Duodenum-preserving pancreatic head resection: 10-year follow-up of a randomized controlled trial comparing the Beger procedure with the Berne modification

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Background. *Since the introduction of the duodenum-preserving pancreatic head resection for operative treatment of chronic pancreatitis, various modifications of the original Beger procedure have emerged. A randomized controlled trial comparing the Beger procedure and the Berne modification indicated that the latter is an equivalent alternative, but a comparison of the long-term results of both procedures has not yet been published.*

Methods. *Between December 2002 and January 2005, 65 patients were randomized intraoperatively to the Beger or the Berne procedure. For this 10-year follow-up, patients were contacted by phone and in writing to evaluate patient-relevant outcome parameters. Statistical analysis was made on an intention-to-treat basis.*

Results. *Median follow-up was 129 (111–137) months. Forty of 65 patients were available for follow-up; 11 of the original study cohort had died, and 14 were otherwise lost to follow-up. Quality of life, pain, occupational disability, exocrine and endocrine pancreatic function, endoscopic interventions, and redo operations were comparable in both groups. More than half of the patients were completely free of pain, and the majority in both groups judged that the index operation had improved their quality of life.*

Conclusion. *Ten-year follow-up showed no differences in patient-relevant outcome parameters between the Beger and Berne procedures for treatment of chronic pancreatitis. Because short-term results have shown the Berne modification is superior in terms of operation time and duration of hospital stay, it should be preferred whenever possible, depending on the individual surgeon's expertise and the intraoperative findings. (Surgery 2016;160:127-35.)*

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Chronic pancreatitis (CP) is characterized by irreversible damage to and fibrosis of the pancreatic parenchyma as the result of a persistent inflammatory process, which causes consecutive loss of exocrine and endocrine pancreatic function.[1] The options for treatment comprise conservative therapies, endoscopic and interventional approaches, and operative procedures.[2] In patients who have intractable abdominal pain and/or present with signs of local complications due to inflammatory enlargement of the pancreatic head, operative procedures are indicated and are considered superior to endoscopic treatments.[3-5]

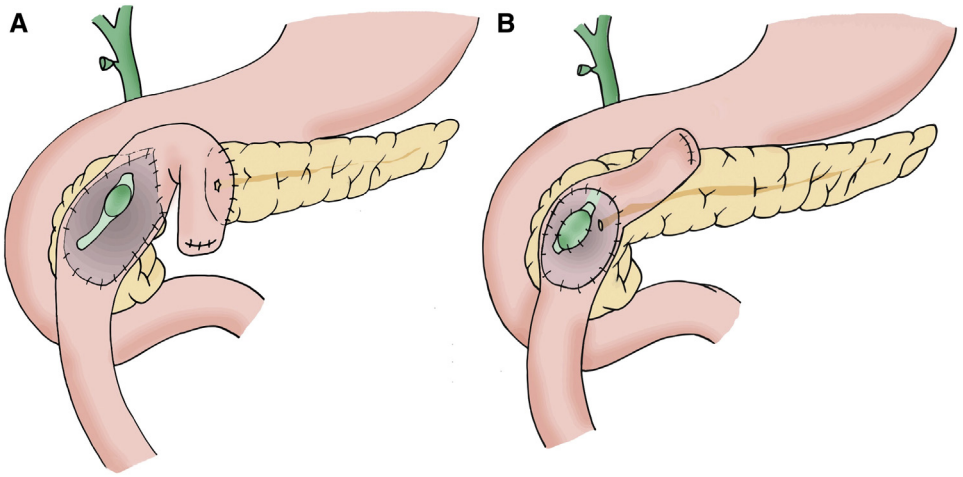

Fig 1. Duodenum-preserving pancreatic head resection according to Beger (*A*) and the Berne modification (*B*).

Contrary to pure drainage operations, resection procedures aim at removal of the inflamed parenchyma as the main source and so-called "pacemaker" of the patient's pain.[6] Based on this rationale, partial pancreatioduodenectomy (PD) is a common treatment option. Surmising that patients might benefit from a more organ-sparing procedure, Beger et al[7] introduced duodenum-preserving pancreatic head resection (DPPHR) in 1972 (Fig 1, *A*).

