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Laparoscopic Distal Pancreatectomy Using Single-Port Platform: Technique, Safety, and Feasibility in a Clinical Case Series

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Abstract

Background:A novel technique using a single-incision laparoscopic approach has been described for several laparoscopic procedures. The aim of this article is to describe our experience with an alternative technique for laparoscopic distal pancreatectomies using a single-port platform. **Materials and Methods**: We have performed this procedure on 20 patients with pancreatic tumors in the pancreatic body or tail. A transumbilical incision is performed, and a single-incision platform is introduced. The stomach is sutured to the abdominal wall to expose the pancreas. This technique uses an additional 5-mm trocar in the left quadrant, ultimately used for drainage after the end of the procedure. **Results**: The median operative time was 176 minutes, and the hospital stay was 2 days. Mortality was 0%, and morbidity was 20%; 4 patients developed grade A pancreatic fistula. During follow-up (median, 11 months), no patient developed an incisional hernia. The cosmetic appearance of the incision was excellent in all cases. **Conclusions**: Laparoscopic distal pancreatectomy using a single-port platform is feasible and can be successfully performed by surgeons with experience in pancreatic and advanced laparoscopic surgery

Introduction

In the past decade, minimal access surgery has minimized surgical trauma by reducing the numbers and sizes of ports. Recently, a novel technique using a single-port laparoscopic approach has been described.1 This technique was initially used in young female patients for its splendid cosmetic results; however it is not a widespread technique for pancreatic surgery. The benefits of laparoscopy have been proven in different studies for distal pancreatectomies. 2-4 Therefore, the combination of these two technical advances made possible the performance of single-port (SPDP). We found few reports in the literature describing SPDP.5-10 The aim of this article is to report an alternative technique for laparoscopic distal pancreatectomy using single-port platform and report the preliminary results of our initial experience with 20 cases.

Methods

From November 2012 to June 2014, 20 patients with pancreatic tumors in the pancreatic body or tail underwent laparoscopic distal pancreatectomy using single-port platform at our center. Computed tomography and/or magnetic resonance imaging were performed in all cases. Endoscopic ultrasound guided fine-needle aspiration biopsy was performed in selected cases for diagnostic purposes. Intraductal papillary mucinous neoplasms (IPMNs) and mucinous cystic neoplasms were handled according to the International Consensus Guidelines.11

The advantages, disadvantages, and possible risks of the surgical procedure were explained to each patient, and informed consent was obtained. Data were collected prospectively.

Surgical Technique

The patient is placed under general anesthesia and positioned in a supine and reverse Trendelenburg position. The surgeon is positioned between the patient's legs while the assistant is on the right side and the monitor on the patient's cranial side. A transumbilical 3-cm skin incision is performed (Fig.1a), and a single-incision advanced access platform with a gelatin cap, self-retaining sleeve, and wound protector (GelPoint, Applied Med. R.S. Margarita, CA, USA) is introduced (Fig.1b). One 5-12 mm and two 5-11 mm working ports are introduced through the single-port device (Fig. 1c). By using the gel cap and sleeves, no articulated instruments are necessary. A CO2 pneumoperitoneum is established at 12-mm Hg. A rigid 30-degree 10-mm laparoscope is introduced. The single port is able to accommodate, at the same and without triangulation prejudice, a 10-mm laparoscope, a 12-mm flexible stapler, and a 5-mm instrument such as a harmonic scalpel, grasper, scissor, or dissector (Fig. 1d). The main modification of the original technique is the insertion of an additional 5-mm trocar in the left quadrant. This small opening is subsequently used for drainage. This additional trocar is used by the surgeon's right hand.

