ANNALS OF SURGERY
Vol. 223, No. 3, 280–285

Laparoscopic Distal 70% Pancreatectomy and Splenectomy for Chronic Pancreatitis

Alfred Cuschieri, M.D., Ch.M., F.R.C.S.,* Jack J. Jakimowicz, M.D., Ph.D.,†
and Jan van Spreeuwel, M.D.‡

From the Department of Surgery, Ninewells Hospital and Medical School, University of Dundee, Dundee, Scotland; and the Departments of Surgery† and Gastroenterology,‡ Catharina Hospital, Eindoven, The Netherlands*

Objective
The authors performed an initial clinical evaluation of laparoscopic pancreatectomy with splenectomy for chronic pancreatitis.

Summary Background Data
Severe intractable pain is the most common indication for resection in chronic pancreatitis. Localized accentuation of the pathology, usually in the head of the organ, is the basis for localized proximal resection, often with preservation of a rim of pancreas and the duodenum, although some favor total pancreatectomy. The reported results for distal pancreatectomy have been variable. Distal resections are limited to those patients in whom the gross pathology is maximal in the left hemipancreas.

Methods
A consecutive series of five patients with intractable pain due to chronic pancreatitis have been treated with laparoscopic 70% distal pancreatectomy and splenectomy using a 5-port technique.

Results
The procedure was completed in all with an average operating time of 4.5 hours and a mean intraoperative blood loss of 400 mL. There was one minor pancreatic leak, which resolved spontaneously. The median postoperative hospital stay was 6 days.

Conclusions
Laparoscopic distal pancreatectomy for chronic pancreatitis is feasible, the procedure appears to be safe, and it is accompanied by an accelerated recovery.

Severe intractable pain is the most common indication for resection in chronic pancreatitis, and the outcome in terms of pain relief is good, provided the patient is well motivated and gives up alcohol. Although the disease is diffuse, localized accentuation of the pathologic process, usually in the head of the organ with the creation of an "inflammatory pseudotumor" in many patients, has been used as an argument for localized resection, often with preservation of the pylorus or the duodenum,[1,2] although some favor total pancreatectomy in all patients.[3–5] Our experience with duodenum-preserving to-

Address reprint requests to Prof. A. Cuschieri, Department of Surgery, Ninewells Hospital and Medical School, University of Dundee, Dundee DD1 9SY, Scotland.
Accepted for publication May 26, 1995.

Table 1. CLINICAL FEATURES OF PATIENTS UNDERGOING LAPAROSCOPIC DISTAL PANCREATECTOMY FOR CHRONIC PANCREATITIS

Sex	Age (yrs)	Etiology	Indication for Surgery	Diabetes	Exocrine Insufficiency*
Female	54	Post-ERCP	Intractable pain	No	Yes
Male	43	Alcoholic	Intractable pain	Yes	No
Male	38	Alcoholic	Intractable pain	Yes	Yes
Female	50	Alcoholic	Intractable pain	No	No
Male	54	Alcoholic	Intractable pain	Yes	Yes

ERCP = endoscopic retrograde cholangiopancreatography.
* Steatorrhoea or positive PABA test.

tal pancreatectomy[6] has not been favorable because of the complications, particularly late duodenal stenosis, and we agree with Beger that a rim of pancreatic tissue should be left surrounding the terminal confluence of the bile and pancreatic duct close to the duodenal curve.[1,2] The reported results for distal pancreatectomy with or without preservation of the spleen have been variable.[7-9] We have practiced distal resections selectively and limited them to those patients in whom the gross pathology was confined to the left hemipancreas. During the last 2 years, five such patients from two hospitals have been subjected to this procedure, which was performed laparoscopically at the request of the patients.

CLINCIAL DETAILS OF PATIENTS

All patients were in good nutritional health without any serious comorbid disease, including cirrhosis (ASA II). The clinical details are shown in Table 1.

