

Surgical Treatment of Pancreatic Pseudocysts

Analysis of 119 Cases

CLAYTON H. SHATNEY, M.D., RICHARD C. LILLEHEI, M.D., Ph.D.

A review was made of the hospital records of 119 patients with pancreatic pseudocysts. Alcoholism, biliary disease and abdominal trauma were the most common antecedent conditions. Abdominal pain was the most frequent symptom, and abdominal tenderness or mass were the most common physical findings. Abdominal echography and contrast study of the upper gastrointestinal tract were diagnostic in 90% of the patients examined. X-rays of the chest, colon, and biliary tract revealed pathology in 30–40% of the patients. Compared to patients with uncomplicated pseudocyst, patients who were acutely ill at the time of external drainage had twice the incidence of postoperative complications. Each subgroup experienced similar, high rates of postoperative death and pseudocyst recurrence. Both groups of patients treated by internal drainage had lower rates of postoperative morbidity, mortality, and pseudocyst recurrence than patients with uncomplicated pseudocysts undergoing external drainage. External drainage should be used in all patients with immature pseudocysts and in critically ill patients with mature pseudocysts not juxtaposed to a portion of the upper gastrointestinal tract. Internal drainage is a safer and more effective procedure in most other patients with mature pseudocysts, irrespective of the clinical status of the patient.

A PSEUDOCYST OF THE PANCREAS has traditionally been considered a rare or uncommon entity. In 1960 Jordan¹⁰ reported a .007% incidence of pancreatic cysts, of which 80% were pseudocysts, in more than two million hospital admissions. Until recently the majority of reports on the subject consisted of 20 or 30 cases collected over the entire history of an institution. In the past few years, however, the number of pseudocysts reported in the literature has risen dramatically. van Heerden and ReMine¹⁶ reviewed 71 cases treated surgically at the Mayo Clinic between 1962–1972. Hastings, et al.⁸ found 98 cases between 1962–74 at four New Orleans hospitals, where there had been 56 cases in the preceding 23 years. At our own institutions we have treated eight to twelve patients with pseudo-

From the Department of Surgery, University of Minnesota Health Sciences Center, Minneapolis, Minnesota

cyst per year during the past seven years, compared with a previous annual incidence of five patients.

Apparently, either the incidence of pancreatic pseudocyst is on the rise or the levels of diagnostic suspicion and capability are much higher than in years past. The literature suggests that both factors are probably operative. From the prospective study of Bradley, et al.⁴ it now appears that about 7% of patients develop "acute pseudocyst" following a bout of pancreatitis and that the incidence of pseudocyst formation increases in patients with recurrent or chronic pancreatitis. In view of these considerations, we thought it worthwhile and timely to review the experience with pancreatic pseudocysts at our institution.

Clinical Material

A review was made of the records of patients with documented pancreatic pseudocysts treated from 1945–76 at the University of Minnesota and affiliated hospitals. Only patients receiving active treatment for pseudocysts or their complications were retained in the study. Patients with pseudocysts found incidentally at autopsy were excluded. Patients who were placed under medical observation following the clinical diagnosis of pseudocyst were eliminated from the review. Lastly, patients with pancreatic cancer or pancreatic abscess were excluded from the study. Using these criteria 119 patients were available for analysis. Five of these patients died prior to or during operation, four from massive bleeding into the pseudocyst and one from pseudocyst rupture. The remaining 114 patients underwent surgical treatment of their pseudocysts.

There were 98 males and 21 females in the total series, which includes 62 males from a Veterans Administration hospital. The ages ranged from two and a

Reprint requests: Clayton H. Shatney, M.D., Division of Surgery, Walter Reed Army Institute of Research, Walter Reed Army Medical Center, Washington, D.C. 20012.

Submitted for publication: October 30, 1978.

half to 83 years, with a median age of 48 years. Pseudocysts were most prevalent during the fifth and sixth decades of life. The duration of symptoms prior to hospitalization ranged from one day to seven years, with a median duration of four weeks. In 47 patients a clinically detectable pseudocyst appeared during convalescence from an episode of pancreatitis. The time of pseudocyst diagnosis ranged from five days to four months following the onset of symptoms of pancreatitis. The median interval for pseudocyst formation was four weeks. The remainder of the patients harbored a pseudocyst at the time of admission to the hospital for evaluation of their symptoms.

Etiology of Pseudocyst

It is generally agreed that pseudocyst formation represents a complication of pancreatitis. The causes of pancreatitis in our patients are presented in Table 1. Alcoholism was the most common etiologic agent, especially in the veteran population, where alcohol abuse was a contributing factor in over two-thirds of the patients. In the nonveteran patients the cause of pancreatitis was fairly equally divided among the categories of alcoholism, biliary tract disease, trauma, and idiopathic. In three patients pancreatitis was probably pharmacologically induced and was associated with chronic steroid therapy, prolonged administration of thiazide diuretics, and organophosphorus poisoning.

