Original articles

Surg Endosc (2004) 18: 1420–1426
DOI: 10.1007/s00464-003-8204-z

SURGICAL ENDOSCOPY and Other Interventional Techniques

Laparoscopic drainage of pancreatic pseudocysts

A. Dávila-Cervantes,[1] F. Gómez,[1] C. Chan,[1] P. Bezaury,[2] G. Robles-Díaz,[3] L. F. Uscanga,[3] M. F. Herrera[1]

[1] Department of Surgery, Instituto Nacional de Ciencias Médicas y Nutrición, Vasco de Quiroga 15, Tlalpan, 14000, México, D.F. Mexico
[2] Department of Radiology, Instituto Nacional de Ciencias Médicas y Nutrición, Vasco de Quiroga 15, Tlalpan, 14000, México, D.F. Mexico
[3] The Pancreatic Clinic, Instituto Nacional de la Nutrición de Ciencias Médicas y Nutrición, Vasco de Quiroga 15, Tlalpan, 14000, México, D.F. Mexico

Received: 18 December 2003/Accepted: 9 March 2004/Online publication: 22 July 2004

Abstract
Background: Laparoscopic drainage of pancreatic pseudocysts (PPs) has been used in selected cases. The aim of this study is to analyze our results with the laparoscopic technique and to compare them with those of a cohort of patients treated by open surgery during the same time period.
Patients and methods: Ten patients underwent laparoscopic drainage of PPs during a 7-year period [laparoscopic group (LG)]. The type of drainage was chosen according to the size and location of the PP. Demography, surgical details, results, and complications were analyzed and contrasted with those of 6 patients who underwent open drainage [open group (OG)].
Results: All patients presented with mature PPs developed after a documented episode of acute pancreatitis. Mean age of the LG was 42 years (six males and four females). In the OG, mean age was 36 years (five males and one female). Etiology of the pancreatitis was alcoholic in eight patients, biliary in five, toxic in two, and associated with systemic lupus erythematous in one. Laparoscopic procedures included Roux-en-Y cystojejunostomy in four patients, extraluminal cystogastrostomy in four, and intraluminal cystogastrostomy in two. There were no conversions. In the OG, cystogastrostomy was performed in three patients and Roux-en-Y cystojejunostomy in three. One patient in the LG developed upper gastrointestinal bleeding the day after surgery that resolved uneventfully, one patient presented a postoperative abscess that required open drainage, and one patient presented a residual pseudocyst that was treated by endoscopy. Morbidity in the OG included a small bowel obstruction secondary to an internal hernia that required reoperation, pneumonia, and a residual pseudocyst that was treated conservatively in one patient each. At a median follow-up of 22 months (range, 1–72) all patients were asymptomatic with no evidence of recurrent disease by computed tomography scan.
Conclusion: Laparoscopic drainage of PPs is feasible, safe, and effective. Results are similar to those obtained using the open technique.

Key words: Pancreatic pseudocysts — Pancreas — Laparoscopic surgery

Correspondence to: M. F. Herrera

Pancreatic pseudocysts (PPs) are well-known complications of acute and chronic pancreatitis. They consist of fluid collections surrounded by fibrous tissue and lack epithelial lining. The factors involved in the outcome of PPs vary, and the ideal procedure of drainage and the appropriate timing for performing it are debatable [20]. Drainage of PPs can be performed using several approaches. Among the most common approaches are percutaneous external drainage, endoscopic drainage to the stomach or the duodenum, and surgical drainage [1, 5, 20]. For mature symptomatic cysts, internal drainage has demonstrated the best results. It can be done to the stomach, duodenum, or jejunum depending on the relation of the pseudocyst to these structures [20].

Advances in laparoscopy have made it feasible to drain PPs using this approach [7, 9, 14]. The aim of this study is to describe the surgical technique used in our institution for the laparoscopic treatment of PPs and to analyze our results in an initial series of 10 patients and compare these with those of a cohort of patients who underwent the open drainage technique.

Patients and methods

From March 1996 to November 2003, 10 patients underwent laparoscopic surgical management of a PP at the Instituto Nacional de Ciencias Médicas y Nutrición "Salvador Zubirán." The diagnosis was confirmed by ultrasonography and computed tomography (CT) scan in all patients. In the absence of contraindication for laparoscopic surgery, laparoscopic drainage was the first surgical alternative.

