Safety and Feasibility of Single Incision Laparoscopic Spleen Preserving Distal Pancreatectomy

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Purpose: Single-incision laparoscopic distal pancreatectomy (SIL-DP) has recently been attempted in the treatment of left-sided benign neoplasms of the pancreas. This study was conducted to evaluate the perioperative outcomes of SIL-DP compared with conventional laparoscopic DP (CL-DP).

Methods: Patients who received laparoscopic DP from a single surgeon for benign pancreatic neoplasm from January 2012 to January 2014 were included. The patients were divided into two groups, SIL-DP and CL-DP. We used four trocars for CL-DP and a custom-made glove port for SIL-DP and analyzed the conversion cases separately. Perioperative outcomes were compared between types of surgery.

Results: SIL-DP was attempted in 13 patients, five of whom required conversion to CL-DP or dual-incision surgery. CL-DP was attempted in 27 patients and all were successful without open conversion. The spleen was preserved in all patients who underwent SIL-DP without conversion, in four of five (80%) in the conversion group, and 21 (78%) of those who underwent CL-DP. The complication rate was 13% in the SIL-DP-only group, 60% in the conversion group, and 19% in the CL-DP group. The operation time, estimated blood loss, numeric pain intensity score, and hospital duration were similar in the SIL-DP and CL-DP groups.

Conclusion: SIL-DP was associated with a moderate need for an additional port, and the complication rate was high in the conversion group. Our findings indicate that SIL-DP should be attempted carefully. Further studies are needed to evaluate the long term follow-up outcomes of SIL-DP.

Keywords: Laparoscopy, Pancreatectomy, Minimally invasive surgical procedures

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INTRODUCTION

Minimally invasive surgical techniques now comprise a large proportion of surgeries. There are four main types of minimally-invasive surgery: conventional laparoscopic (CL) surgery, single-incision laparoscopic (SIL) surgery, single-site robotic surgery, and natural orifice transluminal endoscopic surgery.

In pancreatic surgery, conventional laparoscopic distal pan-

createctomy (CL-DP) is accepted as an alternative to open surgery and is recommended for most benign pancreatic neoplasm. Recent studies suggest that CL-DP is superior to open DP in terms of the postoperative morbidity and length of hospital stay. The advantages of the laparoscopic approach also include confirmation of the diagnosis, less pain, and better cosmetic results.¹⁻³

SIL surgery is used increasingly in various surgical areas because it has several advantages, including better cosmesis

and the ability to convert to a multiport procedure without difficulty. It uses only a single incision at the umbilicus, which is considered a natural orifice of the human body. SIL surgery is currently used in appendectomy, cholecystectomy, and colorectal surgery, but it is not yet a common surgical procedure for pancreatic disease.^{4,5} There are only few case reports of the preliminary experiences with SIL-DP.⁶⁻¹¹ The safety and effectiveness of SIL surgery for pancreatic disease are unknown.

The aim of this study was to evaluate the perioperative outcomes of SIL-DP compared with those of CL-DP.

MATERIALS AND METHODS

The research ethics board of Samsung Medical Center (Seoul, Republic of Korea) approved this study (No. 2013-10-122). From January 2012 to January 2014, all patients who underwent laparoscopic DP performed by a single surgeon for benign pancreatic neoplasm were included. We reviewed prospectively the information collected in the pancreatic surgery database of our center. We included patients who underwent CL-DP or SIL-DP for benign pancreatic neoplasm by a single surgeon. The surgeon has specialized in hepatobiliary pancreatic surgery for more than 15 years and has performed more than ten CL-DP since 2005 and 300 SIL cholecystectomies since 2010 annually. The indication for SIL-DP was younger patients who preferred fewer scars. However, the types of surgery were finally determined according to the surgeon's preference. Patient diagnoses included intraductal papillary neoplasm, mucinous cystic neoplasm (MCN), neuroendocrine tumor (NET), solid pseudopapillary neoplasm (SPN), serous cystic neoplasm (SCN), and other benign disease. We obtained informed consent from every patient.

