

Laparoscopic pancreaticoduodenectomy with segmental resection of superior mesenteric vein-splenic vein-portal vein confluence in pancreatic head cancer: can it be a standard procedure?

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The feasibility of laparoscopic pancreaticoduodenectomy (LPD) in the treatment of pancreatic cancer is still disputed. However, advances in surgical technique and accumulating experience have led to the use of LPD with combined vascular resection and reconstruction as a safe and feasible procedure, especially in pancreatic cancer with major vascular involvement. A 64-year-old woman presented with obstructive jaundice secondary to pancreatic head cancer. Contrast abdominopelvic computed tomography revealed a pancreatic head tumor measuring approximately 22 mm in diameter that was abutting the first jejunal branch of the superior mesenteric vein at an angle of $< 180^\circ$. The patient underwent LPD, which failed to resect the pancreatic head tumor invading the superior mesenteric vein. Consequently, segmental resection of the confluence of the superior mesenteric vein, splenic vein, and portal vein (SMV/SV/PV) was completely performed in laparoscopic approach without complication. The patient recovered without any event and was discharged on postoperative day 9. LPD combined with vascular resection and reconstruction is feasible in cases involving major blood vessels. Further surgical expertise and education are required before LPD can be used as a standard procedure. ([Ann Hepatobiliary Pancreat Surg 2018;22:419-424](#))

Key Words: Laparoscopic pancreaticoduodenectomy; Minimal invasive surgery; Vascular resection; Vascular reconstruction

INTRODUCTION

No randomized controlled studies have compared the open and laparoscopic approaches to distal pancreatectomy. Nonetheless, with advances in laparoscopic techniques and increased surgical expertise, laparoscopic distal pancreatectomy is considered safe and effective in treating benign and low-grade malignant tumors of the pancreas.^{1,2} In fact, laparoscopic radical pancreatectomy is suggested as a technically feasible and oncologically safe intervention in well-selected cases of left-sided pancreatic cancer.³⁻⁵

Conversely, the use of laparoscopic pancreaticoduodenectomy (LPD) remains controversial, especially in the

treatment of pancreatic cancer, where it can increase the risk of cholangitis and pancreatitis, interfering with efforts to obtain a margin-negative resection. In addition, pancreatic head cancer carries a risk of unexpected major vascular involvement. In particular, the superior mesenteric vein (SMV), portal vein (PV), or confluence of the SMV, splenic vein (SV), and PV may be involved, warranting surgery for combined vascular resection and appropriate vascular reconstruction.⁶⁻¹⁰

However, few studies have reported the technical and oncological feasibility of LPD combined with venous vascular resection.¹¹⁻¹⁷ In the current report, we present the case of a patient with pancreatic head cancer who underwent successful LPD with segmental resection of the

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SMV–SV–PV confluence, resulting in negative surgical margins.

CASE

Preoperative evaluation

A 64-year-old woman presented with general weakness, poor oral intake, and jaundice. The patient had a history of hypertension and a recent diagnosis of diabetes. She also reported weight loss (–8 kg) during the previous 3 months.

The physical examination showed no abnormal findings other than those mentioned above. Her body mass index was 22.48 kg/m², and her initial laboratory findings are summarized in Table 1.

The woman showed high levels of serum total bilirubin (6.9 mg/dL), alkaline phosphatase (1,090 IU/L), and γ -glutamyl transferase (1,079 IU/L) suggesting obstructive jaundice. Preoperative imaging (Fig. 1) revealed a pancreatic head mass and secondary dilatation of the intrahepatic and extrahepatic bile ducts, suggesting pancreatic head cancer. The finding suggested that the tumor was a resectable pancreatic cancer with no distant metastasis. To resolve obstructive jaundice, the patient underwent endoscopic retrograde cholangiopancreatography with biliary drainage.

Operation

The woman underwent LPD on April 4, 2018. As a standard procedure, three 5-mm trocars and three 12-mm trocars were used in this procedure (Fig. 2). Laparoscopy

confirmed the absence of clinical evidence associated with peritoneal seeding or liver metastasis, and the gastrocolic ligament was divided by dissection. The colonic mesentery was detached from the pancreatico-duodenal unit and right gastroepiploic vessels. The right gastric vessels were dissected and ligated. The duodenum was divided using an endo-GIATM stapler. The pancreatic neck was dissected and encircled using a nylon tape. The common bile duct was dissected, isolated, and divided, followed by cholecystectomy.

