# Duodenum preserving pancreatic head resection in the treatment of chronic pancreatitis

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## Abstract

Chronic pancreatitis is an inflammatory disease which is characterized by a progressive conversion of pancreatic parenchyma into fibrous tissue. Most frequent causes are alcohol over-consumption, beside anatomic variants such as pancreas divisum, cholelithiasis or individual genetic predisposition. The process of fibrotic transformation with consecutive loss of pancreatic parenchyma leads to exocrine insufficiency and maldigestion, and in advanced stage of the disease to diabetes mellitus. In addition to exocrine and endocrine malfunction, mechanical complications such as formation of pancreatic pseudocysts, duodenal and common bile duct obstruction occur.

About 50% of the patients with chronic pancreatitis will need surgical intervention due to intractable chronic pain. Recent investigations suggest that the head of the pancreas triggers the chronic inflammatory process. Therefore, resection of this inflammatory mass must be regarded as the pivotal part of any surgical intervention. Radical techniques such as Whipple-procedure are undoubtedly successful regarding pain reduction. However, even in its pylorus preserving variant this technique is associated with a high postoperative morbidity due to large loss of pancreatic parenchyma and the loss of the duodenal passage.

30 years ago, H. G. Beger described for the first time the technique of duodenum preserving pancreatic head resection that better combines resection of the pancreatic head with low morbidity. Over the years different variations of the original Beger technique (Frey, Izbicky, Berne modification) have been developed, and the excellent results obtained with these techniques underline, that organ sparing procedures should be preferred in the surgical treatment of chronic pancreatitis.

Key words:    chronic pancreatitis, chronic pain syndrome, DPPHR, diabetes mellitus, maldigestion.

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## Introduction

Chronic pancreatitis is an inflammatory disease which is characterized by an irreversible conversion of pancreatic parenchyma to fibrous tissue. The incidence in the western world is up to 10/100 000 pa with rising morbidity of female [1]. Alcohol overconsumption accounts for most of the cases (75-90%), other reasons are idiopathic disease, anatomic variants such as pancreas divisum, cholecystolithiasis or genetic predisposition [2-4]. The fibrotic transformation of the pancreas with consecutive loss of intact parenchyma leads to exocrine insufficiency, maldigestion and weight loss, later on to endocrine insufficiency and diabetes mellitus. Beside endocrine and exocrine insufficiency, mechanical problems arise such as formation of pancreatic pseudocysts, duodenal obstruction and stenosis of the ductus hepatocholedochus [5] (*Fig. 1*).

## Chronic pain syndrome

Abdominal pain is the leading symptom of chronic pancreatitis. 50% of the patients will need surgical intervention due to untractable pain during their lifetime [6]. The ethiopathogenesis of the chronic pain syndrome in chronic pancreatitis is not fully clarified [7]. Ductal hypertension due to protein plugs and stenosis, or intestinal compartment with local ischemia are traditionally believed to play a crucial role in

the pathogenesis of this disease. According to this hypothesis, reduced secretion of pancreatic enzymes should lead to a reduction of pain in chronic pancreatitis patients. However, this could not be proven clinically. Neither administration of pancreatic enzymes [8] nor octreotid [9,10] could influence frequency and intensity of pain attacks. Furthermore it is well described that even a burn out of the gland with complete loss of exocrine secretion does not lead to a significant pain release in chronic pancreatitis patients [11]. The hypothesis that different mechanisms have to be involved in the pathogenesis of pain generation in chronic pancreatitis is additionally supported by the observation, that surgical drainage procedures, even in case of a dilated pancreatic duct lead to pain relief only in about 50% of the patients [12].