Access to the lesser sac is gained by opening the omentum along the greater curvature of the stomach using a

FIG. 1. The single-port platform set up (a) A 3-cm skin incision is performed at the level of the umbilicus (b) A self-retaining sleeve and wound protector is introduced through the umbilical incision (c) The advanced platform for a single-port procedure is installed. A gelatin cap with three working ports, one 5-12 mm (arrow) and two 5-11 mm, is attached (d) A 30-degree 10-mm high-definition laparoscope is used together with a harmonic scalpel and standard grasper.The single port can accommodate a 10-mm laparoscope, a 12-mm flexible stapler, and a 5-mm instrument at the same time with no triangulation prejudice (e) A surgical specimen is removed through the single port (f) Final view of surgical wound.

harmonic scalpel (Ultracision, Ethicon, Cincinnati, OH),taking care not to injure the gastroepliploic vessels.

The stomach is sutured to the abdominal wall to expose the anterior face of the pancreatic body and tail (Fig. 2a). Once other lesions are discarded, intraoperative ultrasound (SonoSite, Inc., Bothell, WA, USA) is used to ascertain the tumor's location and relationship to splenic vessels (Fig. 2b). If the splenic artery and vein are not involved by the tumor, the spleen is preserved. The ultrasound examination is useful in establishing a proximal negative margin. The peritoneum is released from the inferior border of the pancreas at the level of the tumor, exposing the splenic vein. A tunnel is opened behind the body or tail of the pancreas between the gland and the splenic vein by blunt dissection, and a cotton tape is placed around the pancreas. The tape is pulled upward and pancreas dissected proximally, about 2-3 cm, to allow easy insertion of the stapler (Fig. 2c). The splenic artery is dissected, encircled, and kept away from the area to be divided. The pancreas is then divided with a flexible endostapler (Echelon Flex Endopath 60, Ethicon Endo Surgery, Cincinnati, OH) (Fig. 2d).

In two cases, splenectomies were performed. In these two cases, after division of the pancreas, the splenic vein was divided with stapler, the splenic artery was ligated with synthetic non-absorbable suture (Mersilene 2/0, Ethicon, Cincinnati, OH) and divided between metallic clips. In the other cases, where the spleen was preserved, small venous and arterial branches from the pancreas were clipped or divided with a harmonic scalpel along the body and tail of the pancreas (Fig. 2e). Distal pancreatectomy is then completed (Fig. 2f). Surgical specimen is removed through the single port (Fig. 1e). The raw surface of the pancreas is checked for bleeding, and hemostatic tissue was inserted into the dissected area. A closed suction drain is placed near the pancreatic stump and exteriorized through the 5-mm trocar in the left quadrant, after which the umbilical incision is closed

(Fig. 1f). In all cases, cefazolin is given prophylactically. The nasogastric tube is removed at the end of the procedure, and clear liquids are initiated on the first postoperative (PO) day. Drain fluid amylase (DFA) is checked on PO1 and before discharge. If less than 300 U/L the drain is removed on the 7th postoperative day. If higher than 300 U/L, DAF is checked again on the 7th PO day and if it remains high, a late removal of the drain is advised.

