ACS Case Reviews in Surgery
Vol. 5, No. 1

Giant Perforated Duodenal Diverticulum Management

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Background	Giant duodenal perforations (>2-3 cm) present a significant challenge, carrying high morbidity and mortality. These large perforations are infrequent and not typically amenable to omental patch or primary suture repair. This leads to increased technical difficulties not only in repairing the defect but also in diverting gastric and biliary flow away from the defect to allow for healing. Duodenal diverticula, as the etiology of such perforations, are rarely identified preoperatively, and the standard of care for management has yet to be established.
Summary	A 76-year-old otherwise healthy male presented with acute onset abdominal pain, focal peritonitis, leukocytosis, and imaging findings concerning for a duodenal perforation prompting emergent operative intervention. Intraoperative findings revealed a large duodenal defect secondary to a perforated duodenal diverticulum, precluding primary closure or Graham patch repair. Given the size and complexity of the perforation, we performed a pyloric exclusion, loop gastrojejunostomy, and placed feeding tubes and drains. The patient's postoperative course was prolonged and complicated by portal vein thrombus; however, he otherwise recovered appropriately. Management of his tubes and drains postoperatively was augmented by fluoroscopic studies and endoscopic intervention for direct visualization. A percutaneous transhepatic cholangiography tube diverted his biliary output and allowed refeeding of bile to prevent dehydration. After a prolonged hospital stay of two and a half months, the patient was discharged home with subsequent removal of all drains.
Conclusion	This case highlights the complex management of a rare giant perforated duodenal diverticulum. The size of the perforation precluded standard primary closure or omental patch repair, necessitating a multidisciplinary approach. Percutaneous transhepatic cholangiography (PTC) with drain placement by interventional radiology effectively diverted high-volume biliary flow, facilitating perforation healing and endoscopic evaluation by gastroenterology, enabling close monitoring of the perforation's healing progress and guided PTC drain management. Although giant perforations are rare, this case underscores the need for further discussion on optimal management strategies for giant duodenal perforations, particularly emphasizing the crucial role of multidisciplinary collaboration in achieving successful outcomes.
Key Words	giant duodenal perforation; duodenal diverticulum; pyloric exclusion; gastrojejunostomy

DISCLOSURE STATEMENT:
The authors have no relevant financial relationships to disclose.

FUNDING/SUPPORT:
The authors have no relevant financial relationships or in-kind support to disclose.

ACKNOWLEDGMENT/ARTIST CREDIT: Daniel Lara

RECEIVED: July 13, 2023
REVISION RECEIVED: December 13, 2023
ACCEPTED FOR PUBLICATION: January 24, 2024

To Cite: Reddington H, Nochur S, Cherng N. Giant Perforated Duodenal Diverticulum Management. *ACS Case Reviews in Surgery*. 2025;5(1): 15-18.

Case Description

A 76-year-old otherwise healthy male with no significant past medical history presented with acute onset of diffuse abdominal pain, accompanied by nausea, vomiting, fevers, and loss of appetite for two days. Upon evaluation, he was afebrile and hemodynamically stable with moderate abdominal distention and focal peritonitis in his right upper quadrant. Laboratory findings were notable for leukocytosis (20.2 K/uL). Abdominal CT imaging with IV contrast demonstrated a complex multiloculated fluid collection with extraluminal air in the right upper quadrant, abutting the duodenum, gallbladder, and transverse colon, with associated wall thickening (Figure 1).

Figure 1. Contrast-Enhanced CT Scan on Presentation. Published with Permission

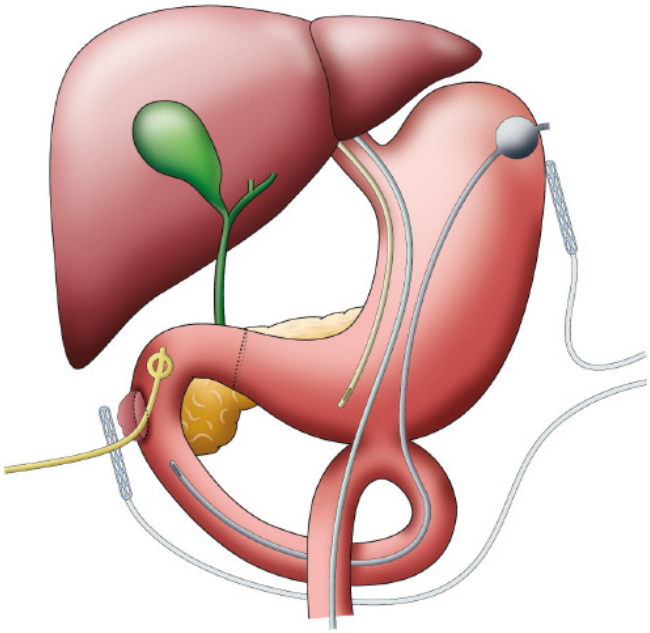
Note the perforated diverticulum in the second portion of the duodenum with a large associated abscess cavity outlined in red.

