

# Surgical options for control of abdominal pain in chronic pancreatitis patients

This article was published in the following Dove Press journal:  
*Journal of Pain Research*

Xiaodong Tian  
Yongsu Ma  
Hongqiao Gao  
Yan Zhuang  
Yinmo Yang

Department of General Surgery, Peking University First Hospital, Beijing 100034, People's Republic of China

**Background:** Long lasting and unbearable abdominal pain is the most common symptom of chronic pancreatitis (CP). This study aimed to evaluate surgical options for the control of chronic pancreatic pain based on anatomical morphological changes.

**Methods:** A retrospective review of patients who underwent surgery for treatment of chronic pancreatic pain in Peking University First Hospital between January 2000 and December 2017 was performed. The surgical options included modified Puestow procedure, Frey procedure, Beger procedure, pancreaticoduodenectomy (PD) or pylorus preserving pancreaticoduodenectomy (PPPD), distal pancreatectomy and total pancreatectomy.

**Results:** Among 116 patients, pain relief rate after surgery was 82.6% (95/115) while 22 (23.2%) cases suffered recurrent chronic pancreatic pain during follow-up. Pain relief rate was 83.1% (54/65) after modified Puestow procedure, 63.6% (7/11) after distal pancreatectomy, 83.3% (10/12) after PD/PPPD, 86.7% (13/15) after Frey procedure, and 90% (9/10) after Beger procedure. Pain recurrence rate was 27.8% (15/54) after modified Puestow procedure, 42.9% (3/7) after distal pancreatectomy, 10% (1/10) after PD/PPPD, 15.4% (2/13) after Frey procedure, and 11.1% (1/9) after Beger procedure.

**Conclusion:** The surgical options for the control of chronic pancreatic pain according to the anatomical morphological changes of CP is reasonable and effective. The procedure of distal pancreatectomy alone should be cautiously used for pain relief.

**Keywords:** chronic pancreatitis, abdominal pain, surgical treatment, pathological anatomy

## Introduction

Chronic pancreatitis (CP) is a process of irreversible fibrosis in the pancreas caused by multiple etiologies. CP leads to both exocrine and endocrine insufficiency, which mainly manifests as abdominal pain, diarrhea, diabetes mellitus, and malnutrition.<sup>1</sup> The incidence of CP is low, and the degree of severity varies widely between patients. While acute pancreatitis and pancreatic cancer have been paid much attention as two common diseases of the pancreas, clinical diagnosis of CP also becomes urgent.

The clinical investigation of CP has not been emphasized in eastern countries, leading to a large gap in the knowledge of CP compared with Western countries. Chronic abdominal pain is the main presenting symptom for which patients with CP seek medical attention, and is also the main indication for surgical treatment.<sup>2</sup> However, the indications for the procedural selection, the surgical safety, and the short- and long-term control of abdominal pain associated with each surgical procedure are still controversial. Therefore, this study aimed to evaluate surgical options for the control of chronic pancreatic pain based on anatomical morphological

Correspondence: Yinmo Yang  
Department of General Surgery, Peking University First Hospital, 8th Xishiku Street, Beijing, People's Republic of China  
Tel +86 108 357 2772  
Fax +86 106 611 9730  
Email yangyinmosci@163.com

changes. We summarized the clinical data and follow-up information of patients with CP with refractory abdominal pain as the main manifestation who underwent surgical treatment from 2000 to 2017. The clinical effectiveness of different surgical procedures for the treatment of CP-related abdominal pain was explored in relation to the abnormal anatomical pathology in the pancreas.

## Materials and methods

### Patients

This study was approved by Ethics Committee of Peking University First Hospital and was conducted in accordance with the Declaration of Helsinki. All patients over the age of 18 years or a parent or legal guardian of patients under the age of 18 years provided the written informed consent. A total of 116 patients with CP (mean age  $51.5 \pm 18.2$  years, range 10–82 years; 83 males, 33 females; male: female ratio 2.5:1) with complete postoperative follow-up information who underwent surgery from 2000 to 2017 in Peking University First Hospital were enrolled. All cases of CP were diagnosed based on endoscopic ultrasonographic criteria. The etiology of CP was alcoholism in 56 patients (48.3%), biliary disease in 37 (31.9%), autoimmune disease in five (4.3%), and idiopathic in 18 (15.5%). All patients had chronic abdominal pain (100%); the other clinical symptoms included emaciation (67.2%, 78/116), diabetes mellitus (54.3%, 63/116), jaundice (32.8%, 38/116), diarrhea (19.8%, 23/116), and hematemesis/tarry stools (4.3%, 5/116).

