

Case Report

Laparoscopic distal pancreatectomy for left-sided pancreatic cancer in patients with radical subtotal gastrectomy for gastric cancer

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After radical subtotal gastrectomy (RSTG) for stomach cancer, the remnant stomach is supposed to be perfused through the short gastric vessels. What if a patient who received previous RSTG is diagnosed with resectable distal pancreatic cancer? Can radical distal pancreatectomy (DPS) be performed safely without ischemic damage to the remnant stomach? Unfortunately, there are limited studies on this specific clinical issue. Notably, in spite of rare clinical presentation, it is expected to increase due to prolonged survival of patients with resected gastric cancer. Therefore, we aimed to demonstrate the safety and feasibility of the radical DPS in patients with previous RSTG. In this study, we investigated perioperative and long-term survival outcomes of DPS for left-sided pancreatic cancer in patients with previous RSTG.

Key Words: Distal pancreatectomy; Gastrectomy; Laparoscopic; Remnant stomach

INTRODUCTION

The incidence of pancreatic cancer is relatively low among gastrointestinal tract cancers, however, 5-year survival is still poor and there has been no improvement in the last 20 years [1]. At the time of diagnosis, most pancreatic cancer cases are already locally advanced or metastatic with the resectable disease accounting for only 10% of the total cases [2]. The 5-year survival of pancreatic cancer ranges from 2% to 9% in published literature, which is the most dismal prognosis among all the gastrointestinal tract cancers [1,3,4].

For patients diagnosed with resectable disease, radical sur-

gery with a negative resection margin is the only treatment that provides a chance of cure. Unfortunately, up to 75% of patients experience recurrence after surgery, thus, adjuvant chemotherapy after surgery is recommended.

Minimally invasive (laparoscopic or robot-assisted) distal pancreatectomy (DP) has been increasingly adopted in surgical practice for pancreatic cancer over the last decade [5]. However, without randomized controlled trials, the oncologic efficacy of minimally invasive distal pancreatectomy (MIDP) remains controversial. Nonetheless, MIDP, when performed by an experienced expert surgeon, can be regarded as a preferred treatment approach for pancreatic body or tail cancer [6]. Outcomes are improved after MIDP as compared to open DP, without obvious downsides in high-risk subgroups [7].

Gastric cancer is one of the most frequent cancers in Korea [8]. Early diagnosis of gastric cancer is consistently increasing due to the recent expansion of endoscopic evaluation for routine medical check-ups, and long-term survival is expected after curative treatment. Pancreatic cancer often occurs later during the long-term follow-up period after radical subtotal gastrectomy (RSTG) for gastric cancer. In clinical circumstances of resectable pancreatic body or tail cancer in patients with previous RSTG for gastric cancer, is laparoscopic distal pancreateo-

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splenectomy (DPS) feasible and appropriate treatment option? Is blood perfusion in the remnant stomach well preserved after DPS?

Herein, we present two consecutive patients who underwent successful laparoscopic DPS for left-sided pancreatic cancer after RSTG for gastric cancer. The purpose of this study was to prove the technical feasibility and safety of laparoscopic DPS after RSTG for gastric cancer.

CASES

Case 1

A 78-year-old male patient with abdominal discomfort was diagnosed with advanced gastric cancer, Borrmann type II, after an esophagogastroduodenoscopy (EGD). He underwent RSTG with Billroth II anastomosis (with incidental cholecystectomy) in 2011. A pathologic report confirmed moderate differentiated tubular adenocarcinoma with submucosal invasion without lymph node metastasis (T1bN0M0-stage Ia). The patient had regular postoperative follow-up without adjuvant chemotherapy. A follow-up computed tomography (CT) scan in 2016, showed a 1cm-sized pancreatic mass with distal pancreatic duct dilatation (Fig. 1A), and subsequent endoscopic ultrasonography and fine-needle aspiration (Fig. 1B) was performed, showing a few clusters of highly dysplastic epithelial cells, suggestive of malignancy.