## Chronic pain syndrome and neuroimmune interaction

A recent pathophysiological concept interprets the generation of pain as an interplay between the nerve- and immune system [13-16]. Immunohistochemical analysis shows a high density of enlarged nerve fibres in chronic pancreatitis tissue [17]. Keith et al. could show that the pain level in patients with chronic pancreatitis correlated more with the degree of eosinophil infiltration of these enlarged nerves rather than with the degree of duct dilatation [18]. Electrone microscope analysis of these nerves reveals damaged perineurium and infiltration of leucocytes which may explain how pancreatic enzymes and mediators of inflammation enter neural structures and alter their structure and functioning [19]. Immunhistochemical analysis of chronic pancreatitis tissue revealed an altered pattern of intrinsic and extrinsic innervation with overexpression of different neurotransmitters such as "Substance P" und "Calcitonin Gene Related Peptide" (CGRP) in enlarged intrapancreatic nerves [20]. Since both cytokines are important pain transmitters, these findings provide evidence that alterations of pancreatic nerves themselves are involved in the pathogenesis of the disease and lead to the concept of neuroimmune interaction as a basic mechanism in the pathogenesis of CP and chronic pain syndrome.

This interesting hypothesis is confirmed by the fact, that the presence of growth-associated-protein-43 (GAP-43), an established marker of neuronal plasticity, correlates with individual pain scores in patients with CP [19].

## Surgical therapy of chronic pancreatitis

Chronic pancreatitis is first of all a domain of conservative treatment. However, indication for surgical therapy is given when mechanical complications such as stenosis of the common bile duct or pancreatic duct, gastrointestinal obstruction due to the pancreatic head tumor or pseudocysts occur, or if untractable chronic pain leads to a significant reduction of the patient's quality of life and ability. About 90% of the patients suffer from chronic abdominal pain, and in two third of the patients, untractable pain is the indication for surgical intervention.

In principle draining and resective surgical procedures have to be distinguished. The advantage of simple drainage procedures is, that no healthy tissue is sacrificed. However it is clear that drainage procedures do not remove inflamed tissue especially in the head of the pancreas that may be regarded as the pacemaker of the disease. For this reason simple drainage procedures are indicated only in well defined cases, and the absence of clear concept will result in unsatisfactory outcome of the individual patient [21,22].

## Drainage procedures

On the base of ERCP and NMR-cholangio-pancreaticography findings, two different types of chronic pancreatitis can be distinguished: First the so-called "large duct" – form which is characterized by a dilated pancreatic duct (>7 mm), and a "small duct" – form where the ductus wirsungianus is not dilated (4-7 mm) [23]. Distinguishing between these two forms has a certain impact on the operation technique. Drainage procedures are definitively not indicated in the small duct form of chronic pancreatitis where the entire gland is involved in the process of chronic inflammation and fibrosis. In contrast, in case of the large duct form, disturbed drainage of the pancreatic duct due to stenosis in the pancreatic head leads to its proximal dilatation [12]. In these cases, it may be discussed whether augmented intraductal pressure plays a role in the pathogenesis of chronic pain and whether drainage procedures like longitudinal pancreatico-jejunostomy may be indicated [24]. This technique is simple to perform, is associated with a low complication rate and allows for reliable drainage of the pancreatic tail and body with minimal loss of pancreatic parenchyma [21,22]. However, although performed in selected cases, this operation leads to satisfactory pain relief in only half of the patients [12,25,26]. This gives evidence that dilation of the pancreatic duct reflects ductal obstruction, but drainage of these ducts is only a part of a therapeutical concept. The point is, that a longitudinal incision of the gland will not allow for the drainage of the pancreatic head. Even if the pancreatic head seems to be normal in its aspect and diameter, irreversible neuroinflammatory alterations may be present that act as a pacemaker of the disease [12] and propose the chronic pain syndrome [18,27].

## Resecting procedures

Over the years, the Kausch-Whipple procedure represented the surgical standard in the treatment of patients with chronic pancreatitis and complicated disease, and it could be shown that this operation could be performed in specialized centers with a very low mortality and morbidity rate [28-30]. However, while the complete removing of the pancreatic head assures good results regarding pain relief, the loss of duodenum and pylorus is associated with a relatively high morbidity and reduction of quality of life [23,31].