The four patients with an alcoholic etiology had given up their alcohol habits. The patient with post endoscopic retrograde cholangiopancreatography pancreatitis had a previous open intervention (cystogastrostomy) to drain a pseudocyst, and another patient had undergone highly selective vagotomy 12 years previously. The pathologic anatomy of the pancreas was defined by computed tomography scanning and endoscopic retrograde cholangiopancreatography, which showed predominantly distal disease in all patients, the details as follows: narrow strictured duct disease with loss of secondary and tertiary branches in three patients; ectatic duct with multiple strictures, pancreatic calcification and calculi in one patient; and multiple small pseudocysts associated with a stricture pancreatic duct in one patient. The serum bilirubin level was normal in all patients, but the alkaline phosphatase level was elevated in one. Thrombosed splenic vein with sectorial hypertension was discovered at operation in one patient. This patient had never bled, although she had prominent left gastroepiploic varices, and a splenic vein could not be identified during the pancreatic dissection.

TECHNIQUE OF LAPAROSCOPIC DISTAL PANCREATECTOMY

Patient Positioning and Instrumentation

The procedure was undertaken under general endotracheal anesthesia with standard intraoperative monitoring. A blood tariff of 4 units of cross-matched blood has been our routine in these cases.

The patient is placed in the supine position with elevation of the left chest on a sand bag and with the table in a 30° head-up tilt. The surgeon and assistant operate from the right of the operating table, whereas the camera person and scrub nurse stand on the opposite side. The port sites are shown in Figure 1. The following instruments were used for performing the pancreatic resections: standard straight insulated graspers (atraumatic); curved coaxial instruments[10]; scissors; Babcock and duck-bill forceps (Storz, Tuttlingen, Germany); superelastic dissectors/suture passers (Storz); needle drivers; disposable clip applicator (U.S. Surgical Corp., Norwalk, CT); Endoretract (U.S. Surgical Corp.); SurgiWhip (U.S. Surgical Corp.); and EndoGIA and EndoTIA staplers (U.S. Surgical Corp.) with vascular and large (green) cartridges. In addition, the Aloka ultrasound probe (Aloka, Tokyo, Japan; 7.5 Mhz, linear array, rigid or flexible) was used in two cases.

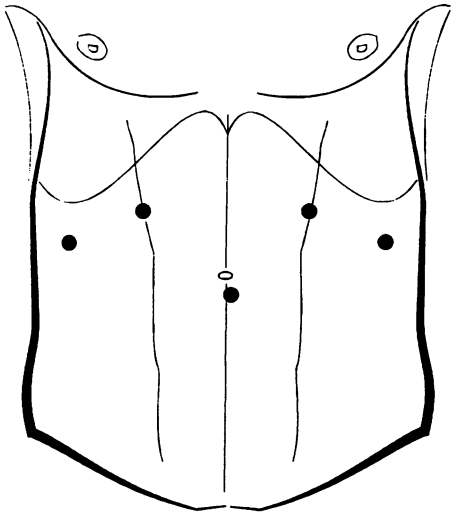

Figure 1. Diagram of the port sites used for laparoscopic distal pancreatectomy.

Gastric Mobilization and Entry into Lesser Sac

In patients without adhesions between the anterior aspect of the stomach and liver (n = 3), the transparent section of the lesser omentum is divided without ligature of the left and right gastric vessels. This step was omitted in two patients with prior surgery (highly selective vagotomy, cystogastrostomy) in whom the inferior surface of the liver was firmly adherent to the stomach and attempts at separation proved unsuccessful.

The lesser sac is entered through the gastrocolic omentum. A small window is created by initial ligature and division of one of the gastroepiploic vessels halfway along the greater curvature. Thereafter, the EndoGIA stapler (U.S. Surgical Corp.), loaded with vascular cartridges, is used to complete the separation that extends from the distal antrum to the fundus and includes the short gastric vessels. Approximately five to six applications (using one reloadable stapler) are needed to complete this step. In one patient with sectorial hypertension (thrombosed spleen), stapler division of these vessels resulted in some bleeding, which required application of ligatures to control the bleeding points.

