Pancreatoduodenectomy for Chronic Pancreatitis

Long-term Results in 105 Patients

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Hypothesis: For patients with head-dominant, small-duct chronic pancreatitis who require operative intervention, pancreatoduodenectomy can be performed safely and affords satisfactory pain relief in most.

Design: Retrospective case series. Follow-up was complete in 86% of study subjects (average, 6.6 years).

Setting: Tertiary care center.

Patients: Among 484 consecutive cases of chronic pancreatitis treated surgically from January 1976 through April 1997, 105 (22%) in which pancreatoduodenectomy was performed were reviewed with regard to criteria for selection, operative procedure, postoperative course, and long-term outcome.

Main Outcome Measures: The main outcome measure was degree of pain relief. Additionally, late mortality, cause of death, the presence of endocrine and exocrine insufficiency, and quality of life were recorded.

Results: There were 72 men (69%) and 33 women (31%) with a mean age of 51 years (range, 24-77 years). The cause of chronic pancreatitis was alcohol related in 58 patients (55%) and idiopathic in 41 (39%). Clinical manifestations included abdominal pain in 86 patients (82%), obstructive jaundice in 27 (26%), and vomiting in 11 (11%). Suspicion of malignant neoplasm was a concern in 67 patients (64%). Operative morbidity was 32%, and mortality, 3%. Mean hospital stay was 16 days (range, 12-82 days). Survival was significantly lower than that of age-matched controls. Among 66 patients with preoperative pain, pain relief was achieved in 59 (89%); it was complete in 44 patients (67%) and partial in 15 (23%). Operation resulted in a significant increase in patients with normal functional status (73 patients [81%] vs 51 [49%]; P<.001). Forty patients (48%) had diabetes. Steatorrhea was observed in 39 patients (43%), while weight maintenance or gain occurred in 59 (66%).

Conclusions: Pancreatoduodenectomy achieves pain relief and good quality of life in a large percentage of selected patients with small-duct, head-dominant disease and is especially useful when a malignant neoplasm must be excluded. Morbidity and mortality are acceptable in experienced hands. Onset of diabetes and steatorrhea, while reflecting the natural course of the disease, is likely accelerated by pancreatoduodenectomy.

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During the past 2 decades, substantial changes in our surgical philosophy regarding the treatment of patients with chronic pancreatitis have occurred. A better understanding of the pathophysiological characteristics of the disease, more sophisticated diagnostic imaging modalities, and improved morbidity and mortality after major pancreatic resections (including pancreatoduodenectomy [PD]) resulted in an increased use of proximal pancreatectomy in the surgical management of chronic pancreatitis. In carefully selected patients, pain relief can be achieved in a large percentage, with acceptable morbidity and mortality in experienced hands.1,2

In an effort to further decrease both the immediate and long-term complications of proximal pancreatic resection for chronic pancreatitis, Beger and Buchler3 and Frey and Smith4 introduced, respectively, the duodenum-preserving pancreatic head resection and local resection of the head of the pancreas combined with longitudinal pancreateojunostomy. Although the results of the 2 operations are noteworthy, for patients with small-duct, head-dominant disease, we have preferred to perform PD. The aim of the present study was to review our 21-year experience with patients undergoing PD for complications of pancreatitis to provide outcome data to serve as a benchmark for comparison with alternative therapeutic approaches.
PATIENTS AND METHODS

Records of 484 consecutive patients with chronic pancreatitis who underwent surgery at the Mayo Clinic, Rochester, Minn, from January 1976 through April 1997 were reviewed. The diagnosis of chronic pancreatitis was based on laboratory tests, radiographs, ultrasonography, computed tomography, endoscopic retrograde (and in some cases intraoperative) pancreatography, and gross inspection of the pancreas at laparotomy and confirmed by histological examination.

Among the 484 patients, 105 (22%) underwent PD, including 33 women (31%) and 72 men (69%), with a mean age of 51 years (range, 24-77 years). Patients who had either completion pancreatoduodenectomy or 1-stage total pancreatectomy were excluded from analysis.

INVESTIGATION OF THE PANCREATIC GLAND AND ADJACENT ORGANS

Exocrine pancreatic insufficiency was assessed clinically by the presence of gross steatorrhea, on occasion supplemented by pancreatic function tests. Endocrine pancreatic insufficiency was defined as diabetes requiring some type of treatment (diet, oral drugs, or insulin).

The pancreas was imaged with contrast-enhanced abdominal computed tomography and ultrasonography in 93 and 69 patients, respectively. In 9 patients, endoscopic ultrasonography was also performed. Biliary and pancreatic ductal anatomy was delineated by endoscopic retrograde cholangiopancreatography (ERCP) in 70 patients, while percutaneous transhepatic cholangiography was performed in 2 patients. Selective celiac and superior mesenteric angiography with both arterial and venous phases was carried out in 2 patients to identify suspected vascular abnormalities and to determine whether there was inflammatory encroachment or occlusion of the great veins. Twenty-eight and 38 patients had barium meal radiography and esophagogastroduodenoscopy, respectively, to investigate the upper gastrointestinal tract for various reasons.

