Original articles

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SURGICAL ENDOSCOPY and Other Interventional Techniques

Are major laparoscopic pancreatic resections worthwhile?

A prospective study of 32 patients in a single institution

J. L. Dulucq, P. Wintringer, C. Stabilini, T. Feryn, J. Perissat, A. Mahajna

Department of abdominal surgery, Maison de Santé Protestante, Bagatelle, Route de Toulouse 203, 33401 Talence-Bordeaux, France

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Abstract
Background: Laparoscopic surgery has been used increasingly as a less invasive alternative to conventional open surgery. Recently, laparoscopic therapy for pancreatic diseases has made significant strides. The current investigation studied pancreatic resection by laparoscopy. The objective of this study was to assess the feasibility, safety, and outcome of laparoscopic pancreatic major resection for benign and malignant lesions of the pancreas.
Methods: A prospective study of laparoscopic pancreatic resections was undertaken in patients with benign and malignant lesions of the pancreas. Over an 8-year period, 32 patients underwent laparoscopic pancreatic major resection: 21 left pancreatectomies (1 performed using a retroperitoneal approach), and 11 pancreatoduodenectomies (10 Whipple procedures and 1 total pancreatectomy). All the operations were performed in a single institution.
Results: The operations were performed without serious complications. Only one left pancreatectomy was converted to laparotomy because of massive splenic bleeding, and one Whipple procedure was converted because of adhesion to the portal vein. In four of the Whipple operations, the resection was performed completely laparoscopically, and the reconstruction was done via a small midline incision. There was no operative mortality. In 16 patients of the left pancreatectomy group, the spleen was preserved. The mean blood loss was 150 and 162 ml; and the mean operating time was 154 and 284 min, respectively, for the left pancreatectomy and the Whipple procedure. Postoperative complications occurred for five patients after left pancreatectomy and for three patients after the Whipple procedure. Two patients needed surgical reexploration after left pancreatectomy because of intraperitoneal haemorrhage and eventration of the extraction site. Two patients underwent reoperation after the Whipple procedure: one because of intraabdominal bleeding and the other because of small bowel obstruction.The mean hospital stay was 10.8 days after left the pancreatectomy and 13.6 days after the whipple procedure.
Conclusion: Laparoscopic left pancreatectomy for benign and malignant lesions is feasible, safe, and beneficial. We believe that pancreatoduodenectomy should be performed only in selected cases and by a highly skilled laparoscopic surgeon. If there is any doubt, an open resection should be performed.

Key words: Laparoscopy — Left pancreatectomy — Whipple operation — Pancreatic resection

Laparoscopy has become widely accepted in gastrointestinal surgery. Various gastrointestinal operations have been performed and have proved to be beneficial to the patients in terms of postoperative recovery, morbidity, and hospital stay [16, 22, 24].

Laparoscopic surgery of the pancreas was considered to be mainly investigational. However, in the past few years, laparoscopic interventions for pancreatic diseases have made significant strides. These interventions include diagnostic laparoscopy for the staging of pancreatic cancer, laparoscopic palliation of unresectable pancreatic cancer, laparoscopic management of pancreatic pseudocysts, and laparoscopic resection. The diagnostic value of laparoscopy for the staging of pancreatic cancer and detection of liver and peritoneal metastases is well known [4, 23]. Surgical palliation of pancreatic cancer using minimally invasive procedures such as laparoscopic choledochojejunostomy and gastrojejunostomy has been described [4]. Laparoscopic necrosectomy for acute necrotizing pancreatitis is widely accepted. Only limited series and case reports concerning laparoscopic resection for pancreatic cancer have been published recently[25].

Correspondence to: J. L. Dulucq

The purpose of this study was to review our experience with laparoscopic pancreatic major resections, and to discuss the role of these procedures in the treatment of benign and malignant diseases of the pancreas.