Clinical Findings

Abdominal pain was the most common presenting symptom, occurring in 98 patients (86%). Fifty-eight patients (51%) complained of nausea and vomiting, while 31 patients (29%) reported a reduction in body weight. Weight loss ranged from 2.7 to 22.7 kg, with a median decrease of 11.4 kg. Twenty-seven patients

TABLE 1. *Etiological Factors of Pancreatitis in Patients with Pseudocysts*

Cause	Patient Population		
	VAH	Non-VAH	Total
Alcoholism	31	14	45
Biliary disease	7	14	21
Trauma	10	8	18
Blunt abdominal	8	5	13
Operative	2	3	5
Unknown	4	11	15
Alcoholism and biliary disease	8	4	12
Probably drug-related	1	2	3

(VAH—Veterans Administration Hospital patients).

(24%) complained of anorexia, and 20 patients (18%) experienced a sensation of abdominal fullness. Other symptoms occurring less frequently included chills and fever, diarrhea, constipation, jaundice, belching, hematemesis and melena.

Abdominal tenderness was noted in 73 patients (64%) on physical examination. An abdominal mass was palpable in 69 patients (60.5%). Eighteen patients (16%) had auscultatory abnormalities of the chest, while fever or ascites was present in ten patients. Clinical jaundice was evident in six patients.

Laboratory Findings

Results of pertinent laboratory studies in these patients are presented in Table 2. In order to better delineate the chemical abnormalities associated with the presence of an uncomplicated pseudocyst, the data was subdivided according to the clinical status of the patient. On the basis of their clinical presentation patients were divided into acutely ill and nonacutely ill groups. Patients were deemed acutely ill if: 1) they were suffering from unrelenting pancreatitis associated with

TABLE 2. *Pertinent Laboratory Results in Patients with Pancreatic Pseudocysts*

Determination	No. of Patients Examined	Criteria of Abnormality	No. of Patients with Abnormal Results		
			Total	Acutely Ill	Per Cent Abnormal
Hemoglobin	105	<12.0 g/dl	40	16	38%
White blood count	105	>10,000/ μ l	50	21	48%
Bilirubin	95	>1.2 mg/dl	16	5	17%
Protime	91	>16.0 sec	13	6	14%
Blood glucose	90	>110 mg/dl	35	12	39%
Serum amylase	89	>160 SU/dl	45	18	51%
Calcium	87	<8.5 mg/dl	11	6	13%
Alkaline phosphatase	86	>13.1 K.A. U >220 IU	31	7	36%
Urine amylase	81	>300 SU/dl	50	16	62%
SGOT	80	>25 IU	23	8	29%
BSP	28	>5%	18	6	64%

TABLE 3. Radiologic Findings in Patients with Pancreatic Pseudocysts

Procedure	No. of Patients Examined	No. of Patients with Abnormal Findings
Chest x-ray	103	42 (41%)
Upper GI series	92	82 (89%)
Flat plate of abdomen	88	36 (41%)
Oral cholecystogram or intravenous cholangiogram	60	19 (32%)
Barium enema	45	20 (44%)
Intravenous pyelogram	42	15 (36%)
Retrograde pancreatography	27	27 (100%)*
Abdominal echogram	11	10 (91%)
Celiac arteriogram	8	6 (75%)
Pancreatic or ACTA scan	3	2 (65%)

* Pseudocyst demonstrated in 13 patients (48%).

persistent elevation of the urine amylase and systemic symptoms; 2) they were experiencing ongoing systemic symptoms from a complication of pancreatitis or pseudocyst, such as respiratory insufficiency, renal insufficiency, fistula, hemorrhage, biliary or gastrointestinal tract obstruction, or acute pseudocyst rupture; or 3) they presented with an acute exacerbation of an existing disease, such as hepatic insufficiency, chronic obstructive lung disease or congestive heart failure, in association with a pseudocyst.

As seen in Table 2, the urine amylase was elevated in over half of the patients sampled. Only one-third of the abnormal values occurred in patients who were acutely ill. Two thirds of the patients studied had an abnormal BSP clearance. The majority of these patients were alcoholics with known liver disease. About half of the patients exhibited an elevation of the peripheral white blood cell count, and 40% of the abnormal results occurred in patients classified as acutely ill. Carbohydrate intolerance was demonstrated in 40% of the patients, one third of whom were acutely ill at the time of assessment. Roughly 40% of patients with pseudocyst were found to have a low hemoglobin concentration. Less than half of the abnormal values occurred in patients who were acutely ill. Reflecting the high incidence of alcoholic liver disease in this population, 15–35% of the patients had abnormalities of various liver function tests.

