



Long-Term Results of Side-To-Side Pancreaticojejunostomy

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Chronic alcoholism is the etiologic factor initiating most instances of chronic pancreatitis and its complications in the United States of America. The goal of operative intervention is to relieve incapacitating abdominal and back pain, while preserving as much endocrine and exocrine function as possible. Ultrasound and computed tomography scans are helpful for the identification of gross anatomical changes in the pancreas, but endoscopic retrograde cholangiopancreatography is critical for the precise delineation of pancreatic ductal anatomy. In patients who exhibit dilation of the pancreatic duct secondary to single or multiple sites of obstruction, pancreatic ductal drainage will provide complete or significant relief of pain in greater than 80% of patients. Side-to-side pancreaticojejunostomy has evolved as the operation which permits the widest drainage of the entire pancreatic ductal system. Although, initially, it was hoped that pancreatic exocrine and endocrine function would improve or stabilize after pancreatic ductal drainage, follow-up studies show that the destructive process in the pancreatic islets and acinar cells initiated by chronic alcoholism continues during the years after operation with an increasing incidence of diabetes and steatorrhea. Late mortality is primarily related to continued alcoholism and death secondary to alcohol- (and smoking-) associated diseases. Correction of coexistent complications secondary to chronic pancreatitis including pseudocyst and biliary and/or duodenal obstruction should be considered at the time of pancreatic ductal drainage.

The primary indication for surgical intervention in chronic pancreatitis is to relieve incapacitating abdominal pain. Although a variety of surgical procedures has been proposed to correct this problem, only pancreatic ductal decompression [1-6] and varying degrees of resection of pancreatic tissue [7-11] are widely accepted as beneficial. In part, the debate over the relative merits of these 2 approaches [1, 2] hinges on the origin and pathogenesis of the pain in chronic pancreatitis. The rationale for drainage is readily apparent if the pain is due to obstruction and distention of the pancreatic duct. If the site of disease is in the small ducts and parenchymal tissue with no associated distention of the major duct, resection of a portion or all of the pancreas may be necessary to control pain. Since clinical evidence exists to support both concepts, it must be concluded that the anatomical and pathological features of chronic pancreatitis which result in severe abdominal pain are not uniform but represent a wide spectrum. Surgeons treating

this disease must retain flexibility and select that operation which best suits the pathological anatomy encountered in each individual.

The goal of operative therapy for chronic pancreatitis is to relieve abdominal pain while preserving as much exocrine and endocrine function as possible. We favor drainage of the pancreatic duct with a side-to-side pancreaticojejunostomy when ductal obstruction and dilation are present. Pancreatic resection is reserved for those patients with no demonstrable dilation of the major pancreatic ducts and evidence of substantial existing impairment of exocrine and endocrine function, severe involvement of the gland limited to specific sites such as the body, tail, or head of the pancreas, or a failed drainage procedure. Although operative mortality rates are similar for both operations, early postoperative morbidity is higher following major resections of the pancreas, and the incidence of insulin-dependent diabetes is significantly increased. Management of diabetes is particularly precarious in this population group, many of whom continue to use excessive amounts of alcohol.

Any evaluation of the long-term results following operative management for chronic pancreatitis must take into account certain additional complications of this disease. Intractable abdominal pain that is often associated with stricture and dilation of the pancreatic duct remains the usual indication for operation in chronic pancreatitis; however, fixed fibrotic obstruction of the common bile duct and duodenum as well as pseudocyst arising in the chronic pancreatitis setting have been recognized with increasing frequency as additional complications that may require surgical correction. Based on these frequently observed coexistent complications, we now carefully evaluate the patient with severe abdominal pain and chronic pancreatitis for the presence of pseudocyst and biliary and/or duodenal stricture. When present, alternatives in operative management are considered to address these coexistent problems in addition to pancreatic duct drainage.