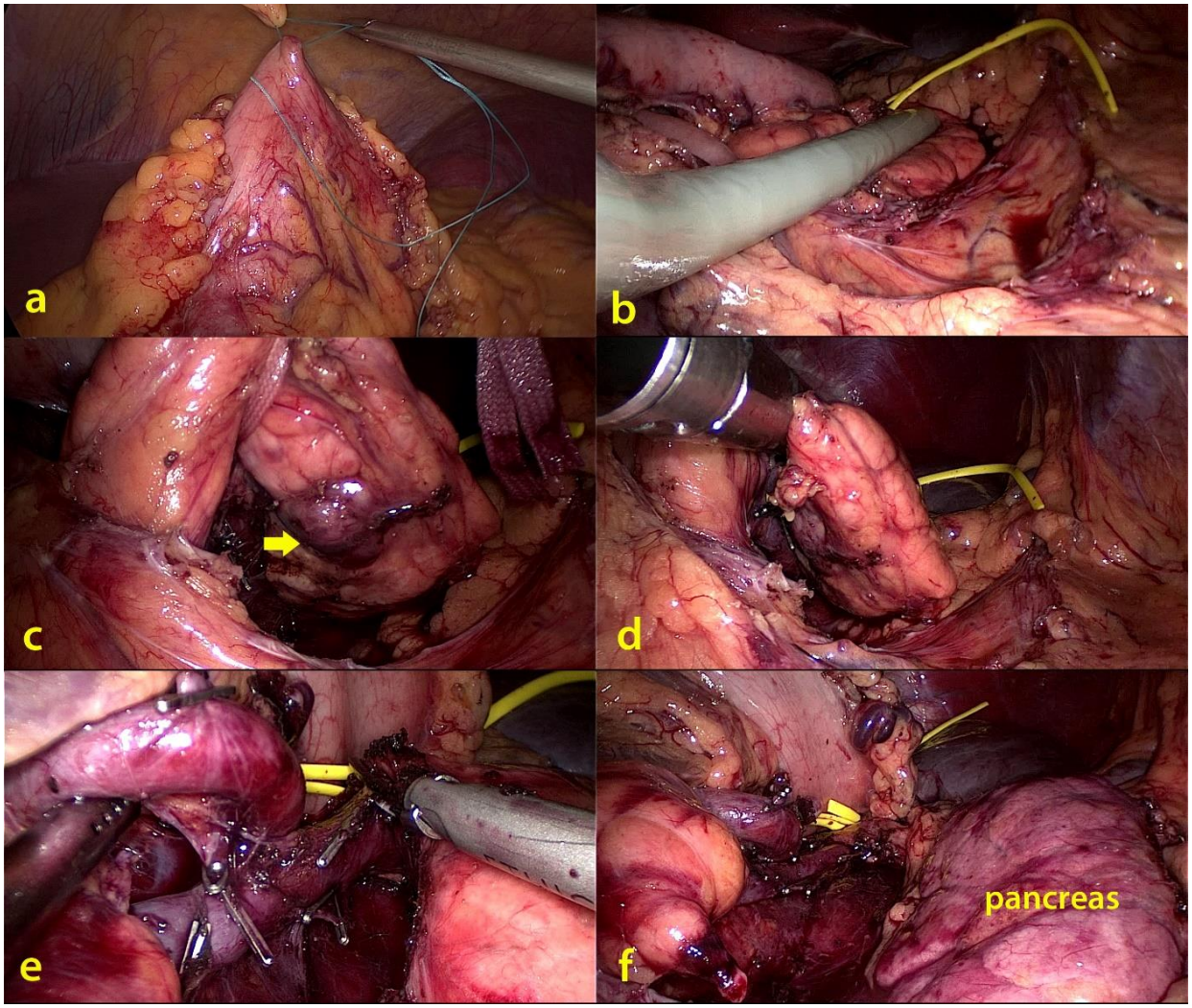

FIG. 2. Laparoscopic spleen-preserving distal pancreatectomy using single-port platform (a) Stomach is sutured to the abdominal wall to expose the anterior face of the pancreatic body and tail (b) Intraoperative ultrasound is performed through the single port (c) Tumor is located at the posterior of the pancreas (arrow). A tape is passed around the pancreas, pulled upward, and dissection is completed about 2-3 cm proximally to allow easy insertion of the stapler (d) Splenic artery is dissected, encircled, and kept away from the area to be divided. Pancreas is then divided with a flexible endostapler (e) After division of the pancreas, small venous and arterial branches are clipped or divided with a harmonic scalpel along the body and tail of the pancreas. (SV, splenic vein; SA, splenic artery) (f) Distal pancreatectomy is completed.

Results

The demographics and clinical characteristics of the patients are summarized in Table 1. There were twelve women and eight men with a median age of 43.5 years (range, 20-71). In all cases, enucleation was not feasible because of proximity to the main pancreatic duct. The surgical margin was negative in all cases.

We treated ten neuroendocrine tumors (NETs), and all except one (patient 4) were small, nonfunctioning, tumors with preoperative signs of a low grade neoplasm. The exception presented a large tumor (35 mm) with signs of vascular invasion, and therefore underwent left pancreatectomy with splenectomy, lymphadenectomy, and removal of peripancreatic tissue. Final pathology disclosed a grade 2 NET (Ki-67 of 6%) with free surgical margins and no lymph node involvement. One patient was operated on for having a suspected NET, but the final diagnosis was a solid pseudopapillary neoplasm.