Three different laparoscopic drainage procedures were performed. The surgical procedure was chosen according to the proximity of the PP to adjacent hollow viscous.

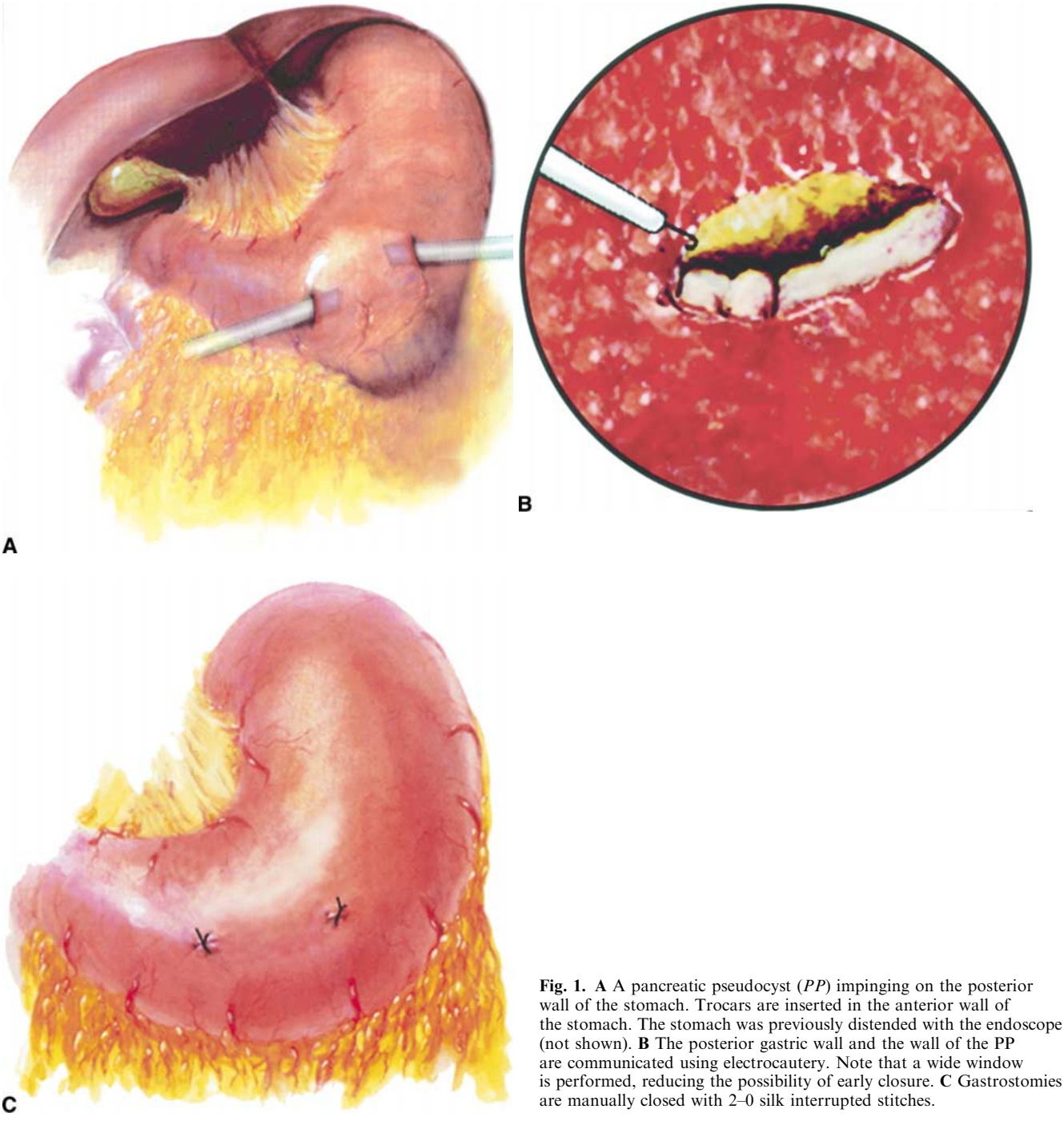

Fig. 1. **A** A pancreatic pseudocyst (*PP*) impinging on the posterior wall of the stomach. Trocars are inserted in the anterior wall of the stomach. The stomach was previously distended with the endoscope (not shown). **B** The posterior gastric wall and the wall of the PP are communicated using electrocautery. Note that a wide window is performed, reducing the possibility of early closure. **C** Gastrostomies are manually closed with 2–0 silk interrupted stitches.