The patients were classified into three groups without randomization: SIL-DP, conversion and CL-DP groups. We classified a patient into the conversion group if the surgeon had inserted one or more additional trocars during SIL-DP.

The outcomes of SIL-DP were compared with those of CL-DP. Patient characteristics included sex, age, body mass index, American Society of Anesthesiologists (ASA) score, pathological diagnosis, and the location and size of the tumor. Perioperative outcomes included spleen preservation, splenic vessel preservation, splenic infarction, complications, duration of hospital stay, operation time, estimated blood loss, postoperative opioid use, visual analogue scale of pain, daily amount of drainage, and ascites amylase level. The amount of blood loss was estimated from intraoperative drainage fluid and the amount of irrigation fluid was subtracted. The severity of any complication was classified using the Clavien-Dindo classification.¹² A Clavien Dindo score of grade 2 or more was

considered significant. The postoperative pancreatic fistula (POPF) grade was determined using the International Study Group of Pancreatic Fistula (ISGPF) criteria and classified into grade A, B, or C. POPF was defined as an amylase content >3 times that of serum amylase activity in any measurable volume of fluid on or after postoperative day 3. POPF grades were defined according to the clinical outcomes of each patient's hospital course.¹³ Computed tomography (CT) images were obtained 6 or 7 days after surgery to evaluate postoperative complications including splenic infarction. Perioperative outcomes were assessed according to the clinical features and laboratory investigations 30 days after surgery.

Surgical technique for SIL-DP

The patient was placed in the right semidecubitus position. The primary incision was made through the umbilicus. The initial incision length was 3 cm and was extended up to 4 cm if the tumor was too large to be extracted through the incision. We used an Alexis® wound retractor (Applied Medical, Rancho Santa Margarita, CA, USA) and a custom-made glove port comprising of a powder-free left hand surgical glove (Latex Biogel® Surgeons, Mölnlycke Health Care, Gothenburg, Sweden). The wound retractor was inserted transumbilically and the glove port was fixed with the palms facing upwards. We used two 12 mm diameter trocars and one 5 mm diameter trocar. The 12 mm trocar was connected to the first and third finger of the glove port, and the 5 mm trocar was connected to the fifth finger (Fig. 1A). The abdomen was insufflated with carbon dioxide gas, and the 30-degree laparoscopic camera was inserted through the 12 mm trocar in the center. The patient was placed in a 15-degree reverse Trendelenburg position. The surgeon and assistant holding the laparoscope stood beside the patient to his right side. Two monitors were placed near the patient's shoulder. We used a LigaSure Advance™ Instrument (LF5034) (Covidien, Mansfield, MA, USA) for vessel or tissue sealing.

The greater omentum was divided into the splenocolic ligament, and the gastrocolic ligament was opened wide along the suprapancreatic border. We used a Cinch Organ Retractor (Aesculap, Center Valley, PA, USA) to elevate the stomach upward. The posterior wall of the stomach was tagged to the subcostal peritoneum with the intraperitoneal retractor. We did not use the external traction technique. After careful dissection of the visceral peritoneum along the inferior pancreatic border, we detected the splenic vein. After mobilizing the inferior pancreatic portion, we moved up to the superior pancreatic border. We detected the splenic artery and rechecked the location inferior to the pancreas. We used intraoperative ultrasonography to define the exact tumor location

Fig. 1. (A) Operation field of single incision laparoscopic distal pancreatectomy (SIL-DP) using custom-made glove port. (B) Main procedures of SIL-DP. Pancreatic body tumor and the splenic vein were exposed with careful dissection of the visceral peritoneum along the inferior pancreatic border. After mobilizing the splenic artery and vein from the pancreas we use a blunt tip device to create a tunnel between the neck of the pancreas and the splenic vessel.

and a blunt-tip device to create a tunnel between the neck of the pancreas and the splenic vessel (Fig. 1B). The pancreas was divided through this tunnel with an Endo GIATM Ultra Universal Stapler (Covidien, Mansfield, MA, USA). The pancreatic stump was reinforced with Endo ClipTM III (Covidien Co., LTD., Mansfield, MA, USA). The specimen was removed using a LapBagTM (Sejong Medical Co., LTD., Paju, Korea).

