Laparoscopic distal pancreatectomy for pancreatic cystic lesions: early center experience

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Background
Owing to the advancements in technology along with increased laparoscopic experience's curve, advanced laparoscopic surgeries including distal pancreatectomy can be easily performed with acceptable oncologic results, and decreased mortality and morbidity. We describe our early experience with laparoscopic distal pancreatectomy (LDP) in the management of pancreatic cystic lesions.
Patients and methods
We included patients with pancreatic cystic lesions who underwent LDP and followed up in our center between May 2015 and October 2020. The patients were divided into two groups according to the procedure performed: laparoscopic splenic-preservation distal pancreatectomy (LSPDP) group and LDP with splenectomy.
Results
Twenty-seven patients were included of whom 19 patients underwent LSPDP and eight patients underwent LDP with splenectomy. The LSPDP group demonstrated longer operative duration than LDP/splenectomy group, but less estimated blood loss. Moreover, LSPDP had shorter hospital stay and less postoperative complications. The overall morbidity was 18.51% with no mortality, and no recurrence of the lesion was detected in the follow-up period.
Discussion
LDP is an acceptable modality in management of patients with pancreatic cystic lesions with an acceptable complication rate.

Keywords:
cystic lesions, distal pancreatectomy, splenic preservation

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Introduction

Although the pancreatic cystic lesions are extremely rare, a challenging list of differential diagnoses should be considered [1]. Pancreatic cystic lesions include pancreatic pseudocysts, pancreatic cystic neoplasia, parasitic cysts, congenital cysts such as duplication cysts, and acquired developmental benign cysts [2].

Thanks to the developments in imaging techniques, there is an increasing detection rate of asymptomatic or early pancreatic cystic neoplasms that favors the early resection of pancreatic lesions with improved outcomes [3].

When it comes to resection, pancreatic body and tail neoplastic lesions should be attempted surgically. Preoperative workup (clinical/radiological/laboratory) decides whether the lesion has a malignant potential so as to proceed with distal pancreatectomy concurrently with splenectomy as a preferred modality for lesions with malignant potential, or implying the preservation of spleen if the lesion has no malignant potential [4].

Recently, the European Association for Endoscopic Surgery Clinical Consensus Conference stated with a high level of consensus from the scientific community that laparoscopic distal pancreatectomy (LDP) is a feasible and safe alternative to open distal pancreatectomy (ODP) in the treatment of benign and malignant pancreatic lesions. LDP provides advantages in terms of reduced blood loss and enhanced postoperative recovery that result in a shorter hospital stay than with ODP [5].

Use of laparoscopic surgery to resect pancreatic tumors has been evolving since it started in 1994 with the published work of Gagner and Pomp [6] in laparoscopic pancreaticoduodenectomy. Since then, the revolution in laparoscopic techniques and instruments has made LDP to be a standard surgical procedure for pancreatic benign and malignant conditions [7,8].

With distal pancreatectomy, splenectomy is needed for technical and oncological reasons. Due to its anatomical proximity to the pancreatic tail, removal of the spleen frees the way open for easy surgical access and ensures extensive oncological resection of the involved lymph nodes, particularly in pancreatic lesions with malignant potential [9]. Sacrificing the spleen during LDP is not without a payback. Spleen is part of the reticuloendothelial system offering an immunological role that may be compromised after splenectomy, resulting in serious postoperative, including subphrenic abscesses, hypercoagulability, and the most serious one, overwhelming postsplenectomy infection [10]. However its questionability, preserving the spleen during LDP may be practiced, particularly for benign and low-grade malignant tumors [9]. Preserving the spleen has also its paybacks that include its complex anatomical position to the distal pancreas and surrounding tissues, and uneasy control of splenic vessels and hilum, making laparoscopic spleen-preservation distal pancreatectomy (LSPDP) a risky and difficult surgery. Moreover, it prolongs the operative time, increases the patient's intraoperative surgical risk, and may expose the patient to additional increased postoperative complications [11].

Two different techniques have been proposed for LSPDP according to either high ligation of splenic vessels while preserving short gastric and gastroepiploic vessels [12], or preserving the splenic vessels, and both work in its place [13]. We have adopted LDP at our center, and we aimed, in this study, to demonstrate and assess our early experience with LDP in the management of pancreatic cystic lesions.