Intraluminal cystogastrostomy

This technique was chosen for PPs located in the posterior aspect of the stomach in a wide contact surface with the posterior gastric wall. For this technique, pneumoperitoneum was established in the usual manner and a 10-mm trocar was inserted through the umbilicus. The abdominal cavity was explored. Two 5-mm umbrella-type trocars were inserted inside the stomach under direct vision using an endoscope to fully distend the stomach and to guide trocar insertion (Fig. 1A). A 5-mm scope was introduced through one of the trocars. Endoscopic ultrasound was used to determine where the pseudocyst wall was thinnest and in close contact with the stomach as well as to avoid the celiac trunk. Using the hook cautery, a 4 to 6-cm opening was made to allow communication between the PP and the stomach (Fig. 1B). No sutures were placed between the posterior gastric wall and the PP. The cavity of the pseudocyst was inspected searching for partially communicated areas, hemostasis was performed, and the trocar orifices were closed using interrupted stitches (Fig. 1C).

Extraluminal cystogastrostomy

This technique was selected for PPs in close contact with the inferior aspect of the stomach. In these patients, pneumoperitoneum was established in the usual manner. Three 10-mm trocars were inserted—one at the umbilicus, one in the subxifoid space, and one in the left pararectal supraumbilical region—and a 12-mm trocar was placed in the right pararectal area.

The abdominal cavity was inspected and the greater omentum was transected using a harmonic scalpel. The anterior aspect of the PP was