Roentgenologic Studies

Although in many cases the diagnosis was strongly suspected after history and physical examination, in the majority of patients confirmation or discovery of the presence of a pancreatic pseudocyst was ultimately made in the x-ray department. Abdominal examination by ultrasound and contrast study of the upper gastrointestinal tract were the most reliable diagnostic aids,

revealing the presence of a pseudocyst in 90% of the patients (Table 3). Abdominal echography was helpful not only in demonstrating a non-solid pancreatic mass but also in providing data regarding the thickness of the pseudocyst wall. Barium study of the stomach and duodenum characteristically revealed displacement or effacement of one or both of these organs by the pseudocyst. Gastric outlet obstruction and duodenal obstruction by a pseudocyst were each demonstrated in two patients. Fistulization between the pseudocyst and the small bowel was seen in three additional patients.

Chest x-rays revealed abnormalities in 40% of the patients. Findings included pleural effusion, atelectasis, pneumonitis and elevation of the left hemidiaphragm, in order of frequency. Plain films of the abdomen demonstrated abnormalities in about 40% of the patients. In most cases calcification in the area of the pancreas was the only abnormality observed. However, in several patients a mass lesion could be diagnosed by the displacement of the gastric air bubble or by downward displacement of the transverse colon. Barium enema examination documented abnormalities in over 40% of the patients studied. Findings included displacement of the colon, fistulization between the pseudocyst and colon (four patients), and segmental narrowing of the colon.

Intravenous pyelography and contrast studies of the biliary system each demonstrated abnormalities in one-third of the patients examined. In general, pyelography was not helpful in establishing the diagnosis of pseudocyst. Downward displacement of the left kidney was the typical abnormal finding, but in one patient obstruction of the left ureter was noted. Biliary tract obstruction by either the pseudocyst or adjacent inflamed pancreatic tissue was seen in 11 patients. A fistula between the common bile duct and the pseudocyst was demonstrated in another patient. Endoscopic retrograde cholangiopancreatography was successfully performed in 27 patients. Abnormalities in the pancreatic or biliary ductal systems were seen in all patients, and a pseudocyst was demonstrated in 13 patients (48%). Celiac arteriography and CAT scanning were performed in a limited number of patients. Although these studies were diagnostic in over two-thirds of the patients, cost and risk factors limit their use, and usefulness, to only selected patients.

Surgical Treatment and Results

One hundred fourteen patients underwent 117 surgical procedures for the primary treatment of their pseudocysts (Table 4). In general, the procedure employed was determined by the anatomic presentation of the pseudocyst at operation. However, the particular

TABLE 4. Overall Results of Surgical Treatment of Pancreatic Pseudocysts in 114 Patients

Procedure	No. of Procedures		Patients with Complications		Mortality		Recurrence		Median Follow-up Interval (mo.)
	Total	Pt. Acutely Ill	Total	No. Acutely Ill	No. Patients	No. Acutely Ill	Total	No. Acutely Ill	
External drainage	36	23	18 (50%)	14	10 (28%)	7	13 (36%)	8	25
Cystgastrostomy	35	7	10 (29%)	4	3 (8.6%)	1	3 (8.6%)	2	6
Roux-en-Y									
Cystjejunostomy	26	4	12 (46%)	1	2 (7.7%)	0	3 (11.5%)	0	20
Cystduodenostomy	8	0	2 (25%)	0	0	0	0	0	53
Marsupialization	6	2	1 (17%)	1	0	0	0	0	33
Excision	4	0	1 (25%)	0	0	0	0	0	28
Colostomy†	2	0	0	0	0	0	0	0	18
Totals	117*	36	44 (38.6%)	20	15 (13.2%)	8	19 (16.7%)	10	

* Three patients had two pseudocysts treated simultaneously.

† Treatment for patients with spontaneous pseudocystduodenocolostomy and pseudocystcolostomy.

procedure performed was also determined by the clinical status of the patient and, at times, by the personal prejudices of the operating surgeon. As with the analysis of laboratory findings, the data on surgical treatment were examined with regard to the clinical status of the patient. For each surgical procedure patients who were acutely ill at the time of surgery were isolated from the total group. The aim of this approach was to better evaluate the results of a given procedure in patients with complicated and uncomplicated pseudocysts.

Characteristics of Pseudocysts

Information on pseudocyst location was available in 93 patients. In 29 patients the mass was found in the body of the pancreas. The pseudocyst was located in the head of the gland in 23 patients and in the tail in 20 patients. In 11 patients the lesion was in the head and body, and in ten patients it was in the body and tail of the pancreas.

In 116 patients only one pseudocyst was present, while in three patients two pseudocysts were discovered. Data on pseudocyst size were available in 42 patients. The diameter ranged from 2 to 20cm, with a median diameter of 8cm. In 53 patients an estimate

of the volume of the pseudocyst was made by the surgeon. Pseudocyst capacity ranged from 30 to 3000 ml. The median volume was 1000 ml. Amylase concentration was determined on pseudocyst contents in 59 patients. The amylase concentration ranged from 50 SU/dl to 2,440,000 SU/dl, with a median amylase level of 16,179 SU/dl. In 70 patients the material within the pseudocyst was cultured for microorganisms. Positive cultures were obtained in 42 patients (53%). Enteric organisms predominated, with an equal incidence of gram positive and gram negative bacteria.