The patient underwent laparoscopic DPS with splenectomy. Intraoperative findings showed prominent adhesion around the left-sided pancreas under previous gastrojejunostomy (GJ) site without major vascular structure invasion. The gastro-splenic ligament was securely divided and after the division of the pancreatic neck, both splenic artery and vein were con-

trolled at the origin. After meticulous adhesio-bandylysis, retroperitoneal dissection was performed to obtain a safe tangential margin of the pancreas (Fig. 1C). After completion of the laparoscopic DPS, it was confirmed that remnant gastric perfusion was well preserved (Fig. 1D).

The patient recovered without complications and was discharged on a postoperative day (POD) #9. On pathologic examination, the lesion on the pancreas body was confirmed as moderately differentiated adenocarcinoma of 2.1 cm × 1.3 cm (pT2) in size. There was no lymphovascular invasion, however, perineural invasion was noted. The resected pancreatic margin was reported to be free from tumor. Lymphatic metastasis was not noted (0/6, pN0). The patient was treated with 6 cycles of adjuvant chemotherapy (Gemcitabine) and is on regular follow-up without evidence of tumor recurrence.

Case 2

A 75-year-old female patient with recurrent epigastric pain underwent evaluation and an EGD biopsy showed early gastric cancer on the anterior wall of the lesser curvature. The patient underwent an endoscopic submucosal dissection procedure, and the resection margin was basal 200 μm (submucosal 2 invasion). Subsequently, the patient received laparoscopic RSTG with Billroth II anastomosis. The patient was on regular follow-up without evidence of recurrence for 12 years postoperatively. Later, due to elevated tumor markers (carcinoembryonic antigen 9.02 ng/mL, carbohydrate antigen 19-9 146.0 U/mL), the patient underwent a PET-CT scan (Fig. 2B) and a mass with intense FDG uptake in the pancreatic tail was found.

A biliary CT (Fig. 2A) scan was done to check the major vessel anatomy and variation, and a laparoscopic DPS was performed. In the operative findings, there was moderate adhesion

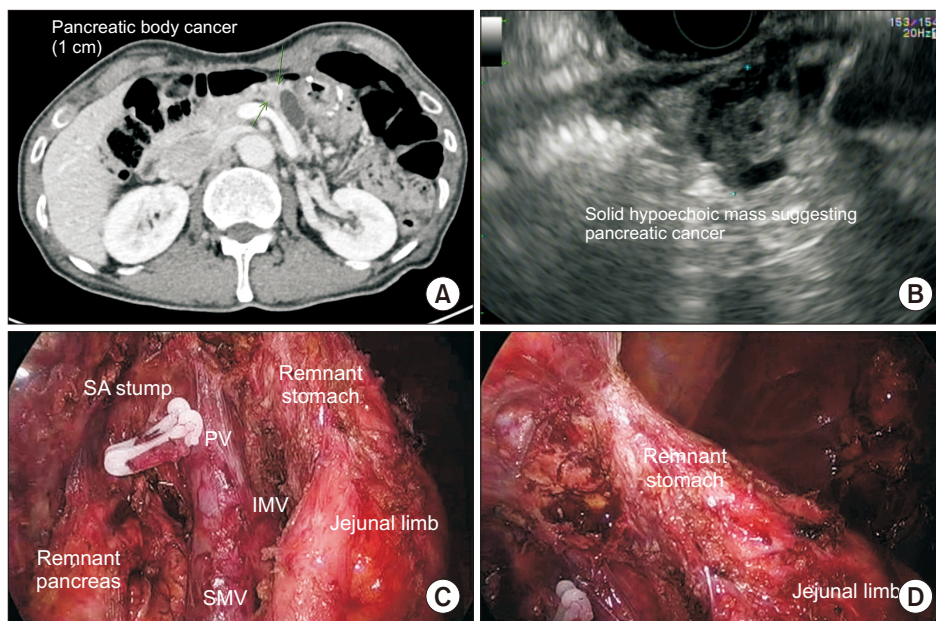


Fig. 1. (A) Preoperative computed tomography, (B) preoperative endoscopic ultrasound, (C) final view of the distal pancreatectomy, (D) well preserved perfusion of the remnant stomach. SA, splenic artery; PV, portal vein; IMV, inferior mesenteric vein; SMV, superior mesenteric vein.

