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Comparative Analysis of the Results of Various Methods for Pancreatic Head Resection in Chronic Pancreatitis

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BACKGROUND In more than half of cases of chronic pancreatitis (CP), enlargement of the pancreatic head is diagnosed with the presence of complications that serve as an indication for organ resection. The development of an optimal method for the surgical treatment of CP with damage to the pancreatic head (PH) is one of the tasks of surgical pancreatology.

AIM OF STUDY To perform comparative evaluation of immediate and late results of different types of PH resection in CP.

MATERIAL AND METHODS A prospective controlled study was conducted with a comparative analysis of the results of surgical treatment of 131 patients with CP with pancreatic head enlargement. In 29% (n=38) cases inflammatory complications were revealed, in 86.3% (n=113), they have been associated with compression of adjacent organs, jaundice also developed (n=60), as well as duodenal obstruction at the level of duodenum (n=43), regional portal hypertension (n=10). A total of 47 pancreatoduodenal, 58 subtotal, and 26 partial resections of the pancreas were performed.

RESULTS Duodenum preserving pancreatic head resections had significantly better short-term results compared to pancreatoduodenal resections. Subtotal PH resection in the Berne modification was superior to all other resections in terms of average duration of surgery, postoperative inpatient treatment, and intraoperative blood loss. The frequency of relaparotomy for intraperitoneal complications of hemorrhagic etiology was 8.2% (n=4). The frequency of the adverse effect according to pain preservation 5 years after duodenum preserving resection was 0.125; after pancreatoduodenal resection — 0.357 with a statistically significant relative risk (RR) of 0.350 (CI95% = 0.13–0.98). According to other indicators of clinical long-term surgical treatment depending on the various methods of PH resection, there were no statistically significant differences (p>0.05). The quality of life of patients 5 years after the operation according to the EORTC QLQ-C30 questionnaire was statistically significant (p=0.0228) by only two indicators: dyspnea (DY:8.3) and insomnia (SL:16.67; 27.4) with higher values after operations of Beger and the Berne modification of the subtotal PH resection, respectively.

Keywords: chronic pancreatitis, pancreas, pancreatic head, major pancreatic duct, pancreatoduodenal resection, duodenum preserving resection of the pancreatic head, subtotal resection of the pancreatic head, partial resection of the pancreatic head, longitudinal pancreatojejunostomy, quality of life

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CBD - common bile duct
CP - chronic pancreatitis
CT - computed tomography
DPPHR – duodenum-preserving pancreatic head resection
LPJ - longitudinal pancreatojejunostomy
MPD - major pancreatic duct
NPTP - number of patients being treated for one adverse outcome prevented
NPT - number of patients, who must be treated
OJ - obstructive jaundice
PDR - pancreatoduodenal resection
PH – pancreatic head
PPHR - partial pancreatic head resection
QL - quality of life
SPHR - subtotal pancreatic head resection

INTRODUCTION

According to a survey of doctors (according to the international associations IHPBA, APA, EPC, ESGE and DPSG) from 47 countries of the world, chronic pancreatitis (CP) is a disabling disease characterized by the development of diabetes mellitus, malabsorption, calcification of the pancreatic parenchyma in 75%, the presence of pseudocysts in 55%, enlargement of the pancreatic head (PH) in 59% of cases, and frequent development of extraorgan complications [1]. If the patient has a history of CP for 5 years or more, the risk of pancreatic cancer increases 8–10 times, and increases with smoking and the presence of diabetes mellitus [2–5]. The most informative method for diagnosing CP is computed tomography (CT), the priority of which is currently beyond doubt [6, 7]. The diagnosis of CP is both simple and complex at the same time: despite the presence of pathognomonic signs of CP, there is no correlation between them, including the correlation of the intensity of pain syndrome and the severity of structural changes in the pancreas [4], the intensity of the pain syndrome and the degree of intraductal hypertension [8, 9], the degree of calcification of the pancreatic parenchyma (68.3%; A.K. Jha, 2018) and the incidence of other diagnostic signs of CP [10, 11]. The international agreement on the definition of CP (D.C. Whitcomb et al., 2018) has not even accepted histological verification of the diagnosis as an absolute criterion [12]. The lack of precise diagnostic criteria leads to uncertainty of tactics when choosing methods for treating CP up to the complete denial by some authors of the dependence of the results on the method of surgical treatment [13–15].

In the literature, there are many studies analyzing the results of surgical treatment of CP depending on the volume of pancreatic head resection; there are different interpretations of the performance of this or that intervention, which complicates the comparative analysis of the results due to the possible incomparability of the groups. According to T. Keck (2009), the difference in the described PH size when analyzing the results of resection operations differs in German (median 4.5 cm) and North American (median 2.6 cm) authors ($p < 0.001$) [16]. A number of publications present the results of treatment without a description of the technique of the performed operations [17] or, conversely, presents too detailed division of them according to the volume of intervention, for example, the Frey procedure into local, minimal (with an average volume of PH resection of 1.8 ± 0.3 cm3) and modified (with an average resection volume of 3.0 ± 0.4 cm^3) [18]. Some publications provide statistics on the results of longitudinal pancreatojejunostomy (LPJ) with resection of PH according to Frey in patients without the presence of an inflammatory mass and an PH enlargement (n = 13) [19].

According to J.D. Tillou (2017), the decision on the optimal method of surgical treatment of CP should be made for each patient individually and depends on the options for pathological changes in the pancreas [20].