We tried to preserve the spleen as much as possible. We performed Warshaw's procedure if there was splenic vessel tumor invasion. The splenic vessels were double-clipped and divided at the origin during Warshaw's procedure and concurrent splenectomy and the short gastric vessels were preserved during Warshaw's procedure. Concurrent splenectomy was performed only in those patients for whom Warshaw's procedure was not possible.

There was no definite indication for additional trocar insertion. The surgeon decided to use additional ports if the operation was considered too difficult to proceed without one. The additional trocar was generally located in the left upper quadrant area. The diameter of the additional trocar was 5 mm. We inserted a closed drainage catheter through the insertion site of the additional port or transumbilical incision. The drainage catheter was removed on day 5 after surgery. However, we usually remove the drainage catheter 1 or 2 weeks after discharge if a pancreatic fistula is suspected.

Statistics

The categorical variables are presented as number (percentage). The continuous variables are presented as mean $\pm$ standard deviation (SD) for variables with a normal distribution or median (range) for variable with a nonnormal distribution according to the Kolmogorov-Smirnov test. The categorical variables were compared using the chi-square test. The continuous variables were compared using the Kruskal-Wallis test.

Statistical analysis was performed using R software version 3.1.2 (The R Foundation for Statistical Computing, <http://www.r-project.org>, accessed January, 30, 2015). A *p* value less than .05 was considered significant.

RESULTS

Demographics

Forty patients who underwent laparoscopic DP for benign pancreatic neoplasm were included. The median age was 55.5 years (range, 19 to 81), and the perioperative outcomes (30 days postoperatively) were evaluated prospectively in all 40 patients. We attempted the SIL-DP in 13 patients and 27 patients (Table 1).

Patient sex, age, ASA score, pathological diagnosis, and tumor size did not differ significantly between the SIL-DP

Table 1. Characteristics of patients who attempted single incision laparoscopic distal pancreatectomy (SIL-DP) (n = 13)

Age/ sex	Diagnosis	Tumor size (cm)	Body mass index (kg/m ²)	Conversion of surgery	Cause of conversion	Operation time (min)	Hospital duration (days)	Complication*	Pancreatic fistula grade [†]
71/M	IPMN	2.3	18.1	Conversion to conventional laparoscopy	Splenic vein invasion	144	8	Mediastinal abscess	Grade A
41/F	SPN	2.2	25.6	0	0	164	7	None	Grade A
49/F	IPMN	1.2	23.5	0	0	137	6	None	Grade A
36/M	MCN	6.0	25.6	Conversion to dual-incision	Splenic vein invasion	149	8	Splenic infarction	Grade A
43/M	MCN	2.1	21.6	0	0	185	8	None	Grade A
70/F	Squamoid cyst	2.0	20.8	0	0	126	7	None	Grade A
73/M [‡]	NET	0.9	25.2	0	0	253	10	Pseudocyst	Grade A
53/M	NET	3.5	22.3	0	0	120	6	None	Grade A
20/F	SPN	5.0	18.7	Conversion to dual-incision	Splenic venous bleeding	178	6	Splenic infarction	Grade A
64/F	MCN	1.7	29.7	Conversion to dual-incision	Narrow operation field	165	7	None	Grade A
69/F	SCN	5.8	25.3	Conversion to dual-incision	Splenic vein invasion	127	6	None	Grade A
31/M	Squamoid cyst	2.5	21.6	0	0	175	6	None	Grade A
46/M	NET	1.7	24.46	0	0	157	6	None	Grade A

