



# Duodenum-preserving pancreatic head resection or pancreatoduodenectomy for the surgical treatment of paraduodenal pancreatitis: a retrospective cohort study

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## Abstract

**Purpose** Paraduodenal pancreatitis (PDP) is an uncommon yet well-described type of focal chronic pancreatitis. The aim of our study was to compare the outcomes of surgical treatment of patients with PDP using pancreatoduodenectomy and duodenum-preserving pancreatic head resection (DPPHR).

**Methods** A retrospective analysis of 153 consecutive patients with PDP was performed. Patients who were treated with either DPPHR or PD were enrolled. The primary endpoint of the study was pain control achieved at the time of follow-up. The secondary endpoints of the study were complication rate (Clavien-Dindo > 2), hospital length of stay, and 90-day mortality. All patients were followed up after discharge for the assessment of pain cessation for a minimal period of 10 months.

**Results** The final study population consisted of 71 patients. A total of 14 patients (19.7%) underwent pancreatoduodenectomy, and 57 (80.3%) were managed with DPPHR. Complication rate was significantly lower in DPPHR group at  $\chi^2 = 4.2677$ ,  $p < 0.05$ . Mean hospital length of stay was 9.3 days (range 3–29) in DPPHR group and 13.9 days (range 7–35) in PD group ( $p < 0.05$ ). No postoperative mortality was recorded. The mean follow-up period of the patients after surgery was  $41.8 \pm 20.6$  months (range 10–88). Pain scores at the time of operation were calculated as  $50.9 \pm 12.1$  in DPPHR group and  $56.1 \pm 11.4$  in PD group. At the time of follow-up, pain scores improved significantly in both groups and were  $10.3 \pm 8.8$  and  $10.9 \pm 8.6$ , respectively.

**Conclusion** DPPHR achieves similar results in pain control as PD with a lower complication rate and shorter hospital LOS.

**Keywords** Paraduodenal pancreatitis · Groove pancreatitis · Pancreatoduodenectomy · Duodenum-preserving pancreatic head resection · Pancreatitis pain

## Introduction

Paraduodenal pancreatitis (PDP) is a type of focal chronic pancreatitis [1, 2]. It is defined as a segmental inflammatory lesion in the pancreatoduodenal groove area with compression of blood vessels, tubular stenosis of the common bile duct, duodenal wall rigidity or cystic transformation, and

luminal narrowing [1, 3]. The disease was described in the literature under a great variety of names, such as groove pancreatitis, cystic dystrophy of the pancreas/duodenum, paraduodenal wall cyst [1, 3–8]. The term paraduodenal pancreatitis was suggested by Adsay and Zamboni in 2004 when it was shown that all that plethora of names, in fact, described one pathological process [1].

A wide range of conservative and surgical treatment options for PDP has been proposed through the last years, and this topic was frequently discussed in the literature [2, 9–12]. Even though the quality of evidence is low and the agreement is only conditional, most recent guidelines consider pancreaticoduodenectomy (PD) as optimal surgical technique for PDP treatment [13]. Most authors prefer to perform a PD when surgery is indicated in patients with PDP, but it was never compared to other

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surgical modalities in RCT [9, 10, 14]. Such aggressive surgical procedure may not always be justified for the treatment of benign disease. According to recent guidelines, duodenum-preserving pancreatic head resection (DPPHR) is superior to PD in the surgical treatment of head-predominant chronic pancreatitis [13]. That might also be the case with PDP, where the pacemakers for pain are the inflammatory masses in the head of the pancreas and increased pressure in the main pancreatic duct. Thus, the aim of our study was to compare the results of surgical treatment with PD and DPPHR in patients with PDP.