Patients and methods

Patients

The clinical records of 67 patients who underwent pancreatic laparoscopic intervention in the department of abdominal surgery at the Institute of Laparoscopic Surgery (ILS, Bordeaux, France) between April 1995 and December 2003 were collected prospectively. Of these, 31 patients who underwent palliative surgery because of unresectability or metastatic disease and 4 patients who had laparoscopic drainage procedures for acute pancreatitis were excluded. A total of 32 patients underwent laparoscopic pancreatic resection, 21 of whom had left pancreatectomy, one performed via a retroperitoneal approach because of previous abdominal surgeries and expected adhesions. Of the 11 patients who underwent pancreatoduodenectomy, 10 had Whipple procedure and 11 had total pancreatectomy. The patients included 23 women and 9 men with a mean age of 59 years (range, 24–86 years).

All the patients underwent preoperatiye endoscopic ultrasound and dynamic computed tomography (CT) scanning with a continuous bolus of intravenous contrast or magnetic resonance imaging (MRI) to establish a diagnosis, to determine the extent of disease, and to evaluate resectability. Before the operations were performed, all the cases were reviewed at a weekly meeting attended by staff surgeons, anesthesiologists, radiologists, and pathologists. The patients were informed which procedure was expected, and the possibility of conversion was discussed.

Data studied

The demographic data of the patients, the surgical procedure, the postoperative course, and outpatient follow-up evaluation were studied. The following data were collected prospectively: age, sex, localization studies, type and location of the tumor, tumor size, type of procedure, duration of surgery, blood loss, intraoperative complications, pathologic findings and nodal status, postoperative complications, hospital stay, recurrence, and distant events.

Variables are presented as median and range. Statistical analysis included chi-square test or student *t*-test when indicated, and *p* values less then 0.05 were considered significant.

Operative technique

For all interventions, the patient was placed in the supine position with legs apart. The surgeon stood between the patient's legs, with an assistant standing on the left side of the patient and a scrub nurse holding a 0° camera on the opposite side. Pneumoperitoneum with carbon dioxide (CO_2) was induced, and intraabdominal pressure was monitored and maintained below 12 mmHg.

The camera was inserted through a 10-mm port at the umbilicus, and a second 12-mm working port was placed on the right side of the left mammarian line 2 cm above the umbilical level. A 5-mm working port was placed on the left side of the right mammarian line 2 cm above the umbilical level. An assistant port was placed on the cystic point. The second assistant port was placed on the left midclavicular line, subcostally. We always kept a triangular view using the camera and the working port. Before every resection, a full abdominal exploration was performed.

Left pancreatectomy

First, a window is created in the gastrocolic ligament using scissors with electrocautery, and if necessary, some transverse branches from the gastroepiploic arcade are coagulated and divided with the ligasure (Valleylab, Tyco Healthcare Group Lp, Boulder, CO, USA). The stomach is elevated, and an exploration of the whole pancreas with a laparoscopic ultrasound probe (Lynx- U/S scanner, B-K Medical A/S Sandtoften, 9 DK 2820 Gentofle) is performed. A dissection of the inferior border of the pancreas is performed by opening the peritoneum and the fatty tissue in the root of the transverse colon. The retroperitoneal avascular plane of the pancreas is easily dissected. The superior mesenteric vein and the splenic vein are identified. The splenic vessels are gently separated from the pancreas, starting at the pancreatic isthmus. If the splenic artery and vein are preserved, a meticulous dissection using clips and Harmonic Scalpel (Ultracision, Ethicon Endo Surgery, Cincinnati, OH, USA) is performed between the pancreas and the splenic vessels. Otherwise, dissection and ligation of the splenic artery and vein at the neck of the pancreas is performed, leaving the spleen supplied by the short gastric vessels.