Especially in the United States, the pylorus preserving variant of pancreatic head resection became popular and

*Table 1*. Results of duodenum-preserving pancreatic head resection

|  | Author and year of publication | n= | Morbidity | Mortality | Pain free/-release | Follow-up (years) |
|---|---|---|---|---|---|---|
| **BEGER** | **Beger et al.** (1984) | 57 | 19/57 | 1.8% | Fully rehabilitated 87% | 2 |
|  | **Bloechle et al.** [50] (1995) | 25 | - | 0 | QoL index from 28 to 85 | 1.5 |
|  | **Eddes et al.** [51] (1996) | 15 | 30% | 0 | 73% / 86% | 3.1 |
|  | **Büchler et al.** [52] (1997) | 298 | 28.5% | 1% | - / 88 % | 6 |
|  | **Izbicki et al.** [53] (1997) | 38 | 32% | 0 | - / 89% | 2.5 |
|  | **Beger et al.** [43] (1999) | 504 | - | 0.8% | 78.8% / - | 14 |
|  | **Witzigmann et al.** [54] (2002) | 35 | - | 0 | QoL index from 30 to 72 | 2 |
| **FREY** | **Keus et al.** [55] (2003) | 36 | - | 2.8% | - / 60% | 4.6 |
|  | **Frey et al.** [44] (1994) | 50 | 22% | 0% | 74% / 87% | 3.1 |
|  | **Izbicki et al.** [56] (1995) | 22 | 9% | 0 | - / 94% | 1.5 |
|  | **Izbicki et al.** [23] (1998) | 31 | - | 3.2% | - / 90% | 2 |
|  | **Kelemen et al.** [57] (2002) | 13 | 0 | 0 | - / 57% | 1.7 |
|  | **Farkas et al.** [58] (2003) | 30 | k.A. | 0% | 100% | 0.8 years |
| **BERN** | **Farkas et al.** [59] | 100 | - | 0% | 92% | 2.4 years |
|  | **Friess et al.** * | 42 | 0 | 14 | 81% / 93% | 0.9 years |

* unpublished data

represents more and more an alternative to the classical Kausch-Whipple procedure. Preservation of the pylorus and the first part of the duodenum allows for a controlled gastric emptying and reduces the incidence of dumping and gastric biliary reflux with consecutive gastritis. Regarding postoperative morbidity and quality of life parameters, the pylorus preserving pancreatico-duodenectomy is superior to the classical variant. 90% of the patients gain weight after the operation and 89-95% experience significant pain relief, although delayed gastric emptying can jeopardize the improvement of quality of life [32,33]. However, the principal disadvantage of pancreatico-duodenectomy in the treatment of patients with chronic pancreatitis remains. The loss of the duodenal passage has a negative impact on digestion and regulation of serum glucose level. In addition, about 45% of the patients will develop diabetes mellitus, due to the extended loss of pancreatic parenchyma [34,35]. This indicates that despite of relatively good results regarding pain reduction, this originally for the treatment of pancreatic malignomas designed intervention represents an over-treatment in this benign disease. Apart from single cases in which patients history or imaging cannot rule out malignancy, it is not justified, to sacrifice the duodenum and a part of the stomach and common bile duct to remove the inflammatory pancreatic head tumor.

Before CT and ERCP entered the scenery as diagnostic tools to identify an enlarged pancreatic head, left pancreatic resection was regarded as a standard procedure in the treatment of chronic pancreatitis with dilated pancreatic duct. Interestingly, the results obtained with this technique regarding pain release are not satisfactory. Only 55% of the patients experience an acceptable pain release after left pancreatic resection and the incidence of postoperative endocrine insufficiency is high due to the high density of islets in the tail of the gland [36]. Furthermore, satisfactory pain release after left pancreatic resection cannot be expected in even those cases, where CT and ERCP localize the inflammatory alterations in the tail of the gland. This important observation supports the hypothesis, that alterations in the pancreatic head are crucial for the progression of the disease and the development of the chronic pain syndrome. In conclusion, left pancreatic resection should be used only in single and well defined patients. We see the best indication for this technique in the treatment of isolated cysts of the pancreatic tail where chronic pain is not the indication for surgery [37,38].
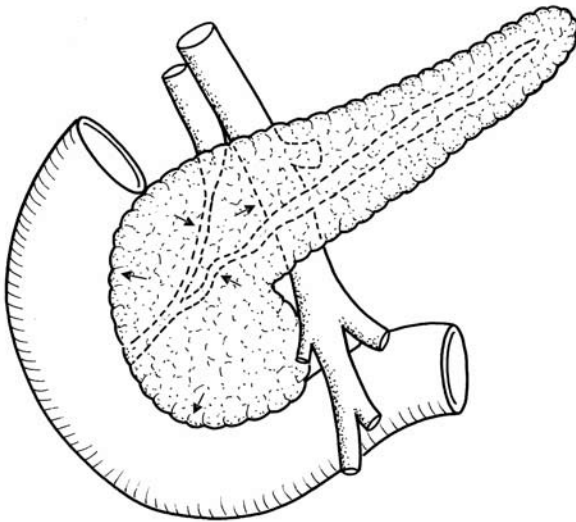
## The technique of "duodenum preserving pancreatic head resection"