The presence of complications due to compression of the PH with organs adjacent to the pancreas in combination with functional disorders and the complexity of the technical implementation of resection interventions explain the high frequency of relaparotomies, which is 19.1%,= according to the A.V. Fisher (2017), with more than half (58.9%) performed for infectious complications and gastrostasis [17]. The high incidence of postoperative complications (24.2–36.8%) and mortality (6.5–11.5%) after pancreatic surgery is an unresolved issue in leading European clinics [21]. The current trend in world pancreatology is a slow improvement in the results of resection interventions. According to H.G. Beger (2018), the 30-day mortality rates of one of the complex surgical interventions, pancreatoduodenal resection (PDR), decreased from 3 to 0% over 20 years, with the incidence of almost all postoperative complications (gastrostasis from 10 to 13%, pancreatic fistula from 5 to 13%, hemorrhagic intra-abdominal complications from 1 to 11%) [4].

Aim of study: to conduct a comparative assessment of the immediate and long-term results of various methods of resection of PH in CP.

MATERIAL AND METHODS

A prospective controlled study was carried out in 131 patients with CP with impaired patency of the major pancreatic duct (MPD) and enlarged PH with an analysis of the results of surgical treatment. The study was carried out on the basis of the surgical department of BHIOR RCH (Budgetary Health Institution of Omsk Region Regional Clinical Hospital) from 1998 to 2018. There were 108 men, 23 women. The average age of patients was 41.4 ± 9.4 years. Most of the patients were admitted to the clinic urgently. Previously, 47.3% of patients were operated on for pancreatitis or pancreatic injury. In 117 patients (89.3%), alcohol abuse was the main etiological factor in the onset of CP. Complications associated with compression of the PH of adjacent organs were present in 86.3% of cases, including obstructive jaundice (OJ) (n = 60), obstruction at the level of the duodenum due to compression with the PH cyst or duodenal stenosis (n = 43), extrahepatic portal hypertension with gastric varicose veins (± esophagus) (n = 10). Inflammatory complications were present in 29% of cases, including suppuration (n = 17), cyst perforation (n = 1), pancreatic fistula (n = 17), gastroduodenal artery pseudo-aneurysm (n = 2) and perforation of the posterior duodenal wall (n = 1). Intra-secretory pancreatic insufficiency was noted in 27.5% and exocrine pancreatic insufficiency - in 94.7% of cases. Before surgery, all patients underwent CT (n = 128) and / or magnetic resonance imaging (n = 10), which made it possible to diagnose virsungolithiasis in 93, pancreatic cysts - in 64, and MPD dilatation - in 126 patients. Biliary hypertension was diagnosed in 84 cases and portal hypertension in 24 cases. In all patients, the PH was enlarged, a head size greater than 4–5 cm was observed in 80.2% of cases. All patients signed voluntary informed consent for the study. The clinical study was approved by the ethics committee of the Federal State Budgetary Educational Institution of Higher Education "Omsk State Medical University" (extract from protocol No. 97/1 dated October 26, 2017).

The range of operations performed: PDR - pancreatoduodenal resection (± LPJ - longitudinal pancreatojejunostomy) - 47, subtotal resection of the pancreatic head (SPHR) according to Beger (± LPJ of the Beger – Frey type) - 9, SPHR of the Bern variant (± LPJ) - 49 partial pancreatic head resections (PPHR) of the Frey type - 26. In 9 patients, PDR was performed in the pyloric-preserving variant - 9, supplemented with LPJ - in 2 patients. Patients operated on in the amount of PDE were admitted to the clinic with the greatest number of complications, including: OJ (n = 34), duodenal stenosis (n = 22), gastric varicose veins (± esophagus) due to portal hypertension (n = 5), while in 16 cases a combination of several complications was noted in one patient at the same time. Three patients had urgent indications for PDR: false aneurysm of the gastroduodenal artery (n = 2) and perforation of the posterior wall of the duodenum (n = 1).

The classic version of the Beger operation was performed in 6 patients, in 3 patients it was supplemented with a LPJ (Beger – Frey). OJ was diagnosed in 7 out of 9 patients operated on as part of the Beger operation, in 3 - portal hypertension, which arose due to cicatricial stenosis of the splenic vein at the level of the pancreas isthmus (according to CT data). In this group, 6 out of 7 patients underwent additional internal (n = 5) or external (n = 1) drainage of the common bile duct (CBD).

Subtotal resection of the PH in the classic version of the Berne modification of the Beger operation was performed in 20 patients, and with the addition of LPJ - in 29 patients. In patients operated on in the volume of the Berne modification of subtotal resection, biliary hypertension was diagnosed in 31 cases (according to CT data), in 15 cases with the presence of OJ. Opening and anastomosing of the terminal part of the CBD from the side of the cavity of the resected PH was performed in 22 patients, in a number of cases - with additional external drainage of the CBD. In 10 cases, SRHPH was performed in an original way with terminal-terminal pancreatojejunostomy at the recovery stage (RF patent for invention No. 2479270) [22].

Partial resection of the PH was performed in 26 patients. Unlike SPHR, the border of excision of the parenchyma in PPHR was the contour of the fibrous node of the PH, which removal made it possible to restore the patency of the GLP. In this case, the size of the RV did not exceed 4–5 cm. In one case, the PPHR was supplemented with resection of the pancreatic tail for cyst perforation, in 4, in the presence of OJ, with deep excision of the pancreatic parenchyma with opening the lumen of the terminal section of the CBD (n = 2) and hepaticojejunostomy (n = 2).

In 3 cases of CP with a MPD width less than 5 mm, the resection of the PH was supplemented with excision of the distal pancreatic parenchyma in an original way in the form of triangular fragments in order to expand the anastomosis zone [23], being in fact a modification of the Hamburg procedure suggested in 2007 by J.R. Izbicki [24].