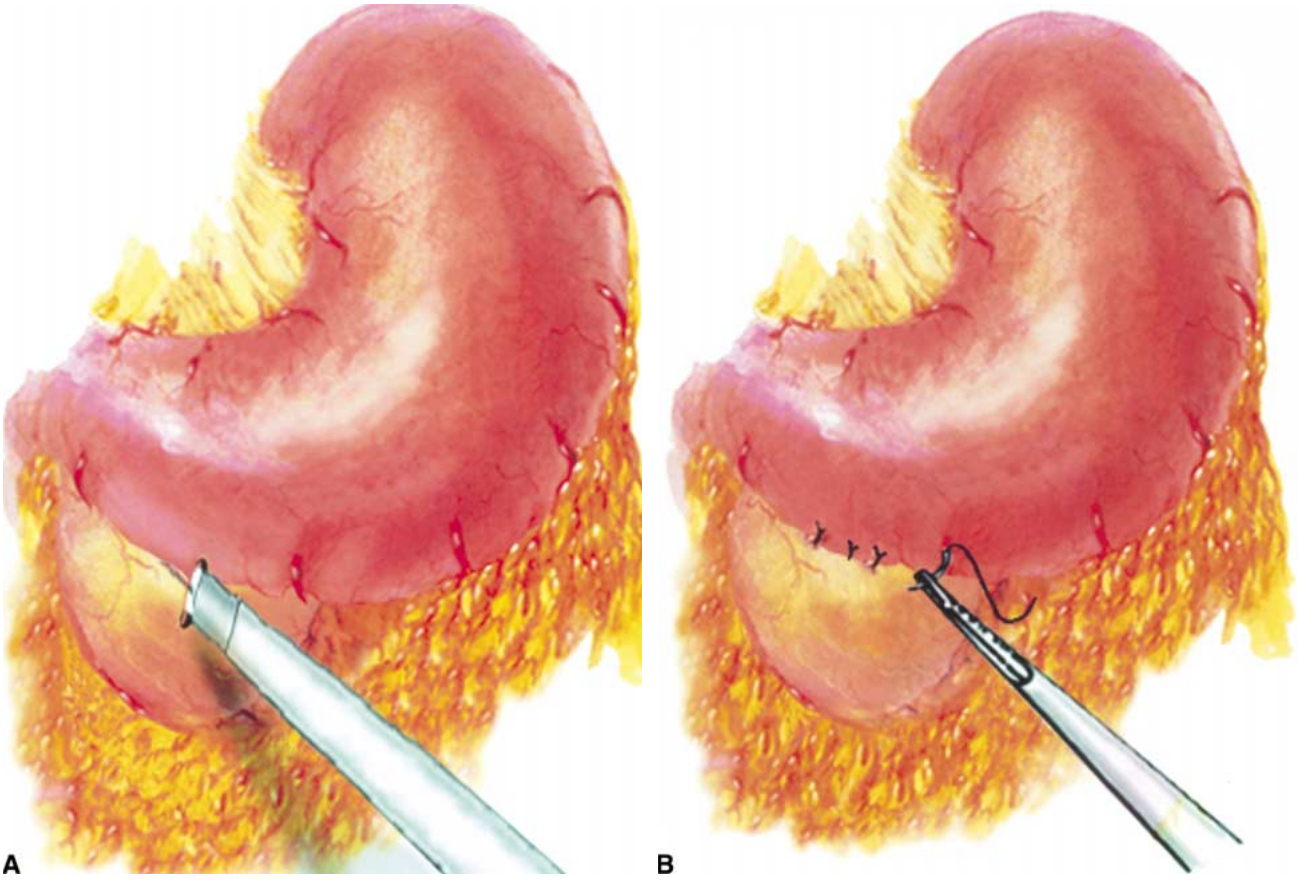

Fig. 2. **A** A pancreatic pseudocyst (*PP*) in contact with the stomach but in a lower relation than in the case shown in Fig. 1. One-centimeter openings are performed on the PP and the stomach. A 60-mm linear stapler is introduced and fired. **B** The opening is closed with 2–0 silk interrupted sutures.

identified and confirmed by ultrasound/puncture. Two 1-cm openings were made where the stomach and the pseudocyst were in close contact. A 60-mm endoscopic linear stapler was introduced in the openings and fired to construct the cystogastrostomy (Fig. 2A). The common opening of the stapler was closed using interrupted stitches to complete the anastomosis (Fig. 2B).

Cystojejunostomy

This technique was preferred for PPs located in a more caudal position in order to drain the most dependent aspect. After the pneumoperitoneum was established, four trocars were inserted in a similar fashion as for the extraluminal cystogastrostomy. The greater omentum was opened using the harmonic scalpel and the position of the pseudocyst was confirmed by ultrasound and puncture/aspiration. One of the proximal loops of jejunum was identified and transected using a linear stapler (Fig. 3A). An antecolic cystojejunostomy was performed using a 60-mm linear stapler (Fig. 3B). The enterotomy was closed with interrupted stitches and a jejuno-jejunostomy was constructed using a linear stapler (Fig. 3C).

All procedures were performed under general anesthesia. In the last six patients, intraoperative ultrasound with a 7.5-mH transducer was used at the beginning of the procedure to confirm the position of the pseudocysts and after the drainage was completed to rule out noncommunicated persistent collections. Closed drains were used in all cases. Diet was initiated 48 hours after surgery, and a CT scan was performed 1 week later. Patients in the laparoscopic group were followed in the outpatient clinic every month for the first 3 postoperative months, every 3 months for the next 6 months, and yearly thereafter. A postoperative CT scan was obtained in all patients to confirm cure of the PP, and if there was clinical suspicion of recurrence a CT scan was performed.

Results of this group of patients were analyzed and compared to those of a cohort of six patients who underwent conventional open drainage at the same institution during the same time period.

Results

General characteristics, etiology of the pancreatitis, and, comorbid conditions are comparatively analyzed in Tables 1–3. All cases originated in a well-documented episode of acute pancreatitis. In all patients, a CT obtained during the acute episode did not show evidence of a PP, and none of the patients had evidence of chronic alcoholic pancreatitis. Indications for surgical drainage in the laparoscopic group (LG) were abdominal pain in six patients, the presence of an abdominal mass unresponsive to conservative management in two patients, and food intolerance in two patients. In the open group (OG) indications for surgical drainage were abdominal pain in one patient and abdominal mass unresponsive to conservative management in five patients. Three patients in the LG and all six patients in the OG had previous abdominal operations. Previous surgical procedures are shown in Table 4.