Long before sophisticated imaging techniques were available, Hans Beger identified the pancreatic head as the pacemaker of chronic pancreatitis. In 1972, he was the first to describe a novel surgical technique which allowed the isolated resection of the pancreatic head without further organ loss [39-42]. If performed in specialized centers, the duodenum preserving pancreatic head resection can be performed with a very low morbidity and mortality [43,44]. The advantage of preservation of the duodenal passage is a nearly physiological regulation of enteral function and blood glucose level. In addition, preservation of islet rich parts of the pancreatic parenchyma in the tail of the pancreas results in a low incidence of postoperative diabetes mellitus compared to other resective procedures [37,39,40]. The effectiveness of this surgical technique on long-term pain release is high (>80% after a median follow-up of 5 years). Endocrine function is mostly impaired and a high rate of professional rehabilitation can be achieved (~70%) [7,39,40,43,45,46]. In all relevant aspects, duodenum preserving pancreatic head resection is comparable or even superior to more radical resective procedures (*Fig. 2* and *Fig. 3*).

In 1985 Frey and Smith introduced a modification of duodenum preserving pancreatic head resection which combines a longitudinal pancreatico-jejunostomy with a local resection of the pancreatic head [47,48]. This technique combines the principle of duodenum preserving pancreatic head resection

*Table 2*. Controlled randomized trials comparing different surgical approaches for the treatment of chronic pancreatitis

| Author and year of publication | Type of intervention | n = | Results |
|---|---|---|---|
| **Klempa et al.** [30] (1995) | Beger / ppWhipple | 21 22 | DEPKR / Whipple: shorter hospital stay (16d vs 21d, p<0.05), lower rate of exocrine insufficiency (4 vs 20, p<0.05), less analgetics (0 vs 6, p<0.05) |
| **Büchler et al.** [60] (1995) | Beger / ppWhipple | 20 20 | DEPKR / ppWhipple: pain free (75% vs 40%, p <0.05), better weight gain (4.1 vs 1.9, p<0.05), less frequent endocrine insufficiency (p<0.01) |
| **Müller et al.** [34] (1997) | Beger / ppWhipple | 10 10 | ppWhipple: delayed gastric emptiing (p<0.05), path. secretion pattern of enteral hormones (p<0.05) |
| **Izbicki et al.** [53] (1997) | Beger / Frey | 38 36 | DEPKR / Frey: comparable results regarding pain control (95% vs 94%), improvement of quality of life (both 67%), professional rehabilitation (74% vs 69%) and exocrine and endocrine function |
| **Izbicki et al.** [23] (1998) | Frey / ppWhipple | 31 30 | Frey: lower morbidity (19% vs 53%, p<0.05), improved quality of life (71% vs 43%, p<0.05), professional rehabilitation (68% vs 43%, p<0.05) |

*Figure 1*. **Complications of chronic pancreatitis: stenosis of common bile duct – a, Wirsungian duct – b, duodenum – c and retropancreatic vessels – d. (Modified from [60])**

