

Case Report

Laparoscopy-Assisted Pancreaticoduodenectomy for Pancreatic Head Tumor at a Japanese Cancer Institute

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Laparoscopic surgery is a less invasive treatment option for tumors in the intraabdominal organs; however, the safety and indication of laparoscopic or laparoscopy assisted pancreaticoduodenectomy (LPD) is still controversial. We attempted LPD in four cases for intraductal papillary mucinous neoplasm (IPMN) located in the pancreatic head and we report the surgical records and short-term outcome. LPD was carried out in four patients including three patients with the combined type IPMN and one with the branch type, based on the *International Consensus Guidelines*. None of the patients had invasive carcinoma based on preoperative imaging diagnosis. Laparoscopic procedures were performed until isolation of the pancreas head and duodenum, and final resection of PD and intestinal reconstruction were performed using small incision laparotomy (7-8cm). The mean total operating time was 882 minutes (820-932 minutes), mean blood loss was 925ml (610-1550ml) and red cell transfusion was not required in any patients. One patient underwent reoperation for bleeding at the pancreaticojejunostomy site at day 1. Mean duration until patients were able to walk was 3.5 days (2-6 days) and duration of use of analgesia was limited to within 7 days. Grade B pancreatic fistula was observed in one patient and jejunal ileus was observed in one patient. There were no deaths. LPD was safely performed and blood loss was limited, although the operating time was long. Postoperative recovery in patients without complications might be better than the conventional PD under laparotomy. Future study is necessary.

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Introduction

Surgical resection is the only curable treatment for low grade malignancy of the pancreas, and pancreaticoduodenectomy (PD) is usually selected in such cases as well as pancreatic carcinomas.¹ However, extended lymphadenectomy and complete resection of nerve plexus are not necessary for low grade malignancy of the pancreas.^{1,2} Although some reports have shown limited resections of the pancreatic head in comparison with the conventional PD, a large incision of

the abdominal wall or complicated procedures are necessary, and postoperative complications such as pancreatic fistula cannot be avoided.^{1,3} In surgical treatments for low grade malignancy of the pancreas, a less-invasive treatment modality would improve the postoperative quality of life of patients. Recently, the use of laparoscopic procedures has rapidly spread for treatment of intraabdominal malignancies. This technique has also been applied in distal pancreatectomy in low grade malignancy of the pancreatic body or tail such as an intraductal papillary mucinous neoplasm (IPMN), and

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the validity of laparoscopic distal pancreatectomy has been recognized.^{4,5} With respect to PD, some expert surgeons have used this technique for pancreatic head tumors;⁶⁻¹⁰ however, this method is not used worldwide at this stage. Nevertheless, laparoscopic or laparoscopy assisted PD (LPD) is a promising and less invasive surgical option for low grade malignancy of the pancreas. To confirm the feasibility and postoperative outcomes of LPD, we used LPD in four patients with IPMN at a Japanese cancer institute and here we discuss the clinical significance and problems.

METHODOLOGY

We experienced four patients with IPMN located in the pancreas head in the Division of Surgical Oncology, Department of Surgery, Nagasaki University Hospital (NUH) between January and October 2010. Informed consent for operative procedure and data collection were obtained from each patient. Clinical and pathological findings were followed by the *International Consensus Guidelines for the Management of IPMN and MCN of the Pancreas (11) and Classification of Pancreatic Carcinoma*.¹²

Operative procedures

Pancreaticoduodenectomy (PD) was performed by the subtotal stomach preserving PD and reconstruction by the modified Child's intestinal anastomosis.^{13,14} For IPMN without invasive findings, lymphadenectomy was performed in Group 1 lymph nodes surrounding the pancreas head and the extra-pancreatic nerve plexus around the supra-mesenteric artery and the celiac axis remained. End-to-side anastomosis of pancreatojejunostomy was routinely selected for reconstruction. Fibrin glue was used to prevent pancreatic fistula.