The immediate results of surgical treatment of patients with CP were assessed according to the following indicators: the average duration of the operation (min), the average intraoperative blood loss (ml) determined by the volumetric method, the number of postoperative complications, without reoperations and relaparotomies as well, the average duration of postoperative inpatient treatment and the level of postoperative lethality. Long-term results of surgical treatment of patients with CP were studied 5 years after the primary operation. We assessed: clinical indicators of the degree of pain relief and the presence of diarrhea requiring enzyme preparations. According to the 10-point rating scale of the self-assessment questionnaire developed by us, the patients experienced the symptoms arising over the last month: an increase in body weight after surgery by more than 3 kg, manifestations of detected diabetes mellitus, persistent disability. In addition, the number of complications requiring repeated surgical interventions and "late" deaths from the underlying disease were assessed. To assess the quality of life (QL) of patients after surgery, the international questionnaires MOS SF-36 and EORTC QLQ-C30 were used during the study.

Statistical processing of the obtained data was carried out using the application package "Statistica, version 10.0" by StatSoft Inc., (USA), MS Excel from the MS Office 2007 package. The quantitative characteristics of the variation series in descriptive statistics were estimated by calculating the median (Me), lower [LQ] and upper quartiles [HQ] to determine the value of a feature in a ranked row with 25% deviation in both directions from the mean. The quantitative data of the two independent groups were compared using the Mann – Whitney U test; more than two groups - the Kruskal – Wallis H-test. Qualitative indicators for several groups were compared using Kulback's 2I-statistic, and the details of differences were compared using Fisher's φ-test. In all procedures of statistical analysis, the critical level of significance was taken equal to 0.05.

Evaluation of the effectiveness of various methods of surgical treatment was carried out by constructing four-field tables (tables 2x2) with the following indicators: frequency of adverse effect (persistence or insignificant reduction in pain), relative risk (RR), absolute (RAR) and relative (RRR) risk reduction, the number of patients treated to prevent one additional adverse outcome (NPTP) and the number of patients to be treated (NPT).

RESULTS

Quantitative indicators of the immediate results of treatment of patients with CP, depending on the volume of PH resection are presented in Table 1.

Table 1

Comparison of quantitative indicators of direct results of treatment in patients with chronic pancreatitis depending on the volume of pancreatic head resection, Me [LQ; HQ]

Analyzed indicators	PDR, *n*=47	*Beger surgery*, *n*=9	Berne modification of SPHR, *n*=49	PPHR *n*=26	Total, *n*=131	*p* (*H*)
Average duration of operations (min)	245 [230; 260]	197 [190; 210]	180 [170; 200]	212.5 [175; 240]	215 [180; 240]	*p* <0.001 *H*=63.4
Average intraoperative blood loss (ml)	480 [410; 560]	305 [290; 350]	260 [230; 320]	265 [200; 440]	340 [240; 450]	*p* <0.001 *H*=26.6
Average duration of postoperative inpatient treatment (bed day)	24 [18; 27]	25 [21; 26]	17 [15; 22]	20 [17; 23]	20 [16; 25]	*p* <0.001 *H*=66.9

Notes: * - statistical significance of differences between groups according to the Kruskal-Wallis test, *p*<0.05; PDR — pancreatoduodenal resection; PPHR — partial pancreatic head resection; SPHR — subtotal pancreatic head resection

The statistical significance of the differences in the indices of the immediate results of treatment of patients with CP was analyzed in pairs in 4 groups, depending on the volume of resection of the PH.

In terms of the average intraoperative blood loss (ml), the differences between the PDR (with the greatest blood loss) and the methods of duodenum-preserving resection of the pancreatic head (DPPHR) were statistically significant: Beger operation (p = 0.000; U = 27; Z = 4.1), Berne technique of SPHR (p = 0.000; U = 97.5; Z = 7.1) and PPHR (p = 0.000; U = 211; Z = 4.6). In terms of average intraoperative blood loss (ml), DPPHR were comparable with each other (p> 0.05).

Similarly, a statistically significant difference was obtained in the mean duration of PDR (maximum in minutes) compared with DPPHR, including the Beger operation (p = 0.000; U = 52.5; Z = 3.5), the Berne technique of the SPHR (p = 0.000; U = 82; Z = 7.8) and PPHR (p = 0.000; U = 251.5; Z = 4.1). The average duration of the Berne modification of SPHR (min) was statistically significantly less in comparison with Beger operations (p = 0.005; U = 90.5; Z = 2.8) and PPHR (p = 0.01; U = 406.5; Z = -2.6).

The average duration of postoperative inpatient treatment (bed-days) after PDR was comparable to the Beger operation (p = 0.806; U = 200.5; Z = -0.2) and was statistically significantly longer than that in the Berne modification of SPHR (p = 0.000; U = 514.0; Z = 4.7) and PPHR (p = 0.015; U = 399.0; Z = 2.4). Among DPPHR, the indicator of the average duration of postoperative inpatient treatment (bed-days) statistically significantly showed a shorter hospitalization period in the group of the Berne modification of SPHR compared with the Beger operation (p = 0.002; U = 79.5; Z = 3.0) and PPHR (p = 0.066; U = 63.0; Z = 2.0). The differences between the Beger and PPHR were found to be most statistically insignificant in all parameters (p = 0.473; p = 0.042; p = 0.910). The qualitative indicators of the immediate results of treatment of patients with CP, depending on the volume of resection of the PH are presented in Table 2.