The greater curvature is then grasped and held up. Adhesions—very dense in two patients—were present in all instances, binding the chronically inflamed pancreas to the posterior wall of the stomach. These adhesions require division with the curved coaxial scissors with coagulation of any bleeders to expose the entire anterior aspect of the pancreas from the neck to the tail of the organ. Contact ultrasound scanning can be carried out at this stage to examine the pancreas (Fig. 2) and to locate the common splenic artery if this has not be identified by the dissection.

Identification, Dissection, and Ligature of Common Splenic Artery

The common splenic artery is identified at the upper border of the pancreas soon after its origin from the celiac axis (Fig. 3). It is dissected over a short distance from the pancreas using the curved coaxial instruments and then ligated in continuity using Dacron (U.S. Surgical Corp.) and an external Tayside slip knot. This step greatly reduces the risk of major hemorrhage and results in a significant reduction of the size of the spleen. The stomach and liver are then held up by an expanding retractor for the start of the retroperitoneal mobilization of the pancreas.

Retroperitoneal Mobilization of the Pancreas

The mobilization starts at the reflection of the superior leaf of the transverse mesocolon on the pancreas. The plane behind the inferior border of the pancreas is opened by blunt scissors dissection from the neck to the tail of the pancreas, which is elevated gradually to expose its posterior surface. Small leashes of blood vessels in the loose areolar tissue between the posterior surface of the pancreas and the retroperitoneum require electrocoagulation before division. The mobilization of the posterior aspect of the pancreas continues with curved retractor elevation of the organ, until the splenic vein is identified covered by a layer of pancreatic fascia. Complete mobilization of the terminal 2.0 cm of the splenic vein with exposure of its junction with the portal vein is necessary. The fascia covering the splenic vein is divided, and the vein is mobilized from the pancreas inside this fascial plane. On the lateral aspect of the dissection, direct pancreatic tributaries are identified. These do not require mobilization. Medially the separation continues until the main portal vein is identified (Fig. 4). Sometimes the termination of the left gastric (coronary) vein into the portal vein close to the confluence also is identified. Often, the entrance of the inferior mesenteric vein is close to the confluence, in which case, it is ligated and divided at this stage. The mobilization of the splenic vein from the pancreas is performed with gentle blunt dissection using curved coaxial scissors and variable curvature pseudoelastic dissectors. Once a sufficient length lateral to the portal vein is cleared, the splenic vein is doubly ligated with 1/0 Dacron (using Tayside external slip knots). The medial ligature is placed flush with the portal vein. The splenic vein is then divided with scissors, leaving a substantial cuff medially.

Mobilization of the Proximal Body of the Pancreas

After ligature and transection of the splenic vein, the mobilization of the rest of the posterior surface of the neck and upper border of the pancreas is fairly straightforward, unless there are adhesions binding the stomach and lesser omentum to the organ. The important structure that must not be damaged at this stage is the common hepatic artery. Once complete mobilization is achieved, a vascular sling is placed around the pancreas (Fig. 5). This facilitates the transection and the mobilization of the distal pancreas together with the spleen.

Stapler Transection of the Pancreatic Neck

After the creation of a sufficient window, the neck of the pancreas is transected using either the EndoGIA (n = 4) or EndoTIA stapler (U.S. Surgical Corp.; n = 1) loaded with large cartridges (green, 4.7 mm). If the EndoTIA instrument is used, the pancreatic parenchyma is then divided by scissors a few millimeters distal to the