Patients and methods

This study was performed according to the ethical standards of the Institutional Review Board at our center and the Declaration of Helsinki (as revised in 2013). Written informed consents were obtained from all patients participating in this study. We included all patients who were admitted (fulfilled the selection criteria mentioned later) with the diagnosis of pancreatic cystic lesions (the body and tail of the pancreas) at our center between May 2015 and May 2020.

All the patients underwent physical examination, preoperative investigations consisting of laboratory (CA19-9, serum amylase level), imaging [ultrasonography, computed tomography pancreatic protocol to assess the diameter of the cyst and its relation to the surroundings, and endoscopic ultrasonography with fine-needle aspiration cytology (EUS-FNAC) from the cystic fluid to detect the presence of malignant cells]. Moreover, the selection of patients for this study if (a) location of the lesion at the pancreatic body or tail; (b) pathological report confirming benign tumor or low-grade malignancy on EUS-FNAC or postoperative histopathology.

Surgical technique

Since adopting the LDP surgeries in our center, spleen preservation should be attempted in all patients. However, in patients with pancreatic calcifications or severe adhesions to the splenic vessels, splenic preservation may not be successful.

Patients were operated under general anesthesia; nasogastric tube and Foley's catheter were inserted. There were two laparoscopic set-up positions according to the patient's body habitus and the location of the lesion: (a) French position: the patient lied in lithotomy position, and the surgeon stood in-between the patient's legs, the assistant on the left side, and the camera operator on the right side. Four trocars were inserted 12 mm at the umbilicus for 30° camera, then 12 and 5 mm at the left midclavicular and mid-axillary lines, respectively, and 5 mm at the right subcostal margin midclavicular line; (b) American position: the patient lies in supine position with left side raised and the body tilted to the right side. The surgeon stood on the right side and the camera operator as well, while the assistant stood on the left side. The trocars' positions were the same as French technique, except the 5-mm subxiphoid port instead of the right-side subcostal midclavicular port.

Laparoscopic splenic-preservation distal pancreatectomy

Abdominal cavity was entered and inspected for any pathology, metastasis, and to rule out any entry injury to the internal organs. Mobilization of the splenic flexure of the colon medially, opening the lesser sac to dissect the peripancreatic tissue with dissection of gastrocolic and gastrosplenic ligaments. Consequently, mobilization of the transverse colon was performed; the left gastroepiploic vessels and short gastric vessels were preserved. Additionally, the stomach was retracted cranially to uncover the pancreatic neck, body, and tail. After exposure of the pancreas, and using the posterior–inferior approach, the inferior border of the pancreas was dissected, and the body and tail of the pancreas became free from the retroperitoneum. This mobilization of the left pancreas allowed visualization of the posterior wall of the gland where the splenic vein was easily identified. The splenic vein

was retracted away from the posterior pancreatic wall with gentle blunt dissection (Fig. 1a). Visual magnification through the laparoscope permitted excellent control of the small pancreatic veins, which were sealed with an ultrasonic device, or clipped with titanium clips. A tunnel was created between the splenic vein and the pancreas (Fig. 1b). The splenic artery was identified through this space using blunt careful dissection. Then, superior–anterior margin of the pancreas was dissected free from the splenic artery. Subsequently, adequate surgical margins were obtained; the pancreas was proximally divided 2 cm away from the tumor using 60–3.5-mm stapler (Fig. 1c). Subsequently, a sufficient window was created at the isthmus between the anterior surface of the portal vein and the posterior part of the pancreas. For the dissection of the dorsal side of the pancreas, the distal pancreatic stump along with the body and tail was retracted in the direction of the left lateral side, and the splenic vessels were freed from the distal pancreas (Fig. 1d and e). Washing out the abdominal cavity and hemostasis were performed.

Laparoscopic distal pancreatectomy and splenectomy

First, division of the lienorenal ligament and lateral attachment of the spleen was done. After opening the lesser sac and exposure of the pancreas, a subpancreatic tunnel was made at the isthmus. The splenic vein and artery are dissected and severed between clips or with a vascular endostapler. If the vessels could not be dissected from the pancreatic parenchyma, they could be dissected en bloc together with the parenchyma, using at least two stapler's loads. Once the pancreatic remnant was dissected, the spleen was mobilized by dividing the suspending ligaments.