SIL-DP = single incision laparoscopic distal pancreatectomy; IPMN = intraductal papillary mucinous neoplasm; MCN = mucinous cystic neoplasm; NET = pancreatic neuroendocrine tumor; SPN = solid pseudopapillary neoplasm; SCN = serous cystic neoplasm. *Clavien Dindo score ≥ 2 were regarded as clinically significant complication. [†]There were no pancreatic fistula cases of grade B or C according to the international study group of pancreatic fistula (ISGPF) criteria. All of five patients of grade A were recovered with conservative management. [‡]The patient underwent single incision laparoscopic lower anterior resection for colorectal cancer.

and CL-DP groups. However, the location of the tumor was differed significantly between the SIL-DP, dual-incision or conversion, and CL-DP groups. The tumor was located in the pancreatic body in four patients in the SIL-DP group and (50%), three patients (60%) in the dual-incision or conversion group, and four patients (15%) in the CL-DP group (Table 2). There was no superior mesenteric vein (SMV) involvement in either the SIL-DP or CL-DP group. However, the distance to the SMV was not available in the patients included in this study.

Single-incision laparoscopic distal pancreatectomy

Among the 40 patients in the SIL-DP and CL-DP groups, there were no open conversion cases. We tried SIL-DP in 13 patients with a left-sided benign pancreatic tumor. The tumor had invaded the splenic vessel in five patients (38%). SIL-DP was performed successfully in eight patients. The spleen was

preserved in all patients including two who underwent Warshaw's procedure. Five patients in the SIL-DP group needed conversion to conventional multiport or dual-incision laparoscopic surgery. Splenectomy was performed in one of these patients and Warshaw's procedure was performed in another two of these patients. An additional port was inserted in three patients who had dense adhesions between the tumor and splenic vein, one patient with splenic venous bleeding, and one patient with a narrow operating field. We used a 5 mm trocar for all of these five patients. We inserted a closed drainage catheter through the additional trocar site in these patients, and a drainage catheter was inserted through the umbilical incision in patients who underwent SIL-DP without an additional trocar.

Table 2. Patients characteristics (n = 40)

Characteristics	SIL-DP (n = 8) (%)	Dual-incision or conversion (n = 5) (%)	CL-DP (n = 27) (%)	p value*
Sex (M:F)	4:4	2:3	13:14	0.888
Age (years) ± SD	50.8 ± 14.4	52.0 ± 22.8	55.0 ± 14.9	0.786
Size of tumor (cm) ± SD	1.9 ± 0.9	4.2 ± 2.0	3.2 ± 2.1	0.096
BMI (kg/m ²) ± SD	23.1 ± 1.8	23.4 ± 5.1	23.3 ± 3.0	0.958
ASA score				0.935
1	4 (50)	2 (40)	14 (52)	
2	4 (50)	3 (60)	12 (44)	
3	0 (0)	0 (0)	1 (4)	
Diagnosis				
IPMN	1	1	4	
MCN	1	2	5	
NET	3	0	7	
SPN	1	1	3	
SCN	0	1	5	
Others [†]	2	0	3	
Location of tumor				
Body	4 (50)	3 (60)	4 (15)	0.013
Tail	4 (50)	2 (40)	23 (85)	

SIL-DP = single incision laparoscopic distal pancreatectomy; CL-DP = conventional laparoscopic distal pancreatectomy; SD = standard deviation; BMI = body mass index; ASA = American Society of Anesthesiologists; IPMN = intraductal papillary mucinous neoplasm; MCN = mucinous cystic neoplasm; NET = pancreatic neuroendocrine tumor; SPN = solid pseudopapillary neoplasm; SCN = serous cystic neoplasm. *Chi-square test for categorical variable and Kruskal-Wallis test for continuous variable, [†]Others: squamous cyst, metastatic pancreas cancer, pancreatic pseudocyst.

Perioperative outcomes

The spleen was preserved successfully in 12 patients (92%) and the splenic vessel was preserved in eight patients (62%) who received an attempted SIL-DP. However, five of these patients required conversion to the CL-DP or dual-incision DP. In three patients in the conversion group, there was dense adhesion between the tumor and splenic vessels, and splenic vessel ligation was inevitable. In the CL-DP group, the spleen was preserved in 21 patients (78%) and the splenic vessels were preserved in 18 patients (67%). Splenic infarction was detected in one patient in CL-DP group and in two patients in the dual-incision or conversion group.