HOSPITAL COURSE

Complications were characterized according to the following criteria: delayed gastric emptying was indicated by the need for postoperative nasogastric decompression for more than 10 days; pancreatic fistula, daily drainage of more than 50 mL of amylase-rich fluid (amylase activity >3 times serum activity) after postoperative day 7; intra-abdominal abscess, radiographically defined or surgically found fluid collection associated with clinical signs and symptoms of sepsis; and wound infection, need for the wound to be partially or wholly opened and packed. Bile leak, herein defined, was heralded by drainage of bilious fluid from deep drains or biloma and confirmed by listulogram, transhepatic cholangiography, or reoperation.

FOLLOW-UP

Follow-up information was derived from the recent hospital notes of patients still attending the outpatient clinics, from a response to a survey questionnaire from patients, or, if deceased, from the next of kin. Postoperative severity of pain and performance status were obtained with follow-up inquiry. The patient was asked directly about the presence of pain and, if present, about its severity. “Complete pain relief” corresponded to those patients who were pain free and no longer required analgesia. Patients who had “significant improvement” in pain had a decrease in amount and/or type of analgesia required. Those who experienced significant improvement may have still required intermittent analgesic medications, but their pain pattern was better controlled. Finally, those who did not benefit from surgery were considered “unchanged.” In addition, patients were asked if they were able to return to work or normal activities and, if not, to what extent their limitations resulted from persistent or recurrent symptoms. Quality of life was deemed acceptable if patients had relief or improvement in pain and were able to resume work or, if retired, normal daily activities. Moreover, late mortality, cause of death, and the presence of endocrine and exocrine pancreatic insufficiency were recorded.

STATISTICAL METHODS

Survival analysis was performed by the method of Kaplan and Meier. The log-rank test was used to test for group differences in survival. Expected survival rates were calculated using the white population from the Minnesota state life tables. The χ² or Fisher exact tests were used to test for association among pairs of categorical variables. Group differences in ordinal and continuous variables were assessed with the Wilcoxon rank sum test. Preoperative vs postoperative changes were assessed with the McNemar test for matched pairs for categorical variables and the Wilcoxon signed rank test for ordinal or continuous variables. A significance level of .05 was used for all tests.

RESULTS

PATIENT POPULATION

The cause of chronic pancreatitis was alcohol related in 58 patients (55%), idiopathic in 41 (39%), and familial in 3 (3%). Chronic pancreatitis was related to hyperlipidemia in 2 and pancreas divisum in 1.

Clinical manifestations included abdominal pain in 86 patients (82%), obstructive jaundice in 27 (26%), vomiting in 11 (11%), and weight loss in 45 (43%). Abdominal pain was manifested as constant pain in 30 patients (28%) or as frequent, debilitating attacks of pain in 51 (48%). Five patients (5%) had only occasional episodes of pain. The pain was described as severe in 68 patients (64%) and required narcotic use or hospital admission for control in 65 (62%). Five had undergone percutaneous nerve block previously. Two patients had pancreas-related gastrointestinal tract hemorrhage (hemosuccus pancreaticus). Suspicion of malignant neoplasm, based on both clinical appearance and preoperative investigation, was also a concern in 67 patients (64%). Fifty-one patients (49%) were unable to function productively in work or normal activities and, if not, to what extent their limitations resulted from persistent or recurrent symptoms. Quality of life was deemed acceptable if patients had relief or improvement in pain and were able to resume work or, if retired, normal daily activities. Moreover, late mortality, cause of death, and the presence of endocrine and exocrine pancreatic insufficiency were recorded.
Pancreatic endocrine insufficiency was present preoperatively in 8 patients (8%), requiring insulin treatment in 3, oral hypoglycemic agents in 3, and diet control only in 2. Exocrine pancreatic insufficiency (manifested clinically as steatorrhea) was present preoperatively in 18 patients (17%); most of these patients were under treatment with pancreatic enzyme supplements. Fifteen patients (14%) had a history of peptic ulcer disease. Forty-nine patients had undergone a total of 58 previous upper abdominal procedures, including pancreatic surgery (2 patients) or stenting (10), gastric surgery (9), and biliary surgery (37).

PREOPERATIVE EVALUATION

The primary localization of the disease was in the pancreatic head in all patients. An inflammatory mass (>3 cm in thickness) was present in the head of the pancreas in 85 patients (81%). Pseudocysts, all localized in the pancreatic head, were present in 16 patients (15%). These pseudocysts were single in 12 patients and multiple in 4. Calcifications were present in 38 patients (36%). In addition, intraductal stones were detected either preoperatively or at the time of operation in 11 patients (10%).