This review will focus on the evolution of pancreatic duct drainage operations and the long-term results that have been achieved by side-to-side pancreaticojejunostomy for pain relief as well as the metabolic consequences of this method of management of chronic pancreatitis. Reasons for late mortality will be discussed. In addition, a brief review of coexisting

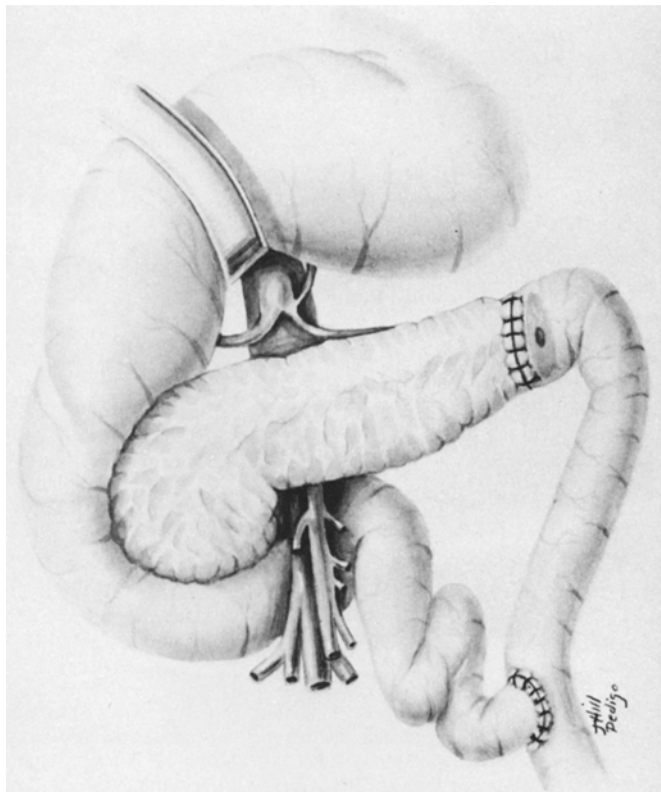


Fig. 1. The concept of pancreatic ductal decompression by retrograde drainage into a Roux-en-Y jejunal loop (caudal pancreaticojejunostomy) was introduced by Duval (1954). Frequently, pancreatic ductal decompression was ineffective because of multiple sites of ductal obstruction in the body and head of the pancreas. Reprinted with permission of publisher [31].

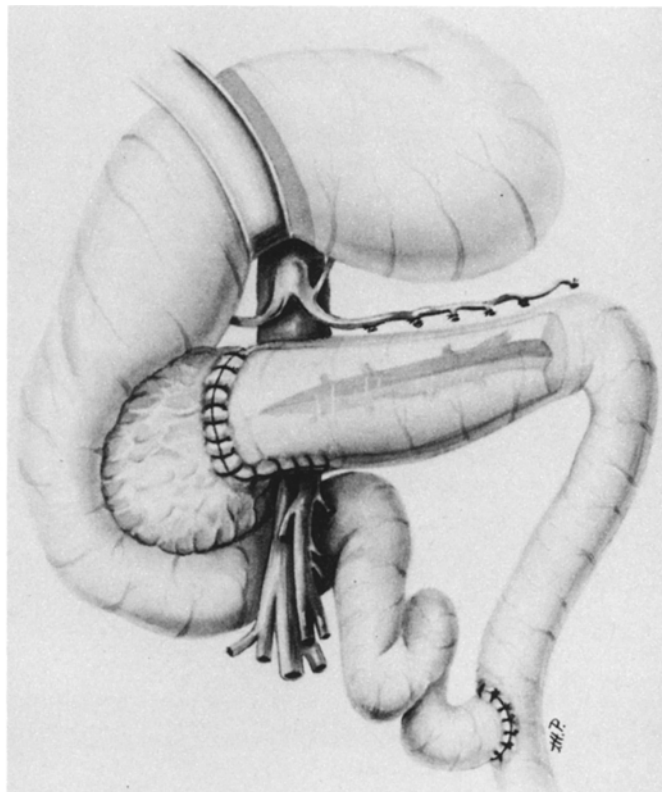


Fig. 2. Unroofing of the pancreatic duct after resection of the tail of the pancreas, as described by Puestow and Gillesby (1958), addressed the problem of multiple strictures within the pancreatic duct. This method of longitudinal pancreaticojejunostomy achieves better pancreatic ductal decompression. Reprinted with permission of publisher [31].