### Imaging

The 116 patients with CP underwent at least two of the following examinations: abdominal B-ultrasonography, enhanced CT, endoscopic ultrasonography, magnetic resonance cholangiopancreatography, and endoscopic retrograde cholangiopancreatography. Among the 116 patients, 80 had pancreatic duct dilatation of  $>5$  mm with or without pancreatic duct stones (69.0%), 38 had cholecholectasia (32.8%), 37 had a mass in the pancreatic head (31.9%), 11 had a lesion in the pancreatic body and tail (6.5%) (five of these patients had concomitant splenomegaly and esophageal and gastric varices), and three had a diffuse lesion involving the entire pancreas (2.6%).

### Surgical procedure

Patients received surgery due to abdominal pain, and no endoscopic treatment was attempted prior to surgery. The

surgical procedure was selected in accordance with the clinical manifestations, physical condition, and imaging results. The surgical procedures included pancreaticojejunostomy (modified Puestow procedure) ( $n=65$ ), Frey procedure ( $n=15$ ), pancreatoduodenectomy (PD)/pylorus-preserving PD (PPPD) ( $n=12$ ), duodenum-preserving pancreatic head resection (Beger procedure) ( $n=10$ ), distal pancreatectomy ( $n=11$ ), and total PD ( $n=3$ ). The severity of abdominal pain was evaluated using the VAS. The pain alleviation rate was calculated as  $(\text{VAS score before treatment} - \text{VAS score after treatment}) / \text{VAS score before treatment} \times 100\%$ . Pain relief was defined as pain that was relieved by 50% or more.

### Statistical analysis

All data are presented as the mean  $\pm$  standard deviation (SD) and analyzed by SPSS version 19.0 software (SPSS, IL, USA).

### Results

For surgical procedures, modified Puestow procedure was performed in 65 patients with pancreatic duct dilatation  $>5$  mm with or without pancreatic duct stones, Frey procedure was performed in 15 patients with pancreatic duct dilatation  $>5$  mm with stones or inflammatory mass in the pancreatic head, PD/PPPD was performed in 12 patients with a mass in the pancreatic head, Beger procedure was performed in 10 patients with a mass in the pancreatic head, distal pancreatectomy was performed in 11 patients with lesions mainly in the pancreatic body and tail, and total PD was performed in 3 patients with a diffuse lesion involving the entire pancreas.

After surgery, all 116 patients received long-term follow-up, and the average follow-up duration was 78.8 months (range 5–156 months). One patient (0.86%) died in the perioperative period after total pancreatectomy due to postoperative intra-abdominal hemorrhage, abdominal infection, and multiple organ failure. The overall incidence of complication was 16.5% (19/115), including ten cases of abdominal infection, five cases of pancreatic fistula, one case of biliary fistula, and three cases of intra-abdominal hemorrhage. All complications were treated conservatively. In detail, abdominal infection was managed by abdominal drainage and anti-infection treatment; pancreatic fistula was managed by prolonging the use of somatostatin and fasting time, and keeping abdominal drainage tube; biliary fistula was managed by keeping abdominal drainage tube; abdominal hemorrhage was managed by interventional embolization.

The abdominal pain relief rate after surgery and before discharge was 82.6% (95/115). However, the total rate of recurrence of abdominal pain during follow-up was 23.2% (22/95). The postoperative complications and abdominal pain control status of the patients who underwent each surgical procedure were shown in Table 1. Pain relief rate was 83.1% (54/65) after modified Puestow procedure, 63.6% (7/11) after distal pancreatectomy, 83.3% (10/12) after PD/PPPD, 86.7% (13/15) after Frey procedure, and 90% (9/10) after Beger procedure. Pain recurrence rate was 27.8% (15/54) after modified Puestow procedure, 42.9% (3/7) after distal pancreatectomy, 10% (1/10) after PD/PPPD, 15.4% (2/13) after Frey procedure, and 11.1% (1/9) after Beger procedure.