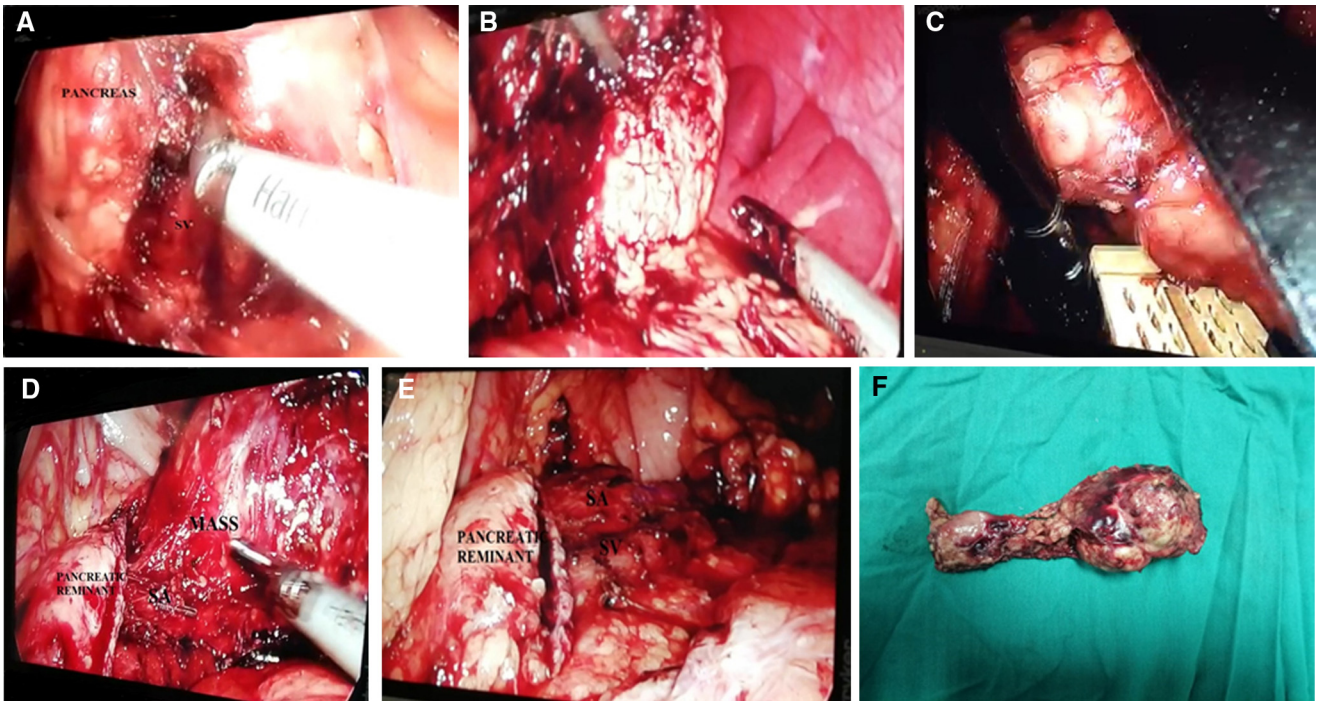
In either technique, the specimen was retrieved through Pfannenstiel's incision and a tube drain was inserted close to the pancreatic stump and brought out through the left-side 5-mm subcostal port-site incision.

We recorded the demographic criteria, associated comorbidities, and location and diameter of the pancreatic cystic lesions. The intraoperative outcomes included duration of surgery, estimated blood loss, and the need for blood transfusion. Moreover, the postoperative outcomes entailed time to the first bowel movement, time to oral fluid intake, length of hospital stay, and postoperative complications.

Statistical analysis

We used the IBM Statistical Package for the Social Sciences (SPSS Inc, Chicago, Illinois, USA for statistical analysis). Continuous data were expressed as the mean±SD and medium with range, and *t* test was used to compare the continuous variables. The difference was statistically significant if *P* value less than 0.05.