Results of Surgery

Tables 4 and 5 summarize the outcomes of the 114 patients treated surgically. The follow-up interval for the entire group ranged from two weeks to 197 months. Median follow-up intervals for each surgical procedure are presented in Table 4.

Thirty-six patients were treated by external drainage, with an overall mortality rate of 28% and a 50% incidence of postoperative morbidity. Pseudocysts recurred in 13 patients (36%). A patient who was acutely ill at the time of external drainage had twice the risk of sustaining a postoperative complication than one who had an uncomplicated pseudocyst. The clinical status

TABLE 5. Results of Surgery in Patients with Complicated and Uncomplicated Pseudocyst

Procedure	No. of Procedures		No. Postop. Complications		Mortality		Recurrence	
	Un-complic.	Acutely Ill	Un-complic.	Acutely Ill	Un-complic.	Acutely Ill	Un-complic.	Acutely Ill
External drainage	13	23	4 (31%)	14 (61%)	3 (23%)	7 (30%)	5 (38%)	8 (35%)
Pseudocystgastrostomy	28	7	6 (21%)	4 (57%)	2 (7%)	1 (14%)	1 (3.5%)	2 (28.5%)
Roux-en-Y								
Pseudocystjejunostomy	22	4	11 (50%)	1 (25%)	2 (9%)	0	3 (11.5%)	0

TABLE 6. *Complications of Surgery for Pseudocyst*

Complication	No. of Patients
Pneumonia	18
Intra-abdominal abscess	14
Upper GI bleeding	13
Septicemia	11
Wound infection	10
Pancreatitis	9
Diabetes	7
Chronic pancreatic fistula	5
Pleural effusion	4
Respiratory insufficiency	4
Bowel obstruction	3
Pancreatic exocrine insufficiency	3
Wound dehiscence	2
Pulmonary embolus	2
Anastomotic dehiscence	2
Gastrointestinal fistula	2
Gastric perforation (by stiff drain)	1
Ventral hernia	1
Cholangitis	1

of the patients undergoing external drainage, however, did not affect either the mortality rate or the incidence of pseudocyst recurrence following this procedure.

Pseudocystgastrostomy was performed in 35 patients. The overall complication rate was 29%, and there were three postoperative deaths (8.6%). Pseudocysts recurred in three patients. Acutely ill patients treated by pseudocystgastrostomy had a postoperative complication rate three times greater than that in patients with uncomplicated pseudocysts. Postoperative mortality was twice as high in the acutely ill group, and the incidence of pseudocyst recurrence was eight times that of the uncomplicated group.

Roux-en-Y pseudocystjejunostomy was used for drainage in 26 patients. Twelve patients (46%) sustained postoperative complications, and two patients (7.7%) died after surgery. Three pseudocysts (11.5%) recurred. The few patients who were acutely ill at the time of surgery actually fared better than those with uncomplicated pseudocysts.

Eight patients were treated by pseudocystduodenostomy, with a complication rate of 25%. There were no deaths or pseudocyst recurrences in this group of patients. None of the patients was acutely ill prior to surgery. Six patients underwent pseudocyst marsupialization, with no deaths or pseudocyst recurrence. Excision of the pseudocyst was accomplished in four patients. One patient sustained a postoperative complication, but there were no deaths or pseudocyst recurrences.

In two patients a colostomy was performed as the treatment of pseudocysts which had spontaneously fistulized to the colon. In one patient there was also a spontaneous pseudocystduodenostomy, which was felt

to be of adequate size to effect drainage. A colostomy was fashioned to eliminate continued seeding of the pseudocyst cavity with fecal matter. The second patient with spontaneous pseudocystcolostomy was treated with external drainage and proximal diverting colostomy. Both patients had uneventful postoperative courses, and neither developed pseudocyst recurrence.

Postoperative Morbidity and Mortality

Major complications occurring in our patients after pseudocyst surgery are outlined in Table 6. Conditions present before surgery, as a result of the pseudocyst or associated disease, have been excluded from this list. Pneumonia was the most frequent complication following pseudocyst surgery, occurring in 18 patients (16%). Fourteen patients (12%) developed an intra-abdominal abscess during convalescence from surgery. Postoperative bleeding from the upper gastrointestinal tract occurred in 13 patients (11%). The sources of blood loss were hemorrhagic gastritis, peptic ulcer, esophageal varices, the pseudocystgastrostomy stoma, and erosion of a major blood vessel by the pseudocyst. Septicemia occurred in 11 patients (9.6%) following surgery, while ten patients developed wound infection. In many cases the offending microorganism was present in the pseudocyst at the time of drainage.

