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Diagnostic Challenges of Periampullary Adenocarcinoma in a Post-Ivor Lewis Esophagectomy Patient

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Background	With improved survival after esophageal cancer treatment, the incidence of second primary malignancies (SPMs) is expected to rise. Patients who have undergone esophagectomy and later require pancreatoduodenectomy pose unique challenges. Gastroduodenal artery (GDA) ligation, often necessary during pancreatoduodenectomy, can compromise the vascular supply of a gastric conduit. Previous reports describe various approaches: GDA preservation, ligation with reliance on collateral circulation, ligation with revascularization, or complete sacrifice of the gastric conduit with colonic interposition for reconstruction.
Summary	A patient with a history of Ivor Lewis esophagectomy for esophageal adenocarcinoma presented with jaundice and was diagnosed with ampullary adenocarcinoma. Axial imaging and angiography revealed the gastric conduit's sole vascular supply was the right gastroepiploic artery. While we were prepared for microvascular revascularization or colonic interposition if needed, we successfully performed a GDA-preserving pancreatoduodenectomy. Additionally, we performed a Roux-en-Y gastrojejunostomy instead of the standard loop to minimize conduit manipulation and ensure tension-free anastomosis. The patient recovered well and was eligible for adjuvant chemotherapy but declined this option.
Conclusion	Surgical management of SPMs in patients may be limited by prior therapies. In these situations, it is best for surgeons to consider conservative operative strategies for improved outcomes and timely additionally indicated treatments.
Key Words	pancreatoduodenectomy; esophagectomy
Abbreviations	gastroduodenal artery (GDA), carbohydrate antigen 19-9 (CA 19-9), esophagogastroduodenoscopy (EGD), endoscopic ultrasound (EUS), superior mesenteric artery (SMA), superior mesenteric vein (SMV), right gastric artery (RGA), pancreatic ductal adenocarcinoma (PDAC), cholangiocarcinoma (CCA), pancreatoduodenectomy (PD), length of stay (LOS), overall survival (OS), recurrence-free survival (RFS), renal cell carcinoma (RCC), squamous cell carcinoma (SCC), intraductal papillary mucinous neoplasm (IPMN)

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Case Description

Standard pancreatoduodenectomy for periampullary malignancies involves division of the gastroduodenal artery (GDA). However, this approach poses challenges when a patient has undergone a prior esophagectomy with a gastric conduit dependent on the right gastroepiploic artery (a terminal branch of the GDA), requiring alternative surgical strategies. Here, we present a patient with a history of Ivor Lewis esophagectomy who subsequently developed resectable ampullary adenocarcinoma.

A 58-year-old male presented with jaundice, dark urine, and pruritis. Labs revealed elevated bilirubin, liver enzymes, and carbohydrate antigen 19-9 (CA 19-9). CT scan demonstrated intra- and extrahepatic biliary and pancreatic ductal dilation without identifiable masses or strictures. Esophagogastroduodenoscopy (EGD) revealed an ampullary mass, and endoscopic ultrasound (EUS) confirmed a 2 cm malignant-appearing mass without lymphadenopathy. Biopsy confirmed invasive adenocarcinoma (T1cN0).

Three years prior, the patient was diagnosed with esophageal adenocarcinoma (cT3N0). Treatment included neoadjuvant chemotherapy followed by a standard open Ivor Lewis esophagectomy. During this operation, the left gastric and short gastric arteries were divided, and a conduit was fashioned from the greater curvature of the stomach, leaving the right gastroepiploic artery as the primary blood supply to the gastric conduit (Figure 1). Notably, pathology demonstrated a complete response to neoadjuvant therapy. The patient recovered well, requiring only occa-sional endoscopic dilations for dysphagia. At the time of presentation, he was two years post-esophagectomy with no evidence of recurrence.

Following a clinic discussion, the patient opted for surgical resection of the ampullary lesion. Preoperative angiography (Figure 2) delineated the gastric conduit's vasculature, confirming exclusive reliance on the right gastroepiploic artery and demonstrating no contributions from the SMA or short gastric arteries, as suggested by prior axial imaging (Figure 3). The patient completed a bowel prep the evening before surgery, allowing for the possibility of colonic interposition.

Figure 1. Schematic Illustration of Gastric Conduit Arterial Supply Post-Ivor Lewis Esophagectomy.

