

COMBINATION OF A FREE JEJUNAL FLAP AND A ROUX-EN-Y COLOJEJUNOSTOMY FOR RECONSTRUCTION OF ESOPHAGEAL STRICTURE SECONDARY TO A DISTANT BLAST INJURY: A CASE REPORT

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Pneumatic perforation of the esophagus caused by blast injury is very rare. Our patient presented with esophageal stricture in the context of a previous reconstruction of an esophageal rupture secondary to a distant air-blast injury. The ruptured esophagus was initially reconstructed with a left pedicled colon interposition in an antiperistaltic pattern. However, dysphagia developed 4 years later because of severe reflux-induced stenosis at the junction of the cervical esophagus and the left pedicled colon segment. A free isoperistaltic jejunal flap was performed to replace the cervical esophagus, with an anti-reflux Roux-en-Y colojejunosomy between the caudal segment of the left pedicled colon and the jejunum. The patient was discharged uneventfully 29 days later with smooth esophageal transit and no further reflux, as shown by scintigraphic scan. Esophageal reconstruction in an isoperistaltic pattern using a free isoperistaltic jejunal flap combined with an anti-reflux Roux-en-Y colojejunosomy has never been reported in the literature and appears to be an effective method to provide smooth passage of food and prevent restenosis of the esophagus. © 2011 Wiley-Liss, Inc. *Microsurgery* 31:331–334, 2011.

Esophageal perforation caused by blast injury is very rare. Only 42 cases have been reported in the literature since 1908.^{1–4} Iatrogenic esophageal injury, as seen with gastroendoscopic procedures, has been the most common cause of esophageal perforation over the last two decades. Other injuries include foreign body ingestion, trauma, and operative injury.⁵ Most perforation occurs in the hypopharynx or cervical esophagus, the normal anatomic narrowing of the esophagus.⁶

The traditional methods for esophageal reconstruction are gastric pull-up and colon segment interposition.⁷ Esophageal stricture in esophageal surgery is a common complication, with the incidence ranging from 20 to 27%. Common causes of esophageal stricture are ischemia and/or leak in the early postoperative period, postoperative radiation therapy in cancer patients, and reflux esophagitis in the late postoperative period.^{8,9}

In this report, we present a case of reconstruction of an esophageal stricture caused by a distant air-blast injury and complicated by a previous esophageal reconstruction

with left pedicled colon interposition. We not only used an isoperistaltic free jejunal flap to replace the esophageal stricture but also performed a Roux-en-Y colojejunosomy over the caudal end of the left pedicled colon flap and the jejunum. The combination of these procedures—never before reported in the literature—serves as an anti-reflux method to circumvent reflux esophagitis in esophageal reconstruction surgery.

CASE REPORT

A tank containing nitrogen exploded ~15 m away from where a 28-year-old female was working. Despite being struck by the subsequent shockwave, she did not suffer any skin wounds, with the exception of a swollen right eyelid. When seen at the hospital, 8 hours after the incident, the woman complained of right-sided chest pain and dyspnea. Chest radiography showed a right hydro-pneumothorax. Significant amounts of fluid were drained out by chest tube. An esophagram showed a leak at the thoracic esophagus.

Under the diagnosis of pneumatic esophageal rupture, the patient underwent a series of procedures, including right pleura decortication, cervical esophagostomy, thoracic esophagectomy, gastrostomy for decompression, and jejunostomy for feeding. There was a longitudinal tear (7 cm in length and 1.5 cm in width) in the thoracic esophagus close to the diaphragmatic hiatus with contamination of the right pleural cavity. The patient did not have any immediate complications after the first surgery. Three months later, she underwent esophageal reconstruction, pedicled antiperistaltic left colon segment interposition via the substernal route, using end-to-side anastomosis with the cervical esophagus and end-to-side