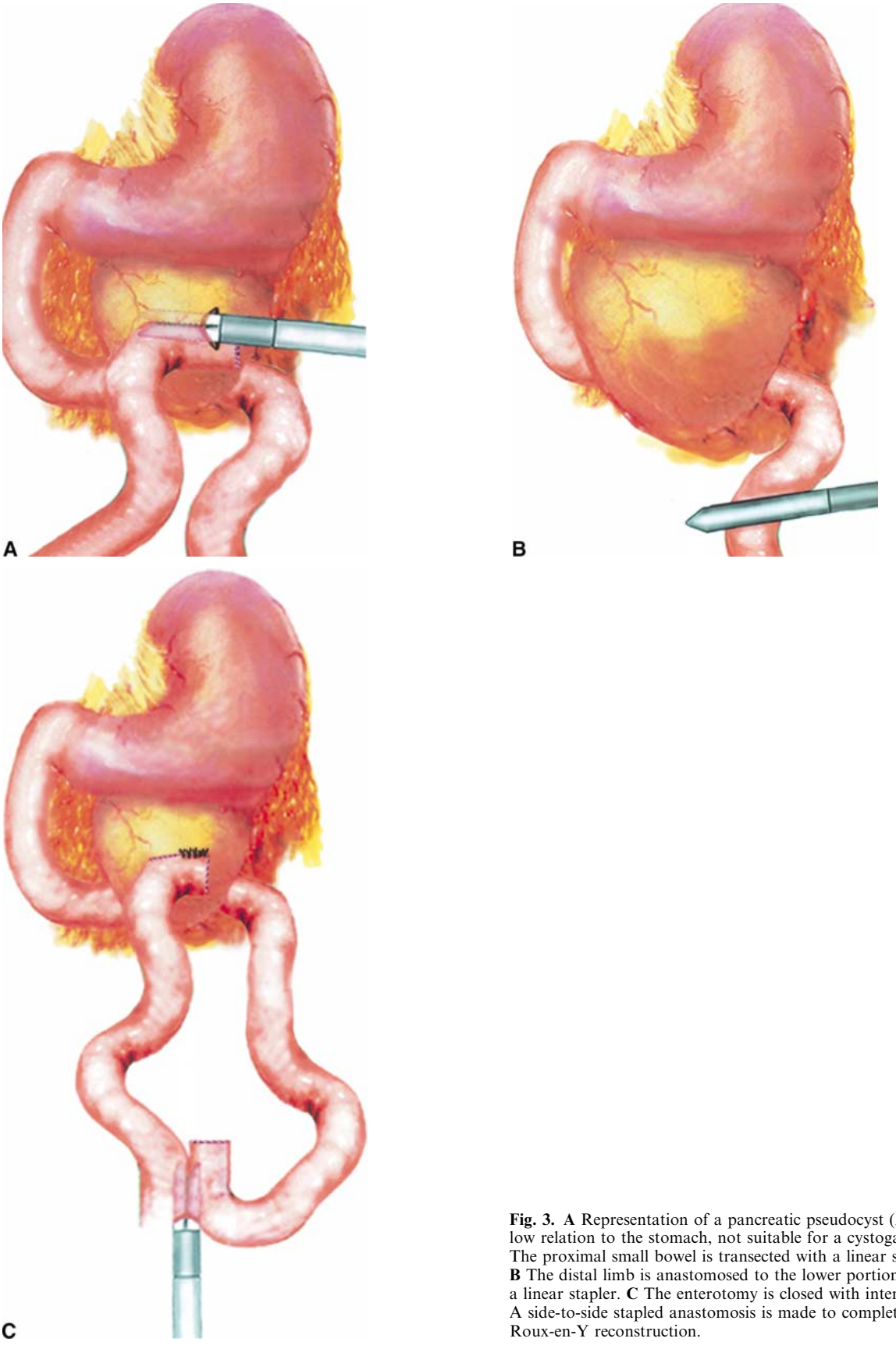

Fig. 3. **A** Representation of a pancreatic pseudocyst (*PP*) in a low relation to the stomach, not suitable for a cystogastrostomy. The proximal small bowel is transected with a linear stapler. **B** The distal limb is anastomosed to the lower portion of the PP using a linear stapler. **C** The enterotomy is closed with interrupted stitches. A side-to-side stapled anastomosis is made to complete the Roux-en-Y reconstruction.

