Successful Whipple Procedure after Ivor-Lewis Esophagectomy with Right Gastroepiploic and Common Hepatic Artery Anastomosis

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Background	Pancreaticoduodenal resection, commonly known as a "Whipple" procedure, is performed to remove tumors from the head of the pancreas. In this operation, the gastroduodenal artery is ligated, and blood supply to the right gastroepiploic artery is lost. In most patients, perfusion to the greater curvature of the stomach is maintained by anastomotic flow from the left gastroepiploic artery. However, in patients with altered anatomy from previous surgery, blood flow through the right gastroepiploic artery is crucial to maintain viability of the greater curvature of the stomach.
Summary	A 74-year-old woman who previously underwent Ivor-Lewis esophagogastrectomy presented with malignancy in the head of the pancreas. The gastric conduit in this situation is supplied by the right gastroepiploic artery, which was predetermined by angiogram. Ligating the gastroduodenal artery, which is standard during pancreaticoduodenectomy, would compromise our patient's gastric conduit. Here we describe a pancreaticoduodenectomy with an anastomosis between the common hepatic artery and the right gastroepiploic artery in order to sustain blood supply to a gastric conduit created during prior Ivor-Lewis esophagogastrectomy. A mesenteric angiogram confirmed successful anastomosis between the two vessels and the patient recovered well from this operation.
Conclusion	Pancreaticoduodectomy can be successfully performed post-Ivor-Lewis esophagogastrectomy by creating anastomosis between the common hepatic artery and the right gastroepiploic artery.
Keywords	Esophagectomy, Ivor-Lewis, Whipple procedure, arterial bypass, right gastroepiploic artery anastomosis, common hepatic artery anastomosis

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Introduction

Surgical resection offers the best survival outcome to patients with carcinoma of the head of the pancreas.[1] Pancreaticoduodenectomy is generally credited to Allen Oldfather Whipple, who published a series of radical pancreaticoduodenectomies in 1935; this surgery is now colloquially known as a "Whipple" operation.[2]

In order to deem a patient eligible for a pancreaticoduodenectomy, CT scan is the study of choice for preoperative staging and resectability determination.[3] Borderline and locally advanced pancreatic and duodenal adenocarcinomas are classified relative to arterial encasement; less than 180 degrees is considered abutment, whereas greater than 180 is considered encasement.[3] Classically, in locally advanced cases, encasement of major vessels usually does not offer the technical option for reconstruction due to extension to the celiac axis or other major vasculature.

Arterial resection and bypass during pancreatecticoduodenectomy has been associated with high morbidity and mortality, and currently is not a standard treatment option for patients with pancreaticoduodenal adenocarcinoma.[1,4] However, there is increased interest among surgeons to be able to perform more complex resections that may be achieved with higher safety.[4] In concordance with these developing interests, we present a successful case of a patient who underwent pancreaticoduodenectomy with right gastroepiploic artery to common hepatic artery anastomosis in order to sustain blood flow to a gastric conduit that was created in a prior Ivor-Lewis esophagogastrectomy.

Case Description

A 74-year-old female with a past medical history of esophageal adenocarcinoma status post-Ivor-Lewis esophagogastrectomy presented to her primary care provider two years later with increased liver function tests and jaundice. A CT scan showed a 4.5 cm mass highly concerning for malignancy with intra and extrahepatic biliary dilation. Ca 19-9 was elevated at 1,927, and she had normal CEA. She was referred to gastroenterology, where she was diagnosed with malignancy of the pancreatic head and uncinate process. The patient underwent endoscopy, during which time they dilated the esophagogastric anastomosis; it also showed a normal stomach and one nonobstructing duodenal ulcer with a clean base (biopsied, negative for cancer).

During her prior Ivor-Lewis esophagogastrectomy, there was mobilization of her gastric conduit. This required ligation of the left gastric artery with preservation of the right gastroepiploic artery. Adequate length and mobilization of the stomach for the neoesophagus was obtained without Kocherization of the duodenum, and no pyloroplasty was performed. A right thoracotomy was used to access and resect the final specimen, and esophagogastric anastomosis was performed in the chest using a 25 end-to-end anastomosis stapling device. She suffered no leak in the postoperative period and recovered well. Her pathology demonstrated G3 poorly differentiated adenocarcinoma with uninvolved margins (T3N0). Neoadjuvant chemotherapy and radiation therapy were completed prior to her operation, and she did not require additional adjuvant therapy.

A staging CT scan was obtained and her pancreatic cancer was deemed resectable; however, the previous Ivor-Lewis esophagectomy left the patient with altered anatomy, which includes a gastric conduit (neoesophagus) that is supplied mainly by the right gastroepiploic artery. During a standard pancreaticoduodenectomy, the gastroduodenal artery (GDA) is ligated. If this were to be performed without arterial bypass, our patient would be at risk of ischemia to the gastric conduit. In order to avoid this devastating complication, the patient was consented for a pancreaticoduodenectomy with right gastroepiploic artery to common hepatic artery transposition or anastomosis. We obtained a preoperative mesenteric angiography to confirm patency and flow throughout her celiac axis, to identify any variant anatomy, and to determine the best options for mesenteric bypass or anastomosis (Figure 1).