*Figure 2*. **Duodenum preserving pancreatic head resection according to Beger before reconstruction: decompression of common bile duct, Wirsungian duct, duodenum and retropancreatic vessels and division of the pancreatic body over the portal vein. (Modified from [60])**
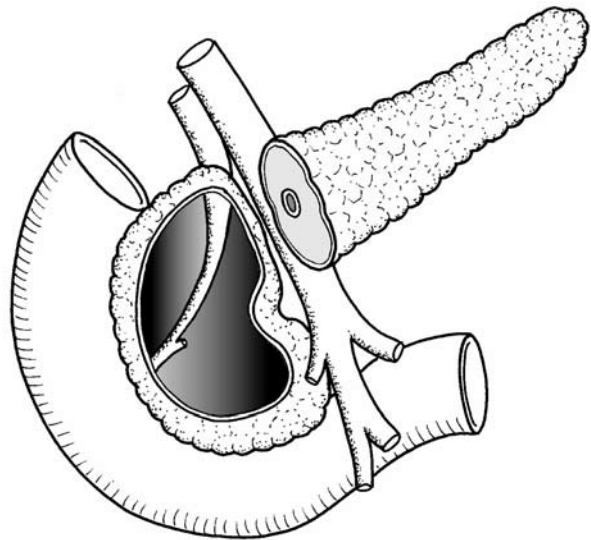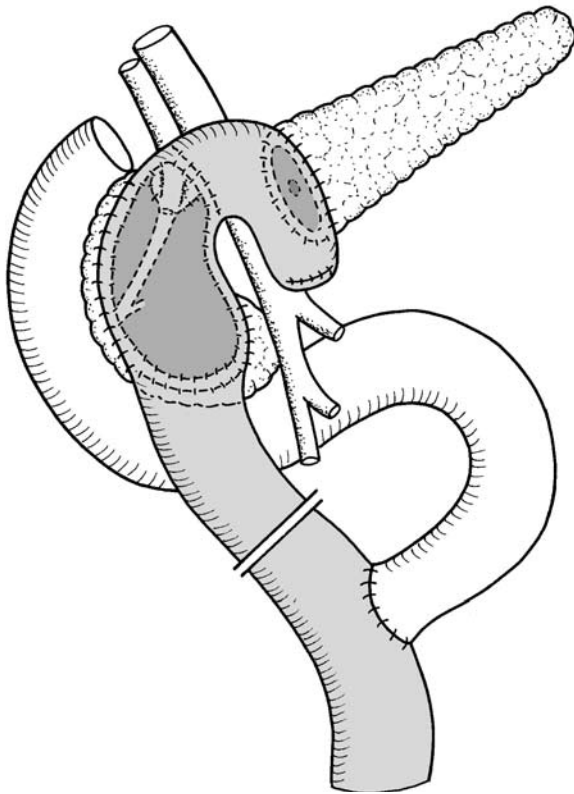




with drainage of the ductus wirsungianus (*Fig. 4*). Compared to the original Beger procedure, this variant is simpler to perform as it spares the dissection of the pancreas from the portal vein and the division of the pancreatic body [23]. In a prospective randomized trial [23], both techniques were comparable regarding pain control (94% Frey vs 95% Beger), prevention of complications (91% Frey vs 92% Beger) and quality of life.

A similar approach to the surgical therapy of the small duct form of chronic pancreatitis is described by Izbicki [49]. He combines a duodenum preserving resection of the pancreatic head with a V-shaped longitudinal incision of the pancreatic body to also reach ductal side branches of II° und III° order. Although only a relatively small number of patient have been treated with this technique, results seem to be comparable to the original Beger technique. 30 patients were operated with a zero-mortality. Within a 30 months follow-up, 92% of the patients were pain free with preserved exocrine and endocrine pancreatic function. The median "Quality of Life" – index rose about 65% and professional rehabilitation was successful in 69% of the patients (*Tab. 1* and *Tab. 2*).

In order to combine the advantages of the well proven original Beger technique with the technique according to Frey, we developed another modification of duodenum preserving pancreatic head resection that combines the advantages of the two techniques and spares the technical demanding division of the gland over the portal vein in order to minimize the risk of intraoperative bleeding (*Fig. 5*). At the moment we are running a randomized trial in which we compare this technique with the