On the basis of both clinical appearance and diagnostic evaluation, a malignant neoplasm was suspected in 67 patients (64%). Typically, these patients had pain, an inflammatory mass in the head of the pancreas, associated biliary and/or duodenal obstruction, and a dominant stricture of the main pancreatic duct without pancreatic calcifications.

Investigation of adjacent organs by various combinations of diagnostic methods showed an element of common bile duct dilation in 51 patients (49%), duodenal obstruction in 5 (5%), splenic vein thrombosis in 2 (2%), and active peptic ulcer disease in 7 (7%).

Body mass index (BMI), calculated at the time of pancreatic surgery, and serum albumin levels were used to estimate the nutritional status of the patients. The BMI and serum albumin concentrations were below normal levels in 30 (29%) and 45 (43%) of the patients, respectively, indicating some degree of nutritional deficit in a substantial percentage of patients. Below-normal BMI was more frequently associated with alcoholic than nonalcoholic cause (37% vs 19%, respectively) (P = .04). The duration of symptoms was longer in patients with below-normal BMI (median, 2.2 years) than in patients with normal or above-normal BMI (median, 0.9 year) (P = .01). However, cause and duration of symptoms were not associated with below-normal albumin concentrations.

OPERATIVE MANAGEMENT

The mean time from onset of symptoms to surgery was 3 years (range, 1 month to 39 years). Seventy-two patients (69%) underwent a classical PD (with anastomosis), while the other 33 (31%) underwent a pylorus-preserving PD. In 1 patient, gastrointestinal continuity after PD was established by a pancreaticogastrostomy. Concomitant total abdominal vagotomy was performed in 26 patients (25%).

POSTOPERATIVE MORTALITY AND MORBIDITY

Three patients died within 30 days of operation (2 of sepsis and 1 of hemorrhage), giving a hospital mortality of 3%. Some form of postoperative morbidity occurred in a total of 34 patients (32%). Major morbidity occurred in 25 patients and included delayed gastric emptying in 11 (10%), anastomotic leak at either the pancreaticoenterostomy in 5 (5%) or the bilioenterostomy in 6 (6%), intra-abdominal abscess in 2 (2%), and intraperitoneal hemorrhage in 1 (1%). Eight reoperations were required in 6 patients. One patient developed bile peritonitis after T-tube removal 4 weeks after PD, requiring exploration and ligation of the fractured fistulous tract. One patient was reoperated on to drain a left pleural effusion after incidental splenectomy and another, to place a drain near a leaking pancreaticojejunostomy. Despite 5 reoperations in the remaining 3 patients, all 3 died postoperatively. One patient had an unreparable dehiscence of the pancreaticojejunostomy with gastrointestinal tract bleeding and died after completion pancreatectomy secondary to an uncontrollable coagulopathy. Another patient with an anastomotic leak at the pancreaticojejunostomy died of multiple-system organ failure after takedown of the pancreaticojejunostomy and oversewing of the duct in the pancreatic remnant. A third patient developed acute coagulopathy related to massive intraoperative bleeding. The procedure was terminated acutely without reconstruction after the pancreatic resection. Despite delayed enterocutaneous reconstruction, the patient died of multiple organ failure.

Mean hospital stay was 16 days (median, 14 days; range, 12-82 days). Among these patients, 50 (48%) were treated in an intensive care unit setting, with a mean intensive care unit stay of 2.4 days (median, 2 days; range, 1-15 days).

LONG-TERM OUTCOME

Survival

Follow-up was complete in 90 patients (86%). Mean follow-up was 6.6 years (range, 1 month to 20 years). Sixty-four patients were alive at the time of follow-up. There were 7 deaths related to pancreatitis, pancreatic surgery, or both. Nine patients died of unrelated causes, while the cause of death remained poorly documented (and unreliable) for 10 patients. Survival was significantly lower than that of age-matched controls (Figure 1). Long-term survival was not associated with resumption of alcohol drinking (P = .21), age at diagnosis (P = .45), time from onset of symptoms (P = .34), or presence of diabetes (P = .76), but was of borderline significance (P = .07) comparing alcoholic vs nonalcoholic cause of chronic pancreatitis.

Pain Control

Among the 66 patients with pain preoperatively and with adequate follow-up, 59 (89%) had complete or partial pain relief (44 patients [67%] and 15 [23%], respectively).
Seven patients (11%) had inadequate relief of pain (ie, inability to work, persistent narcotic use, and/or recurrent hospitalization). Complete pain relief was achieved in 54 (81%) of patients without calcifications compared with 21 (55%) of those with calcifications \( (P = .02) \). The median duration of symptoms for patients with complete relief was 0.6 year, compared with 2.2 years for those with inadequate pain relief \( (P = .002) \). Seventy-three patients (81%) were able to function normally (daily activities) after pancreatic surgery. Surgery resulted in a significant increase in the proportion of patients able to function normally (51 patients [49%] vs 73 [81%]; \( P = .001 \)). Weight maintenance or gain occurred in 59 patients (66%). Nine (86%) of the patients with inadequate pain relief failed to gain weight compared with 14 (24%) of those with adequate pain relief \( (P = .002) \). Moreover, 17 (54%) of those patients who failed to gain weight required narcotic use or rehospitalization for pain control, while only 6 (10%) of those who gained weight required these measures \( (P = .007) \).