The pancreas is transected with a linear cutting stapler (Ethicon Endosurgery, Cincinnati, OH, USA) through a 12-mm trocar port. If necessary, additional hemostatic sutures are placed. When splenectomy is performed, a ligation of the splenic vein is performed first, followed by transection of the pancreas and ligation of the splenic artery. The distal transacted surface of the pancreas is freed from the transverse branches of the splenic vessels using endoscopic clips or a hemostatic laparoscopic ligasure. The resected specimen is always placed inside a bag (Endo Catch II, Auto Suture European Services Center, SA, Elancourt, France) for extraction through enlargement of a left port wound. One suction drain is left at the bed of the transacted pancreas.

Whipple procedure

This operation resects the distal third of the stomach en block along with the right half of the greater omentum; the gallbladder including the cystic and common bile duct, the duodenum as well as the 10 cm of jejunum, the head and neck of the pancreas and varying parts of its body depending on the size and site of the tumor, and the peripancreatic and hepatoduodenal lymph nodes. This operation can be divided into two stages: resection and reconstruction.

First we create a large window in the gastrocolic ligament using the aforementioned technique. An extended exploration of the pancreas is performed using a laparoscopic ultrasound probe inserted through the right port and placed directly on the neck, body, and tail of the pancreas. The head of the pancreas and the area around the duodenal loop are scanned by direct contact, which enables us to rule out additional tumors.

We perform an extended mobilization of the right colon, followed by an extended Kocher maneuver. If necessary, the right gastroepiploic vein and artery are dissected and transected. Once we extend the dissection beyond the vena cava and the duodenum, it is possible to position the laparoscopic probe behind the uncinate process and the posterior pancreas to evaluate resectability. We open the hepatogastric ligament and the omental bursa to visualize the anterior side of the pancreas. With the stomach retracted to the anterior wall of the abdomen, we further dissect the anterior and superior side of the pancreas with visualization and ligation of the right gastric artery and gastroduodenal artery using double titanium clips (Ligaclip Airport, Ethicon Endo-Surgery, Cincinnati, OH, USA).

After dissecting the vessels of the smaller curvature of the stomach using the ligasure, we transect the distal third of the stomach using a linear cutting stapler. We transect the proximal jejunum with a linear cutting stapler and dissect the meso of the jejunum and the duodenum proximally until we find the previous plane of the extended Kocher maneuver. In this way, we create a window in the meso of the transverse colon and place it through the distal jejunum as a preparation for the anastomoses.

We use a 5-mm irrigation suction probe under direct laparoscopic vision for dissection of the posterior pancreas from the portal vein (Figs. 1A and B). The pancreas then is transected with an ultrasonic dissector, beginning inferiorly and moving toward the superior border anterior to the portal vein. The posterior area of the portal vein is dissected, and the uncinate process is cleared from the mesenteric artery and vein using the ultrasonic dissector and the ligasure (Fig. 2). The hepatic duct is closed using a small vascular clamp to prevent spillage of bile during the operation. Finally, the bile duct is transected approximately 2 to 3 cm above the pancreatic border.

For reconstruction, we use the Child's method of reconstruction, which includes three anastomoses: pancreaticojejunostomy, hepaticojejunostomy, and gastrojejunostomy from proximal to distal. The end-to-end pancreaticojejunostomy anastomosis is performed in one