**Figure 3**. Reconstruction after duodenum proserving pancreatic head resection according to Beger: end-to-side and side-to-side pancreatico-jejunostomy. (Modified from [60])
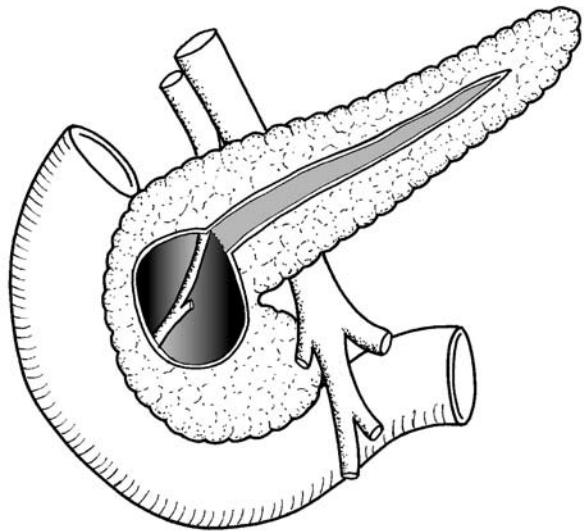
**Figure 4**. Duodenum-preserving pancreatic head resection according to Frey: combinating of duodenum preserving pancreatic head resection and longitudinal drainage of the Wirsungian duct without division of the pancreatic body over the portal vein. (Modified from [60])

original Beger procedure regarding safeness of the intervention and comparability of postoperative results.

### Technical aspects of the duodenum preserving pancreatic head resection according to Beger and the Berne modification

Opening of the abdomen is performed by transverse or median upper laparotomy. Wide exposure to the pancreas is obtained by dissecting the gastro-colic ligament and opening of the bursa omentalis which allows the inspection and palpation of the whole pancreas. The intervention continues with mobilization of the right colic flexure and the Kocher mobilization of the duodenum and pancreatic head. After having identified the superior mesenteric vein at the lower border of the pancreatic body, the surgeon has to decide to perform original Beger procedure or not. In case of the Beger procedure, 4 stay sutures beside the expected resection line are placed at the lower and upper border of the pancreatic body to allow either gently lifting the pancreatic body away from the portal vein and prevent from excessive bleeding when dissecting the gland. The ventral wall of the portal vein is now gently dissected from the pancreatic body and the surgeon should be

aware that especially in case of portal hypertension, this step represents the most delicate part of the intervention. Rupture of the fragile wall of the portal vein may lead to excessive bleeding and can hardly be controlled in this situation. After dissection of the pancreatic body with a scissor or scalpell, the neck of the gland is gently lifted away from the superior and portal vein tacking. Multiple stay sutures are placed all along the periphery of the pancreatic head which serve as reference points for the resection and will provide excellent hemostasis. Dissection of the pancreatic head starts right from the portal vein and is carried on onto the common bile duct. Care has to be taken to leave a 5-8 mm pancreatic tissue slice to the duodenum in order not to affect the blood supply of the duodenal wall (*Fig. 2*). We suggest holding the widely mobilized duodenum and pancreatic head in one hand to have optimal control on the extent of the resection and to avoid injury to the duodenal loop by preserving a cuff of intact pancreatic parenchyma. After the resection, it is essential to ensure meticulous hemostasis with PDS-5/0 single stitches both on the left pancreas and the remaining tissue of the pancreatic head. Reconstruction is performed with a Roux-en-Y loop with end-to-side pancreatico-jejunostomy and another side-to-side reconstruction between the remaining pancreatic head along the duodenum and the interposed jejunal loop. We always perform the pancreatico-jejunostomy in two layers with 5/0 PDS single stitches (*Fig. 3*).

The Berne modification spares the dissection of the pancreatic body from the portal vein. In this case, a single cavum results after the resection of the pancreatic head (*Fig. 5*), wich can be anastomosed side-to-side with a Roux-en-Y jejunal loop (*Fig. 6*).