Pancreatic Function

Diabetes was present in 40 patients (48%) during the follow-up period after PD (31 requiring insulin, 6 requiring oral drugs, and 3 requiring only diet). Diabetes (preoperative vs postoperative) developed or worsened in a significant proportion of patients after surgery \( (P = .001) \). The cumulative probability of developing diabetes steadily increased after PD (Figure 2). The mean time to onset of diabetes among patients who were not diabetic preoperatively was 4.7 years. Hypoglycemic episodes occurred postoperatively in 15 patients (17%). Although alcoholic cause for the chronic pancreatitis was not significantly correlated with hypoglycemic episodes \( (P = .73) \), the hypoglycemic episodes were more frequent in patients requiring narcotic use or repeated hospitalization for pain management \( (P = .02) \).

Postoperative pancreatic exocrine insufficiency (manifested clinically as steatorrhea) was observed in 39 patients (43%). Pancreatoduodenectomy resulted in a significant increase in the proportion of patients with steatorrhea \( (P = .001) \).

Resumption of alcohol excess after PD was documented in 14 (31%) of the 45 patients with chronic pancreatitis of alcoholic cause. Resumed alcohol drinking did not correlate with pain relief \( (P = .82) \).

Other Sequelae

Nine patients developed peptic ulcer postoperatively, 1 of whom required operative intervention.

Comment

The surgical philosophy governing treatment of the patient with painful chronic pancreatitis has undergone a steady evolution in the past 60 years. 

In the 1940s to 1960s, surgical interest centered on neurotomies or neurectomies. This approach was designed in an attempt to interrupt the neural pathways conducting the “pain” rather than being directed at the pancreatic parenchyma, primarily because surgical experience with formal pancreatectomy was limited and the morbidity and mortality of pancreatic resections was high. With the advent of the ability to image the ductal system (ERCP, ultrasonography, abdominal computed tomography), interest centered on ductal drainage procedures for large-duct disease, while for small-duct disease pancreatic resections proceeded from the left to the right sides of the gland, encompassing up to 95% of the pancreatic parenchyma, primarily because of the inordinate mortality and morbidity of proximal pancreatectomy and/or total pancreatectomy. 

The unwritten concept (later disproved) was that relief of the pain of chronic pancreatitis would be proportional to the amount of pancreatic parenchyma resected. With increasing experience with elective pancreatic resection for periampullary malignant neoplasms and its well-documented decrease in mortality and morbidity, coupled with the hypothesis attributed to Longmire at UCLA that the “pacemaker” of pancreatic pain is the head of the gland, the surgical philosophy of treatment of the patient with incapacitating pain and small-duct disease changed in the 1980s. These factors have led to more widespread use of anatomic proximal pancreatic resections for the surgical treatment of patients with chronic pancreatitis treated by pancreatoduodenectomy compared with expected survival based on Minnesota life tables. 

Figure 1. Estimated survival (Kaplan-Meier) of patients with chronic pancreatitis treated by pancreatoduodenectomy compared with expected survival based on Minnesota life tables.

Figure 2. Cumulative probability of developing diabetes after pancreatoduodenectomy for nondiabetic patients with chronic pancreatitis whose postoperative diabetic status was known.
pancreatitis. This trend is evident in our own material, as approximately 75% of the cases reported herein were performed since 1985.

Our experience with 105 patients shows that PD can be performed relatively safely and leads to complete or at least substantial relief of pain in 89% of patients with pain before operation at mean follow-up of 6.6 years. Our experience agrees closely with that of others (Table). Despite complete pain relief occurred in only 67%, this must be considered in the context of the patient's preoperative status of chronic incapacitating pain, necessitating operative intervention in the vast majority of these patients. In all of these patients maximal medical management had failed, including oral pancreatic enzymes, pancreatic stents, or chemical splanchnicectomy (celiac plexus blocks). Thus, these patients represented a particularly difficult, select group of patients with small-duct disease with medical failure. Most of the patients with pain preoperatively were desperate and could not lead a satisfactory life.

A plea has been made to standardize reporting of outcomes for patients undergoing operation for chronic pancreatitis. While the use of both a visual analog scale for pain scoring and accepted quality-of-life instruments would have been ideal, their use was not practical in this retrospective analysis. Nonetheless, we believe that the results reported herein should not be discounted. Because of the inherent characteristics of our referral population, we were able to secure follow-up information in 86% of our patients who were followed up for a mean of 6.6 years. Of the patients who had pain before operation, 67% had neither pain nor analgesic requirement at last follow-up. Moreover, 81% of patients were able to return to work or, if retired or not working, to normal activity.