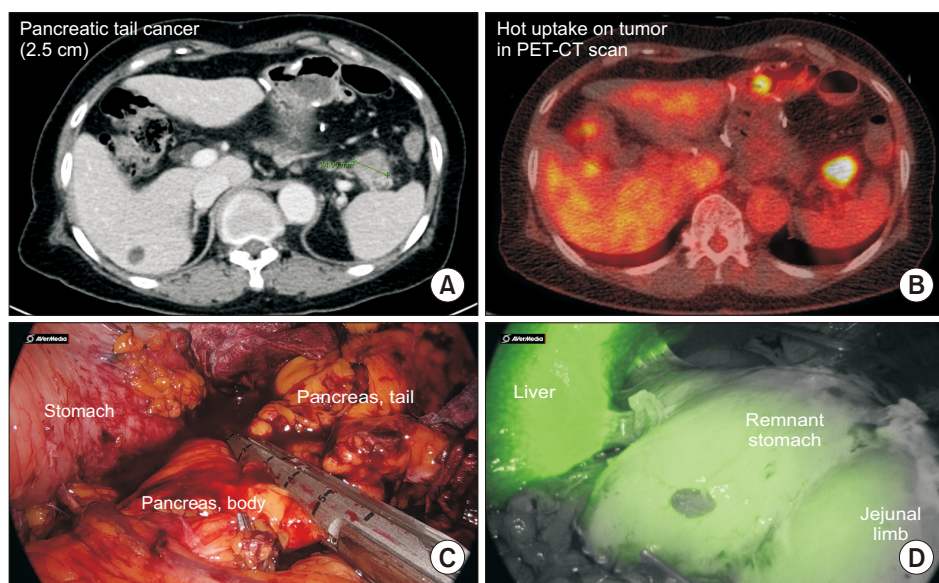


Fig. 2. (A) Preoperative computed tomography (CT), (B) preoperative positron emission tomography-computed tomography (PET-CT), (C) division of the pancreas by modified lasso technique, (D) well preserved perfusion of the remnant stomach confirmed by indocyanine green technology.

around the distal pancreas between the remnant stomach without invasion of the splenic artery or vein. The gastrosplenic ligament and splenicocolic ligament were divided gently, and the pancreas was divided and dissected from the retroperitoneum. DPS was completed by modified lasso technique after ligating the splenic artery (Fig. 2C) and the perfusion of the remnant stomach was confirmed by indocyanine green (ICG) technology (Fig. 2D). After the surgery, the patient had uneventful progress on POD without surgical complications, and was discharged on POD #7.

Pathologic report revealed pT2 cancer with perineural invasion without lymphovascular invasion. The pancreatic paren-

chymal and duct resection margin was free of carcinoma (safety margin: 0.4 cm), and the circumferential margin showed an extension of carcinoma. One out of 5 lymph nodes was positive for metastatic carcinoma (pN1). The patient is scheduled for adjuvant chemotherapy (considering low-dose Gemcitabine/Xeloda).

Institutional experiences of DP in patients with previous radical gastrectomy

Table 1 shows 6 serial cases of our experiences of DP in patients with previous RSTG. The median age at the time of DP was 66.5-year-old (95% confidence interval [CI], 58.41–74.59

Table 1. Cases of distal pancreatectomy (DPS) for pancreatic cancer after radical gastrectomy for gastric cancer

No. of patients	Age (yr)/sex	Previous gastrectomy	Time interval (mon)	Approach for DP	Splenectomy	Stage of PDAC	EBL (mL)	Op. time (min)	LOH (day)	Complication	Postop. adjuvant chemotherapy	Survival since DPS
1	71/Male	STG B2	240	Open	O	pT2N0 Stage IIa	1,700	790	53	DGE	O	30 mon Death
2	59/Male	STG B2	196	Open	O	pT1N0 Stage Ia	250	475	14	None	O	57 mon Alive
3	62/Female	Lap TG	48	Open	O	pT3N1 Stage IIb	1,300	270	9	None	O	31 mon Death
4	58/Male	STG B1	48	Open	X	pT1N1 Stage IIb	50	240	10	None	O	31 mon F/U loss
5 (case 1)	74/Male	STG B2	60	Laparoscopic	O	pT2N0 Stage Ib	50	279	9	None	O	60 mon Alive
6 (case 2)	75/Female	Lap STG B2	144	Laparoscopic	O	pT2N1 Stage IIb	200	160	7	None	O	6 mon Alive

STG, subtotal gastrectomy; TG, total gastrectomy; DP, distal pancreatectomy; PDAC, pancreatic ductal adenocarcinoma; EBL, estimated blood loss; Op., operative; Postop., postoperative; LOH, length of hospitalization; DGE, delayed gastric emptying, stage of PDAC was based on AJCC 8th staging; F/U, follow-up.