## Discussion

The incidence of CP is increasing each year, and about 50% of the patients with CP require surgical treatment due to complications such as refractory abdominal pain. As the fibrosis of CP is irreversible, the basic principle of surgery is to alleviate the symptoms and improve the quality of life, while maintaining the exocrine and endocrine function of the pancreas to the greatest extent. However, as the pathogenesis of long-term refractory abdominal pain is still not clear, the treatment of the pain associated with CP in clinical practice is controversial. The three main reasons for abdominal pain in CP include: 1) an increase in pressure in the pancreatic duct caused by obstruction of the pancreatic duct, often accompanied by pancreatic duct dilatation. This type of pain can be relieved by pancreatic duct decompression. 2) Abdominal pain resulting from increased tension in the capsule of the pancreas, often accompanied by pancreatic duct dilatation. This pain can be relieved by decompression via cutting the capsule of the pancreas. 3) Pain caused by inflammation and damage involving the peripancreatic plexus. The pancreas is located within the peritoneum, with lots of celiac plexus nerves around the pancreatic head; this plexus is easily affected by inflammation, leading to refractory abdominal pain. In this situation, the effectiveness of pancreatic duct drainage or decompression alone is low, so this type of pain is relieved by resecting the affected pancreatic tissue and peripheral plexus.<sup>3,4</sup> Most patients with CP have refractory abdominal pain caused by multiple pain mechanisms simultaneously. Therefore, care should be taken when selecting the appropriate surgical procedure.

The surgical procedures currently used for the treatment of CP include drainage, resection, and combination. The

**Table 1** Postoperative complications and abdominal pain control status after various surgical procedures for chronic pancreatitis

Surgical procedure	Number of case	Pain relief rate % (n/N)	Pain reoccurrence rate % (n/N)	Complication incidence % (n/N)	Mortality rate % (n/N)
Modified Puestow	65	83.1% (54/65)	27.8% (15/54)	10.8% (7/65)	0
Frey	15	86.7% (13/15)	15.4% (2/13)	20.0% (3/15)	0
PD/PPPD	12	83.3% (10/12)	10.0% (1/10)	33.3% (4/12)	0
Beger	10	90.0% (9/10)	11.1% (1/9)	20.0% (2/10)	0
Distal pancreatectomy	11	63.6% (7/11)	42.9% (3/7)	27.3% (3/11)	0
Total pancreateoduodenectomy	3	100% (2/2)	0	0	33.3% (1/3)
Total	116	82.6% (95/115)	23.2% (22/95)	16.5% (19/115)	0.86% (1/116)

most commonly used surgical procedures are the drainage procedures based on the relief of obstruction and high pressure in the pancreatic duct, such as the modified Puestow procedure, which retains the spleen and pancreatic body and tail. This type of drainage procedure can split the total pancreatic duct (including the main and accessory pancreatic ducts) to completely remove the stones, followed by the pancreatico-jejunostomy.<sup>5</sup> The modified Puestow procedure is relatively simple with a high degree of safety, and is appropriate for patients with pancreatic atrophy not combined with an inflammatory mass in the pancreatic head, and for those with pancreatic duct dilatation. The modified Puestow procedure could achieve long-term effective relief of CP-related abdominal pain in 60–70% of patients.<sup>6</sup>

Resection procedures performed to treat CP include classic PD, PPPD, duodenum-preserving pancreatic head resection (Beger procedure), and total PD.<sup>3</sup> The performance of resection procedures has gradually increased with improvements in surgical technique and safety, especially in awareness that the pancreatic head is the initial site of chronic inflammatory lesions. Resection procedures are particularly appropriate for patients with an inflammatory mass in the pancreatic head, especially for those a malignant lesion is hard to differentiate. The advantage of the resection procedure is the complete removal of the pancreatic head with the lesion, resulting in confirmed short- and long-term efficacy. However, the disadvantages of resection are that it is a technically complicated operation with a wide resection range, which requires advanced technical ability, and has high incidences of postoperative complications and mortality during the perioperative period.<sup>6</sup> Distal pancreatectomy is also a type of resection procedure, and is applicable for patients with CP in whom the lesion is limited to the pancreatic body and tail; due to the simplicity of this surgical procedure, it is easily accepted by patients and physicians, but it does not provide satisfactory efficacy in controlling short- and long-term abdominal pain associated with CP.<sup>7</sup>