The patient was resuscitated with IV fluids and broad-spectrum antibiotics. Given concern for duodenal perforation, nasogastric decompression was initiated, and the patient was taken emergently to the operating room for surgical exploration.

We began the case with a diagnostic laparoscopy, which revealed an abscess cavity in the right upper quadrant secondary to a large 3 cm defect in the second portion of the duodenum. Due to the inadequate exposure via laparoscopy and the extent of the defect not amenable to Graham patch repair, we converted to an open laparotomy. With improved exposure, we identified a 4 cm duodenal perforation was identified on the lateral aspect of the second portion. Two 3 cm bezoars were extracted from the duodenal lumen. No palpable mass was detected, and the gallbladder appeared normal and uninvolved in this process.

To divert gastric flow from the proximal duodenum, we performed a pyloric exclusion with gastrojejunostomy (Figure 2). Given the size and friable nature of the perforation, primary repair or Graham patch was deemed infeasi-ble. We, therefore, placed a 20F Malecot drain into the perforation (duodenostomy), but securing it with surrounding tissue was not possible due to tissue friability.

Figure 2. Illustration of Postoperative Anatomy. Published with Permission



Surgical interventions include pyloric exclusion with gastrojejunostomy. The following tubes and drains were placed: nasogastric tube (gastric decompression); nasojejunal tube (post-anastomotic feeding); gastrojejunostomy tube (retrograde drainage); Malecot drain (perforation cavity into duodenum); and Jackson-Pratt drains (perforation cavity, left upper quadrant, and pelvis [not shown]).

Given the need for enteral feeding access, we opted for a nasojejunal tube placed distally, with a nasogastric tube for gastric decompression. To facilitate drainage, a Moss gastrojejunostomy tube was positioned in the fundus, its jejunal limb advanced into the proximal jejunum. We supplemented this with three 15Fr Jackson-Pratt drains: one in the abscess cavity, one pelvic, and one in the left upper quadrant near the gastrojejunostomy. Anticipating biliary drainage through the perforation site, a postoperative percutaneous transhepatic cholangiography (PTC) drain was placed by interventional radiology. The abdomen was closed, and the patient was transferred intubated to the ICU.

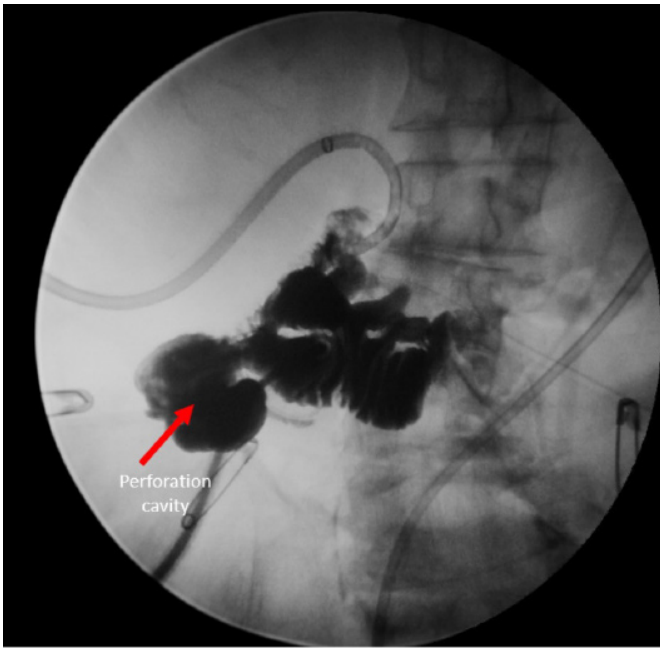
This patient underwent extubation on postoperative day (POD) 1. On POD2, PTC drain placement was performed for biliary decompression, followed by initiation of nasojejunal tube feeds on POD3. Upper gastrointestinal series on POD7 to evaluate the gastrojejunostomy demonstrated no anastomotic leak. Biliary drainage from the PTC was re-fed through his nasojejunal tube to reduce electrolyte derangements, improve absorption, and prevent dehydration. On POD9, the patient developed worsening abdominal pain and an uptrending leukocytosis. Subsequent CT abdomen/pelvis revealed a segmental portal vein thrombosis, prompting initiation of heparin anticoagulation, later transitioned to apixaban for a 6-month course.