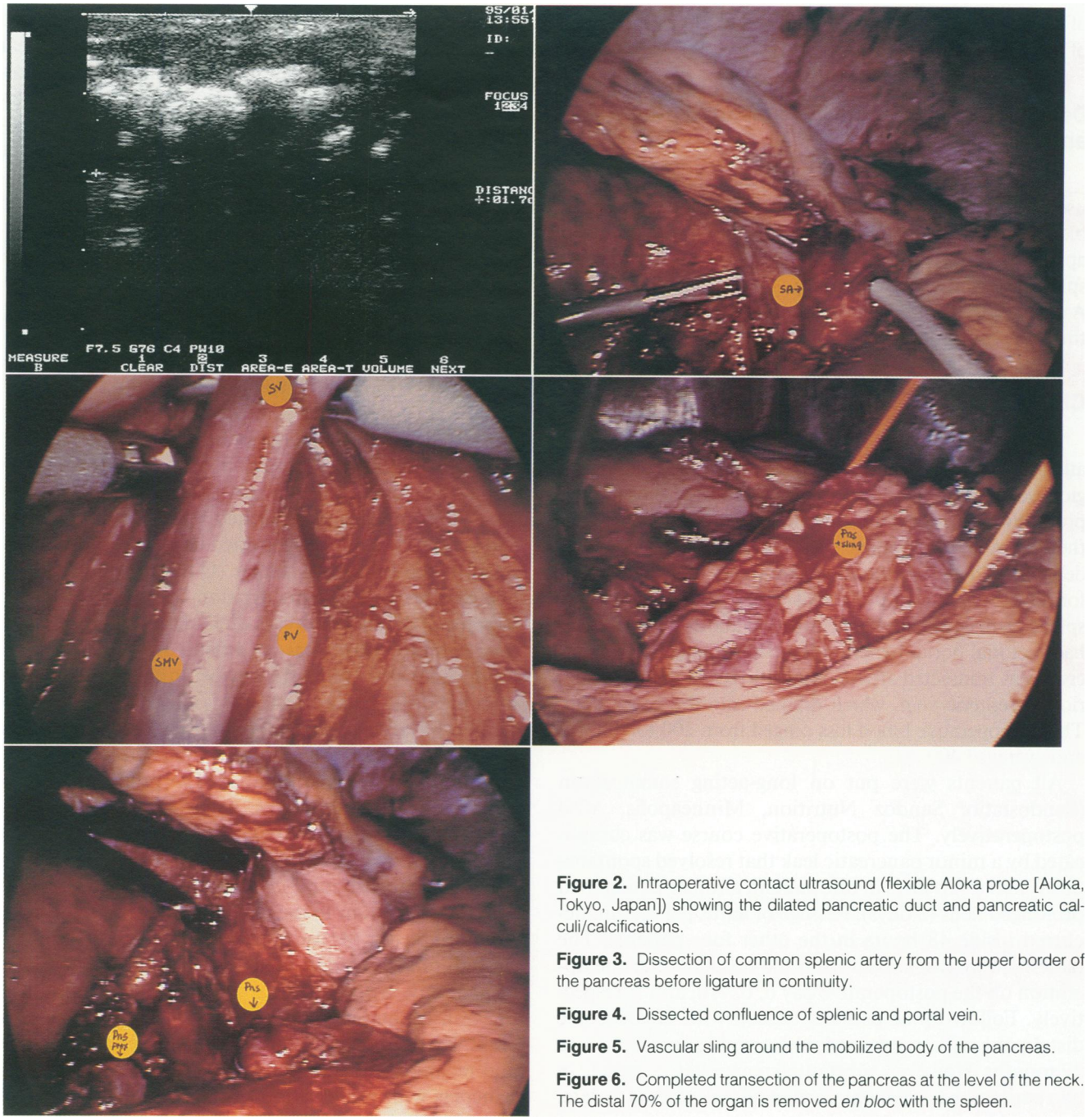

Figure 2. Intraoperative contact ultrasound (flexible Aloka probe [Aloka, Tokyo, Japan]) showing the dilated pancreatic duct and pancreatic calculi/calcifications.

Figure 3. Dissection of common splenic artery from the upper border of the pancreas before ligature in continuity.

Figure 4. Dissected confluence of splenic and portal vein.

Figure 5. Vascular sling around the mobilized body of the pancreas.