With respect to laparoscopic procedure, at first, we applied 5 ports trocar insertion followed by laparoscopic distal gastrectomy (LADG) as shown in Figure 1.¹⁵ In case the liver disturbed the operating field, an additional 5 mm trocar was placed to insert the balloon retractor in the upper-median line as shown in Figure 1. After transection of the omentum, the right gastroepiploic artery and vein, and the right accessory colonic vein were clipped and divided, and then the anterior surface of the superior mesenteric vein was fully exposed. Dissection around the descending duodenum (Kocherization) was performed and the retropancreatic space was fully exposed (Figure 2). For sudden massive bleeding, we prefer to use the bipolar soft coagulation device (BIPOLAR FORCED COAG™, VIO 300D, ERBE,

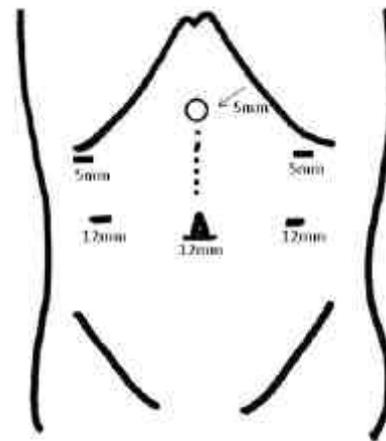


Figure 1. Port positions for laparoscopic assisted pancreaticoduodenectomy. The number indicates the port size. Arrow shows the additional 6th port for balloon retractor. Dotted line shows the incision of laparotomy.

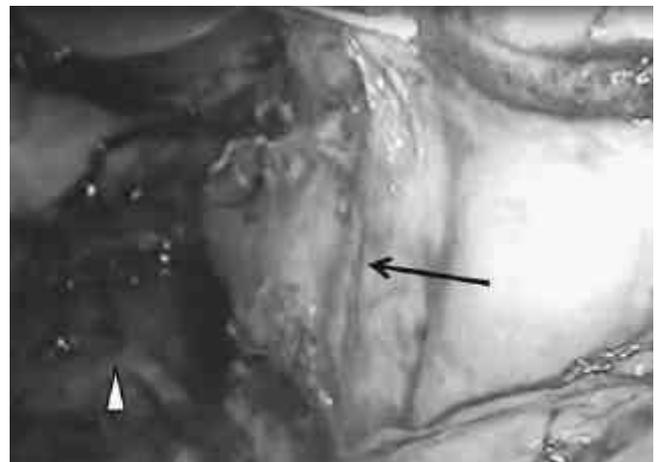


Figure 2. A view of Kocherization. Arrow shows the descending duodenum and the arrowhead shows the inferior vena cava.

Marietta, GA). After transection of the antrum of the stomach using autosuture (ENDO-GIA™ UNIVERSAL STRAIGHT 60, 3.5 mm of blue cartilage, COVIDIEN, Mansfield, MA), the common hepatic artery, the proper hepatic artery and the gastroduodenal artery were dissected and taped. The gastroduodenal artery was clamped using the Hem-o-lock® Ligation system (Teleflex Medical, Research Triangle Park, NC) and cut using an ultrasonic device (Sonosurg, Olympus, Tokyo) (Figure 3). Subsequently, the portal vein and the superior mesenteric vein were exposed and tunneling procedure through the retropancreatic space was performed using the long dissecting forceps. The pancreatic neck was dissected using the Sonosurg with hemostasis (Figure 4). Treitz's ligament was dissected and the proximal jejunum was transected using the ENDO-GIA (white cartilage). The mesentery of the resected jejunum and the horizontal duodenum were sealed and cut using the LigaSure V™

vessel sealing system (COVIDIEN). After isolation of the pancreas head and the duodenum, 7-8 cm of the small incision laparotomy was added and PD was completed via this incision (Figure 5). Intestinal reconstruction was accomplished via laparotomy.