Table 1. Demographic data from both groups

General characteristics	Laparoscopic drainage group (10 patients)	Open drainage group (6 patients)
Mean age (range), yr	42 (17–68)	36 (18–54)
Male:Female	6:4	5:1

Table 2. Etiology of the pancreatitis in both groups

Etiology of the pancreatitis	Laparoscopic drainage group (10 patients)	Open drainage group (6 patients)
Alcoholic	4	4
Biliary	4	1
Toxic	1	1
Associated with SLE	1	0

SLE, systemic lupus erythematosus

Table 3. Comorbid disease in both groups

Comorbid disease	Laparoscopic drainage group (10 patients)	Open drainage group (6 patients)
Diabetes mellitus	1	3
Arterial hypertension	1	0
Kidney stones	1	0
Systemic Lupus erythematosus	1	0
Rheumatoid arthritis	0	1

Table 4. Previous surgical procedures in patients of both groups[a]

Surgical procedure	Laparoscopic drainage group (10 patients)	Open drainage group (6 patients)
Appendectomy	1	2
Cesarean section	2	0
Cholecystectomy	1	3
Pancreatic necrosectomy	0	1

[a] In each group, one patient had history of two surgical procedures

The laparoscopic procedures were cystojejunostomy in four patients, extraluminal cystogastrostomy in four patients, and intraluminal cystogastrostomy in two patients. One patient had two independent PPs that were communicated individually to an isolated loop of jejunum. There were no conversions. Mean surgical time was 4 h (range, 3–6). Median hospital stay was 7 days (range, 4 to 15). Surgical morbidity occurred in one patient, who developed upper gastrointestinal bleeding the day after surgery. An endoscopy showed evidence of recent hemorrhage at the level of the cystogastrostomy. Adrenaline was locally injected and bleeding did not recur. In the CT performed 1 week after surgery, a residual noncommunicated PP in the head of the pancreas was found in one patient. The residual lesion was successfully resolved by endoscopic cystoduodenostomy. One patient developed fever on postoperative day 4. A CT scan showed a residual intraabdominal abscess. The abscess was drained by open surgery. Postoperative outcome was uneventful. There was one late mortality. The patient with systemic lupus erythematosus presented with an episode of acute sepsis and multiple organ failure 6 months after successful drainage of the PP. The autopsy ruled out an intraabdominal cause of dead. In a median follow-up of 22 months (range, 1–72), no evidence of recurrence was seen in any patient. A summary of surgical procedures and outcomes is presented in Table 5.

In the open group, three patients underwent cystogastrostomy and in three patients a Roux-en-Y cystojejunostomy was performed. Mean surgical time was 2 h (range, 2–4). Median hospital stay was 14 days (range, 8–21). One patient in the open group developed a small bowel obstruction secondary to an internal hernia that required reoperation, and one patient presented with a nosocomial pneumonia. One additional patient presented a residual PP that did not require drainage.

Discussion

Management of PPs has been controversial. Bradley et al. [4], in a classic study, recommended an observation period of 4–6 weeks to allow spontaneous resolution and surgery for lesions older than 6 weeks due to an increased number of complications. Size has also been considered as a determinant for surgery. A size of 6 cm has been suggested as a cutoff for deciding between surgical treatment or observation [20]. Some authors have not found that either time or size are good determinants for surgical treatment since some PPs can spontaneously resolve after longer periods and large lesions can be asymptomatic [7, 20].

After drainage is indicated, it can be performed using several approaches. Percutaneous catheter drainage under CT guidance has been used for symptomatic PPs without evidence of pancreatic duct obstruction/dilatation [1, 2]. Drawbacks of this procedure include external pancreatic fistula, infection, and incomplete drainage due to the catheter becoming plugged by debris. Subsequent operative correction may be required in some patients [2, 13].