Figure 6. Completed transection of the pancreas at the level of the neck. The distal 70% of the organ is removed *en bloc* with the spleen.

stapler line. It is important that the pancreas is transected in the gap between the divided ends of the splenic vein. The proximal transected surface is inspected closely for leakage from the pancreatic duct (Fig. 6).

Mobilization of the Distal Pancreas in Continuity with the Spleen

The "devascularised," pancreatic/splenic block then is detached from right to left. Superiorly, the common splenic artery is ligated or stapled (distal to the initial ligature) and then cut. Unnamed branches, usually from the inferior phrenic or upper short gastric vessels, require ligature or clipping because they can cause bleeding during mobilization of the upper pole of the spleen (700 mL in one case). The inferior mesenteric vein requires ligature and division along the lower border of the pancreas if this vein was not identified during mobilization and ligature/division of the splenic vein. The detachment of the lienorenal ligament and subjacent fascial attachment

of the spleen to the left kidney completes the detachment of the pancreatic/splenic block.

Delivery of the Specimen, Final Inspection, and Insertion of Drain

The specimen is delivered inside a rip-proof bag or by use of the extracorporeal pneumoperitoneal access bubble device[11] after enlarging one of the left port wounds to approximately 4 cm. After extraction, the pancreatic and splenic beds are irrigated and inspected for hemostasis. A drain is placed adjacent to the transected pancreas, and the port wounds are closed.

CLINICAL OUTCOME

All five operations were completed with a range of operating time of 4 to 6 hours. These times included one strategic rest break of the operating team midway through the procedure, during which time the ports were left in, but the abdomen was desufflated (*i.e.*, pneumoperitoneum was deflated). There were no major technical problems except for adhesions due to previous surgery in two patients. A splenic vein could not be identified in another patient who had sectorial portal hypertension. In this patient, the pancreas was transected after ligature and division of the inferior mesenteric vein, which drained into the portal vein. The intraoperative blood loss ranged from 200 to 700 mL and averaged 400 mL.

All patients were put on long-acting somatostatin (Sandostatin; Sandoz Nutrition, Minneapolis, MN) postoperatively. The postoperative course was complicated by a minor pancreatic leak that resolved spontaneously after a few days in one patient; another patient had prolonged ileus (3 days). Passage of flatus per rectum occurred inside 48 hours in the other four patients. The patients were discharged from the hospital after the operation on the postoperative day 6, 6, 7, 6, and 7, respectively. Follow-up of patients treated with laparoscopic distal pancreatic resection is short and ranges from 3 to 22 months. However, substantial pain relief, complete in two patients, has been obtained in all the patients to date.

DISCUSSION

There is considerable scope for the use of the laparoscopic approach in the management of patients with pancreatic disease—diagnosis, staging of tumors, and palliative bypass.[12,13] More recently, the detection of occult insulinomas by means of laparoscopic contact ultrasonography and their enucleation by the laparoscopic route has been reported.[14] The series described demonstrates that distal resections can be performed with safety and good outcome, provided that certain criteria are adopted rigorously and the surgical team is experienced in pancreatic surgery. All the patients expressed a clear wish that they wanted the procedure attempted laparoscopically, but accepted the real possibility for conversion. In each case, the operation was the only case scheduled on the list, and the procedures were done by the same two surgeons. At least one rest period for the surgical and nursing team was taken, usually halfway through the procedure. The adoption of these rest breaks is important to prevent the "fatigue syndrome" that develops after sustained mental concentration needed for safe remote surgical manipulations across an electronic (virtual) image of the operative anatomy. Technically, there are no major problems, although the dissection of the splenic vein from the pancreas up to its confluence with the portal vein requires extreme care and should not be attempted unless the surgeon has considerable experience with endoscopic dissection. Moreover, the window created is small and does not permit stapler division. Thus, the vein has to be ligated in continuity at either end before division. We regretted using the EndoTIA instead of the EndoGIA stapler (U.S. Surgical Corp.) in one case because scissors division of the hard diseased pancreatic parenchyma was difficult and the transected edge was rather irregular, as distinct from the clean cut produced by the EndoGIA device. In this series of laparoscopic distal pancreatectomy, we used one disposable stapler (with 6–8 cartridges) in four patients and two disposable staplers in the fifth. Thus, the additional cost of consumables is not substantial. The procedure can be performed without staplers, using intracorporeal ligatures for the gastrocolic omentum and the technique of pancreatic banding with a double 1/0 ligature for the pancreatic transection.[15] However, this would add approximately 1 hour to the operating time.

