

Pancreaticoduodenectomy: Minimal Invasive Resection

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Definition and historical background

Pancreaticoduodenectomy (PD) is defined as the resection of the pancreatic head, duodenum, bile duct, and gall bladder, with or without the distal stomach (pylorus-preserving) for benign or malignant disease in periampullary organs. Laparoscopic pancreatic surgery was first introduced for the staging of advanced pancreatic cancer in the early 1980s. Gagner and Pomp first introduced LPPPD in an advanced laparoscopic surgical trial in 1994. Subsequently, there has been technical progress in LPD that includes hand-assisted LPD as well as laparoscopic-assisted and robot-assisted pancreaticoduodenectomy. When compared to open pancreaticoduodenectomy (OPD), LPD potentially offers the recognized advantages of laparoscopic surgery, including faster postoperative recovery, improved cosmesis, and fewer wound complications. Furthermore, as LPD has comparable morbidity and mortality to OPD, it may be an acceptable alternative to OPD if the technical feasibility and safety of the procedure can be ensured for the treatment of benign or low-grade malignant lesions, and if oncologic outcomes are comparable with those of open procedures for advanced periampullary malignant disease.

1. Positioning and intraoperative preparation

The patient is placed in the supine position with pads underneath the right side of the back to elevate the right side of the abdomen. An anti-Trendelenburg (10-30°) position is used to expose the operation field. Two monitors are placed at the sides of the operator and first assistant. The operator and second assistant, who holds the laparoscope, stand to the right of the patient, and the first assistant and the scrub nurse are positioned to the left of the patient.

2. Placement of the trochar

An open technique is used to establish the pneumoperitoneum through a 12 mm trochar on the umbilicus. Abdominal pressure is maintained at 12 mmHg using CO₂ gas insufflations. An additional three or four trocars are placed under direct scope vision. Two or three 5 mm trochars (one on the right flank for the left hand of the surgeon and one or two on the left flank for surgical assistance if necessary) and two 12 mm trochars (one for the laparoscope and one on the umbilicus for the right hand of the surgeon) are employed.

3. Division of the duodenum or stomach and identification of the portal vein

The gastrocolic omentum is dissected to allow entry into the lesser sac, avoiding injury to the colon. The retropancreatic portal vein is identified at the inferior border of the pancreas and dissected soft tissue over the retropancreatic portal vein. We prefer early division of the duodenum to facilitate the subsequent dissection. The right gastroepiploic vessels are then transected to divide the duodenum. The gastrohepatic omentum is opened to exposed the hepatic artery and its branches. The right gastric artery is ligated using a metal clip or harmonic scalpel. After dividing the branches of the right gastroepiploic vessels along the duodenum, the duodenum is divided 2 cm distal to the pylorus using an endoscopic linear stapler. Resection of the gastric antrum can be performed according to the surgeon's own policy and technique. The stomach is placed in the upper region of the abdominal cavity. A triangular lesion (common hepatic artery, upper border of the pancreas neck, and gastroduodenal artery) is dissected to isolate the pancreas from the portal vein (tunneling) and gentle upward traction of the isolated pancreas is applied using cotton tape in preparation for the next step (division of the pancreas).

4. Mobilization of the right colon and duodenum and identification of the superior mesenteric vein

The right colon is mobilized downward and to the left side of the patient to expose up to the third portion of the duodenum. The coloduodenal flexure should be dissected smoothly along the avascular surgical plane while the assistant pulls the mesentery of the right colon to the left side. The gastrocolic trunk or branches of right gastroepiploic vessels are divided. Mobilization of the duodenum to the Treitz ligament is performed with traction of the duodenum toward the opposite side by the assistant. Careful traction of the duodenum should be performed to prevent perforation of the duodenum. This allows the third and fourth portions of the duodenum to be fully exposed and the duodenum can be separated from the root of the mesentery and dissected with effective visualization. This Kocher maneuver continues to the left renal vein and aorta.

5. Dissection of the porta hepatis

Cholecystectomy is performed. Occasionally, the gall bladder can be used for traction of the liver when the liver is displaced downwards. Lymph node dissection can be performed after opening the gastrohepatic ligament to visualize the superior border of the pancreas and common hepatic artery. Careful dissection of the bile duct should be performed to avoid injury to the accessory or replaced hepatic artery from the superior mesenteric artery travelling posterior to the common bile duct or the low-lying right hepatic artery travelling anterior to the bile duct, especially in the presence of pancreatitis or cholangitis. Division of the common bile duct is executed 2 cm-3 cm proximal to the duodenum. The gastroduodenal artery is isolated and divided using a hemo lock clip or a vascular endoscopic stapler. The portal vein can be exposed clearly after division of the common bile duct and GDA. If further dissection of the lymph nodes or soft tissues around the common hepatic artery (CHA) is required, the CHA can be mobilized and traction can be applied in an upward direction to make the dissection easier. The soft tissue around the portal vein can be easily cleared using ultrasonic shears. A bulldog clamp can be placed on the proximal part of the transected bile duct until reconstruction of the bile duct begins.

6. Division of the neck of the pancreas

Portal vein and superior mesenteric vein (SMV/PV) and its venous tributaries to the uncinate process and the head of the pancreas can be exposed after division of the pancreas neck. We prefer to use ultrasonic shears to divide the pancreas with minimal bleeding. Pancreatic duct can be identified after an upward fine dissection of the pancreatic parenchyma from the inferior border. Retraction of the pancreas parenchyma using cotton tape to separate the portal vein/SMV helps prevent injury to the portal vein. The remaining pancreatic stump is trimmed by 1 cm-2 cm to invaginate the pancreas into the jejunum for the pancreaticojejunostomy.

7. Transection of the proximal jejunum

The peritoneal duodenojejunal flexure (Treitz ligament) is incised to resect the proximal jejunum from the mesentery, taking care not to injure the inferior mesenteric vein, until the third portion of the duodenum can be seen. The jejunal mesentery 10 cm-15 cm distal from the Treitz ligament is divided along the mesenteric vascular arch and mesenteric vessels are ligated. The jejunum is transected with an endoscopic linear gastrointestinal stapler. This procedure can be performed at the right side of the Treitz ligament after pulling the jejunum through the retroduodenal space.

8. Division between the superior mesenteric artery (SMA) and the uncinate process

After division of the neck of the pancreas, detailed features of the tributaries of the portal or superior mesenteric vein can be seen, including the coronary veins and the superior and inferior pancreaticoduodenal veins draining to the portal vein. To aid in the dissection and to control any unexpected bleeding from the portal vein or superior mesenteric vein, umbilical cotton tape is applied to the portal vein and superior mesenteric vein, respectively, just above the splenic vein and the first jejunal vein. After dividing the tributaries from the first jejunal branch, the soft tissue near the SMA should be dissected to identify one or two inferior pancreaticoduodenal arteries. The specimen is placed in a specimen bag and retrieved at the end of procedure either through the 2 cm-3 cm extension of the umbilical port or a separate Pfannenstiel incision. The specimen bag containing the gall bladder is removed at the same time.