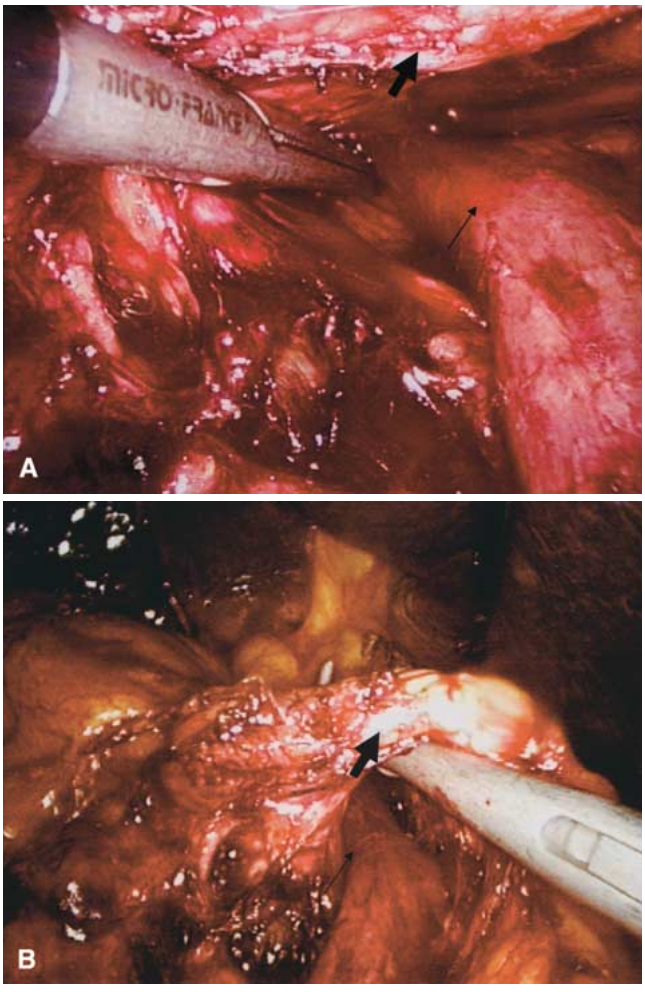

Fig. 1. Dissection of the posterior pancreas from the portal vein using a 5-mm irrigation suction probe under direct laparoscopic vision. **A** Beginning of the dissection. **B** The pancreas is separated from the portal vein and ready for transaction. The thick arrow shows the pancreas, and the thin arrow shows the portal vein.

layer using separate monofilament 4-0 sutures. If the pancreatic duct is dilated, several mucosa-to-mucosa sutures can be placed. The second anastomosis is an end-to-side hepaticojejunostomy, usually performed 10 to 15 cm from the first, with running posterior and anterior 5-0 monofilament absorbable suture lines. The final anastomosis lies 50 cm downstream from the hepaticojejunostomy and consists of an end-to-side mechanical gastrojejunostomy. For six patients, the reconstruction was performed laparoscopically, and for four patients, it was performed through a small midline incision. The specimen was extracted using an endobag after expansion of the opening port to between 3 and 4 cm. A single soft silastic drain was placed behind the pancreatic and biliary anastomoses.

All the patients received prophylactic antibiotics and H_2 inhibitors. Somatostatins or analogues were not given routinely. In cases for which splenectomy was performed, the patients received pneumococcal and hemophilus influenza vaccines.

All pathologic findings were discussed in a multidisciplinary panel, and if necessary, patients received adjuvant treatment. All the patients were followed up in our outpatient clinic and by a gastroenterologist. Additional data were collected by telephone.

Results

This study enrolled 32 patients, with 21 undergoing left pancreatectomy and 11 undergoing pancreatoduodenectomy.

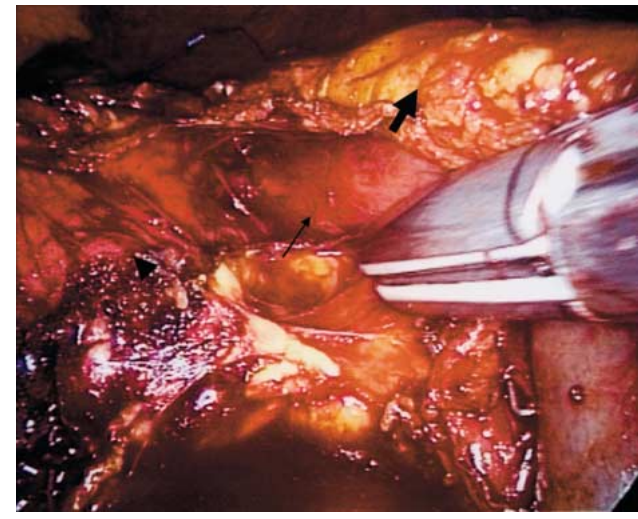

Fig. 2. The posterior area of the portal vein is dissected, and the uncinate process is cleared from the mesenteric artery and vein using the ultrasonic dissector and the ligasure. The thick arrow shows the pancreas remnant, and the thin arrow shows the portal vein. The arrowhead shows the uncinate process.