Four weeks postoperatively, the patient underwent an IR cholangiogram demonstrating contrast flow beyond the perforation site without duodenal leak. Furthermore, a fluoroscopic study with contrast via the Malecot drain showed a contained perforation cavity and contrast passing distally through his gastrojejunostomy, ruling out obstruction (Figure 3).

During this time, his diet was advanced as tolerated with tube feeds via the nasojejunal tube for further nutritional supplementation. The JP drains sitting in his pelvis and left upper quadrant were removed, with the one over the perforation cavity remaining. Persistent bilious drainage from this JP prompted esophagogastroduodenoscopy (EGD) to better understand how his drains were positioned in relation to the cavity.

On POD52, EGD revealed healthy granulation tissue within the abscess cavity and visualized all drains. Under direct visualization, the JP drain was pulled back until it was just abutting the cavity, while the PTC and Malecot were more optimally positioned to be within the duodenal lumen, and the jejunal limb of the Moss tube was threaded anterograde into the jejunum for feeding. The nasojejunal tube was subsequently removed.

Figure 3. Contrast Study via Duodenostomy Tube One Month Postoperatively. Published with Permission



Contrast outlines a contained perforation cavity with free flow into the proximal and distal duodenum. No contrast extravasation is observed.

Post-EGD, the patient's JP drain was pulled back 2 cm every two days, culminating in complete removal on POD66. A follow-up CT scan with triple contrast administration (PO, IV, Malecot) demonstrated no extravasation. Subsequently, the Malecot drain was also serially withdrawn and removed on POD70. Cholangiography via the PTC on POD73 revealed no leak, prompting clamping of the drain. The patient was discharged on POD78 with both the PTC clamped and the moss tube capped.

At his two-week post-discharge clinic visit, the patient reported good tolerance of oral intake, normal bowel function, and no abdominal complaints. Consequently, both the PTC and moss tube were removed without incident.

Discussion

Large duodenal perforations are rare and exceedingly morbid conditions with unique considerations for management. With the widespread use of proton pump inhibitors and triple therapy for *H. pylori*-related peptic ulcer

disease, perforated duodenal ulcers have become less common, and giant duodenal perforations (>2-3cm) are a rare occurrence. While the exact incidence is not described in the literature, a 2005 study reviewing giant perforations at one institution found the incidence of perforations >3cm represents only 1.23% of all perforated duodenal ulcer cases.[1] The majority of discussion regarding management of these injuries is in the trauma literature, with no one surgical technique currently favored.[2,3] Operative management ranges from omental plug and triple tube techniques to pancreaticoduodenectomy. Pyloric exclusion, when employed with primary repair or plugging of the duodenal defect, has contributed to increased hospital stay (32.2 versus 22.2 days, P = 0.003) without mortality benefit.[3] Pyloric exclusion has not previously been described in the setting of drainage without repair of the duodenal perforation.

Duodenal diverticula are the second most common type of gastrointestinal diverticula after colonic diverticula. However, preoperative diagnosis in the setting of a perforation is uncommon.[4,5] Intervention for management primarily depends on patient presentation and comorbidities. With advancements in imaging and available technology, minimally invasive techniques such as percutaneous retroperitoneal drainage have been described.[4] The incidence of duodenal diverticula resulting in giant duodenal perforations is not readily described in the literature; a 2022 systematic review found perforation diameter data in only 0.23% of cases.[6] With friable tissue and larger perforation circumference, they did find this subset of patients tended to require operative intervention rather than minimally invasive drainage techniques, as occurred in our case.

Our surgical approach utilized a combination of diversion with pyloric exclusion and PTC drainage, with adequate wide drainage and enteral access. This strategy was chosen in lieu of a conservative, step-up approach due to the severity of the patient's peritonitis and the radiological evidence of extensive contamination.[6] Despite his long hospital stay, the patient ultimately recovered well and returned to his preoperative quality of life.

Conclusion

The management of giant duodenal perforations is not standardized due to their infrequency, and the addition of a duodenal diverticulum adds to the technical difficulty in a case. Despite the anatomical challenges, the management principles center around the same objectives: gastric and biliary diversion, adequate drainage of the perforation site, and early establishment of enteral feeding access.

Lessons Learned

Duodenal diverticulum as the source of perforation is rarely diagnosed preoperatively. Regardless of the etiology of perforation, wide drainage should be implemented to control contamination and prevent its progression. Collaboration with interventional radiology and gastroenterology can lead to creative and flexible methods for manipulating drains and ensuring desired postoperative progression. Establishing early enteral access is critical to maintaining nutrition status postoperatively.

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