complications of chronic pancreatitis will be analyzed as they relate to the initial management of pancreatic ductal drainage and affect the long-term results following pancreaticojejunostomy.

The Evolution of Pancreatic Ductal Drainage Operations

Based on the presumption that a single stricture of the duct of Wirsung near the ampulla was responsible for the pathophysiological picture of chronic pancreatitis in many instances, Duval [12] introduced the concept of retrograde drainage of the pancreatic duct to a defunctionalized loop of jejunum (Fig. 1). Subsequently, Puestow and Gillesby [13] showed that multiple strictures and dilations (the “chain-of-lakes” phenomenon) frequently occurred throughout the ductal system in chronic pancreatitis. They recommended a longitudinal opening of the pancreatic duct from the site of transection of the tail of the pancreas to a point just to the right of the mesenteric vessels to achieve wider drainage of the pancreatic ductal system (Fig. 2). Splenectomy and resection of the tail of the pancreas are technical requirements for this operation as they are for the Duval procedure. Side-to-side pancreaticojejunostomy is a refinement of the Puestow procedure, first suggested by Partington and Rochelle [14], which permits wide drainage of the

pancreatic duct and requires neither splenectomy nor resection of the tail of the pancreas (Fig. 3). We favor this method of side-to-side pancreaticojejunostomy for symptomatic patients with dilated ducts. Since the greatest concentration of islets is in the tail of the pancreas [15], preservation of this tissue is desired in patients in whom diabetes is present or may develop during the course of their disease. The pancreas need not be implanted into the jejunal loop as originally described by Puestow, so the restriction imposed by the mesenteric vessels is eliminated. This permits the pancreatic duct to the right of the mesenteric vessels to be unroofed to a point close to the duodenum and ampulla with more effective drainage of the ductal system in the head of the pancreas and uncinata process.

Results after Pancreaticojejunostomy

The following conclusions are based on 100 consecutive patients who underwent pancreatic ductal drainage operations to relieve intractable abdominal pain and to interrupt a cycle of repeated hospital admissions for this problem [1]. The follow-up study period was 1–25 years (mean, 7.9 years). Our current experience parallels that seen for those patients in this series treated with side-to-side pancreaticojejunostomy.

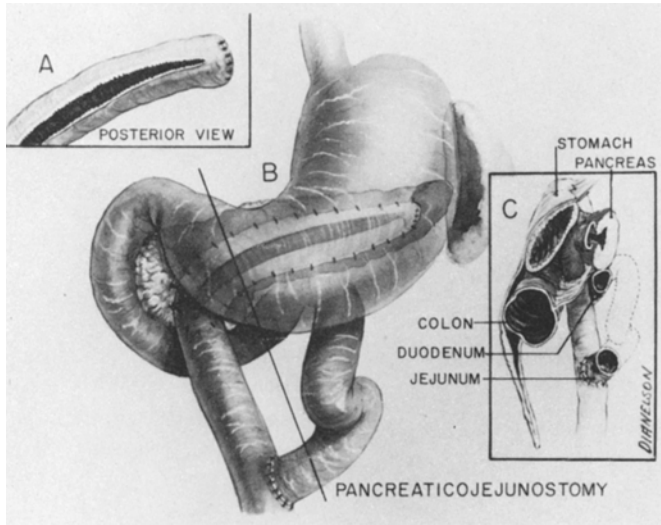


Fig. 3. A modification of the Puestow procedure suggested by Partington and Rochelle (1960) permits wide drainage of the pancreatic duct from the tail to the head of the pancreas without resection of the tail or splenectomy. This method of side-to-side pancreaticojejunostomy must now be considered the procedure of choice for pancreatic ductal drainage in chronic pancreatitis. Reprinted with permission of publisher [32].