The key element of Beger's operation is leaving a thin slice of pancreatic tissue around the duodenal wall during resection of the inflammatory mass in the pancreatic head. This procedure includes dissection of the pancreas along the anterior surface of the portal and superior mesenteric veins. Hence, it is technically demanding, with a substantial risk of severe intraoperative bleeding, especially in patients with portal hypertension and collateral veins, common findings in patients with CP.[8]

To simplify the procedure, Frey and Smith[9] suggested more limited excision of the pancreatic head, including a Partington-Rochelle longitudinal pancreaticojejunostomy.[10] With the aim of combining the advantages of the Beger procedure and Frey's modification, Gloor and colleagues[11] introduced the Berne modification (Fig 1, *B*), which is characterized by subtotal, pancreatic head resection without pancreatic transection above the mesentericoportal axis.

In the past 2 decades, several trials and studies have been undertaken to compare DPPHR with PD. A meta-analysis of the available evidence showed that both DPPHR and PD are safe and effective, with superiority of the duodenum-preserving approaches regarding certain peri- and postoperative parameters and quality of life.[12] So far, the different techniques for DPPHR have been compared in only 2 randomized controlled trials (RCTs), and long-term data are particularly sparse.

Izbicki and colleagues allocated patients with CP to the Beger or the Frey procedure,[13] with follow-up after 8 and 16 years.[14,15] The 2nd trial by Köninger and colleagues[16] is the only RCT to compare the Beger procedure with the Berne modification. The short-term results showed that the Berne modification is a technically simpler alternative with equal safety but superiority in terms of operation time and total hospital stay.

To date, no comparison of the long-term results of the 2 procedures has been performed. Therefore, the aim of this study was to compare the 10-year results of the Beger procedure and the Berne modification.

METHODS

This study was conducted by the Study Center of the German Surgical Society with the support of the Institute of Medical Biometry and Informatics, University of Heidelberg, Germany. It adhered to the Consolidated Standards of Reporting Trials (CONSORT) Statement.[17]

Participants. All of the patients participating in this follow-up had been included in a single-center, parallel-group, randomized trial comparing the Beger procedure with the Berne modification.[16] The trial was designed according to the published study protocol[18] and registered with the International Standard RCT Number (ISRCTN) 50638764.

Adult patients (≥18 years of age) with CP due to any cause and with a life expectancy >24 months who were scheduled for DPPHR at the Department of General Surgery at the University of Heidelberg, Germany, were eligible for participation. Exclusion criteria included absence of patient's written informed consent, a history of previous pancreatic resection, preoperative suspicion of malignancy, and any condition leading to the surgeon's preference for a specific pancreatic procedure. After being screened for the inclusion and exclusion criteria, eligible patients who had given written informed consent were enrolled in the trial.

Between December 20, 2002, and January 11, 2005, 65 patients were randomized intraoperatively to undergo either the Beger (32 patients) or the Berne procedure (33 patients).

The original study protocol[18] and the amendment for the 10-year follow-up, including patient information and informed consent documents, were approved by the independent ethics committee of the University of Heidelberg, Germany (S-219/2002), on September 25, 2002, and April 3, 2014, respectively.

Procedures. As described in detail elsewhere,[16,18] patients were treated according to predefined operative procedures, and the peri- and postoperative treatment plans were standardized. Briefly, included patients underwent operative exploration and were randomized intraoperatively to one operation or the other, provided clinical equipoise was given.

The trial intervention was the Berne procedure, ie, DPPHR as proposed by Gloor et al.[11] In the control group, the Beger operation was performed. In both groups, a bilio-enteric anastomosis was allowed to be constructed to deal with stenosis of the intrapancreatic part of the common bile duct or its accidental opening during resection. To ensure adherence to the study protocol, intraoperative monitoring was performed by supervision of the operative procedures. The peri- and postoperative patient data were assessed as described by Köninger et al.[16,18] During the initial study, follow-up visits were performed after 6 and 24 months.

For 10-year follow-up, all patients allocated initially to the trial were contacted by phone and in writing by an investigator blinded to group allocation. The patients received the patient information and informed consent documents by post to inform them in detail about the scope of the follow-up and the possible consequences of their participation. Together with these documents, questionnaires for the assessment of baseline data and outcome parameters were sent. Patients who were willing to participate gave their written informed consent, filled out the questionnaires, and sent the documents back. They also had the option of adding documents related to previous hospital stays, eg, operative and discharge reports, as well as letters from general practitioners. Any uncertainties regarding the answers on the questionnaire and other information provided were eliminated by subsequent telephone conversations.

Outcomes. The primary end point was defined as a hierarchically ordered combination of the duration of operation, quality of life, duration of intensive care unit (ICU) stay, and duration of total hospital stay. For 10-year follow-up, current baseline data, including patient age, body weight and height, the frequency and amount of habitual alcohol consumption, and the smoking behavior, were recorded. Long-term outcome parameters were defined as follows:

Mortality and loss to follow-up. Only patients with confirmed death due to any cause during follow-up were designated as deceased. All other patients who did not send the documents back or who were not available were declared as lost to follow-up. For the assessment of the causes of death, the patient's general practitioner and/or hospital physicians were interviewed if possible.