Table 2

Comparison of quality indicators of the immediate results of the treatment in patients with chronic pancreatitis depending on the volume of pancreatic head resection

Analyzed indicators	PDR, *n*=47	*Beger surgery*, *n*=9	Berne modification of SPHR, *n*=49	PPHR, *n*=26	Total, *n*=131	*P* (2*I*)
The number of patients with postoperative complications	28 (59.6%)	1 (16.7%)	6 (12.9%)	1 (3.8%)	36 (27.7%)	$p < 0.001$ 2 I = 39.4
Complications requiring repeated operations, of which:	6 (12.8%)	1 (16.7%)	5 (10.2%)	1 (3.8%)	13 (9.9%)	> 0.05
- abdominal abscess	1 (2.1%)	-	12%)	-	2 (1.5%)	> 0.05
- pancreatojejunostomy failure	3 (6.4%)	-	-	-	3 (3.3%)	-
- hepaticojejunostomy failure	1 (2.1%)	-	-	-	1 (0.8%)	-
- intra-abdominal bleeding	-	-	12%)	1 (3.8%)	2 (2.4%)	> 0.05
- bleeding into the lumen of anastomoses	1 (2.1%)	1 (16.7%)	3 (6.1%)	-	5 (3.8%)	> 0.05
Complications that did not require repeated operations, of which:	22 (46.8%)	-	12%)	-	23 (17.8%)	p <0.001; Phi = 5.98
- external pancreatic fistula	5 (10.6%)	-	-	-	5 (3.8%)	-
- external bile fistula	3 (6.4%)	-	-	-	3 (3.3%)	-
- bleeding into the lumen of the stomach	3 (6.4%)	-	-	-	3 (3.3%)	-
- intra-abdominal infiltrate	1 (2.1%)	-	-	-	1 (0.8%)	-
- gastrostasis	8 (17%)	-	-	-	8 (6.1%)	-
- portal vein thrombosis	1 (2.1%)	-	-	-	1 (0.8%)	-
- pulmonary embolism	1 (2.1%)	-	-	-	1 (0.8%)	-
- decompensation of chronic renal failure	-	-	12%)	-	1 (0.8%)	-
Postoperative mortality	2 (4.3%)	-	12%)	-	3 (3.3%)	> 0.05

Notes: * p (2I) — statistical significance of differences in indicators in subgroups (Kulback's criterion); PDR — pancreatoduodenal resection; PPHR — partial pancreatic head resection; SPHR — subtotal pancreatic head resection

The number of patients with postoperative complications after PDR amounted to 77.8% of the total number of patients with postoperative complications, statistically significantly different from DPPHR, including: from Beger operation (2I = 7.86; p <0.01), from Berne modification of SPHR (2I = 24.9; p <0.001) and PPHR (2I = 26.2; p <0.001).

Complications that did not require reoperation (17.8%) occurred after PDD in 95.6% of cases and were diagnosed in almost every second patient (46.8%). External pancreatic fistula after PDR, according to the classification of complications of the International Study Group on Pancreatic Fistula (ISGPF, 2016) [25], corresponded to class A in 5 cases and did not require reoperation. For complications that did not require repeated surgical interventions, we attributed external biliary fistula (n = 3) with bile flow through drainage tubes for more than 7 days after surgery. Gastrostasis (n = 8) was one of the most frequent postoperative complications after PDR (17%), including interventions in the pyloric-preserving variant. In most cases, it was possible to avoid repeated surgical interventions while achieving a stable effect from conservative and endoscopic treatment in patients with bleeding from the anastomoses into the gastric lumen (n = 3) and abdominal infiltration (n = 1).

The frequency of relaparotomies after resection of the PH (9.9%) was about one third of the total number of postoperative complications with a statistically insignificant difference depending on different methods of surgery (3.8–16.7% due to a small sample of observations). Thus, the highest frequency of relaparotomies (n = 1) was observed after the Beger operation (16.7%), where the indication for re-intervention was bleeding from the cavity of the resected prostatic fluid.

The most common indication for relaparotomy after PDR (n = 3) was external pancreatic fistula of classes B and C, according to the classification of complications of the International Study Group on Pancreatic Fistula (ISGPF, 2016) [25]. In two cases, the volume of relaparotomy was limited to the strengthening of the anastomosis, in one - the formation of an external virsungostomy. In case of failure of hepaticojejunostomy with the presence of a biliary fistula with a bile loss of more than 600 ml per day (n = 1) and a more rare complication - profuse bleeding from the area of hepaticoenteroanastomosis (n = 1), the latter was reconstructed (plus the presence or absence of the need for stop bleeding). An abscess of the abdominal cavity with compression of the lumen of duodenoenteroanastomosis on the 10th day after pyloric anastomosis in one observation was an indication for relaparotomy in the amount of abscess drainage and additional gastroenteroanastomosis.

Bleeding from the cavity of the resected RH was the most frequent complication after the Berne modification of SPHR (8.2%), mainly on the 5-8th day of the postoperative period. The volume of reoperation in all cases consisted of stopping bleeding with reconstruction of the anastomosis. After SPHR in the Berne modification, relaparotomy was also performed for intra-abdominal bleeding (n = 1) and abdominal abscess (n = 1). On the 2nd day after PPHR, relaparotomy was performed in one patient for intra-abdominal bleeding from the lower edge of the mobilized PH.

The causes of postoperative mortality after resection of the RH (3.3%) were: pulmonary thromboembolism (n = 1) and portal vein thrombosis (n = 1) in 2 patients after PDR and decompensation of the initial chronic renal failure after the Berne modification of PPHR (n = 1).

Long-term results of resection of the PH 5 years after surgery were assessed in 66.4% of patients (n = 87). The cause of "late" mortality (within 3-5 years after surgery, n = 25) was: complications of diabetes mellitus (n = 3), coronary heart disease associated with alcoholism (n = 7), HIV infection (n = 2) , pancreatic cancer (n = 3), oncological diseases of other location (n = 2), lung diseases (n = 3, of which in one observation - tuberculosis), liver cirrhosis (n = 1), chronic renal failure against the background of alcoholism (n = 1), cholangitis (n = 1), bleeding gastric ulcer (n = 1), and acute intestinal obstruction (n = 1). Clinical results of surgical treatment of CP 5 years after surgery, depending on the volume of resection of the PH, are presented in Table 3.