Pain Relief

Table 1 presents the incidence of effective pain relief following 3 methods of pancreatic ductal drainage: caudal pancreaticojejunostomy (Duval), longitudinal pancreaticojejunostomy (Puestow and Gillesby), and side-to-side pancreaticojejunostomy (Partington and Rochelle). It is clear that the incidence of pain relief correlates closely with the extent of pancreatic ductal drainage. Greater than 80% of patients reported complete or substantial relief of pain with the extensive pancreatic ductal drainage achieved by side-to-side pancreaticojejunostomy. An added benefit to this method of pancreatic ductal decompression is that splenectomy and resection of the tail of the pancreas are not necessary.

In the reported experience for drainage operations, 15–30% of patients fail to obtain pain relief after operation. There may be some common factors responsible for the poor results seen in these patients related to narcotic addiction, continued alcoholism, or some currently unrecognized pathophysiological changes in the pancreas or inflammatory involvement of the sympathetic nerves responsible for sensory innervation of the pancreas. The simplistic explanation that pancreatic ductal dilation is the sole reason for pain secondary to chronic pancreatitis does not adequately explain the documented observation of ductal dilation without pain [16] and the equally documented observation of incapacitating abdominal pain with normal pancreatic ducts on endoscopic retrograde cholangiopancreatography (ERCP) [17].

If persistent or recurrent pain after pancreaticojejunostomy is due to continued or recurrent obstruction of a segment of the pancreatic duct, an attempt to redrain the pancreatic duct should be considered in contrast to an automatic decision to proceed with resection, continued nonoperative management,

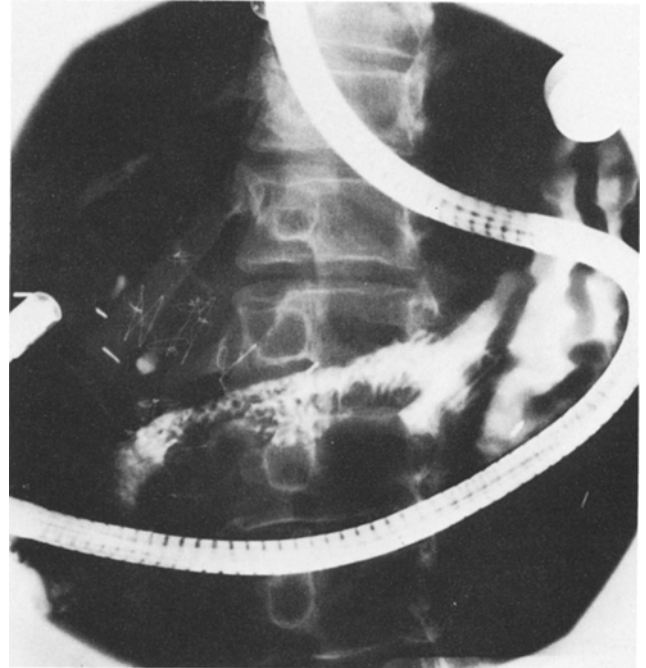


Fig. 4. Evaluation of the effectiveness of pancreatic ductal drainage following pancreaticojejunostomy is accomplished by injection of contrast material into the pancreatic duct during endoscopic retrograde cholangiopancreatography. Immediate filling along the entire course of the Roux-en-Y jejunal limb, as demonstrated here, confirms excellent pancreatic ductal decompression. Reprinted with permission of publisher [32].