The mean duration of symptoms before operation was 3.3 years. Patients with longer duration of symptoms were more likely to have unsatisfactory relief of pain. It is well accepted that operation, ideally, should be offered before onset of narcotic dependence. This observation may allow speculation that narcotic dependence before operation was a predictor of poor postoperative pain relief. Because information regarding preoperative narcotic use in our retrospective study was not consistently addressed in the medical record, further analysis regarding the effect of narcotic use on outcome was not possible. The presence of pancreatic calcification also correlated with persistent pain after operation, perhaps on the basis of disease in the pancreatic remnant.

Pancreatectomy is, however, not without risk. Three of 105 patients died postoperatively of complications directly related to the operation: 2 of a leak of the pancreaticojejunostomy and another of systemic complications related to massive hemorrhage intraoperatively. Also, postoperative morbidity was not insignificant, and, although rates of mortality and morbidity agree overall with our experience with PD for malignant neoplasms, important differences warrant comment.

In general, pancreatic resection for malignant neoplasms is straightforward, and reconstruction of the biliary tree is facilitated by both bile duct thickening and dilatation inherent with obstruction. However, a soft, nonobstructive pancreas may render the pancreaticojejunostomy tenuous at best. Conversely, the fibrosis and inflammation attendant to chronic pancreatitis may involve vascular structures proximate to the pancreas, obliterating tissue planes and significantly increasing the risk of massive hemorrhage during resection, but generally allowing excellent purchase for suture in construction of a secure pancreatic anastomosis. Indeed, several patients underwent exploration during this same interval with the intent to resect, but their pancreas was deemed unresectable because of the intense inflammation, making an attempt at resection too hazardous.

In the present series, the security of the pancreaticojejunostomy in chronic pancreatitis is underscored by an observed leak rate of 5%, which is substantially lower than the 17% rate reported from our institution in 279 patients, the majority of whom underwent Whipple resection for malignant neoplasm.

The leak rate of 6% from the biliary enteroanastomosis reported herein is high and reflects the fact that, in many instances, the anastomosis was made more challenging by the absence of bile duct dilatation in 50% of the patients. When the bile duct is small and thinly walled, fine suture and meticulous technique are essential. In instances in which a satisfactory anastomosis to the bile duct is not feasible, a choledochoenteric anastomosis should be considered.

Pancreatoduodenectomy for chronic pancreatitis also has an obligate potential long-term morbidity. In patients with a normal pancreas, PD has no important clinical ef-

### Results of Pancreatoduodenectomy for Chronic Pancreatitis

<table>
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<th>Source, y</th>
<th>No. of Patients</th>
<th>Operative Mortality, %</th>
<th>Operative Morbidity, %</th>
<th>Endocrine Insufficiency, % Preoperative</th>
<th>Endocrine Insufficiency, % Postoperative</th>
<th>Exocrine Insufficiency, % Preoperative</th>
<th>Exocrine Insufficiency, % Postoperative</th>
<th>Pain Relief, %</th>
<th>Follow-up, y</th>
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*NA indicates not available.
†Collected series.
fect on endocrine or exocrine reserve. However, in the context of chronic pancreatitis, pancreatic endocrine and exocrine insufficiency often develops in the absence of any surgical resection as the natural course of the disease. Because proximal pancreatectomy removes about 40% to 60% of the pancreatic parenchyma, the possibility of prematurely precipitating postoperative pancreatic insufficiency must be considered when such an approach is contemplated. Although exocrine insufficiency had developed in an additional 26% of patients at follow-up and endocrine insufficiency in an additional 30%, the mean time to onset of diabetes mellitus was 4.7 years postoperatively in patients who were not diabetic preoperatively. While this suggests that the chronic fibrosis and glandular destruction of chronic pancreatitis progressed in the pancreatic remnant, the proximal parenchymal resection possibly contributed to a more premature loss of pancreatic endocrine and exocrine reserve. Similar long-term sequelae of the combination of chronic pancreatitis and pancreatectomy have been well described previously, not only after proximal resection (Table),

Although our results are acceptable, no procedure for chronic pancreatitis is ideal. The operation failed in 11% of patients who had pain before the procedure, and its palliative characteristics are attested to by the long-term survival rate, which was significantly lower than that of age-matched controls.

Rather than an indictment of the long-term risks of PD, the decrease in survival more likely reflects the natural course of the disease in the pancreatic remnant with the development of diabetes over time and the ravages of chronic alcohol abuse. While we could document resumption of alcohol excess in only 14 (31%) of 45 patients with chronic pancreatitis of alcoholic origin, surfeitful use by the patient and codependent behavior on the part of the family members may have resulted in substantial underestimation. Moreover, alcohol-related cause of chronic pancreatitis approached significance as a predictor of survival. Although we were unable to demonstrate a relationship between survival and age at onset of disease, duration of symptoms, or the presence of diabetes, previous investigators have reported that diabetes, smoking, and resumption of alcohol abuse are predictors of decreased survival.