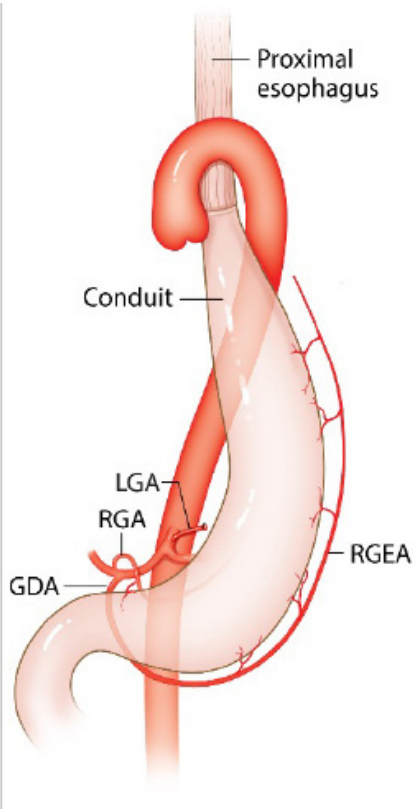
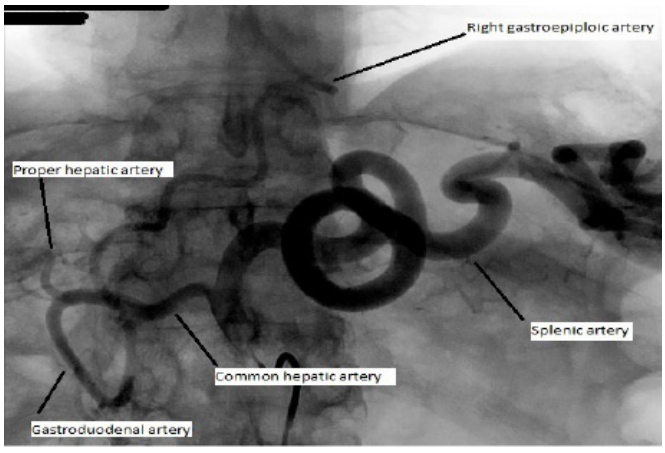
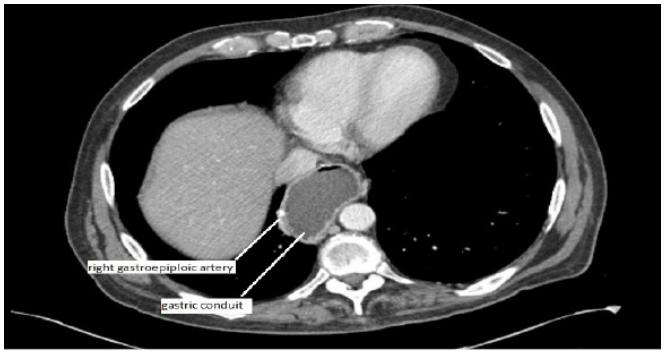


Figure 2. Preoperative Diagnostic Angiogram of Gastric Conduit. Published with Permission



Right gastroepiploic artery is the primary supply to the conduit following prior esophagectomy. Left gastric and short gastric arteries have been ligated. Right gastric artery, though likely patent, is diminutive.

Figure 3. Preoperative CT Scan (axial view). Published with Permission



Gastric conduit vascularized by the right gastroepiploic artery

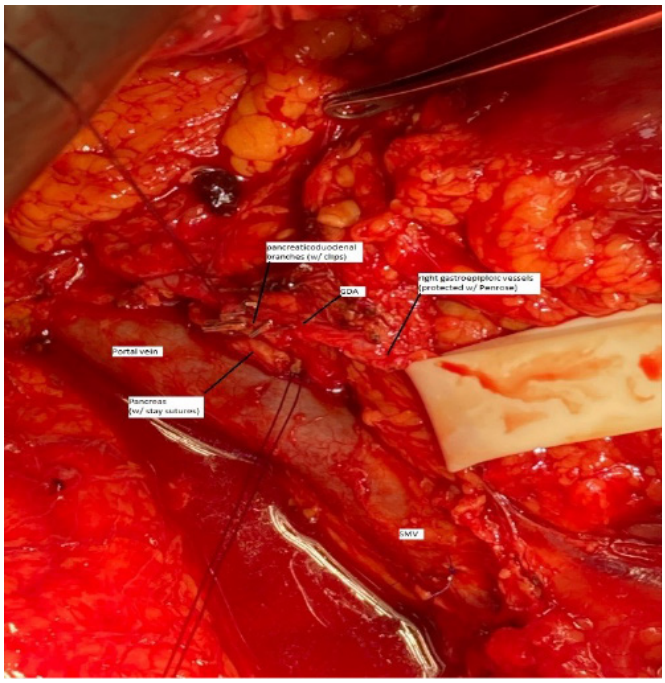
During the pancreatoduodenectomy, the gastric conduit was exposed, and the right gastroepiploic vessels were carefully isolated and protected. The gastroepiploic vein was traced to its superior mesenteric vein (SMV) insertion. The GDA was located in the porta hepatis, and dissection was carried distally, ligating superior pancreaticoduodenal branches. To address previous emptying issues and the tumor's ampullary location, the decision was made to resect the duodenum, favoring this over a pylorus-preserving approach.