or the use of other adjunctive measures such as nerve blocks. In contrast to a major resection in these patients, redrainage is a less difficult and risky means of dealing with continued pain and is less likely to impair exocrine and endocrine function [18]. Patients with persistent or recurrent pain after pancreaticojejunostomy require a complete reevaluation to rule out other causes of pain such as biliary tract or peptic ulcer disease or fibrotic constriction of the intrapancreatic portion of the bile duct and/or duodenum due to inflammatory changes secondary to chronic pancreatitis. Once other causes of pain have been eliminated, the completeness of pancreatic ductal drainage must be examined (Fig. 4). Undrained segments of the pancreatic duct were identified in the proximal portion of the head of the pancreas in 9 of 14 patients who underwent ERCP prior to a redrainage operation [18]. Not surprisingly, the previous drainage operations were primarily caudal or longitudinal pancreaticojejunostomies, although 6 of the 14 were side-to-side pancreaticojejunostomies with inadequate unroofing of the pancreatic duct in the head of the pancreas. Overall, 71% of these patients reported complete or substantial relief of pain after redrainage, a figure only slightly lower than that achieved with primary drainage. The poor results of pancreatic resection after failed drainage operations further emphasizes the need to consider redrainage in these patients. Our own experience [18] consists of 7 patients who underwent a variety of pancreatic resections ranging from distal to total pancreatectomy. None of these patients were free of pain and 3 died of complications of diabetes. Bearing in mind that undrained segments of pancre-

Table 1. Results of pancreaticojejunostomy.

Operation	Complete relief n (%)	Substantial relief n (%)	Minimal to no relief n (%)	Operative mortality n	Unsuspected carcinoma n	Lost to follow-up n
Side-to-side (Partington-Rochelle)	21/50 (42)	20/50 (40)	9/50 (18)	1/53	1/53	1/53
Longitudinal (Puestow-Gillesby)	10/36 (28)	18/36 (50)	8/36 (22)	2/43	1/43	4/43
Caudal Duval	1/5 (20)	1/5 (20)	3/5 (60)	1/8	1/8	1/8

atic duct usually remain in the head of the pancreas close to the duodenum after a failed pancreaticojejunostomy, any resection must deal with these undrained areas. This supports the choice of an operation that removes the head of the pancreas if any success is to be achieved and explains the ineffectiveness of distal pancreatectomy in achieving pain relief in many of these patients.

These findings have important implications for the performance of primary pancreatic ductal operations. Collections in the pancreatic duct within the head of the pancreas adjacent to the duodenum can be easily overlooked and left undrained. Suggestions that a pancreaticojejunal anastomosis of 8–10 cm in length will permit adequate drainage and long-term pain relief can be misleading if undrained collections remain. Complete drainage of the pancreatic ductal system is the “bottom line,” not the length of the anastomosis.

Metabolic Sequelae

The initial hope that pancreatic ductal drainage would improve or stabilize pancreatic exocrine or endocrine function has not been supported by follow-up studies [1, 19]. In 87 of our patients available for long-term follow-up study [1], diabetes was diagnosed in 34 prior to pancreatic ductal drainage, 10 of whom were insulin-dependent. Eight of the nondiabetic patients and 6 of the preoperative noninsulin-dependent diabetics have subsequently required insulin. Insulin-dependent diabetes eventually developed in 28% of all patients. Fortunately, diabetes in these patients who have had drainage procedures is usually readily managed with available medical measures. In contrast, major resections of the pancreas for chronic pancreatitis markedly add to the incidence and severity of diabetes which correlates with the amount of pancreatic tissue lost. The management of insulin-dependent diabetes may be very difficult in the alcoholic.

Similar findings were observed concerning exocrine function. Symptomatic steatorrhea was diagnosed in 29 of 87 patients. In 12 of these patients, exocrine insufficiency developed after pancreatic ductal drainage at varying periods during follow-up. Although the operative procedure does not appear to add to the problems of steatorrhea and diabetes, the destructive process in the pancreatic islets and acinar cells initiated by chronic alcoholism continues during the years after operation.