Time interval: mean = 122.67 mon, 95% confidence interval = 35.27–210.06 mon; Op. time: mean = 369.00 min, 95% confidence interval = 126.63–611.37 min.

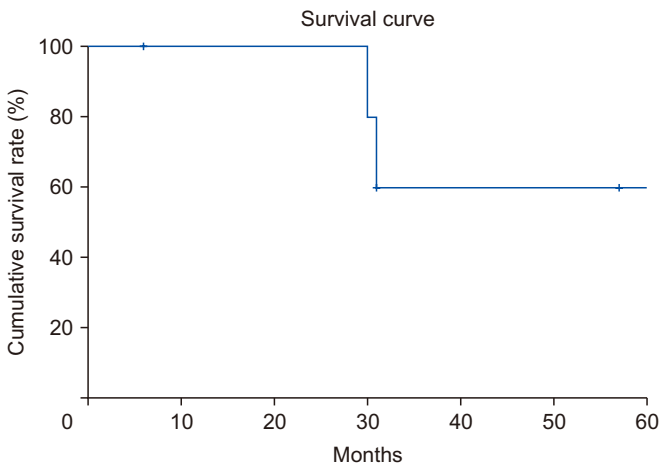


Fig. 3. Long-term oncologic outcomes of patients who underwent radical distal pancreatectomy for pancreatic cancer following previous radical gastrectomy for gastric cancer.

years). Four patients were male and two patients were female. The operative methods were RSTG with Billroth I anastomosis in 1 patient, RSTG with Billroth II anastomosis in 3 patients, laparoscopic radical total gastrectomy in 1 patient, and laparoscopic RSTG with Billroth II anastomosis in 1 patient. The median interval between radical gastrectomy and DP was 122.67 months (95% CI, 35.27–210.06 months). In the second operation (DP), the median estimated blood loss was 591.67 mL (95% CI: –163.21 to 1,346.54 mL) and intraoperative transfusion was done in 2 patients. In the perioperative outcomes, the median operation time was 369 minutes (95% CI, 126.63–611.37 minutes) and the length of hospital stay was 17 days (95% CI, –1.67 to 35.67 days). All the patients received postoperative adjuvant chemotherapy. The mean survival time after radical DP was 48.2 months (95% CI, 35.53–60.87 months) (Fig. 3).

DISCUSSION

According to our previous reports [9,10], the bloodless and margin-negative resection are the most important factors in

the surgical treatment of left-sided pancreatic cancer. Based on this observation, we developed the potential tumor conditions that can lead to the bloodless and margin-negative resection in left-sided pancreatic cancer using the “Yonsei criteria” [11]. Based on these criteria, minimally invasive radical DPS has been carefully applied to well-selected patients for left-sided pancreatic cancer [12]. In particular, the Yonsei criteria were set as the inclusion criteria for pancreatic cancer in the recent multicenter prospective randomized control study comparing open and laparoscopic DPS [12], suggesting the Yonsei criteria as a valuable surgical indication for safe and effective laparoscopic radical DPS. With the validation of our surgical techniques and evidence of the oncological effects of neoadjuvant chemotherapy, currently, laparoscopic DPS has been expanded to tumors exceeding Yonsei criteria [13]. To date, no prospective randomized controlled studies are comparing laparoscopic and open DPS for left-sided pancreatic cancer; however, laparoscopic DPS is carefully regarded as a safe and effective treatment option in well-selected pancreatic cancer patients.

