions around the often-herniated conduit. In fact, 2 of our patients required a lung wedge resection to avoid injuring the densely adhered conduit. Although studies have advocated for a wider gastric conduit to improve perfusion and theoretically decrease the risk of anastomotic leak, we found that significant redundancy of the conduit was a common and problematic theme in all 8 cases.<sup>9</sup> Accessing both the thoracic and abdominal cavities was pivotal for straightening the conduit while concurrently performing operative drainage procedures. As described in our preoperative assessment of patients, the potential need for “plication” or even partial resection of the dilated gastric conduit was considered for all of the patients in the series, but ultimately deemed unnecessary after repositioning of the conduit. However, plication or resection that further reduces conduit redundancy may be potentially helpful in



some cases of a persistent very severely dilated gastric conduit even after conduit repositioning.

We acknowledge several limitations in our report, the biggest factor being that severe conduit dysfunction post-esophagectomy is a rare occurrence. In addition, the review did not employ quality-of-life surveys or other objective parameters to measure the impact of the revision surgery. We also acknowledge that an alternative strategy to manage a poorly functioning gastric conduit after esophagectomy is resection of the conduit with replacement via a colon or jejunal interposition. Our preference is to revise the conduit if felt likely to benefit the patient, as resection with interposition is generally a more complex procedure with a longer recovery. The decision to revise the conduit versus performing a resection is generally based on a subjective evaluation of the patient's imaging and symptoms, but a patient with a long-standing massively dilated gastric conduit where the esophagus has also become very dilated may benefit better from conduit resection and replacement rather than revision. Nevertheless, our series of 8 patients undergoing conduit revision is nevertheless one of the largest cohorts of surgical patients to be described in the literature, and we believe that our standard approach is replicable and generalizable for this unique patient population. Although the patients in this series were not uniform with regard to index operation or management until revisional surgery, we aimed to provide a holistic view on the range of patient presentations and progressions to empower surgeons to offer conduit revision in a timely manner to well-selected patients. In addition, we hope to highlight the importance of avoiding recurrent conduits at the time of initial esophagectomy, given the predominant problem leading to the need for gastric revision in this series was excessive conduit in the chest. However, our series does show that there is a low morbid option for when these situations do occur. The consequences of poor nutrition and aspiration can be very severe for patients. Hence, we advocate for early consideration of conduit revision when

clinically indicated as a safe and effective surgical treatment for severe conduit dysfunction.

### Conflict of Interest Statement

The authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

### References

1. Eyck BM, van Lanschot JJB, Hulshof MCCM, van der Wilk BJ, Shapiro J, van Hagen P, et al. Ten-year outcome of neoadjuvant chemoradiotherapy plus surgery for esophageal cancer: the randomized controlled CROSS trial. *J Clin Oncol*. 2021;39:1995-2004.
2. Kelly RJ, Ajani JA, Kuzdzal J, Zander T, Van Cutsem E, Piessen G, et al. Adjuvant nivolumab in resected esophageal or gastroesophageal junction cancer. *N Engl J Med*. 2021;384:1191-203.
3. Kent MS, Luketich JD, Tsai W, Churilla P, Federle M, Landreneau R, et al. Revisional surgery after esophagectomy: an analysis of 43 patients. *Ann Thorac Surg*. 2008;86:975-83; discussion 967-74.
4. Lanuti M, DeDelva P, Morse CR, Wright CD, Wain JC, Gaissert HA, et al. Management of delayed gastric emptying after esophagectomy with endoscopic balloon dilatation of the pylorus. *Ann Thorac Surg*. 2011;91:1019-24.
5. Maus MKH, Leers J, Herbold T, Bludau M, Chon SH, Kleinert R, et al. Gastric outlet obstruction after esophagectomy: retrospective analysis of the effectiveness and safety of postoperative endoscopic pyloric dilatation. *World J Surg*. 2016;40:2405-11.
6. Eldaif SM, Lee R, Adams KN, Kilgo PD, Gruszynski MA, Force SD, et al. Intra-pyloric botulinum injection increases postoperative esophagectomy complications. *Ann Thorac Surg*. 2014;97:1959-64; discussion 1964-5.
7. Loo JH, Ng ADR, Chan KS, Oo AM. Outcomes of intraoperative pyloric drainage on delayed gastric emptying following esophagectomy: a systematic review and meta-analysis. *J Gastrointest Surg*. 2023;27:823-35.
8. Rove JY, Krupnick AS, Baciewicz FA, Meyers BF. Gastric conduit revision post-esophagectomy: management for a rare complication. *J Thorac Cardiovasc Surg*. 2017;154:1450-8.
9. Ishikawa Y, Chang AC, Lin J, Orringer MB, Lynch WR, Lagisetty KH, et al. Wider gastric conduit morphology is associated with improved blood flow during esophagectomy. *J Gastrointest Surg*. 2023;27:845-54.

**Key Words:** gastric conduit, postesophagectomy, poor gastric emptying, esophagectomy complications