Next, the soft tissue around the left side of the celiac axis, common hepatic artery, and hepatoduodenal ligament was dissected. The proximal jejunum was divided using the endo-GIA stapler approximately 20 cm distal to the Treitz ligament. The proximal jejunum was passed under the mesenteric root into the patient's right side. At this point, it was found that specific parts of the SMV could not be dissected away from the pancreatic head area. Therefore, the neck of pancreas was divided using monopolar cautery. The SV was isolated, ligated, and divided, and laparoscopic bulldog clamps were applied to the proximal and distal parts of the SMV–PV system (Fig. 3A). The venous vascular structure was divided, and the tumor was excised. Using a 5-0 monofilament, vascular reconstruction was performed in an end-to-end fashion (Fig. 3B, 3C).

Subsequently, pancreaticojejunostomy (duct-to-mucosa, all interrupted, two-layer, and short stent) and hepaticojejunostomy (posterior continuous, anterior all interrupted, and single layer) were completed laparoscopically. The specimen was placed into an endo-pouch, which was

Table 1. Initial preoperative laboratory findings

Blood laboratory items	Values
WBC / Hb / Platelet count	4,570/ μ L / 12.2 g/dL / 203,000/ μ L
Glucose / HbA1c	181 mg/dL / 8.1%
BUN / Cr	7.2 mg/dL / 0.54 mg/dL
SGOT / SGPT	449 IU/L / 263 IU/L
Total bilirubin	6.9 mg/dL
ALP / γ -GT	1,090 IU/L / 1,079 IU/L
Amylase / Lipase	237 IU/L / 134 IU/L
Cholesterol / Total protein / Albumin	270 mg/dL / 7.1 g/dL / 4.1 g/dL
CA19-9 / CEA	7.91 ng/ml / 35.4 U/ml

WBC, white blood cells; Hb, hemoglobin; HbA1c, glycated hemoglobin; BUN, blood urea nitrogen; Cr, creatinine; SGOT, serum glutamic oxaloacetic transaminase; SGPT, serum glutamic pyruvic transaminase; ALP, alkaline phosphatase; γ -GT, γ -glutamyl transferase; CA 19-9, cancer antigen 19-9; CEA, carcinoembryonic antigen