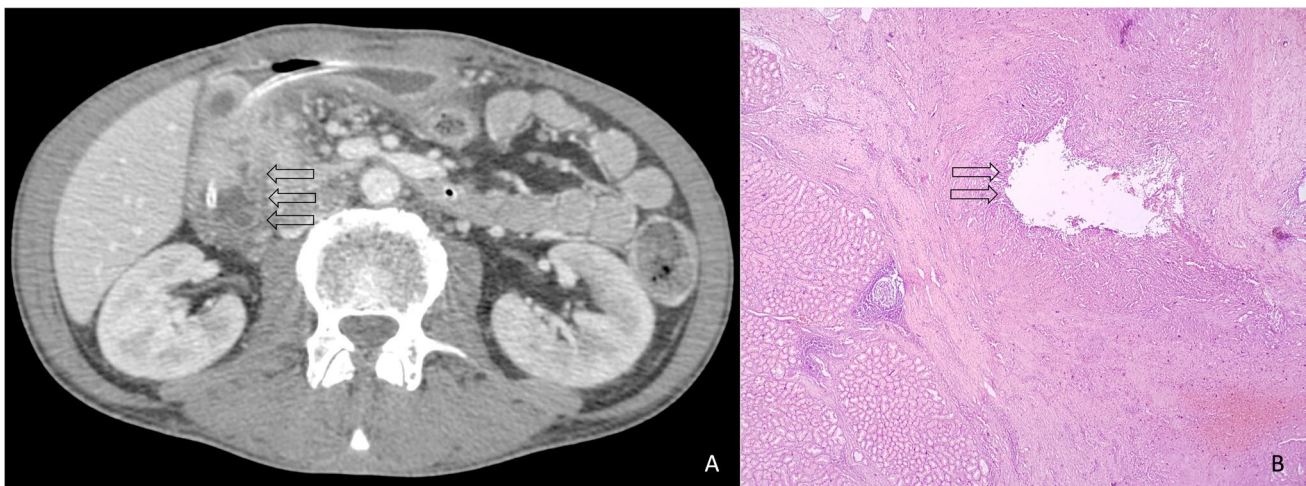
## Materials and methods

A retrospective analysis of a prospectively maintained database consisting of 153 consecutive patients with PDP treated in our clinic was performed. Patients treated with either DPPHR or PD were enrolled in the study. Shalimov National Institute of Surgery and Transplantology is a quaternary level hospital in the Ukrainian highly centralized healthcare system that allowed us to gather and analyze a large number of cases of such a rare disease as PDP in the study period from 2013 to 2020. Diagnosis of PDP was based on a pathohistological examination of the surgical specimen and/or characteristic radiological appearance consistent with PDP together with its clinical features and follow-up data (Fig. 1). Such parameters as demographics, presenting and perioperative signs and symptoms, history of previous tobacco/alcohol use, perioperative complications, and 90-day mortality were recorded. Alcohol abuse was defined as consumption > 80 g/day

calculated by the formula =  $0.79 \times \text{alcohol/volume} \times \text{mL consumed}/100$ . Current study was designed according to the STROBE recommendations [15]. The institutional ethical board approved the study protocol with waived informed consent.