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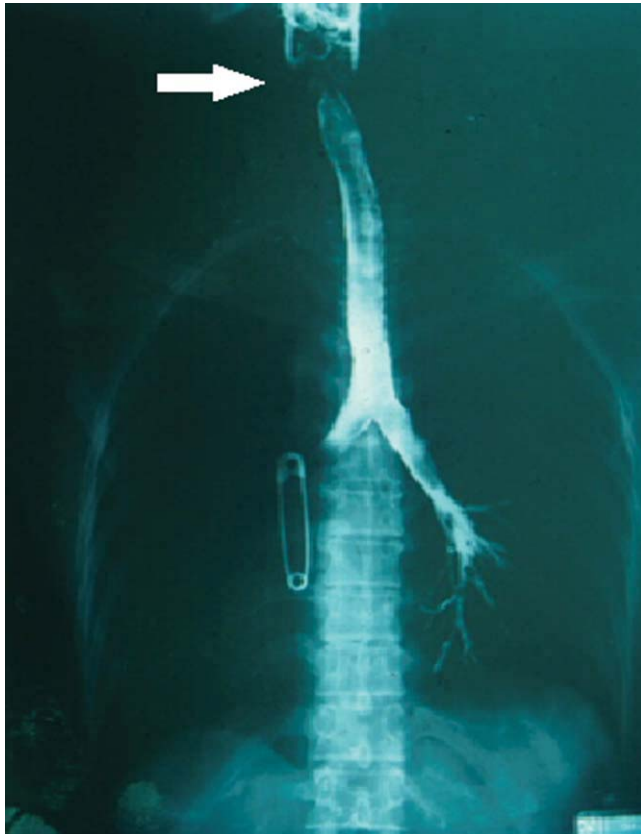


Figure 1. The contrast media was aspirated into the trachea and a narrowed cervical esophagus was noted in the chest radiograph. The arrow indicates the site of stricture. [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]

anastomosis to a jejunum loop. The perioperative period was smooth. However, the patient had worsening dysphagia in the following months. Four years later, she was admitted with severe aspiration pneumonia and hypochromic anemia. Although the endoscopic esophageal dilatation was performed every 2 weeks for 6 months, the esophageal narrowing persisted.

The patient presented to our outpatient clinic 8 years after the injury, with persistent dysphagia and subsequent poor oral intake. An esophagram was attempted and the chest radiography showed a narrowed cervical esophagus and contrast media aspirated into the trachea (Fig. 1). The esophagoscopy showed the colon segment with corrosive injury of the pharynx and cervical esophagus because of severe reflux.

In reconstruction procedures, the free jejunal flap was 15 cm in length and was harvested 30 cm distal to the ligament of Treitz. The free flap was based on the second jejunal artery with a concomitant vein. The flap was transferred to the left neck, with the left transverse cervical artery as a recipient artery and the left external jugular vein as a recipient vein. A 2-cm² window was created along the neck incision wound over the segment of the free jejunal flap and was covered with a skin graft as an access point for monitoring. We also performed an anti-reflux Roux-en-Y colojejuno-stomy (Fig. 2) in which the caudal end of the colon segment was anastomosed to the cephalic end of the ascending jejunal limb. A 50-cm ascending limb of jejunum was selected for the site of the end-to-side jejuno-jejunal anastomosis, which was subsequently performed between the side of the ascending limb and the proximal end of the jejunum.