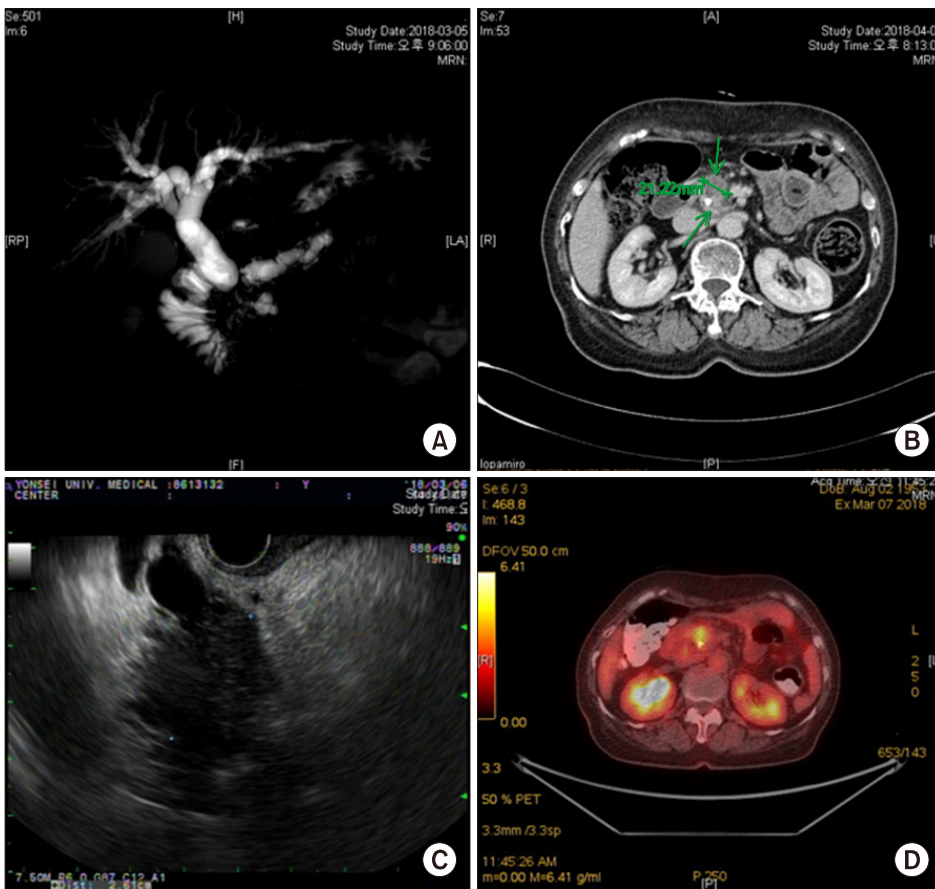


Fig. 1. Preoperative imaging. (A) Magnetic resonance cholangiopancreatography revealed a pancreatic head mass leading to the bile duct, as well as pancreatic duct dilatation. (B) Contrast abdominopelvic computed tomography revealed a pancreatic head tumor measuring around 22 mm in diameter that was abutting the 1st (jejunal) branch of the superior mesenteric vein at an angle of <180°. (C) Endoscopic ultrasonography revealed a solid mass in the pancreatic head measuring 26.1 mm in diameter, with a suspicious duodenal wall invasion. (D) Positron-emission tomography-computed tomography demonstrated significant fluorodeoxyglucose uptake in the pancreatic head lesion, suggesting malignancy (D).

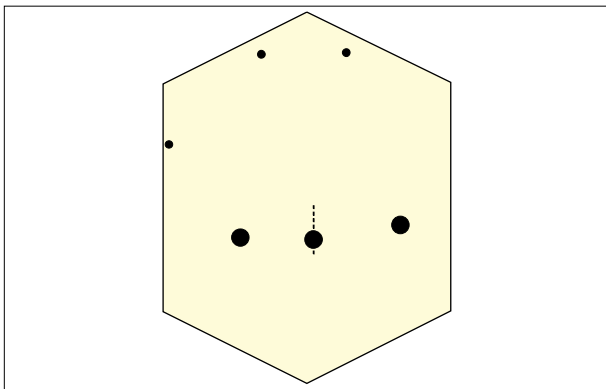


Fig. 2. Port placement for laparoscopic pancreaticoduodenectomy.

then removed through a small periumbilical extension of the wound through which manual duodenojejunostomy was performed.

Bilateral, two-armed, closed suction drains were inserted around the surgical bed. All trocar insertion sites were repaired using a skin stapler. The entire procedure lasted 480 min, including 39 min of vascular clamp time. Intraoperative blood loss was estimated at 500 ml, without

the need for intraoperative transfusion.

Postoperative course

The patient’s recovery was uneventful, without any pancreatic fistula. Her surgical drains were removed on postoperative day 6. A follow-up computed tomography was performed on postoperative day 7 with no PV thrombosis, stricture, or other surgical complications (Fig. 3D). The patient was discharged 9 days after the operation without any complications.

Pathological examination

Pathological diagnosis confirmed the tumor as a moderately differentiated T2 ductal adenocarcinoma measuring 3.5×1.9 cm in size, involving the common bile duct. No lymphovascular invasion was found; however, perineural invasion was noted. A total of 18 lymph nodes were retrieved with no lymph node metastasis (N0, Stage IB). All the resection margins, including the retroperitoneal margin, were negative.

DISCUSSION

Recently, several studies have reported the feasibility and safety of LPD (Table 2). Indeed, a recent meta-analysis found that LPD has several advantages compared with open pancreaticoduodenectomy (OPD), such as reduced intraoperative bleeding, shorter hospital stay after surgery, fewer complications, and shorter time to postoperative chemotherapy.¹⁸⁻²³

Despite advances and increased expertise with laparo-

scopic surgical techniques such as LPD combined with major vascular resection, only a few studies have addressed this topic. Nonetheless, all of these studies reported that LPD is feasible and safe if conducted by an experienced surgeon, even with major vascular resection. To date, laparoscopic surgery has not usually been attempted in cases involving major blood vessels. However, the results of LPD to date have been comparable to, or better than, those of OPD. In particular, the largest study, which was published by Croome et al.,¹² reported the re-