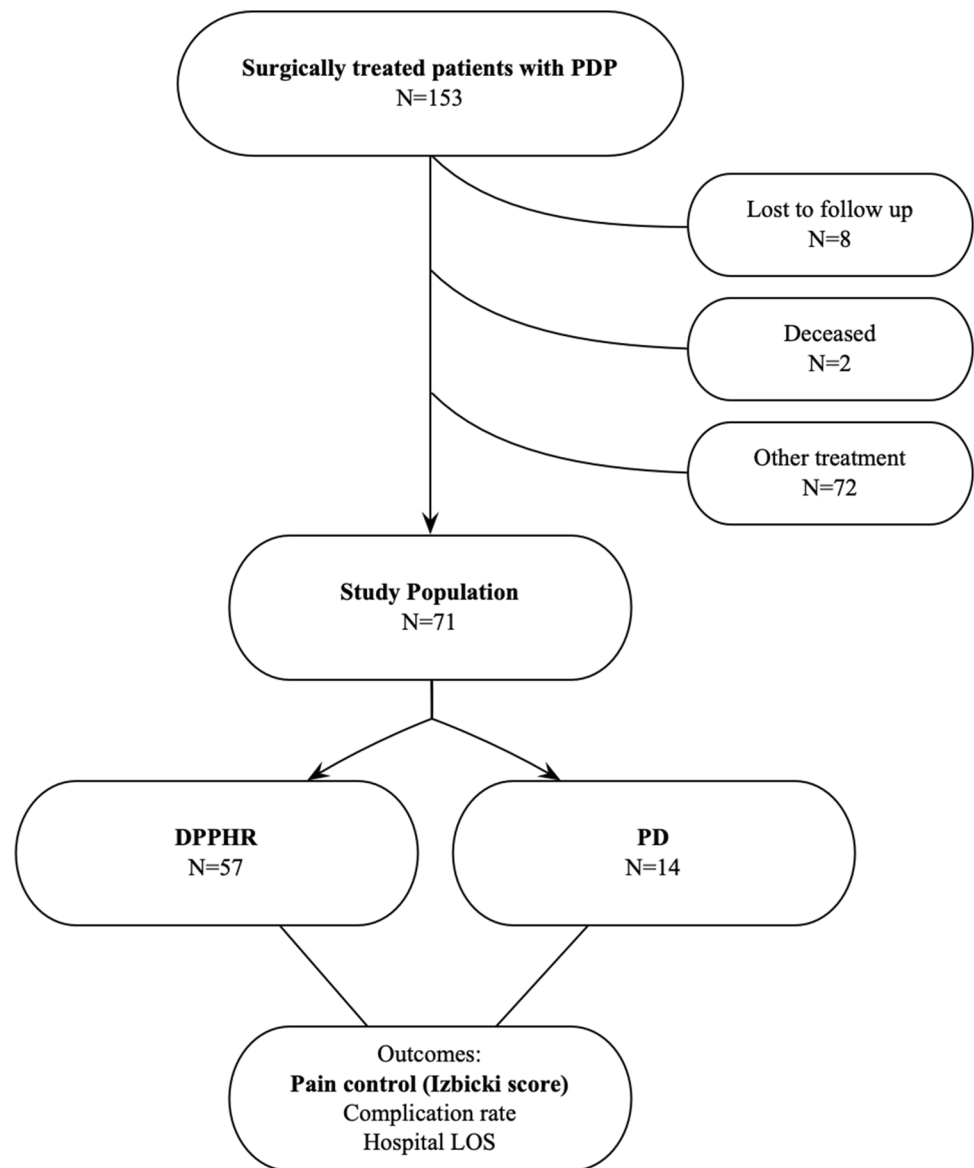
## Surgical procedures

Both pylorus-preserving and classic pancreatoduodenectomy were performed. Such modifications of DPPHR as Berne, Beger, and Frey procedures were used. Surgical approaches (PD vs DPPHR) were selected based on the surgeon's preference, extent of the inflammation, and anatomical variations; exceptions were cases where malignancy could not be reliably excluded pre-operatively, and PD was the only indicated option. Frey procedure was most commonly performed in our patient cohort, consisting of careful and thorough pancreatic head decortication to remove most of the inflammatory tissue with the main pancreatic duct wide open over the head of the pancreas [16]. In case of Frey procedure, drainage was achieved via pancreaticojejunostomy performed in standard fashion. When Beger procedure was used, the head and uncinate process of the pancreas were resected after division of the pancreas over the portal vein requiring complex dissection but sparing the duodenum and intrapancreatic bile duct [17]. Berne technique is a known modification of Beger procedure by Markus W. Büchler described in 2001, which consists of only partial resection of the pancreatic head without division of the gland and a short-range lateral pancreaticojejunostomy [18, 19]. When Berne's technique was performed, it entailed a more extensive resection of the pancreatic head rather



**Fig. 1** CT (A) and pathomorphological (B) appearance of PDP in a 37-year-old male with a history of alcohol abuse. **A** Arrows indicate soft tissue inflammation in the pancreaticoduodenal groove area. **B** Brunner's gland hyperplasia and pseudocyst in muscular layer of duodenum (arrow)

Fig. 2 Study flowchart



than just decortication, such as in Frey's procedure. More detailed descriptions of the surgical procedures could be found elsewhere [20]. All patients were preoperatively seen by a multidisciplinary team. Indications for surgery were intractable pain despite best medical, severe pain and presence of common bile duct compression with associated jaundice, suspected malignancy, duodenal compression with obstructive symptoms, and previous endoscopic treatment failure.