TABLE 1. Demographic and Clinical Characteristics of the Patients

Patient	Age	Gender	Symptoms	Imaging	Preoperative Diagnosis	Location	Size (mm)	Final Diagnosis
1	33	F	Follow-up MEN-1	US, CT	NET	body	20	NET
2	32	F	Incidental	US, MRI, EUS	NET	tail	12	NET
3	45	M	Abdominal pain	US, MRI	IPMN	tail	20	IPMN
4	44	F	Back pain	US, MRI	NET	body	35	NET
5	71	M	Incidental	US, MRI, EUS	IPMN	body	60	IPMN
6	60	M	Incidental	US, MRI	NET	tail	9	NET
7	37	F	Incidental	US, MRI	NET	tail	30	NET
8	47	F	Epigastric pain	CT, MRI	MCN	body	37	MCN
9	57	M	Incidental	CT, MRI, EUS	IPMN	tail	70	IPMN
10	42	F	Incidental	US, MRI	NET	body	45	NET
11	39	M	Incidental	US, MRI	IPMN	body	52	IPMN
12	43	F	Epigastric pain	US, MRI	MCN	tail	33	SCN
13	29	F	Incidental	US, MRI, EUS	NET	tail	23	NET
14	51	F	Incidental	US, MRI, EUS	MCN	body	40	MCN
15	28	M	Incidental	US, MRI, EUS	NET	tail	17	NET
16	55	F	Acute Pancreatitis	US, MRI, EUS	IPMN	tail	32	IPMN
17	20	M	Incidental	US,MRI	NET	tail	27	SPN
18	69	M	Incidental	CT, MRI, EUS	NET	Body	13	NET
19	40	F	Incidental	CT, MRI	IPMN	Tail	34	SCN
20	49	F	Incidental	US, MRI	NET	Tail	28	NET

MEN 1 indicates multiple endocrine neoplasia syndrome type 1; US, ultrasonography; CT, computed tomography; MRI, magnetic resonance imaging; EUS, endoultrasound; NET, neuroendocrine tumor; IPMN, intraductal papillary mucinous neoplasm; MCN, mucinous cystic neoplasm; SCN, serous cystic neoplasm; SPN, solid pseudopapillary neoplasm

Ten cystic tumors were resected. Two patients, in whom mucinous cystic neoplasm and IPMN were, respectively, suspected before surgery, were definitively diagnosed with serous cystic neoplasm.

Data on the surgical aspects and results are shown in Table 2. Patients 4 and 5, in whom splenectomies were performed, required the longest operative times. An associated procedure, cholecystectomy, for cholelithiasis, was performed in patient 15. In all cases, the surgical specimen was retrieved through the single-port platform. The overall median operative time was 176 minutes (range, 110-340).

TABLE 2. Surgical and Hospital Data

Patient	Surgical Procedure	Operative Time (min)	Estimated Blood Loss (mL)	Surgical Complications	Hospital Stay (d)
1	DP	174	< 50	–	2
2	DP	117	< 50	–	2
3	DP	110	< 50	–	1
4	DP + S	300	250	PF	3
5	DP + S	340	200	PF	5
6	DP	135	< 50	–	1
7	DP	179	< 50	–	2
8	DP	120	< 50	–	1
9	DP	189	< 100	–	2
10	DP	210	< 100	–	2
11	DP	196	< 100	PF	2
12	DP	198	< 50	–	1
13	DP	200	< 50	–	1
14	DP	189	< 100	PF	3
15	DP + C	178	< 50	–	1
16	DP	149	< 50	–	2
17	DP	120	< 50	–	1
18	DP	170	< 50	–	2
19	DP	110	< 50	–	3
20	DP	140	< 50	–	5

DP indicates spleen-preserving laparoscopic distal pancreatectomy using single-port platform; DP+S, laparoscopic distal pancreatectomy with splenectomy using single-port platform; C, cholecystectomy; PF, pancreatic fistula

Blood loss was less than 100 mL in all patients, except 4 and 5. None required blood transfusions, however. Four patients developed pancreatic fistula, all grade A, with no need for further treatment other than delayed removals of the drains. Median hospital stay was 2 days (range, 1-5). At a median follow-up of 11 months (range, 2-21) all patients are alive, but one patient developed exocrine and endocrine pancreatic insufficiency. No umbilical hernia or other late complications were observed during follow-up.