Quality of life, pain, and occupational disability. Quality of life was assessed by the validated questionnaire of the European Organisation for Research and Treatment of Cancer (EORTC QLQ-30, version 3.0) and its extension for patients with CP (EORTC QLQ-PAN26).[19,20] Additionally, patients were asked to judge the effectiveness of the index operation in improving their quality of life. For the assessment of pain, patient's average daily pain intensities when at rest and in motion were recorded on the commonly used 11-point numerical rating scale ranging from 0 (no pain) to 10 (worst possible pain). Complete freedom from pain was defined as pain ratings of zero both at rest and in motion. Additionally, the patient's current analgesic medication was assessed. Patients were asked whether they had any occupational disability due to pancreas-related morbidity.

Exocrine and endocrine pancreatic function. For the assessment of exocrine and endocrine pancreatic function, details of the patient's medication, including oral antidiabetic drugs and insulin, and pancreatic enzymes, as well as clinical signs of exocrine insufficiency, ie, daily stool frequency, diarrhea, and steatorrhea, were collected. Exocrine insufficiency was defined as the need for supplementation of pancreatic enzymes and/or the

presence of steatorrhea and/or diarrhea. Diarrhea was defined as >3 stools per day. Endocrine pancreatic function was evaluated by the presence of diabetes mellitus together with the time of its diagnosis and treatment. New onset of diabetes mellitus was defined as the occurrence of any form of diabetes mellitus requiring treatment with oral antidiabetic drugs and/or insulin following the index operation.

Endoscopic interventions and redo operations. Endoscopic retrograde cholangiopancreatography (ERCP) procedures with and without stent implantation following the index operation were also assessed. The indications for redo operations, their frequency, and the operative procedures performed were evaluated.

Statistical analysis. The sample size calculation was designed initially to show a difference in mean operating times of 1 hour with a standard deviation of 1 hour. A sample size of 65 randomized patients was needed to achieve power of 95% at a 2-sided significance level of 5% and to account for protocol violations and losses to follow-up. The statistical analysis in the present study was made on an intention-to-treat basis. To cope with the expected proportion of approximately 40% of patients lost to follow-up or dead after 10 years, data on outcome parameters are presented descriptively. A confirmatory analysis of long-term results was not planned. Statistical measurements, such as imputation, were made to minimize the risk of bias due to incomplete outcome data.[21]

Means with standard deviations or medians with ranges are reported for continuous variables. Absolute and relative numbers are shown for binary variables. The χ^2 test, Fisher exact test, or the Mann-Whitney *U* test were used as appropriate. Scoring procedures for the analysis of the quality of life questionnaires, EORTC QLQ-30 and PAN26, were performed according to the corresponding manual.[22] Statistics were calculated with SAS software (version 9.3; SAS Institute, Inc, Cary, NC).

RESULTS

The peri- and postoperative data, including operation time, durations of ICU stay, and total hospital stay, morbidity, mortality, and reoperations as well as quality of life after 24 months, have already been published in this journal.[16]

Follow-up and mortality. Follow-up examination was performed between April 16, 2014, and January 20, 2015. The median follow-up was 129 months (range 111–137 months). Forty of the 65 patients in the original study cohort (62%) were available for 10-year follow-up (Beger $n = 18$, Berne $n = 22$; Fig 2); 14 patients from the original study cohort (22%) were lost to follow-up (Beger $n = 5$, Berne $n = 9$), and the remaining 11 patients (17%) had died (Beger $n = 9/32$ [28%], Berne $n = 2/33$ [6%]; $P = .02$).

Mortality was related to CP in 2 patients of the Beger group and 1 patient of the Berne group, lung cancer in 1 patient of the Berne group, end-stage amyotrophic lateral sclerosis in 1 patient of the Beger group, and liver cirrhosis in 2 patients of the Beger group. Four patients died of unknown causes.

As shown in Table I, the study populations of the long-term follow-up were comparable regarding the distributions of age, sex, body mass index, alcohol consumption, and smoking status. Table II shows the quality of life data, while functional outcome parameters and reinterventions are summarized in Table III.