Figure 3. View of clamping and cutting the gastroduodenal artery by the ultrasonic dissector. Arrow shows the common hepatic artery.

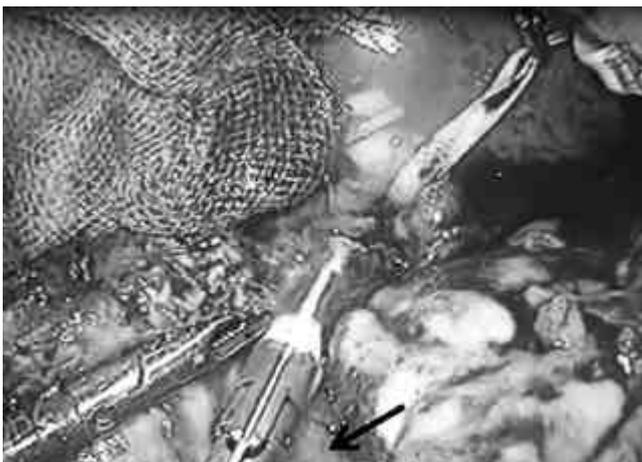


Figure 4. A view of the transection of the pancreatic neck. Arrow shows the superior mesenteric vein.

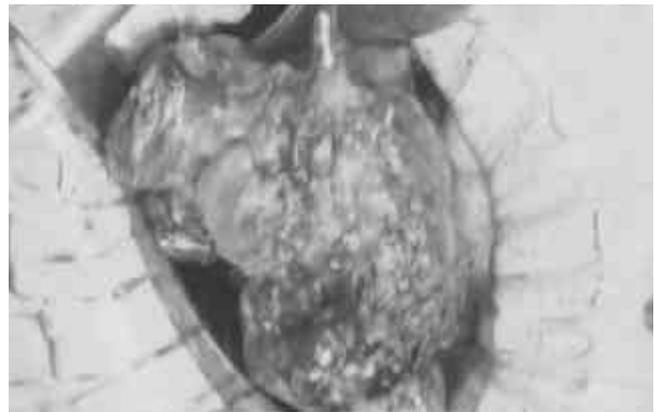


Figure 5. Pancreaticoduodenectomy was completed under the small incision laparotomy.

Results

Patients included three men and one woman with a mean age of 70 years (61-82 years) (Table 1). All diseases were IPMN located in the pancreatic head, in which invasive carcinoma was not diagnosed by imaging diagnosis, preoperatively. Two patients had diabetes mellitus and one was obese (body mass index was 28). Other patients had no severe complications. All patients underwent subtotal stomach preserving PD and Child's reconstruction. Duct to mucosa anastomosis was performed in one patient with dilated main pancreatic duct and the externally completed tube drainage of pancreas juice was selected in 3 patients. Mean total operating time was 882 minutes (820-932 minutes), mean blood loss was 925ml (610-1550ml) and red cell transfusion was not required in any patients. One patient underwent reoperation for bleeding at the pancreaticojejunostomy site at day 1; however, this bleeding was not due to laparoscopic procedures but open procedure. Mean duration until patients could walk was 3.5 days (2-6 days) and duration of

Table 1. Demographics, surgical records and outcomes in patients who underwent laparoscopic pancreaticoduodenectomy

	Age, Gender	Co-morbidity	Location of pancreas	Type of IPMN	Operation	Operating time (minutes)	Blood loss (ml)	Blood transfusion	Gaiting (days)	Use of analgesia (days)	Hospital stay (days)	Postoperative complication
1	81 female	none	Head	Branch duct	SSPPD	900	770	nil	2	5	13	none
2	61 male	none	Head	Main duct	SSPPD	875	610	nil	2	6	16	delayed gastric empty (7 days)
3	76 male	Diabetes Obesity	Head	Mixed type	SSPPD	932	1550	nil	6	13	65	pancreatic fistula(Grade B)* postoperative bleeding
4	61 male	Diabetes	Head	Mixed type	SSPPD	820	780	nil	6	6	58	jejunal ileu

*: findings according to International Study Group on Pancreatic Fistula classification¹¹

IPMN: Intraductal papillary mucinous neoplasm

SSPPD: Subtotal stomach-preserving pancreaticoduodenectomy

use of analgesia was limited to within 7 days. Grade B pancreatic fistula¹⁶ was observed in one patient and jejunal ileus was observed in one patient. Hospital death was not observed. In these patients with postoperative severe complication, hospital stay was prolonged.