Discussion

Laparoscopic pancreatic surgery has experienced significant development in the last few years. Our experience with laparoscopic pancreatic resections began in 2001 with a distal pancreatectomy.11 Similar to what other authors experienced, improvements in our expertise in advanced laparoscopic surgery allowed us to perform more complex operations such as central pancreatectomies, pancreatoduodenectomies, and resections of uncinate processes.12 However, only laparoscopic distal pancreatectomy is considered a gold standard, primarily because techniques have been standardized. Based on the available data, laparoscopic distal pancreatectomy has an adequate safety profile, equivalent or better perioperative outcome, and noninferior oncologic outcome. 2-4,13-16

Single-incision laparoscopy is less invasive than standard multiport laparoscopy, but has unique difficulties for the laparoscopic surgeon. One is the significant limitation of retraction. Another issue is triangulation of instruments. The introduction of a camera and several instruments parallel to each other can result in decreased range of motion and collision of instruments. Another important issue is the drainage of the pancreatic stump. There are some evidences that intraperitoneal drainage should not be eliminated after pancreatic resection. 17,18 Therefore, we use routine drainage after pancreatic resections, especially in patients with soft pancreas. 18 Some authors use the umbilical wound to exteriorize the drain. 5,7 We prefer to exteriorize the drain in the left quadrant that, to our view, is easier to manage and causes less discomfort than in the umbilicus. In order to make single-port laparoscopic distal pancreatectomy easier we decided to use the future site of drainage, inserting an additional 5mm trocar in the left quadrant. This trocar is used by the surgeon's right hand, decreasing triangulation problems and avoiding collisions. Another important maneuver is to suture the stomach to the abdominal wall to expose the pancreas. With these simple modifications in the original technique, we could perform this operation in all cases of distal pancreatectomies for low-grade pancreatic neoplasms since its introduction in our service. Moreover, the adoption of a novel single-incision platform allowed the use of standard instruments because self-retaining sleeves maximized the internal working diameter. We were able to use a high definition 10-mm laparoscope during all steps of the operation. Some authors report the use of a 5-mm camera that, in our point of view, does not have the same quality of a 10-mm. Even during introduction of a 12-mm intraoperative ultrasound probe or a 12-mm flexible stapler, there was no need to replace the main laparoscope with a 5-mm one.

The two patients requiring splenectomy had increased operative time, blood loss, pancreatic fistula and length of stay. Therefore, it is not clear if the single-port technique is advisable for such patients.

In the English literature, we found few cases of single-port pancreas resections reported. 5-10 Most papers were case reports and the largest series compiled five cases. 10 The main reason may be the need for special articulating instruments that requires special skills. We believe that this alternative technique for single-incision surgery may reduce the learning curve for skill acquisition. Our initial experience with laparoscopic distal pancreatectomy using single-port platform showed no exposure or triangulation difficulties, and operative time was not greater than our other laparoscopic cases.

The present series is, to our knowledge, the largest one published to date for pancreatic resection using single-port platform. Although several issues such as cost and learning curve remain to be studied, the cosmetic benefits of a limited incision approach are obvious. In conclusion, the present

series suggests that the alternative laparoscopic distal pancreatectomy using single-port platform is feasible, safe and can be successfully performed by surgeons with experience in pancreatic and advanced laparoscopic surgery.

Disclosure

Drs. Machado, Surjan, and Makdissi have no conflicts of interest or financial ties to disclose.

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