### Outcomes and measures

The outcomes of the patients managed with pancreatoduodenectomy were compared to those who underwent DPPHR. The primary endpoint of the study was pain control achieved at the time of follow-up. The pain was measured

by the validated Izbicki pain score designed specifically for patients with chronic pancreatitis [21]. The secondary endpoints of the study were complication rate (Clavien-Dindo > 2), hospital length of stay, and 90-day mortality [22]. Post-operative pancreatic fistula (POPF) and postpancreatectomy hemorrhage (PPH) were defined and classified according to International Study Group of Pancreatic Surgery (ISGPS) consensus definitions [23, 24].

### Follow up

All patients were followed up after discharge for the assessment of pain cessation. Pain control was assessed using the Izbicki pain score. Patients self-reported pain intensity, frequency, disease-related inability to work, and use of analgesic medications. The pain score was

**Table 1** Baseline characteristics of patients in DPPHR group vs PD group

	DPPHR (n = 57)	PD (n = 14)	p
Sex M	52 (91.2%)	13 (92.9%)	.84
Sex F	5 (8.8%)	1 (7.1%)	.84
Age (median, range)	47 (29–67)	40.5 (34–60)	.34
Duration of chronic pancreatitis-related pain (median, range)	33 (4–183)	22.5 (6–94)	.33
Alcohol abuse	48 (84.2%)	11 (78.6%)	.61
Smoking	39 (68.4%)	11 (78.6%)	.46
Pain	56 (98.2%)	13 (92.9%)	.27
Nausea	33 (57.9%)	8 (57.1%)	.96
Malaise	34 (59.6%)	5 (35.7%)	.11
Weight loss	21 (36.8%)	5 (35.7%)	.94
Jaundice	5 (8.8%)	3 (21.4%)	.18
Previous surgical treatment failure	5 (8.8%)	3 (21.4%)	.18
Suspected malignancy	0	3 (21.4%)	

calculated based on the answers, ranging from 0 (no pain) to 100 (severe, debilitating pain). Minimal follow-up period was 10 months.

## Statistics

Data analysis was carried out using GraphPad Prism (GraphPad Software, Inc., CA, USA). The distribution of the variables is reported as the mean with standard deviation. The normal distribution of the parameters was investigated using the Kolmogorov-Smirnov test. Student's *t* test for independent data was used for normally distributed variables, and Kolmogorov-Smirnov test and Mann-Whitney *U* test were used for non-normally distributed and not continuous variables. Pearson's chi-square test was employed to compare two proportions. Wilcoxon ranked test was used for comparison of related samples. We considered a *p*-value of 0.05 as the limit for statistical significance.

## Results

A total of 153 patients with PDP were treated in our clinic during the study period. After excluding patients who underwent endoscopic treatment or were managed conservatively, we identified 81 patients who required surgical treatment using either PD or DPPHR. We excluded eight patients as lost to follow-up and two deceased patients, whose cause of death was unrelated to surgery or PDP (Fig. 2). Of 72 patients with PDP that did not meet indications for surgery, 38 (52.8%) cases were managed conservatively, and 34 (47.2%) patients underwent endoscopic procedures for symptomatic management.

The final study population consisted of 71 patients. Of them, 66 patients were male (93%) and 5 female (7%). Mean age in the study population was  $46.1 \pm 9.5$ . A total of 59 (83%) of study participants abused alcohol, and 50 (70.4%) were active smokers. The most common symptoms at the time of operation were pain (97.2%), nausea (57.7%), malaise (54.9%), weight loss (36.6%), and jaundice (9.9%). Patients were treated for a median of 30 months before surgery since the time of the diagnosis/onset of pain. The most common indications for surgical treatment were intractable pain despite best medical therapy (85.9%), jaundice (9.9%), suspected malignancy (11.3%), and previous endoscopic treatment failure, which occurred in 8 patients (8.5%). We have not identified any significant differences in demographics and symptoms at the time of the operation between the two cohorts (see Table 1).