Histopathological finding showed that case 1, 3 and 4 showed adenoma with severe dysplasia and case 2 showed carcinoma in situ with adenoma (Stage I).

All patients were satisfied with wound healing and had a pain-free postoperative course. At 6 months after surgery, weight loss in comparison with preoperative state was -5, +1, -2 and -2kg in each case.

Discussion

Recently, aggressive surgical exploration for intraabdominal organs, not only gastrointestinal organs but also the liver and pancreas, has been applied and clinical significance has been clarified.^{4-10,17} As the laparoscopic techniques have remarkably improved, we have performed distal pancreatectomy since 2008 (data not published yet). Laparoscopic distal pancreatectomy was safe and useful based on our series, as well as previous studies.^{4,5} Recovery might be faster and postoperative incisional pain less in comparison with open laparotomy. Based on this experience and instruction by the upper gastrointestinal surgeons at our institute, LPD was attempted at our institute this year.

Laparoscopic pancreatectomy might be considered for low grade malignant disease such as a neuroendocrine tumor, IPMN and other cystic tumors.⁶⁻¹⁰ Although laparoscopic pancreatectomy has also been used for invasive ductal carcinoma of the pancreas or bile duct carcinomas,⁴ this indication is still controversial. Our present indication of laparoscopic pancreatectomy including LPD was limited to precancerous lesions or non-invasive pancreatic tumors because procedures of dissection of extrapancreatic tissues or lymphadenectomy could not be accomplished as effectively as in open surgery.

With respect to patient selection for this technique, obese patients should be avoided in such a complicated procedure. The degree of obesity is one of the main problems in laparoscopic surgery.¹⁹ Our third case was obese and the pancreas itself was fatty and fragile. In this patient, the procedure took a long time, a large volume of blood was lost, and anastomotic procedures were very difficult. Eventually, problematic pancreatic fistula occurred and transabdominal tube drainage was necessary. Based on this experience, obesity is a risk factor for postoperative complication in LPD.

By applying laparoscopic distal gastrectomy, most procedures could be accomplished in LPD because basic procedures are similar. The most difficult point in the laparoscopic procedures was maneuver around the portal vein and supramesenteric artery because many vascular branches were connected with the pancreas head and the operative field was narrow, as occurs in open surgery as well. At this stage, resection was performed under small laparotomy to control for sudden bleeding. However, Cho et al. reported that this procedure could be fully accomplished using laparoscopic techniques.⁹ Step-by-step training is necessary to improve laparoscopic surgical techniques. Concerning anastomotic procedures, we performed these under small laparotomy. Using a 7-cm laparotomy, complete anastomosis was possible and quick, except in the overweight patient (Case 3) in our series. Some investigators showed that pure LPD including anastomotic procedures was possible.^{6-9,20} Recently, robotic surgery was attempted in LPD and this technique may improve the feasibility and safety by finer techniques under laparoscopy.²¹ A serious problem in our series was the longer operating time in comparison with open PD.¹⁴ Based on Briggs's review, operating time widely ranged between 287 and 528 minutes.¹⁰ Our results were much longer than those in this review. We are aiming to shorten the operating time using a step-by-step technique.