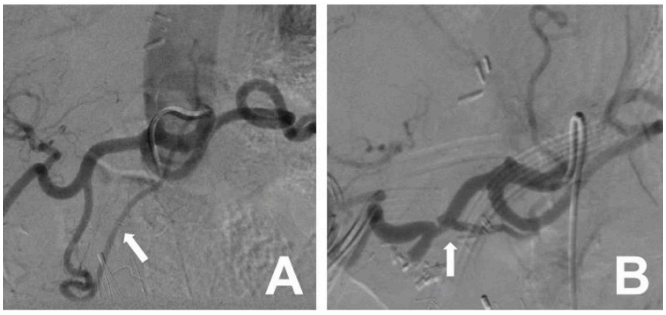

Figure 1. A) Preoperative mesenteric angiogram of the celiac axis showing supply of the gastric conduit via the right gastroepiploic artery (arrow). **B)** Postoperative mesenteric angiogram of the celiac axis showing anastomosis of the right gastroepiploic artery to the common hepatic artery (arrow).

We used a chevron incision for this operation. The right gastroepiploic artery was dissected out and a vessel loop was placed around it. The transverse colon at the level of hepatic flexure was mobilized, followed by dissection of duodenum from its retroperitoneal attachments. A Kocher maneuver was performed to expose the retroperitoneal structures. The fourth portion of the duodenum was then taken down with the ligament of Treitz, going above and below the transverse mesocolon. Because there was no previous Kocher maneuver or pyloroplasty, the dissection in this area was completed without significant inflammation or difficulty.

The mass was deemed resectable, and dissection was continued to the porta hepatis. The hepatic duct/common bile duct and GDA were visualized and dissected out. Vessel loops were placed around the GDA.

To preserve the gastric conduit flow for as long as possible, the GDA was not immediately transected. The specimen was dissected along the superior mesenteric vein, behind the pancreas, across the portal vein and above the superior edge of the pancreas. The pancreas was transected as was the duodenum just distal to the pylorus, ligating the right gastroepiploic at this time. The patient was then heparinized and an arteriotomy in the common hepatic artery was created. The mobilized right gastroepiploic artery was then transposed and anastomosed in an end to side fashion to the common hepatic artery, thereby preserving arterial inflow to the gastric conduit. Prior to reconstruction, patency was confirmed with Doppler evaluation, as well as completion angiogram via butterfly catheterization and contrast angiography on the table (Figure 1). We chose to anastomose the right gastroepiploic artery to the common hepatic artery instead of the GDA stump because the diameter of the common hepatic artery, tension on the anastomosis, and angulation of the anastomosis were superior. Intraoperative angiogram was performed which confirmed no thrombosis, flap, or dissection existed and to visually assess the flow through our anastomosis (Figure 1).

The pancreaticoduodenectomy procedure was completed with a hepaticojejunostomy, pancreaticojejunostomy, and antecolic gastrojejunosotomy. A Witzel jejunostomy tube was also placed, hemostasis was achieved, and the incision was closed. The patient tolerated the procedure well.

The patient's postoperative course was uncomplicated. She suffered from no postoperative gastric emptying issues, anastomotic leaks, or vascular complications related to her operation.

Discussion

Tumors with vascular involvement during a pancreaticoduodenectomy procedure can significantly increase the technical difficulty of the operation, or preclude a patient from surgery altogether, and have been well-described in multiple case series.[1,3] However, successful arterial reconstruction, like the one described here, opens the door for pancreaticoduodenectomy in patients who might have other types variant anatomy; this includes, patients with previous partial gastrectomy, roux-en-y bypass, and/or celiac stenosis. With vascular reconstruction, up to 20 percent of patients once deemed inoperable now may have a chance for successful surgical resection.[5]

In a retrospective study published by Tseng et al,[6] 110 patients underwent vascular reconstruction at the time of pancreaticoduodenectomy compared to 181 patients who underwent standard pancreaticoduodenectomy. The intervention group had a median survival of 23.4 months, which did not significantly differ from the 26.5 month survival in the standard resection group. A key point, however, was that pancreaticoduodenectomy with vascular reconstruction was shown to be better than nonoperative management.

These results are in concordance with a study by Gong et al,[7] which found that the median survival time of the 119 cases that received vascular resection and reconstruction during pancreaticoduodenectomy was 13.3 months. The postoperative complication incidence was 23.5 percent, and the mortality was 6.7 percent; for the group without vascular reconstruction, complications occurred in 8.2 percent of cases and mortality was 3.0 percent. Thus, while there was a significant difference between the two groups in terms of complication rate, the difference in mortality rates was not significant. Like the conclusion drawn by Tseng et al, the median survival time was greater in patients who underwent pancreaticoduodenectomy with vascular reconstruction compared to those of patients who had no operative management at all, undergoing only palliative treatment for pancreatic cancer.

Previous papers have reported operations in which arterial reconstruction was completed with splenic artery or GDA transposition[4,8] or venous reconstruction of the SMV.[1,5] However, extensive literature search has not yet identified a pancreaticoduodenectomy combined with vascular reconstruction due to altered anatomy from previous Ivor-Lewis esophagectomy. We were able to successfully reconstruct the blood supply to the patient's gastric conduit, allowing for R0 resection of her pancreatic adenocarcinoma. With increased likelihood for R0 resection utilizing vascular reconstruction in pancreaticoduodenectomy, there is hope for increased survival benefit for patients who would otherwise be managed nonoperatively.[5]

Conclusion

Pancreaticoduodectomy can be successfully performed post-Ivor-Lewis esophagogastrectomy by creating anastomosis between the common hepatic artery and the right gastroepiploic artery.

Lessons Learned

Patients with altered anatomy due to previous surgical history of esophagectomy with creation of a gastric conduit can still be candidates for pancreaticoduodenectomy. Despite ligation of the GDA in the resection of the duodenum, which would otherwise compromise the gastric conduit, right gastroepiploic blood flow can be sustained via transposition and anastomosis to the common hepatic artery.

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