Late Mortality

Continued alcoholism is a major factor in late mortality due to alcohol-associated diseases. In addition, continued successful

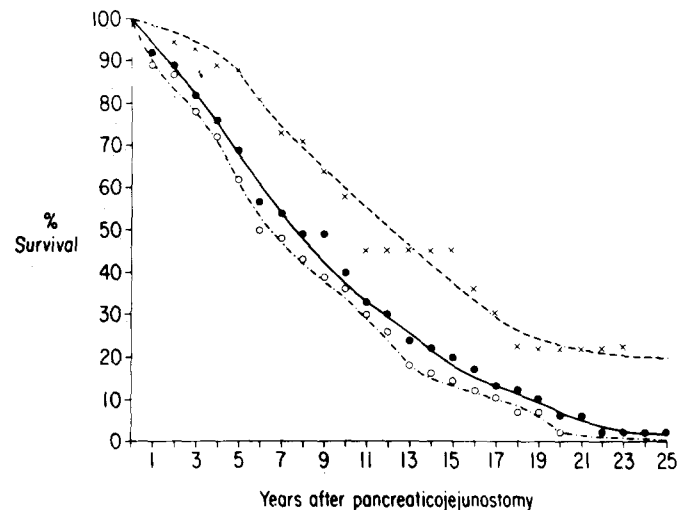


Fig. 5. Continued alcoholism is a crucial factor determining patient outcome. The survival rate of patients who abstain from alcohol is substantially better than the survival of those patients who continue to drink. ●—●: all patients, ○—○: patients who continued drinking, x—x: patients who quit drinking. Reprinted with permission of publisher [1].

pain relief is partially dependent on the patient’s ability to stop drinking. In our series [1], in 16 of 87 patients who received no pain relief from ductal drainage, 14 continued to drink. In contrast, 23 of 87 patients stopped all alcohol intake after operation. Twenty-one of these patients remained pain-free.

Even more striking is the relation of continued alcoholism and late mortality due to alcohol-associated diseases. Over the follow-up study period of 1–25 years, 46 of 87 patients subsequently died 7 months–20 years after operation (average survival period, 6.1 years) (Fig. 5). The major causes of death were those frequently attributed to alcoholism and smoking: cardiovascular disease (24%), cirrhosis or chronic alcoholism (17%), pneumonia or pulmonary disorders (15%), and carcinoma (15%), including oropharyngeal cancer in 4 patients and lung cancer in 2 patients. Late deaths specifically related to chronic pancreatitis and its operative treatment were infrequent occurrences. Four patients died secondary to complications of uncontrolled diabetes, but in 3 of these patients, brittle diabetes occurred only after major pancreatic resection for failed drainage operations.

In 3 of 100 patients in our series, death from metastatic pancreatic cancer occurred within 1 year of operation. Carcinoma had not been detected at the time of pancreatic ductal drainage in spite of pancreatic biopsy. Two other patients were

found to have carcinoma of the pancreas 6 and 10 years after pancreaticojejunostomy for chronic pancreatitis.

Other Complications Secondary to Chronic Pancreatitis

Although this review is not intended to specifically discuss the complications of pseudocyst, biliary stricture, and gastrointestinal complications secondary to chronic pancreatitis, the management of these problems may play a role in the long-term results following pancreatic ductal drainage or, if one of the above complications is the presenting complaint, consideration of pancreaticojejunostomy concomitant with treatment of the above complication may be appropriate. In this context, our experience and current recommendations will be reviewed briefly.