In our series, intraoperative blood loss could be limited and red cell transfusion was not required. Laparoscopic surgery may lead to a decrease of blood loss due to good operative view and delicate handling.²² This point is one of the great advantages of laparoscopic surgery. In our fourth case, the patient required reoperation because of intraabdominal bleeding; however, the bleeding site was the small branches of the pancreatic surface, which was not treated by laparoscopic procedure but rather laparotomy. To reduce the intraoperative blood loss, the latest vessel sealing devices are necessary and, in the present series, we applied various sealing devices. The ultrasonic device is useful for cutting rapidly, which was mainly used for cutting and coagulating even around the main vasculature.²³ Ligasure is a monopolar tip vessel sealer with limited thermal damage in comparison with ultrasonic coagulator, which shows the strong sealing power.²⁴ Therefore, this device was applied for cutting the main artery as gastroduodenal or inferior pancreato-duodenal artery. Bipolar soft coagulator is a useful device for hemostasis of the local bleeding.²⁵ In one case with obesity of the present series, bleeding tendency was observed in the soft tissues during operation. In such a case, bipolar device was useful because there was no necessary to clamp the bleeding site. After all, each device may be selected to use

according to the state of operation by understanding the mechanism of each hemostatic device.

Postoperative complications were observed in three patients. Briggs et al. reviewed cases of morbidity associated with LPD, and they found that complication rate was 26% and the mortality rate was 0-4.5%.¹⁰ Therefore, the safety of LPD in comparison with open PD has not been established yet. The most common postoperative complication was pancreatic fistula, which cannot be avoided even using laparoscopic procedures. In our experience, one patient developed a pancreas fistula and other complications were not fatal. In our study, patients recovered quickly and were able to walk soon after surgery. Complaints of pain were limited as well. In three cases, we asked the patients about their ability to perform daily activities, and the patients were satisfied with their abilities. Body weight and nutrition were also well preserved and stable (mean; -2kg), although mean weight loss after open PD was 7 kg at 6 months after surgery. Based on these findings, LPD was found to be a useful method.

In conclusion, laparoscopy-assisted pancreaticoduodenectomy was performed in four patients with IPMN. Intraoperative blood loss was limited and postoperative recovery was fast, although the operating time was long. Further study in a larger number of subjects is necessary to clarify the clinical significance of LPD; however, this procedure is promising to improve patient's recovery after PD by maintaining surgical curability.