Table 1. Indication and final diagnosis of laparoscopic left pancreatectomy

Indication	Final diagnosis	No. of patients
Body cyst	Sereus cystadenoma	7
	Cystadenocarcinoma	1
Body lesion	Adenocarcinoma	2
	Insulinoma	1
	Pseudopapillary tumor	1
Tail cyst	Mocus cystadenoma	3
	Sereus cystadenoma	2
Tail lesion	Lymphangioma	1
Chronic pancreatitis	Autoimmune pancreatitis	3
Total		21

Laparoscopic left pancreatectomy

Laparoscopic left pancreatectomy was performed for 15 female patients and 6 male patients with a mean age of 58 ± 12 years (range, 24–85 years). The presenting syndromes were feeling of an abdominal mass in 2 patients and chronic pain in 17 patients. Two patients with serous cysts were asymptomatic. The indication and final diagnosis for laparoscopic left pancreatectomy are described in Table 1.

Three patients underwent surgery for a malignant tumor. Four patients had chronic pancreatitis, and the remaining patients underwent surgery for a benign lesion. The mean tumor size of the surgical specimen was 4.2 cm (range, 0.8–7.5 cm). A tumor-free margin was obtained in all patients. One patient required conversion to an open procedure because of massive splenic bleeding. One patient underwent surgery via a retroperitoneal approach without entrance to the peritoneal cavity because of expected adhesions after previous abdominal surgeries.

The mean adult American Society of Anesthesiology (ASA) physical status was 1.7 (median, 2; range, 1–3). The mean blood loss was 162 ml (median, 100 ml range,

Table 2. Final diagnosis and pathology of the Whipple patients

Pathology	No. of patients
Pancreatic adenocarcinoma (T2N0Mx)	1
Pancreatic adenocarcmoma (T3N1Mx)	3
Ampullary adenocarcinoma (T2N0Mx)	1
Ampullary adenocarcinoma (T3N0Mx)	1
Neuroendocrine tumor (T3N1Mx)	1
Chronic pancreatitis	3
Metastasis of renal cell carcinoma	1

50–700 ml). The mean operating time was 154 ± 63 min (median, 150 min; range, 110–240 min). Except for three episodes of mild intraoperative bleeding, there were no major intraoperative complications. In 16 of the 21 patients (72%), the spleen was preserved. There were no perioperative deaths. Mean intensive care unit admission was 3.4 days (median, 3 days; range, 1–5 days). Postoperative complications consisted of five complications (23%). These included one pancreatic fistula (considered as amylase rich fluid drainage of more than 20 ml per day), two intraabdominal abscesses, one eventration of the extracted site, and bleeding in one patient. The pancreatic fistula, which was minor, was contained with a drain and eliminated by postoperative week 3. The abscesses were treated with broad-spectrum antibiotics because of inability to perform subcutaneous drainage. Two patients needed reoperation. The patient with the eventration underwent repair by primary closure, and the patient with the bleeding underwent laparoscopy, which revealed portalsite bleeding.

The mean time to the first bowel movement was 3.4 days (range, 2–6 days) after surgery. The mean time until return to independent selfcare was 2.8 days (range, 2–5 days) after surgery. The mean hospital stay was 10.8 days (median, 11 days; range, 6–15 days). The follow-up period was 4 years and 2 months (range, 2 months to 9.75 years) for benign lesions and 19 months (range, 2 months to 3.8 years) for malignant lesions. All the patients with benign lesions were cured of lesions and symptom free at the follow-up assessment. The mean number of dissected lymph nodes in the patients with malignancy was 18 (range, 16–20). Lymph node metastases were found in two patients, but were limited to the peripancreatic region. During the follow-up period, all the patients were free of disease.