Table 3

Comparison of the clinical outcome of surgical treatment of chronic pancreatitis 5 years after the operation depending on the volume of pancreatic head resection

Long-term results, studied over 5 years	PDR, *n*=23	*Beger surgery*, *n*=5	Berne modification of SPHR, *n*=38	PPHR, *n*=21	Total *n*=87	*p* (2*l*)
Mortality for 5 years	9	1	10	5	25	> 0.05 2*l* = 1.8
Questioned after 5 years	14	4	28	16	62	-
Indicators of long-term results						
Pain relief or reduction *	9 (64.3%)	4 (100%)	26 (92.9%)	12 (75%)	51 82.3%)	> 0.05 2 *l* = 5.88
Presence of diarrhea, requiring enzyme drugs **	5 (35.7%)	1 (25%)	14 (50%)	9 (56.3%)	29 (46.8%)	> 0.05 2 *l* = 2.2
Alcohol consumption after surgery	7 (50%)	2 (50%)	13 (46.4%)	8 (50%)	30 (48.4%)	> 0.05 2 *l* = 0.1
Weight gain after surgery more than 3 kg	9 (64.3%)	3 (75%)	18 (67.9%)	8 (50%)	38 (61.3%)	> 0.05 2*l* = 1.3
Identified Diabetes	4 (28.6%)	1 (25%)	9 (32.1%)	8 (50%)	15 (24.2%)	> 0.05 2*l* = 2.1
Complications requiring repeated surgical interventions	4 (28.6%)	1 (25%)	5 (17.9%)	2 (12.5%)	12 (19.4%)	> 0.05 2*l* = 1.3
Persistent disability	5 (35.7%)	1 (25%)	6 (21.4%)	7 (43.8%)	19 (30.6%)	> 0.05 2*l* = 2.6

Note: * — with the severity of at least 4 points on the developed 10-point-scale of self-assessment during the last month; ** — with the severity of more than 4 points on the developed 10-point-scale of self-assessment during the last month; p (2l) — statistical significance of differences in indicators in subgroups (Kulback's criterion); PDR — pancreatoduodenal resection; PPHR — partial pancreatic head resection; SPHR — subtotal pancreatic head resection

The indication for repeated operations in CP in the long-term period was strictures of the extrahepatic bile ducts (n = 12), with the highest frequency diagnosed after PDR (28.6%). All patients with hepaticojejunostomy stricture after PDR (n = 4) underwent reconstructive hepaticojejunostomy. In 7 patients, 3-5 years after DPPHR, stricture of the terminal part of the CBD developed, requiring hepaticojejunostomy. In one observation, 1.5 years after PPHR, SPHR was performed with a good result.

As you can see from the Table 3, according to the majority of indicators of clinical results of surgical treatment of patients with CP in the long-term (after 5 years) period, depending on various methods of resection of the PH (when comparing 4 groups with each other), statistically significant differences were not obtained (p> 0.05). Nevertheless, when comparing the long-term clinical results of DPPHR and PDR, the index of the frequency of elimination (or reduction) of pain syndrome after DPPHR and PDR turned out to be the closest to statistically significant intergroup differences (p = 0.0599) compared to PDR. In this regard, by constructing four-field tables, the frequency of persistence of pain (adverse effect) in patients 5 years after DPPHR was calculated, amounting to 0.125 (6 out of 48), which was significantly (almost 3 times) lower than the same indicator after PDR - 0.357 (5 out of 14) with a statistically significant relative risk (RR) = 0.350 (95% CI = 0.13–0.98). The reduction in absolute risk (RAR) in the group of patients after DPPHR was 0.232 (95% CI = 0.0–0.5), and the NPT (NPTP) index was 4.31.

The indicators of quality of life in patients with CP 5 years after resection of the PH in CP (points) according to the SF-36 and EORTC QLQ-C30 questionnaires are presented in Table 4, 5.

Table 4

Comparison of quality of life in patients with chronic pancreatitis 5 years after the operation depending on the volume of pancreatic head resection (score) according to the questionnaire MOS SF-36, Me

Questionnaire scales *MOS SF* -36	PDR, *n*=14	*Beger surgery*, *n*=4	Berne modification of SPHR, *n*=28	PPHR, *n*=16	*p* (*H*)
GH (General Health)	55.79	56	52.8	54.1	0.7004
PF (physical functioning)	84.29	88	73	70.9	0.8993
RP (role-based functioning due to physical condition)	55.36	85	67.9	60.9	0.5565
BP (pain intensity)	67.29	87.2	73.1	66.3	0.4876
VT (vital activity)	59.79	75	62.1	58.5	0.2461
SF (social functioning)	77.68	87.5	74.1	72.7	0.6628
RE (role functioning due to emotional state)	71.43	86.67	64.3	64.6	0.6605
MH (Mental Health)	45.8	75.2	66.2	67.7	0.9520
PH (physical component of health)	42.3	47	45.9	42.8	0.3737
MH (psychological component of health)	47.9	53.2	46.3	49.1	0.4980

Notes: p (H) — statistical significance of differences between subgroups (the Kruskal-Wallis H-test); PDR — pancreatoduodenal resection; PPHR — partial pancreatic head resection; SPHR — subtotal pancreatic head resection

Table 5

Comparison of quality of life in patients with chronic pancreatitis 5 years after the operation depending on the volume of pancreatic head resection (score) according to the questionnaire EORTC QLQ-C30, Me