A total of 14 patients (19.7%) underwent pancreaticoduodenectomy, and 57 (80.3%) were managed with DPPHR (Table 2). In DPPHR group, 51 (89.4%) Frey's procedures, 5 (8.8%) Berne, and 1 (1.8%) Beger procedures were performed. The mean duration of the operative procedure was  $265.6 \pm 61.9$  min in DPPHR group and  $380 \pm 68.7$  min in PD group,  $p < 0.005$ . Blood loss was significantly lower in DPPHR group ( $p < 0.05$ ) with the mean of  $256.3 \pm 193$  ml compared to  $457.1 \pm 299.2$  ml in PD group. All cases of PDP after PD were confirmed in the pathology report, and

**Table 2** Preoperative and follow-up Izbicki pain score results

	DPPHR		PD	
	Preoperative	Follow-up	Preoperative	Follow-up
Pain VAS	76	15	75.5	9
Frequency of pain attacks	78.1	21.5	85.7	21.4
Pain medication	14.8	1.5	21.4	0.6
Inability to work	34.9	3.1	42.9	12.5
Pain score	50.9	10.3	56.1	10.9

Mean readings of scores are presented. All results are statistically significant ( $p < 0.05$ )

DPPHR duodenum preserving pancreatic head resection, PD pancreatoduodenectomy, VAS Visual Analogue Score

**Table 3** Primary and secondary outcomes

	DPPHR ( <i>n</i> = 57)	PD ( <i>n</i> = 14)	<i>p</i>
Follow-up time (median, range)	38 (10–88)	29.5 (10–87)	.32
Intraoperative blood loss, ml (median, range)	200 (50–1000)	400 (200–1100)	.02
Operative procedure length, min (median, range)	275 (170–375)	360 (305–485)	.01
Complication rate (Clavien-Dindo >2)	10.5%	42.9%	.01
<i>PPH</i>	3 (5.2%)	1 (7.1%)	.78
<i>POPF (Grade B)</i>	1 (1.8%)	2 (14.3%)	.04
<i>Intra-abdominal abscess</i>	1 (1.8%)	1 (7.1%)	.27
Re-operation	1 (1.8%)	0	
30-day hospital re-admission rate	7%	21.4%	
Hospital length of stay (mean, range)	9.3 (3–29)	13.9 (7–35)	.01

no malignant lesions were identified in the specimens. The complication rate was 10.5% in DPPHR group with PPH encountering most often (2 cases of moderate late hemorrhages from the anastomotic site, 3.5%). In PD group, complication rate was 42.9%, with POPF being most frequent (2 cases of grade B fistula, 14.3%). Complication rate was significantly lower in DPPHR group at  $\chi^2 = 4.2677$ ,  $p < 0.05$ . One patient (1.8%) from DPPHR group required a re-operation secondary to post-operative bleeding. Mean post-operative hospital length of stay was 9.3 days (range 3–29) in DPPHR group and 13.9 days (range 7–35) in PD group ( $p < 0.05$ ). Four patients (7%) from DPPHR and 3 patients (21.4%) from PD group required 30-day re-admission for various reasons. No postoperative mortality was recorded.

The mean follow-up period of the patients after surgery was  $41.8 \pm 20.6$  months (range 10–88). Mean follow-up was not statistically different between groups. Pain scores at the time of operation were calculated as  $50.9 \pm 12.1$  in DPPHR group and  $56.1 \pm 11.4$  in PD group (Tables 2 and 3). Pre-operative pain scores were not statistically different. At the time of follow-up, pain scores improved significantly in both groups and were  $10.3 \pm 8.8$  and  $10.9 \pm 8.6$ , respectively. No patients from our cohort had developed a PDAC in the follow-up period.