Nine patients experienced a new episode of acute pancreatitis following drainage. Pancreatitis typically presented as the appearance of fever, severe abdominal pain, and elevated serum and urine amylase concentrations during the postoperative convalescent period. Pleural effusion and respiratory insufficiency each developed after surgery in four patients. Three patients experienced small bowel obstruction, and two patients suffered wound dehiscence necessitating emergency reoperation. Two patients treated by Roux-en-Y pseudocystjejunostomy experienced a break-down of the anastomosis between the pseudocyst and the bowel. One of these patients began to run a septic course four days after surgery, and the diagnosis of anastomotic dehiscence was confirmed at abdominal re-exploration. The second patient underwent exploratory laparotomy six months after pseudocystjejunostomy for an apparent recurrence of the pseudocyst. At surgery the defunctionalized limb of jejunum was found free-floating in the abdominal cavity. A new pseudocystjejunostomy was fashioned using this piece of bowel, and the patient had an uneventful postoperative course. Other complications occurring less frequently during the convalescent period are listed in Table 6.

Late complications of pseudocyst surgery included the appearance of diabetes requiring insulin in seven patients. Some element of carbohydrate intolerance

was present in all of these patients prior to pseudocyst drainage. Five patients treated by external drainage experienced chronic pancreatic fistulas. All but one fistula closed spontaneously after several months of non-operative management. Three patients developed chronic pancreatic exocrine insufficiency requiring pancreatic enzyme supplements.

Fifteen patients died following pseudocyst surgery. Eight patients were acutely ill at the time of surgery and seven patients had elective surgery for uncomplicated pseudocysts. The mortality rates in the two groups were 22 and 9%, respectively. Eight patients died from overwhelming sepsis, two succumbed from pulmonary emboli, and two died from postoperative gastrointestinal bleeding. One patient died of respiratory failure. The causes of death in the remaining two patients could not be determined.

Discussion

The diagnosis of chronic pancreatic pseudocyst can be a difficult and challenging problem, especially in patients without a palpable abdominal mass. Abdominal pain is the most common complaint and is present in the vast majority of patients. A host of other gastrointestinal symptoms, as well as weight loss, occur to a variable degree. There is, however, no classic or typical symptom complex which readily suggests the diagnosis of pseudocyst. Nevertheless, the occurrence of these nonspecific symptoms in a patient with a history of pancreatitis or abdominal trauma should make one suspect pancreatic disease.

As with the history, physical examination is frequently nondiagnostic. A palpable abdominal mass is present in 45–65% of patients^{7,8} and, when present, should suggest the diagnosis to the discerning physician. Abdominal tenderness is the only other common finding on physical examination. When present by itself, tenderness helps to confirm the presence of organic disease, but does not suggest the source. Other findings, such as auscultatory abnormalities of the chest, ascities or jaundice, also serve only to confirm the presence of organic disease.

Laboratory studies are of little help in diagnosing pseudocysts. The most useful test is the measurement of urine amylase concentration. As shown by Ebbesen and Schonebeck,⁵ patients with acute pancreatitis who have a prolonged, persistent amylase elevation should be closely observed for pseudocyst formation. Among patients with chronic pseudocysts, however, the incidence of hyperamylasuria is variable. Hastings, et al.⁸ reported an elevated amylase level in 57% of their patients, while both Gilman, et al.⁶ and Sankaran, et al.¹² found high serum or urine amylase concentrations

in about 75% of patients with pseudocysts. In none of these series was the effect of the clinical status of the patient or the chronicity of the pseudocyst on amylase concentration evaluated. In the present study 62% of the patients examined had elevated urine amylase values. One third of these patients with abnormal results were acutely ill. Of the 65 patients with uncomplicated chronic pseudocyst, 34 (52%) had an elevated urine amylase concentration. The reason for hyperamylasuria in the presence of a pseudocyst is not known. Persistent inflammation of the pancreas due to compression by the pseudocyst has been suggested.⁵ Since the amylase concentration of pseudocyst contents is usually high, it is also possible that amylase diffuses across the pseudocyst wall to the blood stream. Either mechanism would explain the decrease in urine amylase concentration following surgical drainage of pseudocysts.

Other laboratory studies are necessary and useful in detecting conditions associated with pseudocysts, but they do not aid in establishing the diagnosis of a pancreatic cystic mass. Reflecting the high incidence of alcoholism and biliary tract disease in these patients, 30–40% of patients with acute or chronic pseudocyst have abnormalities of one or more liver function tests. Anemia and carbohydrate intolerance are found with the same frequency. In our series one-third of patients with chronic pseudocyst had an elevated white blood cell count. The cause of this leukocytosis in patients with uncomplicated, established pancreatic pseudocyst is unknown.