The results reported herein with anatomic PD need to be considered in the context of the newer, duodenum-preserving nonanatomic resections. Recent studies have reported encouraging results with nonanatomic subtotal resections of the pancreatic head with preservation not only of gastro-duodenal continuity but also of biliary-duodenal continuity. These 2 types of cephalad subtotal pancreatectomy are attractive because they appear to interfere less with postprandial digestive physiological function (gastric emptying) and the postprandial hormonal milieu (preservation of duodenal enteroendocrine cells) and results with regard to pain relief are comparable with those of PD; however, their respective roles in the treatment of patients with chronic pancreatitis are yet to be determined. While our experience with these procedures is limited, we consider the procedures described by Beger and Buchler and Frey and Smith as inherently different. While the former procedure entails subtotal resection of the inflammatory mass in the head of the gland, it is technically no less demanding than pancreateoduodenectomy, especially if bile duct obstruction is also present. Moreover, if malignant neoplasm is suspected, as was the case in 64% of patients in the present series, subtotal resection of the head of the gland may lead to misdiagnosis or violation of oncological principles of resection if malignant neoplasm is confirmed.

We do not consider the Frey procedure strictly comparable with either the Beger procedure or with PD. As a variant of the Partington-Rochelle longitudinal pancreateojunostomy, the Frey operation calls for removal, on average, of 5.7 g of pancreatic tissue to unroof the ducts of Wirsung and Santorini and those in the uncinate. This significant technical addition enhances drainage of the ductal system within the head and uncinate and, we believe, should be reserved for patients with “large-duct” disease in whom pancreateojunostomy is contemplated. Recently, indications for the Frey procedure have been liberalized to patients with small ducts (3.5 mm or greater), but the number of patients so treated is small and the duration of follow-up is short.

In summary, although we believe that our long-term results are good, we recognize the inherent limitations of this retrospective analysis in allowing firm conclusions to be drawn with regard to outcome. Until prospective studies with adequate long-term follow-up are available, PD can be considered as a reasonable alternative in fit patients requiring operative therapy for chronic pancreatitis with an inflammatory pancreatic head mass and small-duct disease unsuitable for ductal drainage. The procedure is especially useful when malignant neoplasm must be excluded. Whether the nonanatomic, duodenal-preserving subtotal pancreatectomies will replace anatomic resections or fit into the optimal management approach is yet to be fully defined.

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DISCUSSION

Jack R. Pickleman, MD, Maywood, Ill: That was a very well-
presented paper, and I sincerely commend the manuscript to the 
membership because I think it is going to be one of the papers 
that is referred to in any future discussion of chronic pancreati-
tis. In 1987, the Mayo Clinic group presented 30 similar patients 
with small-duct chronic pancreatitis to the Western Surgical meet-
ing in Dallas. One half of those patients underwent a total pan-
createctomy, and the overall results were somewhat unencour-
ging in this group. They now present an updated series with 
results comparable to others employing either a Whipple pro-
cedure or a duodenum-preserving resection of the pancreatic head. 
A mortality rate of 3% and a morbidity rate of 32% is really as good 
as it is going to get operating on patients with chronic pancre-
atitis in whom the surrounding inflammatory response renders 
this procedure technically much more difficult. I note that the 
authors were concerned about the presence of malignancy in 64% 
of their patients, although jaundice was present in only 26%.

I would like to ask, how many of these patients actually 
harborred cancer? I suspect very few indeed. It is likely that with 
contemporary studies including ERCP and endoscopic ultra-
sound, which were used in only 70 and 9 patients, respec-
tively, in this series, plus a very low expected incidence of can-
cer in these patients, this justification for surgery should be 
utilized less and less in the coming years.

My second question has to do with the performance of to-
tal pancreatectomy. In view of the increased long-term mor-
bidity associated with this procedure, do the authors feel there 
is any current justification for doing this in patients with chronic pancreatitis? One of the most important points brought out in 
this review is that these patients, even though they became free 
of pain postoperatively, had an accelerated rate of diabetes mellit-
s, exocrine insufficiency, and death. An additional 14 pa-
tients could not be followed up and apparently chose anonym-
ity or death rather than to return to Rochester, Minn. The 
unanswered question remains, what is the best operation for 
the patient with small-duct chronic pancreatitis? It is highly 
unlikely a randomized trial can be accomplished. I happen to 
agree with the authors that a standard Whipple procedure is 
best, at least in our hands. Others will continue to do the pro-
cedure they are comfortable with, quoting one of my Texas col-
leagues who once stated, “You dance with who brung you.”