Figure 1

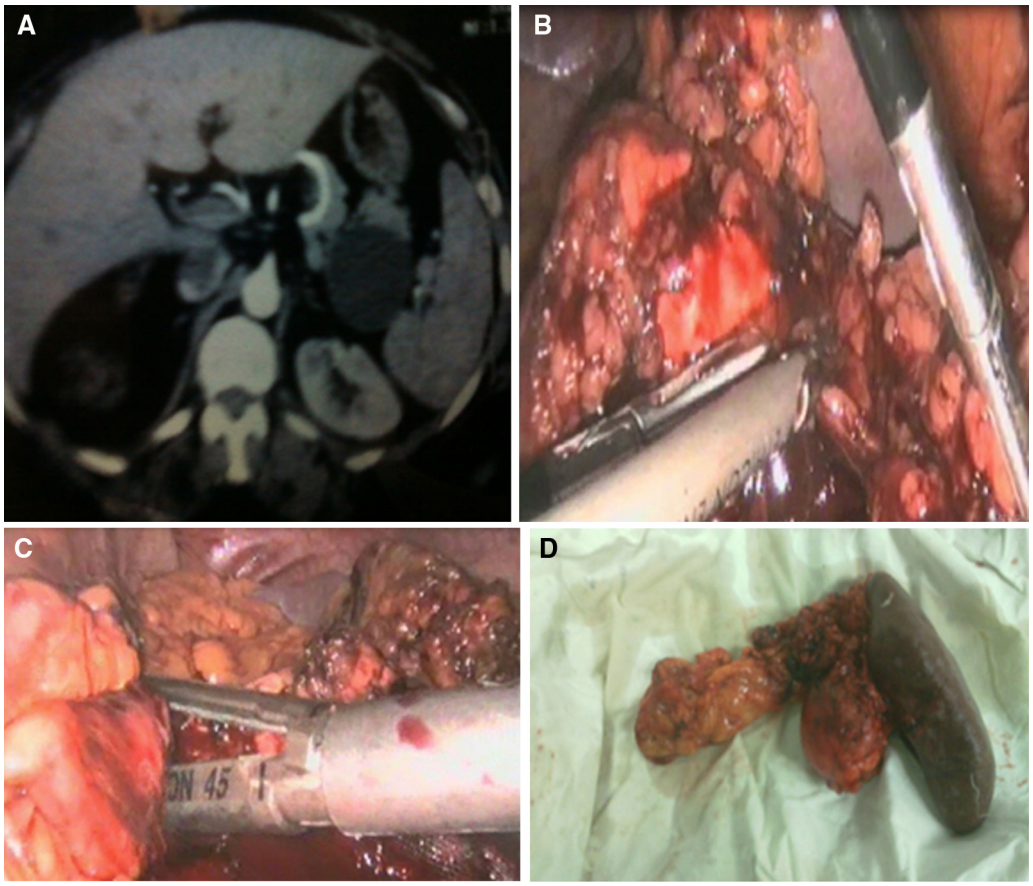


Steps of laparoscopic spleen-preservation distal pancreatectomy (LSPDP). (a) Dissection between the pancreas and splenic vein. (b) Dissection of the pancreatic tail from the splenic hilum. (c) Division of the pancreas using stapler. (d) Dissection of the mass from the splenic artery. (e) Surgical bed after LSPDP. (f) Specimen including distal pancreas.

Results

Twenty-seven patients, with cystic lesions at the pancreatic body and tail, were included in this study. Most of the patients were females (88.9%, 24/27), while males constituted 11.1%. Mean age was 35 ±11.7 years old, and mean body mass index was 24.4 ±3.1 kg/m^2. Four (14.81%) patients were diabetics, while 66.7% (18/27) of the patients were classified as American Society of Anesthesiologists I. All patients presented with abdominal pain (27/27) and associated with palpable epigastric mass (37.04%; 10/27). Mean lesion diameter was 7.1±1.5 cm. The patients' criteria in each group are described in Table 1.

Figure 2



Steps of laparoscopic distal pancreatectomy and splenectomy. (a) Pancreatic cyst at the body and tail. (b) Dissection of the inferior border of the pancreas. (c) Division of the pancreas and splenic vessels using Endo-GIA Stapler. (d) The specimen including the distal pancreas and spleen.

Table 1 Basic criteria for all patients with distal pancreatic cystic lesions

Variables	LSPDP (*N*=19)	LDP and splenectomy (*N*=8)	*P* value
Age (years)	32±9.5	39±13.4	0.54
Sex [*n* (%)]			0.000
Female	17 (89.47)	7 (87.5)	
Male	2 (10.53)	1 (12.5)	
BMI (kg/m^2)	23.8±2.4	25.7±1.9	0.35
Diabetes [*n* (%)]	3 (15.79)	1 (12.5)	0.57
ASA			0.01
ASA I	13	5	
ASA II	6	3	
Amylase (U/l)	59±19.8	62±21.7	0.23
CA19-9 (U/ml)	119.2±4.5	124.4±3.2	0.21
Lesion diameter (cm)	6.8±2.6	7.2±2.8 cm	0.23

ASA, American Society of Anesthesiologists; LDP, laparoscopic distal pancreatectomy; LSPDP, laparoscopic spleen-preservation distal pancreatectomy.