Endoscopic drainage to the stomach or the duodenum has also been used extensively [10, 12]. It can be performed when there is close proximity between the posterior wall of the stomach or the medial wall of the duodenum and the PP. The main disadvantages are related to the difficulty in controlling major bleeding and the risk of free abdominal perforation. Pancreatitis has also been reported when PPs are drained transpapillary. Several groups have evaluated the efficacy and initial and long-term cure of PPs after endoscopic drainage [15]. Resolution of the PP can be as high as 94% with persistent long-term cure of 90%. Overall, morbidity

Table 5. Surgical treatment and outcome of patients who underwent laparoscopic internal drainage of PP and open drainage

Procedure	Complications	Outcome	Follow-up (mo)
Laparoscopic drainage group ($n = 10$)			
Intraluminal cystogastrostomy	Gastric bleeding	Cure	64
Extraluminal cystogastrostomy + chole	None	Cure	72
Roux-en-Y cystojejunostomy	None	Cure	54
Roux-en-Y cystojejunostomy	None	Residual PP	18
Extraluminal cystogastrostomy	None	Cure	48
Intraluminal cystogastrostomy	None	Cure	24
Extraluminal cystogastrostomy	None	Cure	34
Roux-en-Y cystojejunostomy + chole	None	Cure	21
Roux-en-Y cystojejunostomy	None	Cure	20
Extraluminal cystogastrostomy	Intraabdominal abscess	Cure	1
Open drainage group ($n = 6$)			
Roux-en-Y cystojejunostomy	Internal hernia	Cure	22
Roux-en-Y cystojejunostomy	None	Cure	10
Roux-en-Y cystojejunostomy	None	Residual PP	20
Extraluminal cystogastrostomy	Pneumonia	Cure	19
Extraluminal cystogastrostomy	None	Cure	27
Extraluminal cystogastrostomy	None	Cure	12

Chole, cholecystectomy; PP, pancreatic pseudocyst

related to the endoscopic drainage is approximately 20%, mortality is less than 1%, and the recurrence rate is approximately 16% [3, 6, 9, 15]. Some authors have stated that when endoscopic and radiologic drainage fail, there is increased surgical morbidity and prolonged hospitalization [13].

Surgical drainage has been the cornerstone of the management of symptomatic PPs. The most common surgical procedure is internal drainage to the stomach, duodenum, or jejunum. Internal drainage of PPs leads to obliteration of the cystic cavity in a few weeks [16].

With advances in instrumentation and techniques, laparoscopic surgery has been used to treat PPs. Using minimally invasive techniques, PPs can be managed by external or internal drainage [8, 11, 12, 15, 16]. Way et al. [19], in a series of nine patients who underwent laparoscopic transgastric cystogastrostomy, reported a high cure rate with only one conversion. Gagner and colleagues [8] reported six cystogastrostomies and one cystoduodenostomy with similar results. Martinez-Serna and Filipi [11] reported three patients with endo-organ cystogastrostomy with complete resolution after the surgical procedure in two of the three patients. Fernandez-Cruz et al. [7] evaluated the feasibility and outcome of laparoscopic pancreatic surgery by performing distal pancreatectomy in five patients and transgastric drainage of PP in six patients, and they compared the results with those of a group of patients who underwent conventional open distal pancreatectomy. They concluded that laparoscopic surgery offered advantages in terms of reducing parietal damage to the abdomen, a shorter hospital stay, and earlier postoperative recovery.

Our surgical method in the management of PPs includes internal drainage of symptomatic lesions using the most dependent aspect of the PPs. Therefore, in the nine reported patients three different laparoscopic procedures were used. Transgastric cystogastrostomy was performed for PPs that protruded into the stomach or were in close proximity to the posterior gastric wall. For PPs in a more caudal position, an extraluminal cystogastrostomy was preferred. When the most dependent aspect of the PPs was not in contact with the stomach, a cystojejunostomy was the selected procedure. Morbidity associated with our surgical techniques was low, and the cure rate was high. In recent years, laparoscopic ultrasound has become available in our practice. One of the most useful applications of intraoperative ultrasound in the pancreas is the location of small tumors. The recommended transducers employ frequencies from 5 to 10 MHz and either direct contact or water bath scanning of the exposed pancreas make possible the identification of lesions as small as 3 mm. This high frequency and the steerable head of the transducer allow excellent mobility and resolution for evaluation of difficult to access portions of the pancreas, and this is the reason why we perform intraoperative ultrasound in all patients. Intraoperative confirmation of the absence of a residual PP may improve our success rate.