Scales and symptoms of the *EORTC QLQ-C*30 questionnaire	PDR, *n*=14	*Beger surgery*, *n*=4	Berne modification of SPHR, *n*=28	PPHR, *n*=16	*p* (*H*)
PF (physical well-being)	72.02	89.58	76.5	71.4	0.1202
RF (role-based well-being)	75.00	79.17	80,4	74.0	0.6587
EF (emotional well-being)	86.31	97.92	84.8	83.3	0.6276
CF (cognitive well-being)	77.38	95.83	82.1	86.5	0.1295
SF (social well-being)	72.62	83.33	73,2	74.0	0.8600
QL (general health)	57.14	70.83	58.7	62.5	0.3706
FA (fatigue/weakness)	39.68	30.56	32.1	41.7	0.1980
NV (nausea/vomiting)	14.29	8.33	10.1	12.5	0.8957
PA (pain)	26.19	16.67	23,2	36.5	0.0908
DY (dyspnea)	26.19	8.33	8.3	29.2	0.0228
SL (sleep disorder)	52.38	16.67	27.4	31.3	0.0228
AP (loss of appetite)	26.19	8.33	16.7	31.3	0.2350
CO (constipation)	7.14	0.0	4.8	8.3	0.7000
DI (diarrhea)	23.81	33.33	34.5	25.0	0.3492
FI (financial problems)	52.38	25.00	33.3	41.7	0.2761

Note: p (H) is the statistical significance of differences in the characteristics of the subgroups (Kruskal – Wallis H-test)

As shown in Table 4, according to the MOS SF-36 questionnaire, there was no statistically significant difference in indicators in the groups (p> 0.05). Indicators of physical (PH) and mental (MH) components of health in patients with CP 5 years after surgery, depending on the volume of resection of the PH, differed from each other within 9–13%, the results in all groups were comparable.

According to the Table 5, according to the EORTC QLQ-C30 questionnaire, a statistically significant difference was obtained for two indicators: shortness of breath (DY: 8.33, p = 0.0228) and insomnia (SL: 16.67–27.4, p = 0, 0228) with the best possible results after the Beger operation and the Berne modification of SPHR.

DISCUSSION

The concept of an inflammatory mass in PH (inflammatory pancreatic head mass) as a pacemaker of CP was put forward by H.G. Beger in 1973 and adopted by most European surgeons. The frequency of the inflammatory mass in the PH in CP reaches 85% [4]. In 79.4% of the patients we operated on, the PH size exceeded 4–5 cm. The frequency of biliary stricture (45.8%) and duodenal obstruction (32.8%) in our patients exceeded the statistics of foreign authors (35% and 10%, respectively) [four]. According to T. Aimoto (2011), half of patients with CP during surgery require decompression of the bile ducts [26]. According to our observations, strictures of the terminal part of the CBD were the most frequent complication of CP (26%). The presence of extrahepatic portal hypertension, aggravated by varicose veins of the stomach (± esophagus) influenced the choice of the method of surgical treatment of CP and occurred in our observations with a frequency of 7.6%, which is comparable with the data in the literature (7–23%) [27]. Resection of the PH in CP is currently performed in the amount of PDR or in relatively organ-preserving options, united by the term DPPHR. Preservation of the duodenum allows minimizing the symptoms of malabsorption compared to more traumatic PDR. Nevertheless, according to foreign literature, the share of PDR in the structure of interventions performed in CP with the PH involvement reaches 59% [1]. Among our observations, the ratio of PDR: DPPHR in CP with an increase in the size of the RH was 1: 2 (35.9% of PDR). Comparative analysis of immediate and long-term results of surgical treatment of CP with literature data and depending on various methods of resection of the PH was aimed at clarifying the indications and highlighting the most beneficial method of surgical treatment for the patient. The time spent on performing the operation was not the main criterion for us in assessing the immediate results of treatment. Nevertheless, the average duration of the PDR we performed (245 min) was less than that recorded in foreign sources (324.5–431 min), but exceeded the DPPHR ($p = 0.001$), which correlates with the literature data [29–32], although and with a smaller difference than that of G. Farkas (excess of the PDR in the duration of the Berne modification of SPHR by 136 min; 2006) [32]. In a number of works by foreign authors, a comparative analysis of the duration of operations is carried out with an estimate of the difference between them in minutes. The difference in duration between the Beger and Berne modification of SPHR was less (17 min; $p = 0.005$) than that of J. Köninger (46 min; 2008) [31, 33]. The average intraoperative blood loss depended on the complexity of the chosen method of PH resection, as well as the degree of cicatricial and inflammatory changes in the pancreatic parenchyma and adjacent organs. The average intraoperative blood loss in PDR was less than the analogous indicator in the foreign literature (480 ml versus 646.5–1183 ml) and was statistically significantly higher than that in DPPHR ($p = 0.000$) [29–32]. The average duration of inpatient treatment in our patients, especially rural residents, had regional characteristics, often depending on the patient's living conditions and the possibilities of post-hospital observation and treatment, slightly exceeding this indicator abroad (17-25 versus 11.2-17.8 days) [29–32]. The relative difference in the shorter duration of inpatient treatment of our patients after the Berne modification of SPHR compared with PDR (7 days, $p = 0.000$) correlates with the data of G. Farkas (5.1 days), and compared with Beger operations (8 days, $p = 0.002$) - twice the data of J. Köninger (4.0 days) [31–33]. The advantage of DPPHR over PDR in relation to the duration of inpatient treatment has been noted by many authors [31, 34–36]. According to the literature, early discharge of a patient is not always justified, even in large clinics. Thus, the results of resection of the PH according to Frey R. Vellaisamy (2016, n = 78) showed a very short duration of the patient's stay (7 days) with a higher incidence of postoperative complications (21.1%), which exceed this indicator in us by more than 5 times (3.8%) [37]. Similar results for PPHR are given by T.D. Fischer and Y. Zhou (2015) with the duration of hospital stay of 12.6 ± 9.4 days, the presence of postoperative complications in 22–23.2%, and mortality in 0.4–2% of cases [38, 39]. In addition, early discharge of the patient does not always objectively show the statistics of complications. Short hospital stays after complex pancreatic surgeries are often combined with high readmission rates, the results of which are statistically counted separately. According to J.D. Howard (2019), the proportion of 30- and 90-day readmissions after PDR was 17.63% and 26.14%, respectively [40].