The mean operative time was 205±30.5 min with mean estimated blood loss 369±210.5 ml and four patients needed two packed red blood cells per patient. The texture of the pancreas was soft in 17 patients and hard in ten patients. The LSPDP group had statistically significant longer operative time (240±39.7 vs. 195 ±20.5 min, *P*=0.01) and lesser intraoperative blood loss (320±170.4 vs. 480±287.4 ml, *P*=0.03) compared with the LDP/splenectomy group. However, it is nonstatistically significant, the LSPDP group had earlier time to the first bowel movement (1.6±0.7 days), earlier time to oral intake and tolerance (2.2 ±0.4 days), and shorter length of hospital stay (3.4±1.1) compared with the LDP/splenectomy group. The length of the resected pancreas was 10.2±1.1 cm. Postoperative histopathology demonstrated that most of the patients (88.89%, 24/27) had benign lesions and categorized as the following: pancreatic pseudocyst in eight (29.63%), mucinous cystadenoma in nine (33.33%), serous cystadenoma in three (11.11%), solid pseudopapillary neoplasm in four (14.81%), and intraductal papillary mucinous neoplasm in four (14.81%) cases. LSPDP was done in 19 (70.37%) patients, while LDP/splenectomy was done in eight (29.63%) patients (Table 2).

Most of the patients returned to their normal activities after 2 weeks. Overall morbidity was 18.51% with no reported mortality in this study. The postoperative infection was higher in the LDP/splenectomy group. Two patients suffered from pancreatic fistulas and were managed conservatively for 2 weeks. Two patients suffered from intra-abdominal collections post-LDP/splenectomy, needed interventional radiology-guided drainage, and recovered after 2 weeks. The median follow-up was 16 (6–24) months. No tumor recurrences were observed.

Discussion

Typically, small (≤2 cm) serous and cystic lesions of the pancreas are benign. Larger (≥2 cm), mucinous, multilocular cysts, or cysts with a solid component, carry the risk of malignancy [1,14,15]. However, these diagnostic modalities usually fail to differentiate preoperatively among the histologic variants of pancreatic cystic lesions. With increased use, EUS-FNA is currently becoming an indispensable tool in the diagnosis of cystic lesions of the pancreas [16].

In this study, majority of the patients underwent surgery for a benign lesion (88.89%). The results are comparable to other studies. In two larger studies by Song *et al*. [17] and Mabrut *et al*. [18], the proportion of patients with benign tumors was 75 and 87%, respectively. Also, in our study, we performed LDP

Table 2 Operative and postoperative outcomes of all patients with distal pancreatic cystic lesions

	LSPDP (*N*=19)	LDP/splenectomy (*N*=8)	*P* value
Operative time (min)	240±39.7	195±20.5	0.001*
Estimated blood loss (ml)	320±170.4	480±287.4	0.001*
Patients needed blood transfusion (*n*)	1	3	0.35
Pancreatic texture (soft/hard)	14/5	3/5	0.001*
Time to 1st bowel movement (days)	1.6±0.7	2.7±1.2	0.26
Time to oral intake (days)	2.2±0.4	2.8±1.1	0.34
Length of hospital stay (days)	3.4±1.1	5.2±1.9	0.29
Morbidity	2/19	3/8	0.001*
Complications[a]			
Pancreatic fistula	1	1	
Intra-abdominal collection	0	2	
Wound infection	1	2	
Chest infection	0	1	
Length of resected pancreas (cm)	11.3±1.9	10.9	0.35
Pathology [*n* (%)]			
Serous cystadenoma	3 (15.79)	0	
Mucinous cystadenoma	7 (36.84)	2 (25)	
IPMN	1 (5.26)	2 (25)	
Solid pseudopapillary	4 (21.05)	0	
Pancreatic pseudocyst	4 (21.05)	4 (50)	
Posttraumatic	1 (5.26)	2 (25)	
Postinflammatory	3 (15.79)	2 (25)	
Benign/malignant	18/1 (94.74)	6/2 (75)	0.001*

LDP, laparoscopic distal pancreatectomy; LSPDP, laparoscopic splenic-preservation distal pancreatectomy. [a]More than one complication presented in one patient. *P value <0.05 statistically significant.

in eight patients who were confirmed to be histopathologically pancreatic pseudocyst. These eight patients were included because there was an explicit suspicion of a pancreatic cystic neoplasm after preoperative workup. EUS-FNAC might have changed the management of these patients, but there are no adequate cyst fluid markers to make a certain diagnosis of a pseudocyst. Therefore, it is preferred to perform LDP in pancreatic pseudocyst in the body and tail of pancreas [4].