While the history, physical examination and laboratory assessment of patients with pseudocyst can be useful, in most cases the diagnosis or the confirmation of the diagnosis is made in the x-ray department. At present the safest, least expensive and most accurate means of diagnosing a pseudocyst is abdominal ultrasound examination. The studies of both Bradley, et al.³ and Andersen and colleagues¹ have documented a diagnostic accuracy rate of around 90%, with a low incidence of false-negative scans. The correct diagnosis was established by ultrasound in 10 of 11 patients in our series. In addition to giving the diagnosis, ultrasound scanning also provides information regarding the timing of surgical intervention, since an accurate measurement of the thickness of the pseudocyst wall is possible.³ We believe that abdominal echography should be the first diagnostic study in patients suspected of harboring a pseudocyst, after a chest x-ray and plain films of the abdomen are taken.

Contrast study of the upper gastrointestinal tract is also an important examination in patients with pancreatic pseudocyst. In agreement with the results of Thomford and Jesseph,¹⁵ as well as most other series in

the literature, we noted a diagnostic accuracy approaching 90% with upper gastrointestinal x-rays. Not only is this study complimentary to ultrasound scanning, but it may also diagnose pseudocysts when scanning fails to do so. In addition, barium study of the upper gastrointestinal tract can diagnose concurrent disease, such as peptic ulcer, neoplasia, gastrointestinal obstruction, and pseudocystenteric fistula. Consequently, we have found it helpful to obtain a small bowel follow-through study at the time of examination of the stomach and duodenum.

In the present series pathology was noted in 30 and 45%, respectively, of the contrast studies of the biliary tract and the colon. Although these examinations do not often diagnose a pancreatic pseudocyst, we believe that they are a necessary and useful part of the evaluation of a patient with gastrointestinal disease. Not only can associated conditions be recognized, but fistulous communications between the pseudocyst and these organs can be appreciated and treated.

We have not found intravenous pyelography to be very helpful in these patients. Although displacement of a kidney or ureter is a fairly common finding, rarely does one encounter urinary tract pathology which needs specific surgical correction. We currently reserve intravenous pyelography for patients with either a history of genitourinary disease or symptoms which warrant such a study. We also do not routinely use CAT scanning in these patients. This examination is expensive, potentially hazardous, and provides no additional information to that obtainable by other means. Celiac arteriography is reserved for those patients who experience gastrointestinal or intracystic bleeding or for those in whom an abdominal mass becomes pulsatile.

The current role of endoscopic retrograde cholangiopancreatography (ERCP) in the diagnosis of pancreatic pseudocyst is less clearly defined. Using this technique Silvas, et al.¹⁴ visualized a pseudocyst in 75% of their patients and were able to diagnose a pseudocyst in 95%. The authors concluded that preoperative cholangiopancreatography was very beneficial. Andersen, et al.¹ visualized a pseudocyst in only 29% of their patients, but were able to make a diagnosis of pseudocyst in 85%. Nevertheless, these authors preferred ultrasound scanning as a more reliable diagnostic modality. At present we believe that ERCP should not be routinely used in the evaluation of patients with suspected pseudocyst. The procedure is not inexpensive, nor is it without risk. Gastrointestinal perforation, septicemia, and pancreatitis can occur after its use. Although one can usually obtain a picture of the pancreatic ducts with this technique, such information rarely alters the surgical treatment of the pseudocyst. Due to associated pancreatitis the pancreatic ducts are typically abnormal in

patients with pseudocysts. Furthermore, it is generally agreed that definitive treatment of chronic pancreatitis should be deferred at the time of pseudocyst drainage. Although knowledge of the status of the biliary tract is essential before pseudocyst surgery, this information can usually be obtained by intravenous or thin needle percutaneous cholangiography. Thus, in our opinion the prime (and perhaps sole) indication for ERCP is the pseudocyst patient in whom ERCP is the only means of visualizing the biliary system preoperatively.

One of the major objectives of this review was to evaluate the results of the surgical treatment of pancreatic pseudocysts. The present consensus is that, if excision is not possible, internal drainage is the procedure of choice for mature pseudocysts. External drainage is currently used in patients with "acute" (immature) pseudocysts or pancreatic abscesses, in any situation where the surgeon questions the integrity of a pseudocystenterostomy, and in patients who are considered poor operative risks. With the exception of Schumer, et al.,¹³ who strongly recommended pseudocystgastrostomy, virtually every other author in the past two decades has found no advantage of one type of internal drainage over another. By isolating the patients who were acutely ill from those with uncomplicated pseudocysts, we were able to examine the true efficacy of each type of surgical drainage for pseudocyst.