An example of a combination procedure is the Frey procedure, which possesses the advantages of pancreatic head resection and pancreatic duct drainage, maintains the integrity of the digestive tract, and removes the source of inflammation in the pancreatic head. The Frey procedure can stop or delay the process of pancreas fibrosis, and is mainly applied in patients with CP with an inflammatory mass in the pancreatic head and pancreatic duct dilatation. The Frey procedure results in control of abdominal pain in 62–91% of cases.<sup>8</sup>

In this study, surgical procedure used to treat CP was selected based on preoperative imaging findings and abnormalities in local pathological anatomy. Drainage procedures were selected for patients with CP with substantial pancreatic duct dilation but no local inflammatory lesion in the pancreatic head, while resection or combination procedures (including PD/PPPD, and the Beger or Frey procedures) were selected for patients with an inflammatory mass in the pancreatic head. Among all patients with CP in this study, the mortality rate in the perioperative period was 0.86% (1/116), the total incidence of complications was 16.5% (19/115), the postoperative abdominal pain relief rate was 82.6% (95/115), and the abdominal pain recurrence rate was 23.2% (22/95). The abdominal pain relief rate and incidence of complications after the various surgical procedures were similar to those reported in previous studies, proving that the selection of the surgical procedure was safe and appropriate.

The comparison of the degree of patient-reported satisfaction with the surgical procedure regarding CP-related abdominal pain control indicated that distal pancreatectomy alone was the most unsatisfactory. The postoperative abdominal pain relief rate and recurrence rate of distal pancreatectomy were 63.6% and 42.9%, respectively; the relatively low rate of pain relief and high recurrence rate may be due to the maintenance of initial part of the chronic inflammatory lesion (which means that the tension of the capsule of the pancreas is not completely remitted) and the retention of the nerve plexus around the pancreatic head. In addition to the persistent existence of chronic inflammation, these factors may lead to the recurrence of abdominal pain. The choice of distal pancreatectomy alone to control CP-related abdominal pain should be made cautiously, unless there is sufficient evidence to prove that a lesion in the pancreatic body and tail is the only cause of CP.

The modified Puestow procedure alone is the most widely used surgical procedure for treating CP. The modified Puestow procedure is safe and easy, with satisfactory short-term efficacy. However, our data indicated that the recurrence rate of abdominal pain after the modified Puestow procedure was 27.8% (15/54), which was higher than the recurrence rates after PD/PPPD, the Beger procedure, and the Frey procedure (10%, 11.1%, and 15.4%, respectively). The reason for the recurrence of pain after the modified Puestow procedure is the retention of the pancreatic head, which leads to a continuous inflammatory response and peripheral neuroinflammatory destruction;

furthermore, the complete removal of stenosis or stones is difficult. Thus, the modified Puestow procedure is only appropriate for patients without inflammatory mass or calcification in the pancreatic head, or for those with diffuse pancreatic atrophy and pancreatic duct dilatation. Partial or total pancreatic head resection is conducive to abdominal pain relief in patients with CP, which is helpful for removing calcification or stones in the pancreatic head or uncinate process, and for reducing tension in the capsule of the pancreas. Meanwhile, the neuropathy caused by peripheral inflammation of the pancreatic head could achieve satisfactory long-term results.

For patients with CP with an inflammatory lesion involving the whole pancreas and no pancreatic duct dilation, total pancreatectomy may be the only effective surgical treatment. Total pancreatectomy is also appropriate for patients with abdominal pain recurrence after failure of surgical treatment.<sup>9</sup> Total pancreatectomy can effectively relieve abdominal pain, but causes diabetes mellitus, and the patients have to rely on insulin all life long; the lack of blood glucose regulation means that fatal hypoglycemia can easily occur. Thus, this surgical procedure should be chosen cautiously. The procedure currently used for total pancreatectomy combined with islet autotransplantation not only reduces the use of insulin, but also decreases the occurrence of hypoglycemia.<sup>10</sup> The three patients in the present study who underwent total PD all had diffuse CP with no pancreatic duct dilatation. One of these three patients died due to intra-abdominal infection combined with hemorrhage and multiple organ failure in the perioperative period. The possible reason for this death may have been related to the presence of substantial inflammation adhesions around the pancreas and stenosis in the splenic vein, leading to opening of peripheral veins and an extensive bleeding in the surgical area. Furthermore, the postoperative blood glucose fluctuations may have increased the risk of intra-abdominal infection. In the other two patients, insulin pumps were used to achieve long-term blood glucose control, and the abdominal pain control was satisfactory.