The complication rates were 13% in the SIL-DP group, 60% in the conversion group, and 19% in the CL-DP group. One patient in the SIL-DP group and three patients in the CL-DP group were diagnosed with postoperative complicated fluid collection on follow-up CT. In the SIL-DP group, one patient

developed mediastinal abscess. In the CL-DP group, one patient experienced incisional hernia which was repaired in a reoperation.

POPFs were classified as grade A in all patients in the SIL-DP group and conversion groups, and in 19 of 27 patients (70%) in the CL-DP group. No pancreatic fistula was assigned a grade of B or C in any group. All patients recovered without any sequelae after conservative management. The estimated blood loss and drainage volumes differed between the three groups: the volume was smaller in the SIL-DP group than in the other groups. The duration of hospital stay after surgery, operation time, amylase level in ascites fluid, and visual analogue scale pain score did not differ between the SIL-DP and CL-DP groups (Table 3).

DISCUSSION

There were no grade B or C pancreatic fistulas, which can

Table 3. Postoperative outcomes after laparoscopic distal pancreatectomy (n = 40)

Characteristics	SIL-DP (n = 8) (%)	Dual-incision or conversion (n = 5) (%)	CL-DP (n = 27) (%)	<i>p</i> value*
Spleen preservation	8 (100)	4 (80)	21 (78)	0.344
Warshaw [†]	2 (25)	2 (40)	3 (11)	0.265
Complication [‡]	1 (13)	3 (60)	5 (19)	0.132
Peripancreatic fluid collection	1		3	
Symptomatic splenic infarction		2	1	
Mediastinal abscess		1		
Incisional hernia			1	
Pancreatic fistula [§]				0.597
No	0 (0)	0 (0)	8 (30)	
Grade A	8 (100)	5 (100)	19 (70)	
Grade B, C	0 (0)	0 (0)	0 (0)	
Hospital stay (days) ± SD	6.9 ± 0.9	7.0 ± 1.0	6.5 ± 1.5	0.572
Operation time (minutes) ± SD	142 ± 35	152 ± 20	180 ± 48	0.808
Estimated blood loss (ml) ± SD	100 ± 41	260 ± 139	171 ± 113	0.035
Pain score (0 to 10) ± SD	3.9 ± 0.7	4.3 ± 0.9	3.5 ± 1.0	0.099
Drainage amount (ml) ± SD				
POD 1	18 ± 8.3	50 ± 29	66 ± 48	0.019
POD 3	14 ± 11	33 ± 49	63 ± 110	0.876
Ascites amylase (U/dl) ± SD				
POD 1	8,433 ± 6,042	7,529 ± 5,174	6,533 ± 6,167	0.745
POD 3	4,899 ± 6,150	2,910 ± 1,861	2,376 ± 3,186	0.466

SIL-DP = single incision laparoscopic distal pancreatectomy; CL-DP = conventional laparoscopic distal pancreatectomy; SD = standard deviation; POD = postoperative day. *Chi-square test for categorical variable and Kruskal-Wallis test for continuous variable, [†]Splenic vessel preservation and splenic infarction was evaluated in the cases with spleen preservation (n = 33), [‡]Clavien Dindo score ≥ 2 were regarded as clinically significant complication, [§]Grade A was defined by amylase level of drainage fluid POD 5, There were no pancreatic fistula of grade B or C according to the international study group of pancreatic fistula (ISGPF) criteria, ^{||}Visual Analog Scale of pain (0: no pain, 10: most severe pain).

be a clinically significant complication, in the SIL-DP or CL-DP groups. All POPFs were classified as grade A, which is not clinically significant in patients who undergo SIL-DP. However, the complication rate and the incidence of postoperative pancreatic fistula were higher in patients who received SIL-DP than CL-DP. In this study, the spleen preservation rate was 92% and the splenic vessel preservation rate was 62% in patients who received SIL-DP. These values are high compared with those in the CL-DP groups. There were no significant differences in spleen preservation rate, hospital duration, and estimated blood loss volume. The conversion rate was high, and the complication rate was higher in the conversion group than in the CL-DP group. These findings suggest that sur-

geons should carefully consider whether to perform the SIL-DP. Based on our experience, we recommend a CL-DP if there are adhesions between the tumor and splenic vessels.