The GDA dissection was continued, revealing its bifurcation into the right gastroepiploic artery supplying the conduit. Intraoperative ultrasonography was repeatedly used to confirm anatomy and adequate blood flow to the conduit. Despite slight vasospasm, the pulse remained palpable, and the conduit was well-perfused. The gastroepiploic vessels were gently retracted leftward using a Penrose drain to protect the pedicle while tunneling between the pancreas and portal vein (Figure 4).

A Blumgart pancreaticojejunostomy was performed, positioning the gastroepiploic vessels posterior to the anastomosis. The cephalad position of the gastric conduit and significant adhesions limited mobilization, necessitating a Roux-en-Y gastrojejunostomy instead of the standard loop procedure.

Pathological examination revealed a moderately differentiated pancreatic adenocarcinoma originating in the uncinate process with direct ampullary invasion. Focally positive margins were noted on the uncinate, vascular groove, and posterior surface, along with involvement of six of fourteen lymph nodes (pT2N2).

Figure 4. Intraoperative View of Intact Gastroepiploic Pedicle. Published with Permission



The patient's postoperative recovery was uneventful, and he was discharged on the fifth day. Following consultation with his local medical oncologist, he was deemed eligible for adjuvant multi-agent chemotherapy. However, the patient declined further treatment due to lingering side effects from previous chemotherapy regimens.

Discussion

The rising incidence of esophageal adenocarcinoma and improved survival rates suggest clinicians are increasingly likely to manage patients who develop second primary malignancies after esophagectomy.[2] In these cases, treat-ment approaches for resectable second primaries may face constraints due to the patient's prior surgical history.

In fit patients with resectable disease, esophagectomy is often the preferred local therapy for esophageal adenocarcinoma.[3] The most common procedures include transhiatal,[4] Ivor Lewis,[5] and McKeown esophagectomy.[6] Alimentary continuity is typically restored by using the stomach as a neo-esophagus or creating a gastric conduit. This conduit relies primarily upon the right gastroepiploic artery (RGEA)—a terminal branch of the GDA—with minor contributions from the right gastric artery (RGA).[7]

As the GDA is routinely ligated during pancreatoduodenectomy, post-esophagectomy patients requiring pancreatic resection present a unique challenge.

Literature on pancreatoduodenectomy modifications for patients with prior esophagectomy is limited, though some technical adaptations exist to preserve the GDA and RGA.[8] Our preferred approach, based on existing publications (Table 1), was GDA-sparing pancreatoduodenectomy.[9–17]

Table 1. Pancreatoduodenectomy After Esophageal/Gastric Cancer Resection Literature

Authors	Clinical History	Surgical Approach	Outcome
Ikeda et al. (*Arch Surg* 2006)[9]	Patient with previous esophagectomy with gastric conduit Presented with pancreatic cancer (PDAC)	GDA-preserving pancreatoduodenectomy (PD)	Length of stay (LOS) = 31 days; received adjuvant gemcitabine
	Patient with previous subtotal gastrectomy Presented with cholangiocarcinoma (CCA)	GDA-preserving PD with Roux-en-Y duodenojejunostomy	Overall survival (OS) = 3 years
Orii et al. (*Int J Surg Case Rep* 2019)[10]	Previous esophagectomy with gastric conduit Presented with PDAC	GDA-preserving PD with Roux-en-Y gastrojejunostomy	LOS = 36 days Recurrence-free survival (RFS) = 63 months
Okimoto et al. (*Int J Surg Case Rep* 2014)[11]	Previous esophagectomy with gastric conduit Presented with cholangiocarcinoma (CCA)	GDA-preserving PD	LOS = 46 days
Addeo et al. (*Langenbecks Arch Surg*)[12]	Previous esophagectomy with gastric conduit Presented with renal cell carcinoma (RCC) metastasis	GDA-preserving PD	LOS = 30 days
Fragulidis et al. (*J Gastrointest Surg 2011*)[13]	Previous transhiatal esophagectomy with gastric conduit Presented with PDAC	GDA-preserving PD	LOS = 15 days Received adjuvant gemcitabine RFS = 8 months (liver) OS = 14 months
Kurosaki et al. (*Surg Today* 2000)[14]	Synchronous esophageal squamous cell carcinoma (SCC) and intraductal papillary mucinous neoplasm (IPMN)	One-stage transhiatal esophagectomy and GDA-preserving PD	LOS = 43 days RFS = 7 weeks (esophageal anastomosis) s/p radiation therapy OS = 5 years
Uehara et al. (*Surg Today* 2004)[15]	Previous esophagectomy with gastric conduit Presented with IPMN	GDA-preserving PD	N/A
Hirashita et al. (*Surg Case Rep* 2019)[16]	Two patients, each with previous subtotal gastrectomy Presented with CCA	GDA-preserving PD	LOS = 18 and 29 days, respectively
Inoue et al. (*Surg Today* 2014)[18]	Previous esophagectomy with gastric conduit Presented with PDAC	PD with microvascular reconstruction (GDA)	LOS = 56 days RFS = 6 months