Laparoscopic Whipple procedure

Eleven patients (8 women and 3 men; mean age, 63 years; range, 40–85 years) underwent the Whipple procedure. The presenting syndromes were painless jaundice in seven patients and chronic pain in four patients. Eight patients underwent surgery for malignant tumors, and three patients had surgery for autoimmune pancreatitis. One of the patients with pancreatitis underwent total pancreatectomy because of polycystic lesions. The final pathologic diagnoses are listed in Table 2.

The mean tumor size of the surgical specimen was 2.1 cm (range, 1.2–3.3 cm). A tumor-free margin was obtained in all the patients. The mean number of dissected lymph nodes in the patients with malignancy was 14 (range, 11–17). Six patients underwent the procedure completely via laparoscopy. One patient underwent conversion to open surgery because of pancreatic adhesion to the portal vein. In four patients the resection was performed completely via laparoscopy, but the reconstruction was performed through a small midline incision (laparoscopically assisted).

Table 3. Postoperative complications after Whipple operations

Complications	Laparoscopic ($n = 6$)	Laparoscopically assisted ($n = 14$)	Converted ($n = 1$)
Intraperitoneal bleeding	1	1	0
Small bowel obstruction	1	0	0
Jugular vein thrombosis	0	0	1

The mean adult ASA physical status was 1.5 (median, 2; range, 1–3). The mean blood loss was 75 ml (median, 100 ml; range, 50–150 ml) and 83 ml (median 100 ml; range, 50–150 ml); the mean operating times were 268 min (range, 210–360 min) and 286 min (range, 270–300 min), respectively, for the completely laparoscopic and the laparoscopically assisted Whipple procedures. One intraoperative bleeding was seen in the conversion case and none in the laparoscopic groups. There was no intraoperative death. One patient died 10 days after completely uncomplicated laparoscopy because of a cardiac event. The mean intensive care unit admission time was 6 days (median, 5 days; range, 3–8 days) and 7 days (median, 6 days; range, 3–10 days), respectively, for the completely laparoscopic and laparoscopically assisted Whipple procedures. The mean time to the first bowel movement was 3.8 days (range, 2–7days) and 4.1 days (range, 3–7 days) and the mean time until return to independent self care was 5.3 days (range, 4–9 days) and 5.8 days (range, 5–11 days), respectively, after the completely laparoscopic and the laparoscopically assisted Whipple procedures. The mean hospital stays were 13.4 days (median, 15 days; range, 9–21 days) and 14 days (median, 16 days; range, 10–25 days), respectively, for the completely laparoscopic and the laparoscopically assisted Whipple procedures. There were no statistically significant differences ($p > 0.05$) between the two groups for all the parameters checked.

Postoperative complications were seen in two patients (33%) who underwent the laparoscopic Whipple procedure, and in one patient (25%) after the laparoscopically assisted Whipple procedure (Table 3). The intraperitoneal bleeding originated in both patients from small vessels and was managed by re-laparoscopy and hemostasis. One patient had a complete small bowel obstruction 5 days after the laparoscopic Whipple procedures, and required re-laparoscopic exploration, which showed an internal hernia. The patient who underwent conversion had a complication of jugular vein thrombosis and was treated successfully with anticoagulant drugs.

The mean follow-up time was 19 months (range, 2–45 months). Two patients with an adenocarcinoma died. The first patient died 10 days after surgery because of a cardiac event, and the second patient died 2 years after

Table 4. Perioperative data for laparoscopic pancreatic resection

	Left pancreatectomy	Laparoscopic Whipple	Laparoscopically assisted Whipple
Mean blood loss ml (range)	162 (50–700)	75 (50–150)	83 (50–150)[a]
Mean operation time min (range)	154 (110–240)	268 (210–360)	286 (270–300)[a]
Mean intensive care days (range)	3.4 (1–5)	6 (3–8)	7 (3–10)[a]
Mean hospital stay days (range)	10.8 (6–25)	13.4 (9–29)	14 (10–45)[a]
Complications %	23 (5/21)	33 (2/6)[b, c]	25 (1/4)[a, c]

[a] Nonsignificant difference ($p > 0.05$)between the laparoscopically assisted and laparoscopic Whipple procedures
[b] The converted case is not included
[c] Nonspecific complications

the surgery. One patient who liver metastases received adjuvant chemotherapy, and the remainder were disease free. The perioperative data of our series are summarized in Table 4.