If stenosis of the intrapancreatic part of the common bile duct cannot be resolved by decompression and resection of

Figure 5. **Berne modification of the original Beger technique, in this case with additional opening of the intrapancreatic common bile duct. Division of the pancreatic body over the portal vein is omitted. (Modified from [60])**
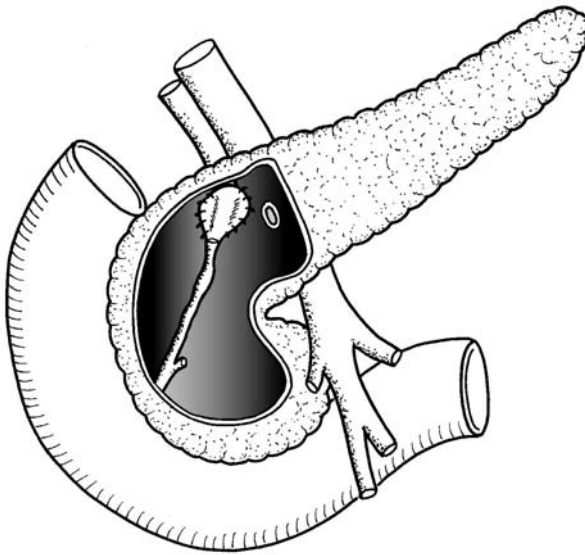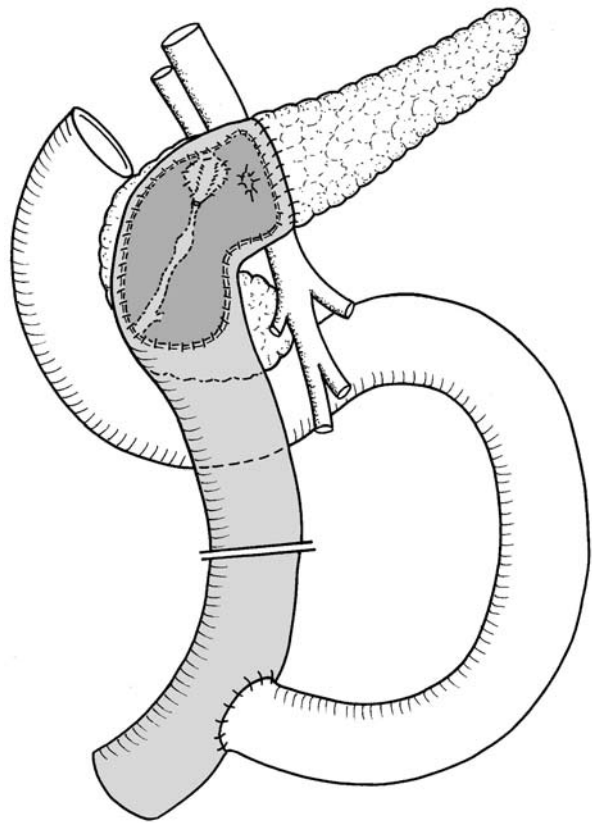
Figure 6. **Berne variation of duodeneum preserving pancreatectomy: reconstruction with Roux-en-Y jejunal loop and internal anastomosis of the opened intrapancreatic common bile duct. (Modified from [60])**

the surrounding pancreatic tissue, or if the intrapancreatic portion of the common bile duct is opened accidentally during pancreatic head resection, the wall of the opened bile duct is fixed with single stitches to the surrounding tissue like an opened door and is included in the same anastomosis (*Fig. 5, 6*). In this case the gall bladder has to be removed to prevent from ascending cholangitis.

## Conclusions

Simple drainage procedures are not sufficient to treat patients with chronic pancreatitis. Recent investigations clearly show that the head of the pancreas represents the pacemaker of this chronic inflammatory disease. Even in absence of a macroscopically enlarged pancreatic head, surgical procedures shall not be restricted to the body and tail of the gland. The aim of every surgical intervention to treat patients suffering from chronic pancreatitis and intractable pain should involve the resection of the inflammatory mass in the pancreatic head, if possible with minimal loss of intact pancreatic parenchyma and without collateral damage to neighbouring organs.

Excellent results regarding pain relief can be achieved with the classical Kausch-Whipple procedure and its pylorus preserving variant. However, these techniques have originally been developed for the treatment of malignancies and to our understanding represent over treatment in most of the cases. The rationale of these procedures is the complete resection of the inflammatory mass in the pancreatic head which can be better achieved by duodenum preserving techniques.

Several randomized trials show that compared with the Whipple procedure, the various techniques of duodenum preserving pancreatic head resection lead to excellent functional results and pain relief and are associated with a significantly reduced postoperative morbidity. Due to the largest experience, we favour the original technique according to Beger which we are actually comparing in a randomized trial with the Berne modification [61].

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