Richard A. Prinz, MD, Chicago, Ill: There are a number of 
technological advances that have allowed us to image the 
pancreatic duct system in noninvasive ways, such as endo-
scopic ultrasound and MRCP. How is the Mayo group cur-
rently imaging the pancreatic duct to make their decision on 
whether to perform a drainage or resection procedure?

You have performed both the standard Whipple and py-
lorus-preserving pancreatoduodenectomy in your patients with 
chronic pancreatitis. Have you followed your patients to see if 
there is any difference in delayed gastric emptying or the long-
term metabolic status of your patients in terms of weight main-
tenance, diabetes, or steatorrhea between the 2 operations?

I have been seeing an increase in the number of patients with 
small-duct disease. I wonder if you could speculate if there 
are any reasons why we are seeing a greater number of pa-
tients with this type of pathology.

Lygia Stewart, MD, San Francisco, Calif: The incidence of 
idopathic pancreatitis seems high in a study of chronic pancre-
itis; typically more of these have alcoholic-related disease. I was 
wondering if the patients with idiopathic pancreatitis, whether 
their prescriptive diagnosis was in fact chronic pancreatitis, or 
in how many of those malignancy was actually suspected.

Second, I was interested in the progression of diabetes, and 
I was wondering if there was a difference in the patients who sub-
sequently went on to develop diabetes in patients who had alco-
holic vs idiopathic pancreatitis. Did the alcoholic pancreatitis 
more commonly progress to diabetes, or were there differences?

Frederic E. Eckhauser, MD, Ann Arbor, Mich: Despite 
Dr Child’s and Dr Frey’s early advocacy in our institution of 
near-total distal pancreatectomy for chronic pancreatitis, we 
too have been much more inclined recently toward resec-
tional therapy. I have 1 or 2 questions that perhaps the au-
thors can clarify. Dr Frey, who is a member of our organiza-
tion, showed a number of years ago that combining distal 
gastroectomy with a Whipple resection significantly increases 
the severity and risk of developing metabolically significant post-
operative steatorrhea. Furthermore, the Dutch have demon-
strated markedly improved long-term nutritional status and/or 
weight maintenance in patients who undergo pylorus pres-
ervation rather than distal gastroectomy. I wonder if the authors 
can tell us whether the choice of standard vs pylorus-preserving 
Whipple resection was either physician or patient specific. That is, what were the criteria used for standard vs pylorus-preserving Whipple resections? I am surprised that pylorus preservation was used in only one third of patients.

Charles F. Frey, MD, Gold River, Calif: Pancreatoduode-
necotomy is an excellent operation for chronic pancreatitis. It is 
not our primary operation for pancreatitis. We use it whenever 
there is a suspicion of cancer. During an interval from 1985 to 
1997, we did 70 local resections of the head of the pancreas com-
bined with longitudinal pancreaticojejunostomy and 15 pancre-
atoduodenectomies because of the suspicion of cancer. It is very 
difficult to compare the various operative procedures available 
in the management of chronic pancreatitis to determine which 
might provide the best pain relief. Patient selection, the patient 
population, and indications for a particular operation often vary 
from one institution to the next. The assessment of pain and qual-
ity of life as assessed postoperatively also varies from one insti-
tution to the next, and follow-up is seldom complete. As Dr Pick-
leman indicated, there is a need for randomized controlled studies
of these operations. Fortunately, Europeans have done randomized studies. Jacob Isbicki in Hamburg, Germany, reported on a randomized controlled study of the duodenum-preserving resection of Beger compared with pancreatoduodenectomy and found no significant differences in pain relief, but quality of life was better with the Beger procedure. Dr Isbicki’s group also carried out a randomized controlled study comparing the local resection of the head of the pancreas with the duodenum-preserving resection of Beger and showed there was no difference in the pain relief between the operations. The quality of life was better with the local resection to the head of the pancreas. The most significant difference that came out of those comparisons was that the local resection of the head of the pancreas is technically a much easier operation to perform in terms of operative time and blood loss. This is a consequence of the fact that in both the duodenum-preserving resection of Beger and pancreatoduodenectomy you have to divide the pancreas, and oftentimes, as you know, the pancreas is densely adherent to the portal and superior mesenteric vein due to chronic inflammation and portal hypertension.

Lawrence W. Way, MD, San Francisco: The authors are reporting on the use of pancreatoduodenectomy for small-duct pancreatitis. Therefore, I was puzzled by the case they used in their presentation to highlight and typify their series. The photographs show that the patient they presented actually had large-duct pancreatitis with calcifications in the lumen and a ductal stricture at the neck of the gland. In my opinion, that patient was an ideal candidate for a Puestow procedure. If there are other such cases in the series, how can you determine whether a good result was due to the resection of the head or to the inevitable improved drainage of the dilated obstructed duct consequent to the Whipple procedure? How many such cases with large-duct disease are included in this series?