The advantages of the laparoscopic approach for PPs cannot be determined from the analysis of this small series. As in other laparoscopic procedures, it should produce less postoperative pain, faster recovery, and lower infection rate. Controlled trials are needed to evaluate these aspects. Nevertheless, in this study the morbidity was higher in the OG compared with the LG, and the hospital stay was longer in the OG.

From our results, we conclude that laparoscopic management of PPs is feasible, safe, and effective. The type of drainage can be tailored to the anatomic characteristics and position of the PP.

References

1. Adams DB, Anderson MC (1992) Changing concepts in the surgical management of pancreatic pseudocysts. Am Surg 58: 173–180
2. Adams DB, Anderson MC (1992) Percutaneous catheter drainage compared with internal drainage in the management of pancreatic pseudocyst. Ann Surg 215: 571–578

3. Barthet M, Sahel J, Bodiou-Bertei C, Bernard JP (1995) Endoscopic transpapillary drainage of pancreatic pseudocysts. Gastrointest Endosc 42: 208–213
4. Bradley EL, Clements JL Jr, Gonzalez AC (1979) The natural history of pancreatic pseudocysts: a unified concept of management. Am J Surg 137: 135–141
5. Champault G, Rizk N, Lebhar E, Catheline JM, Barrat C, Cazacu F (1998) Laparoscopic treatment of pancreatic pseudocyst: 3 cases. Ann Chir 52: 41–44
6. Dohmoto M, Rupp KD (1992) Endoscopic drainage of pancreatic pseudocysts. Surg Endosc 6: 118–124
7. Fernandez-Cruz L, Saenz A, Astudillo E, Pantoja JP, Uzcategui E (2002) Laparoscopic pancreatic surgery in patients with chronic pancreatitis. Surg Endosc 16: 996–1003
8. Gagner M (1994) Laparoscopic transgastric cystogastrostomy for pancreatic pseudocysts. Surg Endosc 8: 239
9. Heniford BT, Iannitti DA, Vargo J, Naitoh T, García-Ruíz A, Gagner M (1997) Percutaneous transgastric needlescopic pancreatic cystogastrostomy [abstract]. Surg Endosc 11: 180
10. Kozarek RA, Ball TJ, Patterson DJ, Freeny PC, Ryan JA, Traverso LW (1991) Endoscopic transpapillary therapy for disrupted pancreatic duct and peripancreatic fluid collections. Gastroenterology 100: 1362–1370
11. Martinez-Serna T, Filipi CJ (1999) Endoluminal surgery. World J Surg 23: 368–377
12. Meltzer RC, Amaral JF (1994) Laparoscopic pancreatic cystogastrostomy. Min Invasive Ther Allied Technol 3: 289–294
13. Mouiel J, Craffa F (1995) Pancreatic cyst treated by cystojejunal anastomosis on a Roux-en-Y loop. Surg Endosc 9: 625
14. Park AE, Heniford BT (2002) Therapeutic laparoscopy of the pancreas. Ann Surg 236: 149–158
15. Rao R, Fedorak I, Prinz RA (1993) Effect of failed computed tomography-guided and endoscopic drainage on pancreatic pseudocyst management. Surgery 114: 843–849
16. Sahel J, Bastid C, Pellat B, Schurgers P, Sarles H (1987) Endoscopic cystoduodenostomy of cysts of chronic calcifying pancreatitis: a report of 20 cases. Pancreas 2: 447–453
17. Smits ME, Rauws EAJ, Tytgat GNJ, Huibregtse K (1995) The efficacy of endoscopic treatment of pancreatic pseudocysts. Gastrointest Endosc 42: 202–207
18. Vitas GJ, Sarr MG (1992) Selected management of pancreatic pseudocysts: operative versus expectant management. Surgery 111: 123–130
19. Way LW, Legha P, Mori T (1994) Laparoscopic pancreatic cystogastrostomy: the first operation in the new field of intraluminal laparoscopic surgery [abstract]. Surg Endosc 8: 235
20. Williams KJ, Fabian TC (1992) Pancreatic pseudocyst: recommendations for operative and nonoperative management. Am Surg 58: 199–205