Biliary Stricture

The fibrosis and inflammation that characterize chronic pancreatitis may cause obstructive jaundice by compressing the intrapancreatic portion of the common bile duct [20, 21]. Jaundice secondary to acute pancreatitis is usually self-limiting, and its resolution parallels improvement in the acute inflammation. In contrast, a fixed high-grade stenosis of the terminal portion of the common bile duct secondary to longstanding pancreatitis is rarely relieved even with adequate decompression of the pancreatic duct. Recognition of this complication is important, since it can lead to cholangitis, biliary cirrhosis, diagnostic confusion with pancreatic carcinoma, and persistence of pain following pancreatic ductal drainage [22]. In our own experience, approximately 29% of patients with chronic pancreatitis were found to have associated obstruction of the biliary tree [23]. In patients with chronic pancreatitis, the suspicion of associated common duct obstruction is based on a substantial elevation in the level of alkaline phosphatase and a mild hyperbilirubinemia. The precise delineation of the anatomical abnormality in the common duct requires the use of invasive radiologic procedures. A long, smooth, gradual tapering of the distal common duct is characteristic of a benign stricture due to pancreatic fibrosis. ERCP is most helpful since it permits delineation both of the biliary tree as well as the pancreatic duct prior to operation. If further evaluation of the distal common bile duct is needed, percutaneous transhepatic cholangiography or operative cholangiography may be required.

The cause of pain in patients with chronic pancreatitis may be multifactorial. In our opinion, it is mainly related to the diseased pancreas with lesser contributions due to involvement of the biliary tract. In patients with biliary obstruction and chronic pancreatitis, biliary decompression alone may not be sufficient to relieve abdominal pain [24]. On the other hand, unrecognized biliary obstruction may be responsible for persistent or recurrent pain after pancreatic ductal drainage [22]. Based on these observations, the following management plan has evolved. In a patient with chronic pancreatitis and abdominal pain who has an elevated bilirubin and/or alkaline phosphatase, distal common bile duct stenosis is suspected. The precise anatomical abnormalities in the pancreas are identified by ERCP. If both pancreatic ductal drainage and surgical bypass of the biliary stricture are required, we prefer construction of the pancreaticojejunostomy to a Roux-en-Y jejunal limb to drain the pancre-

atic duct plus a choledochoduodenostomy for biliary bypass. If duodenal stenosis or stricture is also present, the same jejunal loop used to drain the pancreatic duct is used to drain the common bile duct proximal to the stricture.

Pseudocyst

A pseudocyst that occurs in the chronic pancreatitis setting probably begins as a retention cyst which gradually outgrows its epithelial lining as it enlarges [25]. In these patients, a pseudocyst will typically present as an established entity without an antecedent acute illness. Serial ultrasound examinations indicate these pseudocysts do not resolve spontaneously, and, furthermore, the cyst wall is usually mature at the time of presentation so that surgical drainage may be accomplished soon after diagnosis [26]. In a series of patients with pseudocysts who were treated at our medical center, we noted that 7 of 15 patients required reoperation with an indication of persistent abdominal pain related to pancreatic ductal obstruction and dilation [27]. Based on this observation, consideration is now given to simultaneously draining the pancreatic duct as well as the pseudocyst into a Roux-en-Y jejunal limb [28]. Although ERCP is not routinely used in the diagnostic evaluation of pseudocysts, in patients with documented chronic pancreatitis and pseudocyst formation, this test is used to identify dilation of the pancreatic duct and the feasibility of drainage unless the ductal dilation is significant enough to be detected on computed tomography scan. We have now performed pancreaticojejunostomy combined with pseudocyst drainage in 26 patients with similar morbidity, mortality, and pain relief when compared with pancreaticojejunostomy alone [28].