In conclusion, the mechanism of abdominal pain in patients with CP is complicated, and the selection for surgical treatment should be based on the abnormal changes seen on imaging and anatomical morphological changes of the pancreas. Drainage procedures are feasible and effective at relieving abdominal pain in patients

without substantial inflammation in the pancreatic head, pancreatic atrophy, and pancreatic duct dilatation. Resection alone or in combination with drainage should be performed for patients with a local inflammatory lesion in the pancreatic head, due to the presence of pancreatic duct dilatation. Distal pancreatectomy should be cautiously chosen for those with the lesion limited to the pancreatic body and tail with no substantial pancreatic duct dilation.

## Acknowledgments

This study was supported in part by grants from the National Natural Science Foundation of China (81372605, 81572339, and 81672353) and Foundation of Capital Characteristic Clinic Project from the Beijing Science and Technology Commission, China (No. Z161100000516038).

## Disclosure

The authors report no conflicts of interest in this work.

## References

1. Juel J, Brock C, Olesen SS, et al. Acute physiological and electrical accentuation of vagal tone has no effect on pain or gastrointestinal motility in chronic pancreatitis. *J Pain Res.* 2017;10:1347–1355. doi:10.2147/JPR.S133438
2. Sheehy KA, Lippold C, Rice AL, Nobrega R, Finkel JC, Quezado ZM. Subanesthetic ketamine for pain management in hospitalized children, adolescents, and young adults: a single-center cohort study. *J Pain Res.* 2017;10:787–795. doi:10.2147/JPR.S131156
3. Kleeff J, Whitcomb DC, Shimosegawa T, et al. Chronic pancreatitis. *Nat Rev Dis Primers.* 2017;3:17060. doi:10.1038/nrdp.2017.60
4. Drewes AM, Saw B, Campbell CM, et al. Guidelines for the understanding and management of pain in chronic pancreatitis. *Pancreatol.* 2017;17:720–731. doi:10.1016/j.pan.2017.07.006
5. González M, Herrera MF, Laguna M, et al. Pain relief in chronic pancreatitis by pancreatico-jejunostomy. An institutional experience. *Arch Med Res.* 1997;28:387–390.
6. D'Haese JG, Ceyhan GO, Demir IE, Tieftrunk E, Friess H. Treatment options in painful chronic pancreatitis: a systematic review. *HPB (Oxford).* 2014;16:512–521. doi:10.1111/hpb.12173
7. Riediger H, Adam U, Fischer E, et al. Long-term outcome after resection for chronic pancreatitis in 224 patients. *J Gastrointest Surg.* 2007;8:949–960. doi:10.1007/s11605-007-0155-6
8. Strate T, Taherpour Z, Bloechle C, et al. Long-term follow-up of a randomized trial comparing the beger and frey procedures for patients suffering from chronic pancreatitis. *Ann Surg.* 2005;241:591. doi:10.1097/01.sla.0000165196.32207.dd
9. Gruessner RW, Sutherland DE, Dunn DL, et al. Transplant options for patients undergoing total pancreatectomy for chronic pancreatitis. *J Am Coll Surg.* 2004;198:559–567. doi:10.1016/j.jamcollsurg.2003.11.024
10. Morgan K, Owczarski SM, Borckardt J, et al. Pain control and quality of life after pancreatectomy with islet autotransplantation for chronic pancreatitis. *J Gastrointest Surg.* 2012;16:129–134. doi:10.1007/s11605-011-1744-y

Journal of Pain Research

Dovepress

## Publish your work in this journal

The Journal of Pain Research is an international, peer reviewed, open access, online journal that welcomes laboratory and clinical findings in the fields of pain research and the prevention and management of pain. Original research, reviews, symposium reports, hypothesis formation and commentaries are all considered for publication. The manuscript

management system is completely online and includes a very quick and fair peer-review system, which is all easy to use. Visit <http://www.dovepress.com/testimonials.php> to read real quotes from published authors.

Submit your manuscript here: <https://www.dovepress.com/journal-of-pain-research-journal>