The main reasons for the high average duration of postoperative inpatient treatment after PDR in our observations were: a high incidence of postoperative complications (59.6%), despite the unsatisfactory indicators correlating with similar indicators in foreign literature (19–58%) [29, 30, 41, 42], and the frequency of relaparotomy, slightly higher than this indicator in the foreign literature (after DPPHR: 9.3% versus 4.6%, and after PDR: 12.8% versus 7%) [4].

Among the total spectrum of complications after PDR (13–60%), the high-risk group according to K. Alexiou (2015) is made up of false arterial aneurysms with a lethality of 89% [43]. The results of two PDRs performed by us for a false gastroduodenal artery aneurysm with one fatal outcome confirm the high risk of a poor prognosis in the presence of this complication.

The most common complication after PDR is pancreatic fistula, diagnosed in 13–27% of cases [4, 25, 41, 44–47], and the bulk of mortality is made up of patients with pancreatic fistula of classes B and C, according to the classification of complications of the International Study Group on Pancreatic fistula (ISGPF, 2016) [25]. In our observations, pancreatic fistula was diagnosed only after PDR (17%). After DPPHR, according to foreign publications, this complication occurs in 3.3–4.8% of cases [4]. Biliary fistula was an indication for relaparotomy in only one of 4 patients after PDR (2.1%), the frequency of which, according to S. Andrianello (2108), is 3.6% [48]. We did not observe a biliary fistula after DPPHR, although a similar complication (according to the literature) occurs with a frequency of 0.5% [4].

The statistically significant excess of the incidence of postoperative complications after PDR compared with DPPHR ($p < 0.01$–0.001), obtained by us, correlates with literature data [30, 32, 34, 35, 39, 49, 50], although some authors consider the immediate results to be comparable. of these operations in terms of complication rate [4, 36, 51] or even worse after DPPHR (45% versus 38% with PDR) [52].

Among patients with DPPHR, a statistically significant advantage in terms of the average duration of surgery (min) and postoperative inpatient treatment was obtained by us in the group of the Berne modification of SPHR, which is confirmed by the literature data [31]. The incidence of postoperative complications in our patients after DPPHR was comparable and even lower than in J. Köninger (2008; 19% after the Beger operation and 21% after the Berne modification of SPHR), while maintaining the same proportions of the relative difference between the groups [31, 33].

The main indicator in assessing the immediate results of surgical treatment is postoperative mortality, which in our observations amounted to 3.3% after all resections of the PH and 4.3% after PDR, slightly exceeding the results of foreign authors (after PDR: 4% S. Partelli, 2017; 0 –3% H.G. Beger, 2018) [4, 41]. The main cause of mortality after resection surgery on the pancreas (50%), according to S. Wolk (2017), is postoperative bleeding with a frequency of 7.8%, which, according to our observations, occurred in 5.3% of cases [53].

Comparison of long-term indicators can be reliable only if there is complete comparability of groups before surgery, adequate correction of functional disorders of the pancreas, patient compliance with the recommendations and the correct lifestyle in the postoperative period [13].

Far from all publications there is a correlation between the long-term results of PH resection for CP and the incidence of alcohol abuse in the postoperative period, which we noted in 48.4% of patients 5 years after the operation, which negatively affected the statistics of "late" deaths, disease progression, incapacity for work (30.6%). Regional differences (including economic ones) distort the reliability of the comparison of some indicators of long-term results of surgical treatment of CP and the correlation between the signs. The frequency of alcohol abuse in our patients after PDR was 50%, significantly different from that of H.G. Beger (7%, 2018) with a disability rate of 19%, which is two times less than that obtained in our patients (35.7%) [4].

"Late" (within 3-5 years) mortality after resection of the PH in our patients was 19.1%, exceeding the 10-year mortality rate of U. Klaiber (2016) - 16.9% [54]. The low survival rate of patients with CP is a great burden for society, as indicated by the 16-year mortality rate after DPPHR K. Bachmann (34–39%) [55].

All reoperations in the long-term period after resection of PH (19.4%, n = 12) were performed by us for stricture of the bile ducts at the level of biliodigestive anastomosis (6.5%, n = 4) after PDR or terminal section of CBD after (12.9%, n = 8) DPPHR. The frequency of stricture of the terminal section of the common bile duct in the long-term period after surgical treatment of CP was 12.5–25% and was statistically indistinguishable between different ways of DPPHR ($p > 0.05$). According to the literature, bile duct stricture in the long-term period after PDR is diagnosed in 3–7% of observations within 2.3–4.1 years [56]. The causal factors for the development of biliary stricture after PDR are considered: age over 65 years, the diameter of the lumen of the anastomosed bile duct less than 7 mm, the presence of complications after primary surgery, including biliary fistula, chronic cholangitis [56]. One of the reasons for the development of biliary stricture in the long-term period of surgical treatment of CP may be an inadequate volume of the primary operation, which took place in our two cases of PPHR. The stricture of the terminal part of the CBD in the long-term period of SPHR (3–5 years) was diagnosed in 5 patients, despite the fact that in 44.9% of cases (n = 22) with SPHR, the terminal section of the CBD was opened from the side of the cavity of the resected RH, and in 14.3% (n = 7) - hepaticojejunostomy. In any case, in 7 patients who were reoperated 3–5 years after DPPHR in the volume of hepaticojejunostomy, insufficient drainage of the CBD occurred.