Postoperative pancreatic fistula is the most concern for pancreatic surgery. The SIL approach is not used often in pancreatic surgery because of the high risk of complications including POPF. However, the rate of POPF after SIL-DP has not been evaluated previously. Spleen preservation is also an important issue for DP. A recent study strongly recommended spleen-preserving DP because of its immune functions.¹⁴ Spleen preservation is helpful in maintaining the patient's immunity. Prophylactic vaccination is necessary before or after splenectomy to prevent bacterial infection. However, spleen

preservation is not always possible and the spleen preservation rate was reported as 20% during CL surgery.¹⁵⁻¹⁷ There are only few case reports to show that spleen preservation is possible in SIL-DP.^{7,18}

Laparoscopic cholecystectomy is the standard treatment for benign disease of the gallbladder.¹⁹ Laparoscopic surgery is not yet a standard form of pancreas surgery. However, many studies have reported that the minimally invasive approach is associated with lower morbidity and a shorter hospital stay compared with the open approach, even in recent studies of DP.^{20,21} Laparoscopic-DP is regarded as a substitute for the open procedure.²² Moreover, SIL surgery can be used for benign colorectal disease as well as malignant colorectal neoplasms. Lymph node dissection can be performed more effectively with SIL surgery than with CL surgery.^{5,23,24} SIL liver resection has been reported recently to have similar oncological outcomes and favorable cosmetic results.²⁵

In this study, the surgeons were highly experienced with CL-DP and SIL cholecystectomy. Therefore, the operation time was consistent and we could not evaluate the learning curve. During SIL surgery, a critical issue is the stress experienced by the surgeon because of the narrow operating field. The patient's position and use of well-designed devices are important for reducing the stress level but are not sufficient at this time to eliminate all stress on the surgeon. No studies have focused on the stress experienced by surgeons, especially in SIL surgery. Although recent reports suggest the feasibility of minimally invasive surgery, the stress experienced by the surgeon should be investigated to be able to generalize SIL surgery.

SIL-DP was associated with a moderate need for an additional port. The complication rate was high in the conversion group. These findings suggest that SIL-DP should be attempted carefully. Further studies are needed to evaluate the long-term follow-up outcomes of SIL-DP.