Okochi et al. (*Int J Surg Case Rep* 2015)[19]	Previous esophagectomy with gastric conduit Presented with PDAC	PD with microvascular reconstruction (middle colic)	LOS = 2 months
Minagawa et al. (*Surg Case Rep* 2020)[20]	Previous esophagectomy with gastric conduit Presented with PDAC	PD with microvascular reconstruction (middle colic)	LOS = 90 days Gastrojejunostomy leak managed conservatively Received adjuvant S-1 RFS = 15 months
De Garcia de la Vega et al. (*Acta Chir Belg* 2021)[21]	Synchronous esophageal and ampullary adenocarcinoma	One-stage esophagectomy, total gastrectomy, colonic interposition, and PD	Received adjuvant therapy Hepatic recurrence OS = 2 years
Belyaev et al. (*Langenbecks Arch Surg* 2009)[22]	History of severe chronic pancreatitis Presented with esophageal adenocarcinoma	One-stage esophagectomy, total gastrectomy, colonic interposition, and PD	LOS = 28 days RFS = 30 months
Jayaprakash et al. (*Patient Saf Surg* 2009)[23]	Synchronous esophagogastric junction and ampullary adenocarcinoma	One-stage esophagectomy, total gastrectomy, Roux-en-Y esophagojejunostomy, and PD	LOS = 22 days RFS = 6 months
Honig et al. (*J Pancreat Cancer* 2020)[24]	Previous McKeown esophagectomy with gastric conduit Presented with PDAC	PD with technically difficult duodenojejunostomy	LOS = 6 days DJ leak managed endoscopically

Should GDA preservation prove impossible, our alternative plans were:

- **Revascularization:** Anastomosing the RGEA to the remnant GDA[18] or the middle colic artery.[19,20]
- **Conduit Sacrifice:** If preserving the gastric conduit was impossible, we planned gastrectomy with alimentary continuity re-established via colonic interposition[21,22] or esophagojejunostomy.[23]

A single report describes a standard pancreatoduodenectomy with GDA ligation, relying on the RGA to supply the gastric conduit.[24] However, this was not feasible for our patient due to minimal RGA flow on angiography.

The decision to utilize a Roux limb for the gastrojejunostomy adds a unique element to this case. While most published reports describe a standard loop technique, only two prior cases document the Roux limb approach.[9,10] Given the anatomic location of the gastric conduit and associated adhesions, adequate mobilization for a loop gastrojejunostomy would have increased risk and potentially placed the anastomosis under excessive tension. A previous report where a standard loop technique was performed near the hiatus resulted in an anastomotic leak necessitating multiple reinterventions.[24] Mindful of this risk, and anticipating likely adjuvant therapy,[25] we prioritized minimizing potential complications for our patient. Notably, unlike many published case reports that detail postoperative issues or lengthy hospital stays, this patient fortunately avoided both.

Conclusion

This case demonstrates successful pancreatoduodenectomy after prior Ivor Lewis esophagectomy. Preservation of the gastroduodenal and right gastroepiploic arteries, along with a Roux-en-Y gastrojejunostomy, highlights the importance of surgical strategies that minimize morbidity in complex cases, facilitating timely adjuvant therapy.

Lessons Learned

As the incidence of secondary malignancies after esophageal cancer treatment increases, surgeons will likely encounter more cases where surgical approaches are influenced by prior therapies. Conservative operative strategies may improve patient outcomes and potentially expedite adjuvant therapy in complex scenarios. However, surgeons should always be prepared by developing contingency plans when operating on patients with complex surgical and oncologic histories.

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