Elimination of pain can be considered the main indicator of the effectiveness of surgical treatment of CP in the long-term follow-up. The advantage of DPPHR over PDR in the effectiveness of pain relief is indicated in the meta-analysis by D. Hartmann (2015) [34]. Our research confirmed this statement with an indicator close to statistically significant ($p = 0.055$). The efficiency of pain elimination after the Berne modification of CPH, according to our data, was 92.9%, which fully correlates with the data of H.G. Beger (91.3%), differing only in the ranking of the groups (5 years after the operation in our observations and the average follow-up period of 5.7 years (0.3-14 years) after DPPHR in H.G. Beger), which makes a certain sin in comparative analysis [29]. G. Farkas (2006) [32] points out the absence of statistically significant differences in the analgesic effect after DPPHR and PDR.

If the relief of pain syndrome can be considered as a criterion for the effectiveness of surgical treatment of CP, the progression of functional disorders of the pancreas indicates the irreversibility of pathological changes in the organ and the need for replacement therapy with a frequent pessimistic prognosis. Diabetes mellitus was the cause of "late" mortality in the patients we operated on in 12% of cases. The frequency of diagnosed diabetes mellitus in our patients 5 years after PDR (28.6%) coincided with the indicators of 15-year follow-up of H.G. Beger (28%, 2018) [4]. We did not obtain statistically significant differences in assessing the frequency of functional disorders of the pancreas in patients in the long-term period after resection of the pancreas, similar to the studies of T. Keck (2012) [51]. Nevertheless, a comparative analysis of the long-term results of 93 DPPHR and 91 PDR (H.G. Beger, 2018) showed a statistically significant ($p < 0.01$) advantage of DPPHR in terms of: intra- and exocrine disorders of the pancreas, weight gain, also the comparability of the two operations in terms of pain relief [4]. A similar opinion is shared by a number of other authors, who give priority to DPPHR, taking into account all indicators of long-term results, including the relief of pain syndrome [34, 35, 50].

With regard to the assessment of QOL, the opinions of the authors were divided into those who prioritize DPPHR as a more beneficial intervention for the patient compared to PDR [4, 30] and consider the long-term results of PDR and PDPHP to be comparable without statistically significant differences [32, 36, 51, 57]. A number of authors have noted the advantage of DPPHR only in the assessment of QOL with more pronounced functional disorders of the pancreas compared to the PDR [30]. When comparing long-term results and QOL after DPPHR, most authors did not obtain statistically significant differences between the Beger operation and the Berne modification of SPHR (U. Klaiber, 2016; J. Köninger, 2008), the Beger operation, and PPHR (Z.A.R. Jawad, 2016; K. Bachmann , 2014) [18, 31, 33, 54, 55]. In contrast to the above studies, we obtained a statistically significant advantage of the Berne modification of SPHR and the Beger operation over other methods of surgical treatment in two indicators (dyspnea and insomnia, $p = 0.0228$) of the EORTC QLQ-C30 questionnaires.

CONCLUSION

Thus, proximal resection of the pancreas, performed taking into account the indications in the volume of pancreatoduodenal resection and various methods of duodenal-preserving resection of the pancreatic head, may be the only option for surgical treatment of patients with chronic pancreatitis with an increase in the pancreatic head, the presence of an inflammatory mass in it, impaired patency of the main duct. The immediate results of various methods of resection of the pancreatic head on the example of our observations fully correlate with the complexity of the technical performance of interventions, both when calculating quantitative indicators with statistically significant results ($p < 0.05$) and in relation to most qualitative indicators with $p > 0.05$. Five-year long-term results of surgical treatment, which demonstrated the comparability of different methods of resection of the pancreatic head with each other in terms of the main indicators, were calculated against the background of revealed alcohol abuse by half of the patients in the postoperative period. The long-term results of subtotal pancreatic head resection in the Berne modification of the Beger operation were superior to other methods of pancreatic head resection, nevertheless, without achieving zero mortality rates and the minimum frequency of repeated interventions. Strict adherence to indications, improvement of the technology of subtotal resection of the pancreatic head with a decrease in the incidence of postoperative complications and the absence of postoperative lethality can approve it as a leading and beneficial option for a patient's surgical treatment.

FINFINGS

1. The presence of an inflammatory mass in the head of the pancreas with impaired patency of the major pancreatic duct is an absolute indication for resection aimed at eliminating the pain syndrome and all existing complications associated with the compression of adjacent organs.

2. Duodenal-preserving methods of pancreatic head resection according to the immediate results of surgical treatment are statistically significantly superior to pancreatoduodenal resection.

3. Among duodenal preserving methods, the best immediate results of surgical treatment were statistically significantly obtained with subtotal resection of the pancreatic head in the Berne modification in terms of the average duration of the operation and postoperative inpatient treatment with a frequency of hemorrhagic complications from the resected pancreatic head of 8.2%.

4. Adverse effect (persistence of pain) in patients 5 years after duodenal resections of the pancreatic head (0.125) was observed less frequently than after pancreatoduodenal resection (0.357).

5. The quality of life of patients according to two parameters (shortness of breath and insomnia) of the EORTC QLQ-C30 questionnaire was statistically significantly higher after the Beger operation and the Berne modification of subtotal pancreatic head resection.

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