Clinical investigation of pancreatectomy in patients with previous RSTG has been reported, and most literature are related to the technical feasibility and safety of pancreaticoduodenectomy (PD) after RSTG [13-15]. In fact, our group also published technical notes for PD in patients with previous radical gastrectomy for gastric cancer [16]. However, there are no reports of subsequent DPS in patients with previous RSTG. To the best of our knowledge, this is the first report showing the technical feasibility and safety of laparoscopic DPS for left-sided pancreatic cancer in patients with previous RSTG for gastric cancer.

Is laparoscopic DPS in patients with previous RSTG technically feasible and safe? Two issues should be considered; intra-abdominal adhesion and the potential risk of ischemic gastropathy in the remnant stomach after DPS.

Since the pancreas is located behind the stomach, considering the location of GJ after RSTG, adhesions that occur after RSTG is an important factor in determining the success of laparoscopic DPS for resectable pancreatic cancer. In particular, the anatomic area around the common hepatic artery, left gastric artery, and splenic artery, which are the areas for lymph node

Table 2. Radiological evidence of collateral blood supply to the remnant stomach on pre- and post-distal pancreatectomy state

No. of patients	Age (yr)/Sex	Previous gastrectomy	Time interval (mon)	Radiological evidence of collateral blood supply to the remnant stomach	
				Pre-distal pancreatectomy	Post-distal pancreatectomy
1	71/Male	STG B2	240	No evident enhance of collaterals	Collateral arteries from CHA and left IPA
2	59/Male	STG B2	196	Thin enhanced collateral artery from left IPA	Evident collateral arteries from left IPA and SMA
3	62/Female	Lap TG	48	Total gastrectomy status	Total gastrectomy status
4 ^{a)}	58/Male	STG B1	48	Thin enhanced collateral artery from left IPA	Evident collateral arteries from left IPA and SMA
5 (case 1)	74/Male	STG B2	60	Thin enhanced collateral artery from left IPA	Evident collateral arteries from left IPA and SMA
6 (case 2)	75/Female	Lap STG B2	144	Evident collateral arteries from left IPA and SMA	Evident collateral arteries from left IPA

STG, subtotal gastrectomy; TG, total gastrectomy; IPA, inferior phrenic artery; CHA, common hepatic artery; SMA, superior mesenteric artery.

^{a)}Spleen preserving distal pancreatectomy.

dissection during previous RSTG, and near the GJ can be accompanied by severe adhesion. Therefore, the relationship between the potential pancreatic division line for margin-negative resection and this adhesion area could be an important factor in predicting successful laparoscopic DPS in patients with previous RSTG. Unlike the first case, the second case was clearly less adherent near the GJ site and the potential division line of the pancreas was left to the previous GJ. In this case, the pancreas was transected safely via a modified lasso technique [17].

Regarding potential postoperative ischemic gastropathy, we retrospectively reviewed the radiological evidence of collateral blood supply to the remnant stomach in pre- and post-distal pancreatectomy state (Table 2). On the preoperative CT scan, the patients showed thin enhancing collateral vessels from the left inferior phrenic artery, and SMA and these collaterals got more prominent after DP. Fig. 4. Shows the examples of prominent collateral vessel formation after DP (Fig. 4A, 4B), and one of the patients (case 2) already had prominent collateral vessels

even in pre-distal pancreatectomy state (Fig. 4C). These observations suggest that the remnant stomach can be consistently vascularized by the enforced collateral vessels after DP despite the thin or absence of the collateral vessels in the remnant stomach before DP. Recently, ICG has been demonstrated as an emerging technology for confirming organ perfusion during operation [18,19]. For instance, a Japanese group reported the use of digital subtraction angiography of the remnant stomach to evaluate vessel perfusion after DP [20]. When applied to all of the present cases, the ICG showed perfusion of the remnant stomach to be well preserved despite dividing all gastrosplenic ligaments including short gastric vessels. The preservation of the remnant stomach perfusion was also confirmed by the absence of complications related to ischemia of the remnant stomach after laparoscopic DPS. According to our institution's experience, collateral vessels excepting left gastric artery and short gastric vessel are developed during the interval period after RSTG, and they maintain the perfusion of the stomach without ischemic gastropathy in spite of DPS after RSTG.