Undoubtedly, the use of contact ultrasound during the procedure is beneficial on three counts—identification of anatomy in the presence of adhesions, definition of the transection site, and scanning of the residual pancreas. No doubt with improvements in instrumentation and technique, it should be possible to resect the distal pancreas with preservation of the spleen. We have not attempted this procedure laparoscopically with the current technology; we anticipate problems in safe detachment of the splenic vein from the pancreas because of the extensive fibrosis obscuring normal tissue planes. In fact, splenic vein thrombosis was encountered in one patient in this series.

In regard to clinical outcome, this initial experience has shown that distal 70% pancreatectomy can be performed laparoscopically within an acceptable operating time and without major complications. Our clinical impression is that the postoperative progress is accelerated and the postoperative stay is short.

References

1. Beger HG, Krautzbeger W, Bittner R, et al. Duodenum preserving resection of the head of the pancreasin patients with severe chronic pancreatitis. Surgery 1985; 97:467–473.
2. Beger HG, Buchler M, Bittner R, et al. Duodenum-preserving resection of the head of the pancreas in severe chronic pancreatitis: early and late results. Ann Surg 1989; 209:273–278.
3. Lambert MA, Linehan IP, Russell RCG. Duodenum-preserving total pancreatectomy for end stage chronic pancreatitis. Br J Surg 1987; 74:35–39.
4. Cooper MJ, Williamson RCN, Benjamin IS, et al. Total pancreatectomy for chronic pancreatitis. Br J Surg 1987; 74:912–915.
5. Linehan IP, Lambert MA, Brown DC, et al. Total pancreatectomy for chronic pancreatitis. Gut 1988; 29:358–365.
6. Easter DW, Cuschieri A. Total pancreatectomy with preservation of the duodenum and pylorus for chronic pancreatitis. Ann Surg 1991; 214:575–580.
7. Frey CF. Role of subtotal pancreatectomy and pancreaticojejunostomy in chronic pancreatitis. J Surg Res 1981; 31:361–367.
8. Gall FP, Muhe E, Gebhardt C. Results of partial and total pancreaticoduodenectomy in 117 patients with chronic pancreatitis. World J Surg 1981; 5:269–273.
9. Williamson RCN, Cooper MJ. Resection in chronic pancreatitis. Br J Surg 1987; 74:807–812.
10. Cuschieri A, Shimi S, Banting G, et al. Coaxial curved instruments for minimal access surgery. End Surg 1993; 1:303–305.
11. Cuschieri A, Shapiro S. Extracorporeal pneumoperitoneal access bubble: device for safe extraction and tissue approximation in endoscopic surgery. Am J Surg 1995; 170:391–394.
12. Cuschieri A. Laparoscopic surgery of the pancreas. J R Coll Surg Edinb 1994; 39:187–184.
13. Shimi S, Banting S, Cuschieri A. Laparoscopy in the management of pancreatic cancer: endoscopic cholecystojejunostomy for advanced disease. Br J Surg 1992; 79:317–319.
14. Pietrabissa A, Shimi S M, Vander Velpen G, Cuschieri A. Localization of insulinoma by laparoscopic infragastric inspection of the pancreas and contact ultrasonography. Surg Oncol 1993; 2:83–86.
15. Sadek S, Holdsworth R, Cuschieri A. Experience with pancreatic banding: results of a simple technique for dealing with the pancreatic remnant after distal partial pancreatectomy. Br J Surg 1988; 75:486–487.