Discussion

Our study demonstrates the technical feasibility of laparoscopic pancreatic resections for performed by experienced laparoscopic surgeons for benign and malignant diseases. These procedures can be considered safe because there were no surgical related deaths and no unusual complications.

The value of laparoscopy for gastrointestinal and abdominal solid organ interventions is increasing. Laparoscopy allows for faster recovery, reduces postoperative morbidity, and has even resulted in better survival among patients undergoing colorectal surgery for cancer [16].

Recently, the role of laparoscopy for diseases of the pancreas has gained interest. Although the role of the ''classic'' investigations for evaluation of pancreatic cancer resectability is major [11], the value of diagnostic laparoscopy and contact ultrasonography for pancreatic cancer is of greater accuracy because it detects small metastases in the liver and peritoneum [3, 4, 11, 23, 25]. Palliative laparoscopic surgery for patients with pancreatic cancer is useful [23]. Laparoscopic gastroenterostomy is a straightforward procedure that provides excellent palliation for the fewer than 20% of patients with pancreatic carcinoma in whom duodenal obstruction develops [14]. Laparoscopic choledochoenterostomy has been described previously [5, 26].

Laparoscopic distal pancreatectomy has gained increasing interest because of its relative feasibility. However, the reports described small series, and the role of this procedure still is not established [2, 7, 9, 20, 21]. In our series, we succeeded in performing the procedure laparoscopically in 95% of the cases, and only one patient required conversion to open surgery because of massive splenic hemorrhage. As in other publications, we present evidence of a decline in complications and conversion to open surgery to almost 0% with the increase in experience with laparoscopic surgery [8]. This reflects the feasibility of this procedure in the hands of skilled laparoscopic surgeons. Moreover, there were no major intraoperative complications. Multiple titanium clips were used to manage two patients who had mild intraoperative bleeding from the splenic vein and the dorsal pancreatic branches. We succeeded in preserving the spleen in the majority of cases (72%). In one patient with a solid lesion, we had planned a splenopancreatectomy. The other five patients underwent splenectomy because of uncontrolled bleeding. Park and Heniford [20] preserved the spleen in only 48% of patients with pancreatic tumor and 57% of those with insulinoma. To avoid bleeding and reduce the conversion rates, we divided the splenic artery and vein at the neck of the pancreas and dissected the pancreas posteriorly, leaving the spleen supplied by the short gastric vessels, as described by Vezakis et al. [27] and Warshaw [28]. In addition, we didnot mobilize the splenic flexure systematically. We started the dissection at the body of the pancreas and continued to the lateral side. The morbidity in our series is comparable with that reported in other publications [20, 21].

The literature supports our data regarding the advantages of laparoscopic left pancreatectomy in terms of intraoperative complications, short operative duration, zero mortality, and low morbidity (Table 5).

Whereas there are many reports and series concerning laparoscopic left pancreatectomy, there is little literature about laparoscopic pancreatoduodenectomy. The main reason is that there is no consensus about the role of this procedure. Also, cases are rare, as are technical difficulties that necessitate highly skilled laparoscopic surgeons. The first report was in 1994 by Gagner and Pomp [13], and since then, occasional case reports have been published [12, 18, 19]. This procedure has been evolving into a laparoscopically assisted technique using a pneumosleeve with the hand inside, whereas the advantages of complete laparoscopic pancreatoduodenectomy have been unknown.