Michael J. Hart, MD, Seattle, Wash: My questions are not surgical questions, but more sociologic issues. The authors were able to wean 66% of their patients entirely off pain medications and, as we all know, most of these people are truly addicted before they come to surgery. Did the authors have a particular strategy for weaning their patients off pain medications postoperatively? In the alcoholic population, did they have a requirement for abstinence prior to selection for surgery? Do they have any data on recidivism rates postoperatively and how that related to patient mortality in the long-term follow-up?

John L. Smith, MD, Wichita, Kan: I would like to carry Dr. Stewart’s diabetic question just a little bit further. What were the diagnostic criteria for the diabetics? How were they treated and did this affect the long-term quality of life and mortality?

Dilip Parekh, MD, Los Angeles, Calif: I have 4 questions for the authors. Firstly, was a standardized pain questionnaire used evaluating pain before and after surgery? The pain history is often unreliable, and in the absence of standardized preoperative data on pain, one needs to question how reliable the pain data are. Second, a number of these patients are often addicted to narcotics; in the group that continued to have pain, was the issue of possible narcotic-seeking behaviors addressed? Third, you report a group of 484 chronic pancreatitis patients and you describe 101 patients who underwent a Whipple operation. Was the increased long-term mortality uniform across the 484 patients, or was it inherent in your 101 patients who underwent a Whipple operation? Was the mortality related to the operative procedures that these patients underwent, or is this inherent in the disease? Finally, do you plan to switch to some of the more modern procedures? I would echo what Dr Frey said. We have now performed the pancreatic head resection with preservation of the duodenum in a number of patients and found that the postoperative course and the outcomes in terms of patient recovery are much better compared to a Whipple operation in our hands. The length of hospital stay after duodenum-preserving pancreatic head resection is about 6 days. In 1999, I would question the statement that the Whipple is the standard procedure for pain from chronic pancreatitis with small-duct disease. I think one needs to examine the Frey or the Beger procedure.

Sachinder Hans, MD, Warren, Mich: I would like to know about those 2 patients who had associated splenic vein thrombosis, the degree of portal hypertension and the degree of difficulty of those 2 procedures compared to the rest. Did you perform simultaneous splenectomy in those 2 patients?

Dr Farnell: Dr Pickleman asked how many had cancer. We did not analyze the material in that fashion because of the characteristics of our database. I cannot tell you how many had cancer, but I agree that likely there were few. I should comment that the question of cancer was a coindication for surgery in these patients. There were few patients in whom the question of malignancy was the primary indication for surgery. You asked about the role of a total pancreatectomy in similar patients. We rarely perform a total pancreatectomy. Total pancreatectomy may occasionally be chosen for a patient with familial pancreatitis who is already diabetic and already has steatorrhea or as a salvage procedure for a patient who has failed prior resection or drainage. We have found in our hands that the morbidity and mortality of a total pancreatectomy and also the management of these patients is more difficult.

Dr Prinz asked about magnetic resonance cholangiopancreatography and endoscopic ultrasound. These were rarely used in this series, but we are beginning to integrate both of those modalities into our practice. I do not have information regarding delayed gastric emptying for the standard vs the pylorus-preserving Whipple. With regard to a higher prevalence of small-duct pancreatitis, I do not think we are necessarily seeing more small-duct disease. Rather, I think we are employing proximal resection perhaps more frequently than we did in the past.

The number of patients in the idiopathic group I agree is high, Dr Stewart, and I submit that it is probably because there were patients in our series who were alcoholic on a surreptitious basis and the clinicians who cared for the patient chose to place or label them in the idiopathic group.

Dr Frey, we have followed your work with great interest and consider your contribution to the management of patients with chronic pancreatitis with unroofing of the head of the pancreas in patients with large-duct disease as a major advance. For patients with large-duct disease where a longitudinal drainage is to be used, our preference is to perform the Frey procedure. However, we have yet to embrace the Frey procedure for patients with small-duct disease.

There were a number of questions about whether or not we should abandon pancreatoduodenectomy in favor of the Beger procedure and the Frey procedure. Perhaps I could address all those questions at one time. In the randomized trials that have compared the Beger and Frey procedures to Whipple, the follow-up was very short and the rate of pain relief in the investigators’ hands with the Whipple operation was surprisingly low—much lower than we and other investigators have reported for the Whipple procedure. Further, the Beger procedure is technically no less challenging than the Whipple procedure. As noted, in the randomized trials, the follow-up was very short. I point out here that the follow-up in this group of patients was 6.6 years.

We did not use a visual analog scale to assess pain relief, as this was really not practical. One of the discussants asked about comparing the patient’s perception of pain preoperatively and postoperatively. Because this was a retrospective analysis, it was simply not possible. In prospective trials, use of a visual analog scale is ideal.

The 2 patients with splenic vein thrombosis were technically challenging, and they did have splenectomies. I have not specifically addressed all of the questions because I am out of time, but I really appreciate all of the discussants’ comments and questions.