References

1. Takada T: Surgery for carcinoma of the pancreas in Japan. Past, present, and future aspects. *Digestion*. 60:114-9,1999.
2. Glanemann M, Shi B, Liang F, Sun XG, Bahra M, Jacob D, et al. Surgical strategies for treatment of malignant pancreatic tumors: extended, standard or local surgery? *World J Surg Oncol*. 6:123,2008.
3. Ahn YJ, Kim SW, Park YC, Jang JY, Yoon YS, Park YH. Duodenal-preserving resection of the head of the pancreas and pancreatic head resection with second-portion duodenectomy for benign lesions, low-grade malignancies, and early carcinoma involving the periampullary region. *Arch Surg*. 138:162-8, 2003
4. Kooby DA, Chu CK. Laparoscopic management of pancreatic malignancies. *Surg Clin North Am*. 90:427-46, 2010.
5. Pryor A, Means JR, Pappas TN. Laparoscopic distal pancreatectomy with splenic preservation. *Surg Endosc*. 21:2326-30, 2007.
6. Palanivelu C, Jani K, Senthilnathan P, Parthasarathi R, Rajapandian S, Madhankumar MV. Laparoscopic pancreaticoduodenectomy: technique and outcomes. *J Am Coll Surg*. 205:222-30, 2007.
7. Dulucq JL, Wintringer P, Mahajna A. Laparoscopic pancreaticoduodenectomy for benign and malignant diseases. *Surg Endosc*. 20:1045-50, 2006.
8. Sperlongano P, Pisaniello D, Piatto A, Parmeggiani D, Sperlongano R, Avenia N, et al. The role of laparoscopy in pancreatic surgery. *Front Biosci*. 11:2203-5, 2006.
9. Cho A, Yamamoto H, Nagata M, Takiguchi N, Shimada H, Kainuma O, et al. A totally laparoscopic pylorus-preserving pancreaticoduodenectomy and reconstruction. *Surg Today*. 39:359-62, 2009.
10. Briggs CD, Mann CD, Irving GR, Neal CP, Peterson M, Cameron IC, et al. Systematic review of minimally invasive pancreatic resection. *J Gastrointest Surg*. 13:1129-37, 2009.
11. Tanaka M, Chari S, Adsay V, Fernandez-del Castillo C, Falconi M, Shimizu M, et al; International Association of Pancreatology. International consensus guidelines for management of intraductal papillary mucinous neoplasms and mucinous cystic neoplasms of the pancreas. *Pancreatology*. 6:17-32, 2006.
12. Japan Pancreas Society. In: Kawarada Y ed. Classification of Pancreatic Carcinoma. 2nd English ed., Tokyo: Kanehara & Co., Ltd., 2003, p.4-33
13. Hayashibe A, Kameyama M, Shinbo M, Makimoto S. The surgical procedure and clinical results of subtotal stomach preserving pancreaticoduodenectomy (SSPPD) in comparison with pylorus preserving pancreaticoduodenectomy (PPPD). *J Surg Oncol*. 95:106-9, 2007.
14. Nanashima A, Sumida Y, Abo T, Shindo H, Fukuoka H, Tanaka K, et al. Comparative study of anastomosis in pancreaticogastrostomy and pancreatojejunostomy after pancreaticoduodenectomy. *Hepatogastroenterology*. 54:1243-6. 2007.
15. Kitano S, Shiraiishi N, Kakisako K, Yasuda K, Inomata M, Adachi Y. Laparoscopy-assisted Billroth-I gastrectomy (LADG) for cancer: our 10 years' experience. *Surg Laparosc Endosc Percutan Tech*. 12:204-7, 2002.
16. Pratt WB, Callery MP, Vollmer CM Jr. Risk prediction for development of pancreatic fistula using the ISGPF classification scheme. *World J Surg*. 32:419-28, 2008.
17. Nguyen KT, Geller DA. Laparoscopic liver resection--current update. *Surg Clin North Am*. 90:749-60, 2010.
18. Kooby DA, Hawkins WG, Schmidt CM, Weber SM, Bentrem DJ, Gillespie TW, et al. A multicenter analysis of distal pancreatectomy for adenocarcinoma: is laparoscopic resection appropriate? *J Am Coll Surg*. 210:779-85, 2010.
19. Miskovic D, Wyles SM, Ni M, Darzi AW, Hanna GB. Systematic review on mentoring and simulation in laparoscopic colorectal surgery. *Ann Surg*. 252:943-51, 2010.
20. Kendrick ML, Cusati D. Total laparoscopic pancreaticoduodenectomy: feasibility and outcome in an early experience. *Arch Surg*. 145:19-23, 2010.
21. Horiguchi A, Uyama I, Miyakawa S. Robot-assisted laparoscopic pancreaticoduodenectomy. *J Hepatobiliary Pancreat Sci*. 2010 (Epub)
22. Tsang WW, Chung CC, Kwok SY, Li MK. Minimally invasive surgery for rectal cancer. *Surg Clin North Am*. 85:61-73, 2005.
23. Sasi W. Dissection by ultrasonic energy versus monopolar electrocautery in laparoscopic cholecystectomy. *JSL*. 14:23-34, 2010.
24. Nanashima A, Tobinaga S, Abo T, Nonaka T, Sawai T, Nagayasu T. Usefulness of the combination procedure of crash clamping and vessel sealing for hepatic resection. *J Surg Oncol*. 102:179-83, 2010.
25. Uchiyama A, Miyoshi K, Nakamura K. VIO soft-coagulation system for major pulmonary resections: results in 68 patients with primary lung cancer. *General Thoracic and Cardiovascular Surgery* 59;175-178, 2011.