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REFERENCES

- 1) Zhang RC, Yan JF, Xu XW, Chen K, Ajoodhea H, Mou YP. Laparoscopic vs open distal pancreatectomy for solid pseudopapillary tumor of the pancreas. *World J Gastroenterol* 2013;19:6272-6277.
- 2) Ohtsuka T, Takahata S, Takanami H, et al. Laparoscopic surgery is applicable for larger mucinous cystic neoplasms of the pancreas. *J Hepatobiliary Pancreat Sci* 2014;21:343-348.
- 3) Ding X, Tan J, Qian J. Laparoscopic spleen-preserving distal pancreatectomy (LSPDP). *Hepatogastroenterology* 2013;60:605-610.
- 4) Jorgensen LN, Rosenberg J, Al-Tayar H, Assaadzadeh S, Helgstrand F, Bisgaard T. Randomized clinical trial of single-versus multi-incision laparoscopic cholecystectomy. *Br J Surg* 2014;101:347-355.
- 5) Biehl MO, Schirnhöfer J, Weiss HG. Single incision laparoscopic surgery for colorectal cancer. *Ann Surg* 2015;261:e17.
- 6) Srikanth G, Shetty N, Dubey D. Single incision laparoscopic distal pancreatectomy with splenectomy for neuroendocrine tumor of the tail of pancreas. *J Minim Access Surg* 2013;9:132-135.
- 7) Chang SK, Lomanto D, Mayasari M. Single-port laparoscopic spleen preserving distal pancreatectomy. *Minim Invasive Surg* 2012;2012:197429.
- 8) Kuroki T, Adachi T, Okamoto T, Kanematsu T. Single-incision laparoscopic distal pancreatectomy. *Hepatogastroenterology* 2011;58:1022-1024.
- 9) Yao D, Wu S, Li Y, Chen Y, Yu X, Han J. Transumbilical single-incision laparoscopic distal pancreatectomy: preliminary experience and comparison to conventional multi-port laparoscopic surgery. *BMC Surg* 2014;14:105.
- 10) Kim EY, You YK, Kim DG, et al. Dual-incision laparoscopic spleen-preserving distal pancreatectomy. *Ann Surg Treat Res* 2015;88:174-177.
- 11) Kuroki T, Kitasato A, Adachi T, Soyama A, Takatsuki M, Eguchi S. Single-incision laparoscopic distal pancreatectomy: our initial experience. *Hepatogastroenterology* 2014;61:212-214.
- 12) Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. *Ann Surg* 2004;240:205-213.
- 13) Bassi C, Dervenis C, Butturini G, et al. Postoperative pancreatic fistula: an international study group (ISGPF) definition. *Surgery* 2005;138:8-13.
- 14) He Z, Qian D, Hua J, Gong J, Lin S, Song Z. Clinical comparison of distal pancreatectomy with or without splenectomy: a meta-analysis. *PLoS One* 2014;9:e91593.
- 15) Jean-Philippe A, Alexandre J, Christophe L, et al. Laparoscopic spleen-preserving distal pancreatectomy: splenic vessel preservation compared with the Warshaw technique. *JAMA Surg* 2013;148:246-252.
- 16) Abu Hilal M, Takhar AS. Laparoscopic left pancreatectomy: current concepts. *Pancreatol* 2013;13:443-448.
- 17) Beane JD, Pitt HA, Nakeeb A, et al. Splenic preserving distal pancreatectomy: does vessel preservation matter? *J Am Coll Surg* 2011;212:651-657; discussion 657-658.
- 18) Misawa T, Ito R, Futagawa Y, et al. Single-incision laparoscopic distal pancreatectomy with or without splenic preservation: how we do it. *Asian J Endosc Surg* 2012;5:195-199.
- 19) Gurusamy K, Junnarkar S, Farouk M, Davidson BR. Meta-analysis of randomized controlled trials on the safety and effectiveness of day-case laparoscopic cholecystectomy. *Br J Surg* 2008;95:161-

- 168.
- 20) Nigri GR, Rosman AS, Petrucciani N, et al. Metaanalysis of trials comparing minimally invasive and open distal pancreatectomies. *Surg Endosc* 2011;25:1642–1651.
 - 21) Briggs CD, Mann CD, Irving GR, et al. Systematic review of minimally invasive pancreatic resection. *J Gastrointest Surg* 2009;13:1129–1137.
 - 22) Kooby DA, Gillespie T, Bentrem D, et al. Left-sided pancreatectomy: a multicenter comparison of laparoscopic and open approaches. *Ann Surg* 2008;248:438–446.
 - 23) Hirano Y, Hattori M, Douden K, Hashizume Y. Single-incision laparoscopic surgery for stage IV colon cancer. *Surg Laparosc Endosc Percutan Tech* 2014;24:e35–37.
 - 24) Yun JA, Yun SH, Park YA, et al. Single-incision laparoscopic right colectomy compared with conventional laparoscopy for malignancy: assessment of perioperative and short-term oncologic outcomes. *Surg Endosc* 2013;27:2122–2130.
 - 25) Tayar C, Subar D, Salloum C, Malek A, Laurent A, Azoulay D. Single incision laparoscopic hepatectomy: Advances in laparoscopic liver surgery. *J Minim Access Surg* 2014;10:14–17.