## Discussion

Paraduodenal pancreatitis is a rare form of chronic pancreatitis that involves the C-loop between the pancreas and the duodenum [1]. The disease is frequently discussed in the literature; there is, however, no standardization regarding the optimal treatment options. Due to the rarity of the disease, available data primarily consists of retrospective series with relatively small sample sizes. Hence, the treatment strategy of an individual with PDP depends solely on the judgment of the healthcare provider that encountered the patient. At the moment, patients are generally referred to surgery due to the failure of previous treatment regimens, e.g., debilitating

pain despite best medical therapy [9, 10, 25]. There are, however, cases of PDP with duodenal obstruction, jaundice, or cases that mimic periampullary malignancy that warrant surgical treatment of PDP. Most authors prefer to perform PD in patients with PDP when there are indications for open surgical treatment. Such treatment has proved itself to be effective, according to several reports [9, 10, 14, 25]. There is, however, a concern regarding the use of such an aggressive procedure for the treatment of benign disease.

The most common presenting symptom of PDP is pain [26]. The pain in PDP is often long-lasting, recurrent, and may lead to a limited ability to work. The main concern related to the use of DPPHR is not addressing the inflammation in the groove area between the C-loop of the duodenum and the pancreatic head. We believe the pain in PDP, as a form of chronic pancreatitis, is multifactorial. Inflammation in the groove area inevitably causes hypertension in the main and accessory pancreatic ducts as well as secondary inflammation in the pancreatic head. The increased pressure in main and accessory pancreatic ducts causes tissue ischemia which, together with inflammation of the pancreatic parenchyma, leads to alterations in pancreatic nerves that resemble neurogenic inflammation. In our series, we have observed a large number of patients to have enlarged and inflamed pancreatic head, which corresponds to the previously defined in literature segmental form of PDP [12]. Therefore, liquidation of pancreatic duct hypertension and decortication of the inflammatory core in the head of the pancreas (all achieved by DPPHR) at early disease stages may prevent the irreversible damage to neural fibers and the development of “central” pancreatic pain [26, 27]. At the same time, hypertension in the accessory pancreatic duct which is considered one of the possible etiopathogenetic mechanisms of PDP is also reversed with DPPHR through pancreatic ducts decompression [2].

In patients with classic CP and an enlarged pancreatic head, duodenum-preserving pancreatic head resections, such as Frey, Beger, and Berne procedures, are currently favored over the PD [13]. DPPHR has shown better results when

compared to PD in terms of postoperative complications and length of hospital stay while offering similar results in pain control. According to our data, there is an excellent pain control achieved by DPPHR at the time of follow-up. The Izbicki pain score results are not significantly different from those achieved by PD. Concurrently, we have found that DPPHR outperformed PD in the postoperative period with a lower complication rate and shorter hospital length of stay after the surgery.

The present study has several limitations. Though because of the rareness of PDP, retrospective study design seems most suitable, any study of this kind, including ours, possesses the risk of data loss, inaccurate reproduction of the data by study participants, and selection bias. The major concern is selection bias related to the decision-making process regarding the choice of surgical procedure. In our study, a decision was mostly made based on the surgeon's discretion and judgment, except for the cases where PD was strongly indicated, such as duodenal compression with subtotal obstruction or inability to exclude malignancy. Due to the retrospective nature of the analysis, we have no control over the above-mentioned decision process, and the PD group consists of a much smaller number of cases. Thus, more prospective studies on the surgical treatment of PDP are needed to investigate the role of different surgical techniques and outcomes for the patients, as well as to define the role and indications of DPPHR vs PD.

## Conclusions

In our study of patients surgically treated for PDP, we found that DPPHR achieves similar results in pain control as PD. At the same time, according to our data, patients treated with DPPHR have lower complication rate and shorter hospital LOS. Although more evidence is needed due to study limitations, DPPHR may be considered for the surgical treatment of PDP.

**Authors' contributions** All the authors have participated in the conception and design or analysis and interpretation of the data; drafting the article or revising it critically for important intellectual content; and approval of the final version.

**Data availability** The data that support the findings of this study are not publicly available due to legal and ethical issues.

## Declarations

**Ethics approval** This study protocol was reviewed and approved by the ethic committee of Shalimov National Institute of Surgery and Transplantology, Kyiv, Ukraine, protocol number 9 from 25 Nov. 2020. Written informed consent was waived by the committee.

**Competing interests** The authors declare no competing interests.

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