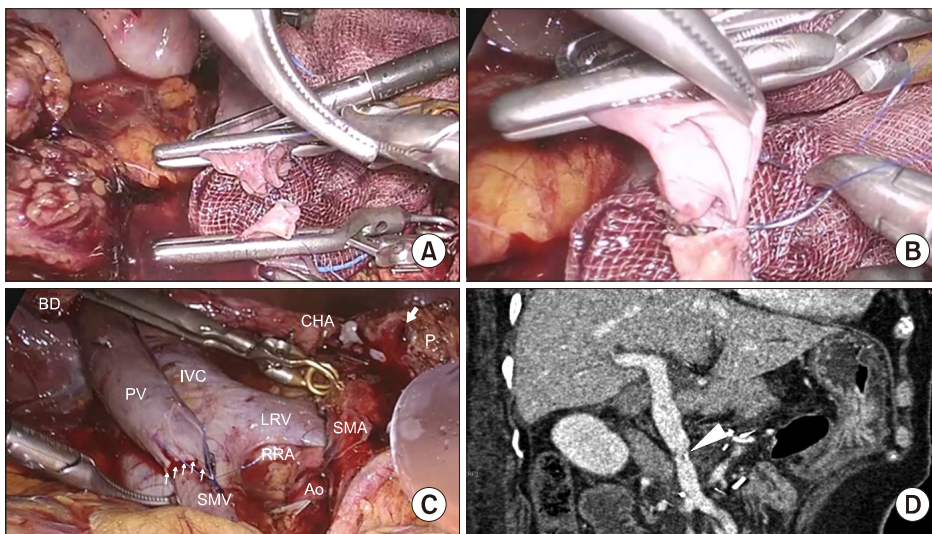


Fig. 3. Intraoperative and post-operative findings. Ao, aorta; BD, bile duct; CHA, common hepatic artery; LRV, left renal vein; PV, portal vein; RRA, right renal artery; SMA, superior mesenteric artery; SMV, superior mesenteric vein. Labels: pancreatic duct (short white arrow); anastomosis site (multiple small white arrow); vascular patency confirmed (large white arrow head).

Table 2. Studies reporting laparoscopic pancreaticoduodenectomy combined with venous vascular resection

Authors, year	N	Vascular resection type	Op. time (min.)	Clamp time (min.)	EBL (mL)	Transfusion (%)	LOH	Morbidity (%)	Mortality (%)
Present, 2018	1	EEA	480	39	500	No	9	No	No
Cai et al. 2018 ¹¹	18	Wedge: 8 EEA: 6 Graft: 4	448	32	213	11.1	13	33.3	0
Dokmak et al. 2018 ¹³	4	Parietal peritoneum patch	397	54	437	25	NA	25*	0
Khatkov et al. 2017 ¹⁵	8	Wedge: 5 EEA: 1 Graft: 2	560	51.5	450	NA	15	25 (12.5)	12.5
Croome et al. 2015 ¹²	31	Wedge: 22 EEA: 7 Graft: 2 *HA-GDA: 1	465	46.8	841	NA	6	35 (6.4)	3.2
Palanisamy et al. 2015 ¹⁶	1	EEA	412	45	200	No	10	No	No
Kendrick et al. 2011 ¹⁴	11	Wedge: 10 EEA: 1	413	35	500	NA	7	54.5	0

OP, operation; EBL, estimated blood loss; EEA, end-to-end anastomosis; HA, hepatic artery; GDA, gastroduodenal artery; LOH, length of hospital stay

sults of LPD combined with major vascular resection. They successfully demonstrated not only the feasibility and safety of LPD with major vascular resection, but also its association with similar perioperative surgical outcomes such as OPD with major vascular resection.

However, these encouraging reports must be carefully interpreted, because technical feasibility may not be an indication for surgery. Instead, indications should be general clinical conditions that are amenable to standardized, well-documented, and validated surgical management with acceptable morbidity and mortality. In this regard, acute cholecystitis and empyema of the gallbladder may illustrate the concept of *surgical indication* in the laparoscopic era. In the past, acute cholecystitis was regarded as a contraindication for laparoscopic cholecystectomy.^{24,25} However, with accumulating experience and reports showing the technical feasibility, effectiveness, and safety of the laparoscopic approach, the disease finally became an accepted surgical indication for laparoscopic cholecystectomy.²⁶⁻²⁹

In the case of LPD, the safety of the procedure is still unclear.^{21,30} In addition, publication bias must be considered in that researchers tend to report selected cases with favorable results, but not worse perioperative outcomes that are less likely to be accepted for publication. Acceptance of LPD with combined major vascular resection as a standard technique requires additional reports and assessments. In this regard, Table 2 shows that only rare cases have been reported from specialized centers. Ideally, a randomized, controlled study is desirable. However, few surgeons are currently proficient in this technique, and its safety.

Therefore, periampullary malignant pathology cannot be regarded as an indication for LPD combined with major vascular resection. It is only indicated in selected cases and when conducted by surgeons specializing in both minimally invasive and open pancreaticoduodenectomy. Surgeons need to be able to rapidly compensate for any unexpected intraoperative event or perioperative complication. To begin with, a detailed and systematic surgical educational program for LPD must be established to ensure the safe introduction of LPD for beginning surgeons.

In summary, we have reported a successful case of LPD with segmental resection of the SMV-SV-PV confluence and end-to-end anastomosis to treat pancreatic

head cancer. This case demonstrates the technical and oncological feasibility of this advanced laparoscopic approach to pancreatic cancer. However, patient selection criteria, surgical qualifications, and educational strategies need to be established before this surgical procedure can become the standard of care, to ensure patient safety.

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