Some authors have raised the suspicion that patients have been put at risk during the blind passage of the laparoscopic instrument along the superior mesenteric vein behind the neck of the pancreas [19]. To avoid a risky blind dissection, we used a 5-mm irrigation suction probe under direct laparoscopic vision for dissection of the pancreas from the large vessels (Fig. 1A and B), and there was no unusual bleeding. Another concern has been that the laparoscopic Whipple procedure is a compromised cancer operation in which it is difficult to avoid leaving a remnant of pancreas attached to the superior mesenteric vein while dissecting the uncinate process with a linear stapler [19]. This problem was solved by using the ultrasonic dissector in the dissection of the superior mesenteric vessels from the uncinate process (Fig. 2).

Table 5. Laparoscopic left pancreatectomy in the English literature (series smaller than 3 patients are not included)

Authors	Patients (*n*)	Operative time[a,b] (min)	Blood loss[a,c] (ml)	Morbidity (%)	Conversion (%)	Death (*n*)	Hospital stay (days)
Gagner [14] 1996	7	270	—	0	43	0	5
Cuschieri [6] 1996[d]	5	270	400	20	0	0	6.4
Cushieri [7] 1998[d]	9	240–300	400	11	0	0	7.1
Vezakis [27] 1999	6	300	—	33	33	0	34.5
Park [19] 1999	5	300	—	20	0	0	4.9
Patterson [21] 2001	15	264	200	26	20	0	6
Barlehner [1] 2001	5	—	—	0	0	0	14
Mahon [17] 2002	3	104	733	0	0	0	4.7
Faber [8] 2002	13	280	—	30	15	0	7
Park [20] 2002	25	222	274	16	8	0	4.1
Fernandez-Cruz [15] 2002	13	240	—	8	23	0	5
Gramatica [15] 2002	5	—	—	20	0	0	5
Our data	21	154	162	23	5	0	10.8
Total	125					0	

[a] Mean, [b] Minute, [c] mL
[d] Contains duplicate cases

A tumor-free margin was obtained for all our patients, and we achieved a mean of 14 lymph nodes in the patients with malignancy. Our mean follow-up time for these patients was 19 months. One patient with an adenocarcinoma died 2 years after surgery; one patient had liver metastases and received adjuvant chemotherapy; and the remainder were disease free. Further studies and a longer follow-up period are needed to determine definitive results.

In addition, laparoscopy causes less immunosuppresion than laparotomy and therefore is beneficial to the patient with cancer. One of the major concerns regarding the laparoscopic Whipple procedure is the prolonged duration of the operation, which increases morbidity. In our series, the mean operative time was 290 min. Postoperative complications were nonspecific (bleeding and small bowel obstruction), and no bile leak, pancreatic fistula, or gastric dilatation occurred. There were no surgically related deaths. Therefore, in selected cases, laparoscopic pancreatoduodenectomy is considered to be a safe procedure when performed by highly skilled laparoscopic surgeons.

As mentioned, in most cases we performed the anastomoses laparoscopically, and in only four selected cases was the resection performed laparoscopically and the reconstruction performed by minilaparotomy (laparoscopically assisted). According to our series, the complete laparoscopic resection yields better results than the laparoscopically assisted technique, but the difference is not significant (Table 4).

Conclusion

Pancreatic surgery is a relatively rare and difficult procedure to perform and has been done mainly using an open approach. Recently, case reports and small series have been published suggesting promising results using the laparoscopic approach. To the best of our knowledge, our series is the largest study of laparoscopic pancreatic resections reported to date.

In our series, laparoscopic left pancreatectomy for benign and malignant lesions had good results and was proved to be feasible and safe procedure, as supported by the literature. Little has been published regarding laparoscopic pancreatoduodenectomy, mainly because of the technical difficulties in the reconstruction stage. This procedure should be performed only in selected cases and by highly skilled laparoscopic surgeons. Otherwise, the combined technique is an option. It is our opinion that this approach should be performed and given the same oncologic consideration as open surgery, but further studies are needed. If there is any doubt, an open resection should be preferred.

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