Gastrointestinal Complications

Due to their close anatomical relationship to the pancreas, it is not surprising that the stomach and duodenum may be affected by diseases involving the pancreas. Although considerable attention has been devoted to involvement of the upper gastrointestinal tract by carcinoma and the need for palliative bypass, relatively little emphasis has been given to gastric and duodenal involvement from inflammatory pancreatic disease. In our Medical Center [29], only 16 patients were identified with fixed gastric outlet and duodenal obstruction among 1,911 patients who were discharged with a diagnosis of pancreatitis, an incidence of less than 1%. On the other hand, when only patients with severe chronic pancreatitis were evaluated, approximately 10% had duodenal stenosis or stricture severe enough to require surgical relief. Thus, in the setting of chronic pancreatitis, upper gastrointestinal obstruction should be suspected in a patient with persistent nausea and vomiting. The diagnosis is easily confirmed by barium radiographs of the stomach and duodenum and by endoscopy. Gastroenterostomy will effectively relieve duodenal obstruction. If abdominal pain is present in addition to duodenal obstruction, appropriate diagnostic measures are initiated to determine concomitant biliary and/or pancreatic ductal obstruction. A variety of surgical bypasses combined with pancreatic ductal drainage may be used to handle the involvement of these multiple organs secondary to chronic pancreatitis [23, 30].

Résumé

L'alcoolisme chronique est le facteur étiologique principal de la pancréatite chronique et de ses complications, aux États Unis du moins. Le but de l'intervention chirurgicale est de soulager la douleur abdominale et dorsale invalidante tout en conservant au mieux la fonction pancréatique endocrine et exocrine. L'échographie et la tomодensitométrie aident à identifier les modifications anatomiques du pancréas, mais la pancréatographie endoscopique par voie rétrograde est essentielle pour définir l'anatomie du canal de Wirsung avec précision. En cas de dilatation du canal de Wirsung secondaire à une obstacle simple ou multiple, le drainage pancréatique procure un soulagement complet ou partiel de la douleur chez 80% des patients. L'anastomose pancréaticojejunaie latéro-latérale apporte de loin les meilleures possibilités de drainage du canal de Wirsung en entier. On espérait d'abord que la dérivation améliorerait ou stabiliserait la fonction endocrine et exocrine mais les études de contrôle montrent que la destruction des cellules pancréatiques insulaires et acinaires provoquée par l'alcoolisme chronique continue pendant des années et finit par provoquer diabète et stéatorrée. La mortalité tardive est surtout en rapport avec la continuation d'absorption d'alcool ou est provoquée par des maladies en liaison avec l'alcoolisme et le tabagisme. Il faut toujours envisager la cure de complications coexistentes, pseudokyste ou sténose biliaire et/ou duodénale, lors de l'anastomose pancréaticojejunaie.

Resumen

El alcoholismo crónico es el factor etiológico iniciador de la mayoría de los casos de pancreatitis crónica y sus complicaciones en los Estados Unidos de América. El propósito de la intervención operatoria es controlar el incapacitante dolor abdominal y de la espalda pero conservando tanta función endocrina y exocrina como sea posible. La ultrasonografía y la tomografía computadorizada son de utilidad para identificar cambios anatómicos mayores en el páncreas, pero es la colangiopancreatografía endoscópica retrógrada el estudio crítico para delinear en forma precisa la anatomía ductal. En pacientes que exhiban dilatación del canal pancreático secundario a obstrucciones únicas o múltiples, el drenaje del canal resulta en control total o muy significativo en más de 80% de los casos. La pancreaticoyejunostomía látero-lateral ha venido a convertirse en la operación que permite el más amplio drenaje de todo el sistema ductal pancreático. Aunque inicialmente se tuvo la esperanza de que la función exocrina y endocrina podría mejorarse o estabilizarse con el drenaje del canal pancreático, los estudios de seguimiento indican que el proceso destructivo de los islotes pancreáticos y de las células acinares iniciado por el alcoholismo crónico continúa a lo largo de años después de la operación y se manifiesta por una aumentada incidencia de diabetes y esteatorrea. La mortalidad a largo plazo aparece primordialmente relacionada con alcoholismo continuado y con causas relacionadas con el alcohol y el cigarrillo. La corrección de complicaciones coexistentes de la pancreatitis crónica tales como pseudoquistes y obstrucción biliar y/o pancreática debe ser considerada con ocasión del drenaje del canal pancreático.

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