Since the report of Warren, et al.¹⁷ in 1958, external drainage has been considered a less than satisfactory operation for pseudocyst. The high incidence of morbidity and mortality has been primarily attributed to the use of this procedure in poor risk patients. Accordingly, the principal objection to the use of external drainage has been the high risk of pseudocyst recurrence, necessitating reoperation. The incidence of recurrence has been in the range of 23–30%, as reported by Balfour² and by Hastings, et al.,⁸ respectively.

Our results support the concept that external drainage is an unsuitable procedure for patients with pseudocyst and should be employed only when circumstances give the surgeon no other choice. We noted a 31% incidence of postoperative complications among patients with pseudocyst who were otherwise healthy. The complication rate doubled in the patients who were acutely ill at the time of external drainage. Surprisingly, the clinical status of the patient did not affect the operative mortality, which was in excess of 20%, or the incidence of pseudocyst recurrence, which was at least 35%, in both groups. We conclude that external drainage should be restricted to patients with immature pseudocysts or frank pancreatic abscesses and to patients who are extremely poor surgical risks.

Pseudocystgastrostomy was employed in 35 patients, with an overall mortality rate of 8.6% and a 29% incidence of morbidity. Contrary to the report of Hut-

son, et al.,⁹ only one patient experienced bleeding from the sutured anastomosis between the stomach and the pseudocyst. Among patients with uncomplicated pseudocyst the mortality rate was 7.7%, and the incidence of complications was 21%. One patient (3.5%) experienced a recurrence of the pseudocyst. These data are in agreement with those in the recent collected series of Schumer, et al.¹³ Mortality and morbidity rates doubled in patients who were acutely ill at the time of surgery. The frequency of pseudocyst recurrence was also higher, but was still not as great as that in either group of patients treated by external drainage. Furthermore, the mortality rate among acutely ill patients undergoing pancreatic cystgastrostomy was less than that in patients receiving external drainage for uncomplicated pseudocyst. Pseudocystgastrostomy is a reasonably safe and reliable means of treating pancreatic pseudocysts, especially in otherwise healthy patients undergoing elective surgery. Even when used in acutely ill patients, however, the overall results are superior to those obtainable with external drainage. Since the time involved in performing pseudocystgastrostomy is comparable to that needed to effect adequate external drainage and since both procedures entail laparotomy, our data suggest that pancreatic cystgastrostomy should be used more frequently in patients with mature pseudocysts who have previously been considered too ill to withstand internal drainage.

Twenty-six patients underwent Roux-en-Y pseudocystjejunostomy, with a complication rate of 46% and an operative mortality of 9%. Three patients (11.5%) experienced pseudocyst recurrence. All but four patients had uncomplicated pseudocysts. None of the postoperative deaths or recurrences occurred in patients who were acutely ill at the time of surgery. Although these results are not as good as those obtained after pancreatic cystgastrostomy, they are still far superior to those seen following external drainage. Because of the time required for this procedure, however, it is not recommended in critically ill patients.

Pseudocystduodenostomy was used in eight patients, all of whom had uncomplicated pseudocysts. Two patients experienced postoperative complications. There were no deaths or pseudocyst recurrences in this group. Our experience parallels that originally reported by Mercadier,¹¹ as well as the recent experience of Hastings, et al.⁸ Pseudocystduodenostomy is the ideal operation in patients with mature pseudocysts juxtaposed to a portion of the duodenum. Since it is not too time-consuming, this procedure should also be considered in acutely ill patients with mature pseudocysts.

Four patients in the present series underwent excision of the pseudocyst with excellent results. There

were no deaths or pseudocyst recurrences, and only one patient experienced a postoperative complication. These results compare favorably with those reported in the recent literature. Excision is the ideal treatment for small pseudocysts located in the tail or the body and tail of the pancreas. This technique affords the surgeon the rare possibility of definitively treating the pseudocyst and, at times, chronic pancreatitis simultaneously. The excellent quality of intra- and perioperative care today has lowered the morbidity and mortality rates to levels similar to those seen following internal drainage. Excision is the preferred treatment of small pseudocysts in the distal pancreas.

Pseudocyst marsupialization, a form of external drainage, was employed in six patients with excellent results. This procedure is no longer used in the treatment of pseudocysts—and rightly so. Since it involves suturing the pseudocyst to the abdominal wall, it can safely be employed only in patients with mature pseudocysts. These patients are better served by internal drainage. Even in acutely ill patients marsupialization has no advantage over internal drainage, since the time needed to marsupialize a pseudocyst is comparable to that required to perform pancreatic cystgastrostomy.

In addition to these operative considerations, our review has also suggested that it is helpful and prudent to culture the contents of pseudocysts for microorganisms. Forty-two patients, including nine with fistulas, had positive pseudocyst cultures for microorganisms. In many patients with postoperative septic complications the responsible organism(s) had previously been isolated from the pseudocyst. Hence, it may be worthwhile to consider intra- and postoperative antibiotic administration, if gram staining of the pseudocyst contents reveals microorganisms.