Surgical intervention is considered the appropriate treatment for pancreatic cysts when symptomatic, or if the cystic mass enlarges and compresses adjacent organs. In these cases, the risk of malignancy is high, and surgery is considered mandatory. Moreover, most pancreatic cyst neoplasms tend to originate from the body or tail of the pancreas; therefore, distal pancreatectomy is the most common procedure in such lesions [19].

LDP has developed as the preferred surgical procedure for the benign and low-grade malignant tumors, with benefits of reduction in postoperative pain, reduction in wound infections, shorter length of hospital stay, reduction in the rate of incisional hernia, better cosmetic results, and earlier recovery after surgery than that of ODP [13,20]. LDP can generally be performed with or without splenectomy. However, it is proposed that the spleen maybe preserved if feasible, especially in young patients, because splenectomy can lead to life-threatening complications such as overwhelming postsplenectomy infection syndrome [21,22].

LDP can be performed by different techniques described in the literature, such as superior–anterior [23], inferior–posterior [11], and lateral approaches [24]. Basically, superior–anterior and inferior–posterior approaches commence dissection of pancreas from medial to lateral toward the pancreatic tail. However, superior–anterior approach focuses on the splenic artery first, whereas inferior–posterior approach focuses on the splenic vein first as a priority. On the other hand, in the lateral approach, dissection of the pancreas is performed from the pancreatic tail toward the pancreatic head. Lateral approach does not reveal the superior mesenteric vein; the free portion of the splenic vessels is comparatively shorter where there is a higher incidence for the vascular injury. In this study, we used the posterior–inferior approach, a retrograde pancreatectomy with initial mobilization of the pancreatic body and dissection of the inferior margin of the gland to look for the splenic vein. As soon as the vein is identified, it is important to dissect it free from the parenchyma with an ultrasonic device or clips of the short branches if needed [7].

There are two distinct approaches to perform LSPDP. The classic procedure (Kimura technique) [25] is to identify, isolate, and preserve the splenic artery and vein. Alternatively, in Warshaw technique [11], the splenic artery and vein are ligated with the pancreas, and perfusion of the spleen is maintained by the short gastric vessels. It is unclear whether the Kimura or Warshaw technique is superior. However, spleen-related complications are seen much more often after use of the Warshaw technique than with the Kimura technique, such as postoperative splenectomy (2 vs. 0%, respectively), splenic infarction (20.8 vs. 2%, respectively), and chronic abdominal pain (38 vs. 0%, respectively) [26]. In the present study, we used Kimura technique.

In this study, the LSPDP was performed in 19 (70.37%) patients. It showed shorter hospital stay and less postoperative complications compared with the LDP/splenectomy group. Shoup *et al.* [27] reported the series from the Memorial Sloan-Kettering Cancer Center, including 211 patients undergoing distal pancreatectomy for different causes. Splenectomy was performed in 79 (63%) patients and splenic preservation in 46 (37%). Postoperative complications occurred in 49% after splenectomy and in 39% after splenic preservation. Postoperative infectious complications and severe complications were significantly higher in the splenectomy group (28 and 11%), compared with the splenic-preservation group (9 and 2%). The length of hospital stay was 9 days postsplenectomy and 7 days postsplenic preservation.

Overall morbidity in this study was 18.51%, and fistula rate was 7.41%. The previously reported fistula rates in similar studies have ranged from 8 to 50% [28]. Mortality in LDP is low. When summarizing the data from similar studies (including >50 patients), there were three (0.3%) reported deaths in 950 patients who underwent laparoscopic distal pancreatic resections [29,30].

To conclude, LDP is feasible with an acceptable rate of complications in patients with pancreatic cystic lesions. The advantage of laparoscopy in the management of distal pancreatic tumors is represented by the high quality of vision, which makes it possible to maximize the percentage of spleen preservation; LSPDP has less postoperative complications and shorter hospital stay.

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Conflicts of interest

There are no conflicts of interest.

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