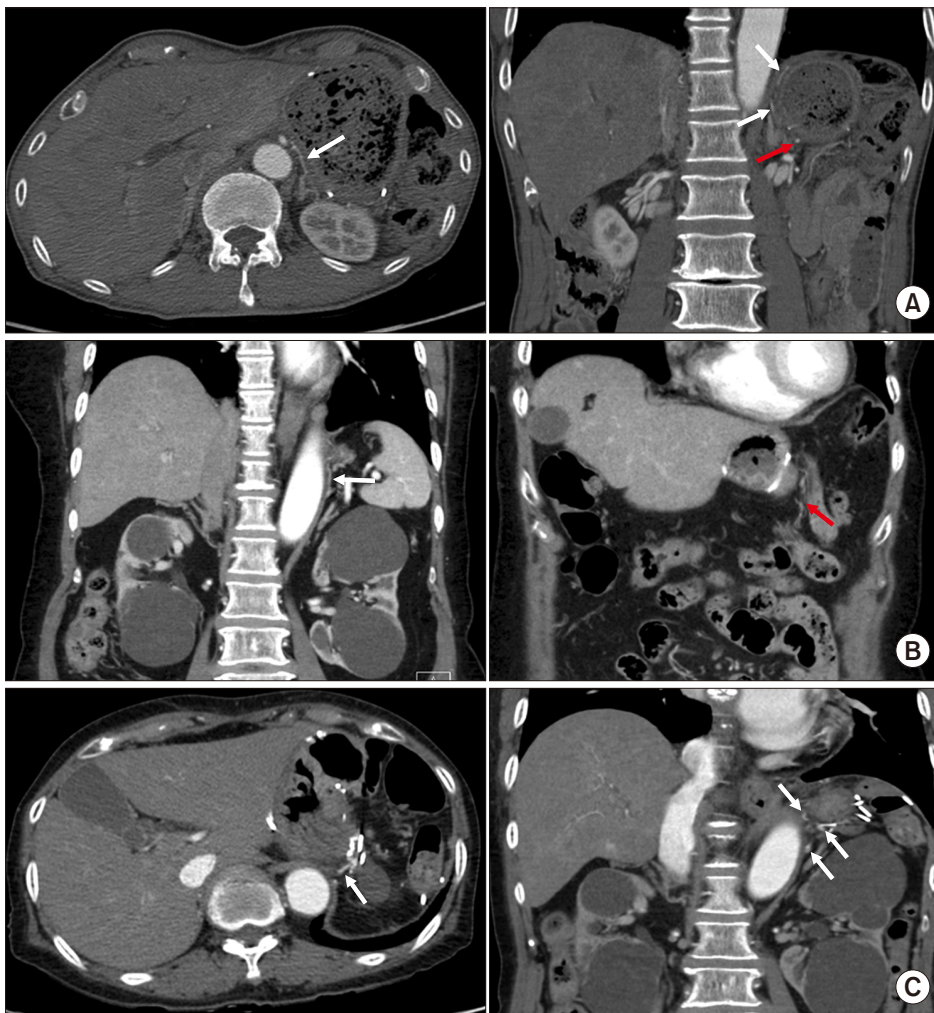


Fig. 4. Radiological (axial and coronal) evidence of the collateral vessels supplies to the remnant stomach. (A) Case 1: after distal pancreatectomy. Case 2: before (B) and after (C) distal pancreatectomy. White arrows indicate left inferior phrenic artery; red arrows, jejunal branch from superior mesenteric vein.

In conclusion, laparoscopic DPS in patients with previous RSTG is feasible and safe. In this study, improved long-term oncologic outcomes were reported. Considering long-term survival after radical gastrectomy for gastric cancer, cases of second primary left-sided pancreatic cancer found during follow-up are also expected to increase in near future, which will be one of the challenges for pancreatic surgeons. Individualized pancreatectomy should be conducted considering not only oncologic safety but also the patient's general safety. Further study based on accumulating clinical experiences is needed.

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CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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AUTHOR CONTRIBUTIONS

Conceptualization: WJL. Data curation: KHL. Methodology: SK. Visualization: HKH. Writing - original draft: SSH. Writing - review & editing: CMK.

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