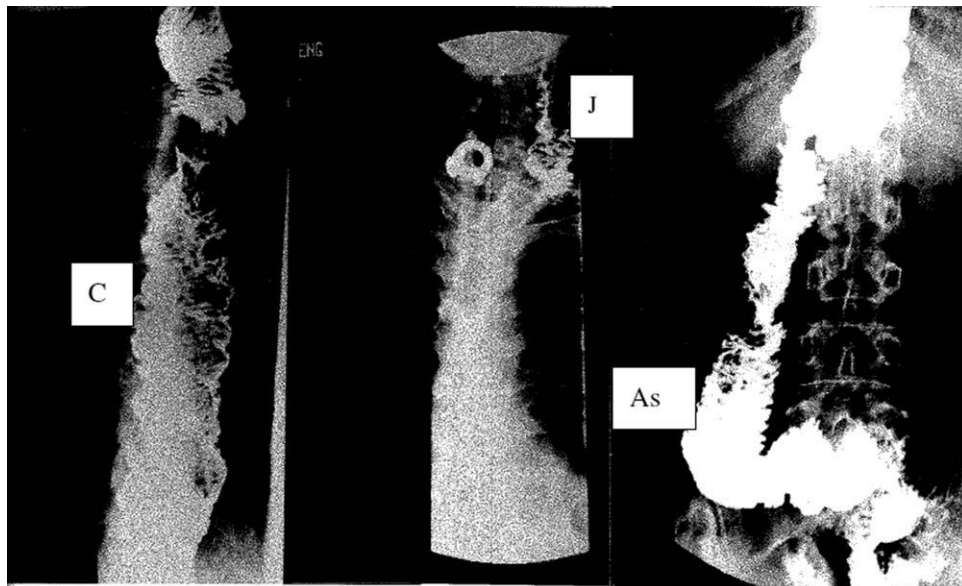


Figure 2. The design of surgery. The free jejunum flap is in the isoperistaltic direction for reconstruction of cervical esophageal stricture, and the anti-reflux Roux-en-Y colojejuno-stomy is as illustrated in the abdomen.

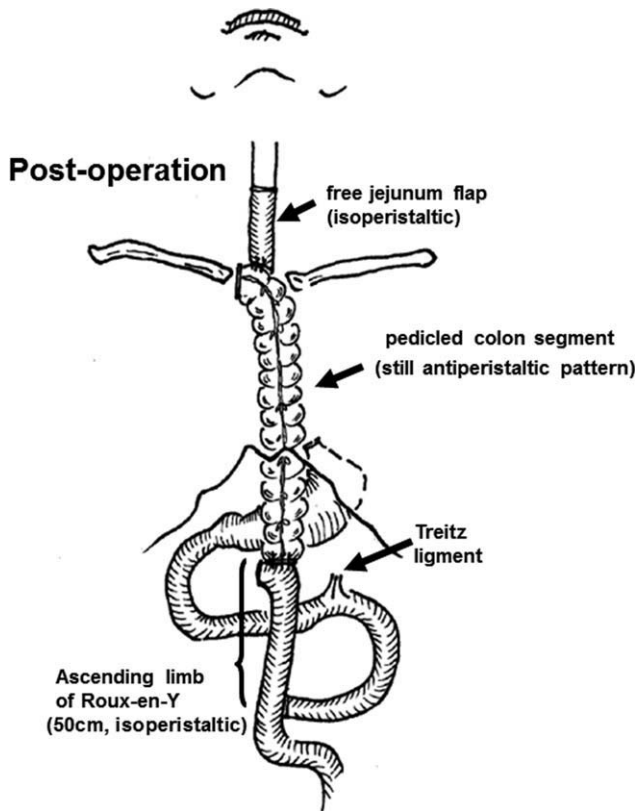


Figure 3. No more stricture was noted in esophagogram, 3 years later. (J: isoperistaltic jejunal flap; C: colon segment; As: ascending limb of jejunum in the anti-reflux Roux-en-Y loop.)

Techniques for monitoring of the free jejunal flap included: 1) Doppler echography for detection of jejunal vessels' patency, 2) observation of the color and motility of the free jejunal flap through a skin graft window,¹⁰ and 3) observation of motility with light palpation of the jejunal wall.

After surgery, the patient was sent to the surgical ICU for 1 day pending stabilization of cardiopulmonary status. Because the blood vessels appeared large in caliber with good blood flow, the patient required no anticoagulant or vasodilator during the perioperative period. Flatus passage began 2 days later and tube feeding via jejunostomy was started thereafter. The postoperative course was smooth and the wound healed without complication. The patient started oral intake 3 weeks postoperatively and she was discharged 29 days after surgery. She was doing well and her body weight increased 10 kg during the 3-year follow-up. She had smooth food passage with no further reflux, as shown by esophageal scintigraphy (Fig. 3).