Summary and Conclusions

Both acute and chronic pancreatic pseudocysts are being seen in such numbers that the disease is no longer rare. There are no pathognomonic symptoms, but the presence of abdominal pain and tenderness in a patient with a history of pancreatitis or abdominal trauma should cause the clinician to entertain the diagnosis of pseudocyst. Almost two-thirds of these patients have a palpable abdominal mass, which should also suggest the diagnosis.

Laboratory studies are nonspecific in patients with pseudocyst. The diagnosis is usually made or confirmed in the x-ray department. Abdominal ultrasound scanning and contrast study of the upper gastrointestinal tract are each accurate in about 90% of the cases, with a combined diagnostic accuracy rate in excess of 90%. A complete radiologic evaluation of the entire gastrointestinal tract and biliary system is recom-

mended in these patients. ERCP is reserved for patients in whom other techniques cannot outline the biliary tract.

The surgical treatment of pancreatic pseudocyst must be tailored to the individual patient. External drainage is mandatory in patients with immature pseudocysts and should probably be employed in severely ill patients with mature pseudocysts which are not juxtaposed to a portion of the upper gastrointestinal tract. Excision is ideal for patients with uncomplicated, mature pseudocyst of the distal pancreas. In all other patients with mature pseudocysts, however, internal drainage should be strongly considered, irrespective of the clinical status of the patient. Biopsy of the pseudocyst wall and microbiological culture of the pseudocyst contents are recommended in all patients.

References

1. Andersen, B. N., Hancke, S., Nielsen, S. A. D., et al.: The Diagnosis of Pancreatic Cyst by Endoscopic Retrograde Pancreatography and Ultrasound Scanning. *Ann. Surg.*, 185: 286, 1977.
2. Balfour, J. H.: Pancreatic Pseudocysts: Complications and Their Relation to the Timing of Treatment. *Surg. Clin. North Am.*, 50:395, 1970.
3. Bradley, E. L., III and Clements, J. L., Jr.: Implications of Diagnostic Ultrasound in the Surgical Management of Pancreatic Pseudocysts. *Am. J. Surg.*, 127:163, 1974.
4. Bradley, E. L., III, Gonzalez, A. C. and Clements, J. L., Jr.: Acute Pancreatic Pseudocysts: Incidence and Implications. *Ann. Surg.*, 184:734, 1976.
5. Ebbesen, K. E. and Schönebeck, J.: Prolonged Amylase Elevation. *Acta Chir. Scand.*, 133:61, 1967.
6. Gilman, P. K., Gibbons, J. C., Kaplan, M. S., et al.: Unusual Diagnostic Aspects and Current Management of Pancreatic Pseudocysts. *Am. Surg.*, 40:326, 1974.
7. Grace, R. R. and Jordan, P. H., Jr.: Unresolved Problems of Pancreatic Pseudocysts. *Ann. Surg.*, 184:16, 1976.
8. Hastings, P. R., Nance, F. C. and Becker, W. F.: Changing Patterns in the Management of Pancreatic Pseudocysts. *Ann. Surg.*, 181:546, 1975.
9. Hutson, D. G., Zeppa, R. and Warren, W. D.: Prevention of Postoperative Hemorrhage After Pancreatic Cystogastrostomy. *Ann. Surg.*, 177:689, 1973.
10. Jordan, G. L., Jr.: Pancreatic Cysts. In Howard, J. M. and Jordan, G. L. Jr. eds. *Surgical Diseases of the Pancreas*. Philadelphia, J. B. Lippincott. 1960. p. 283.
11. Mercadier, M.: Cystoduodenal Anastomosis for Cephalic Cyst of the Pancreas. *Ann. Surg.*, 153:81, 1961.
12. Sankaran, S. and Walt, A. J.: The Natural and Unnatural History of Pancreatic Pseudocysts. *Br. J. Surg.*, 62:37, 1975.
13. Schumer, W., McDonald, G. O., Nichols, R. L., et al.: Transgastric Cystogastrostomy. *Surg. Gynecol. Obstet.*, 137:48, 1973.
14. Silvis, S. E., Vennes, J. A. and Rohrmann, C. A.: Endoscopic Pancreatography in the Evaluation of Patients with Suspected Pancreatic Pseudocysts. *Am. J. Gastroenterol.*, 61:452, 1974.
15. Thomford, N. R. and Jesseph, J. E.: Pseudocyst of the Pancreas. A Review of Fifty Cases. *Am. J. Surg.*, 118:86, 1969.
16. van Heerden, J. A. and ReMine, W. H.: Pseudocysts of the Pancreas. Review of 71 Cases. *Arch. Surg.*, 110:500, 1975.
17. Warren, W. D., Marsh, W. H. and Sandusky, W. R.: An Appraisal of Surgical Procedures for Pancreatic Pseudocyst. *Ann. Surg.*, 147:903, 1958.