DISCUSSION

Esophageal perforation from distant blast injury is very uncommon. In our case, the patient was about 15 m

away from the explosion. Only a few cases have been reported in the literature.¹ Four clinical features are usually noted: wounds/burns of the face or in the mouth, chest or epigastric pain, subcutaneous emphysema, and respiratory distress.

Pneumatic rupture of the esophagus has been reported mostly in the lower third of the esophagus.¹¹ Esophageal rupture is a dramatic event, carrying a mortality rate of up to 40%.¹² Indeed, misdiagnosis and delayed treatment may occur in more than 50% of the patients with spontaneous esophageal rupture.¹³ Therefore, early diagnosis is an important prognostic factor in this critical illness.

In this case, the diagnosis was made in a timely manner and subsequent management was uneventful. Esophageal reconstruction with left pedicled antiperistaltic colon interposition was performed without any immediate perioperative complication. The esophageal stricture which developed in the subsequent months may have resulted from ischemia. However, the esophageal stricture progressed gradually and may instead have been because of severe reflux esophagitis, which however rare has been reported in pedicled colon interposition for esophageal reconstruction.¹⁴ Isoperistaltic colon segment usually has a reasonable reservoir function and clearance that prevents regurgitation and aspiration.¹⁵ Our patient had a severe reflux esophagitis which resulted from an antiperistaltic pattern pedicled colon interposition for esophageal reconstruction.

Nonoperative management for progressive stenosis of cervical esophagus because of reflux includes anti-reflux medications, proper sleep postures to alleviate the reflux, and instrumental dilatations.¹⁶ Dilatation with instruments is a less invasive method and is effective in patients with esophageal stricture.⁸ In our patient, multiple attempts at endoscopic balloon dilatation were performed, given the severity of the esophageal stricture caused by reflux esophagitis. When the anatomical stenosis can not be reversed with conservative treatment, replacing the strictured esophageal segment with a skin flap or jejunal flap is indicated.¹⁷ We preferred a free isoperistaltic jejunal flap for the severe reflux esophagitis in our patient because of the associated benefits with regard to leak rate, stricture rate, and motility.

The esophageal reconstruction with a free isoperistaltic jejunal flap was combined with an anti-reflux Roux-en-Y colojejunostomy for duodenal diversion. The application of Roux-en-Y colojejunostomy for total duodenal diversion in esophageal stricture patients was initially advocated by Holt and Large.¹⁸ In esophageal reconstruction, the Roux-en-Y loop has been used with a pedicled colon segment for reflux esophagitis, especially when the use of an anti-peristaltic colon segment is chosen.^{19,20} A Roux-en-Y loop has also been performed in other anti-reflux procedures.^{21,22} The Roux-en-Y loop should be

longer than 40 cm to divert the duodenal contents and biliary-pancreatic secretions, to include more ectopic pacemakers and maintain a better isoperistaltic propulsion, and to prevent regurgitation into the reconstructed esophagus.^{23,24} For these reasons, we chose a Roux-en-Y loop as an anti-reflux procedure to replace the previous colon segment end-to-side anastomosis to a jejunum loop.

In summary, we propose a combination anti-reflux procedure for the reconstruction of esophageal stricture—which in this case was caused by distant air-blast injury and complicated by a previous esophageal reconstruction with the left pedicled colon interposition. Specifically, the combination is that of an isoperistaltic free jejunal flap to replace the stenotic cervical esophagus and a Roux-en-Y colojejunosomy to prevent the reflux esophagitis. In our experience, the combination procedure yields significant benefits with regard to smooth passage of food, prevention of reflux, and improvement in outcome.

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