Quality of life, pain, and occupational disability. The quality of life scores (EORTC QLQ-C30 and PAN26) were well balanced between the 2 groups (Table II). Additionally, the patients in both groups displayed high median levels of physical, role, emotional, cognitive, and social functioning as well as a high median global health status. Regarding nausea and vomiting, pain, loss of appetite, diarrhea, and other relevant disorders that impair quality of life, the median severities of symptoms were rather low. In line with these results, the majority of patients in both study groups judged that the index operation had improved their quality of life (Beger $n = 16/18$ [89%], Berne $n = 15/22$ [68%]; $P = .15$; Table II).

The average daily pain ratings were similar in the 2 groups, both at rest (Beger 1.6 ± 2.6, Berne 1.0 ± 1.4; $P = .89$) and in motion (Beger 1.3 ± 2.2, Berne 1.2 ± 2.2; $P = .94$; Table III). Moreover, the mean pain ratings were relatively low in both groups, ranging from 1.0–1.6 (0 = no pain, 10 = worst possible pain). Ten patients of the Beger group (56%) and 12 patients of the Berne group (55%) were completely free of pain ($P = .94$), and the rates of patients with regular intake of analgesics compared well (Beger $n = 6/18$ [33%], Berne $n = 8/22$ [36%]; $P = .84$).

Regarding the number of patients with occupational disability due to pancreas-related morbidity, no difference was shown between the 2 procedures (Beger $n = 3/18$ [17%], Berne $n = 3/22$ [14%]; $P = 1.00$).

Exocrine and endocrine pancreatic function. Exocrine pancreatic insufficiency was similar in

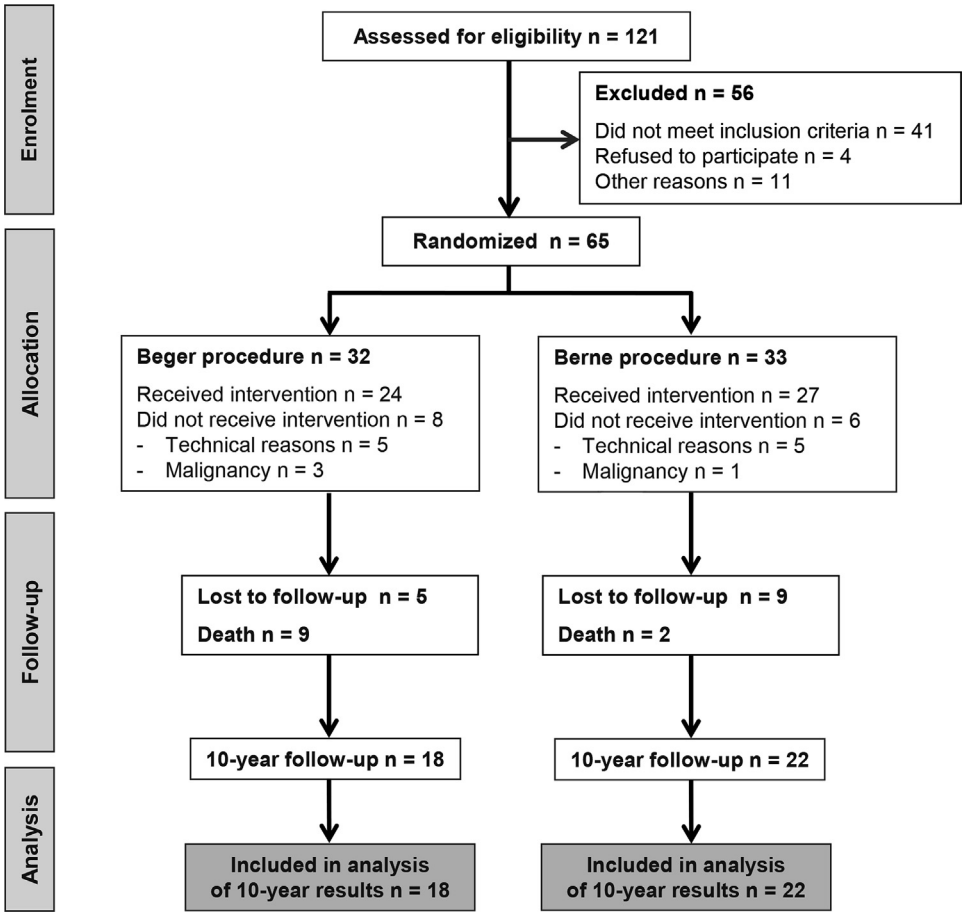

Fig 2. CONSORT flow chart.

Table I. Baseline data (last available follow-up)

	Beger (n = *18*)	*Berne* (n = *22*)
Age (y)	59 (45–75)	58 (23–75)
Sex (male:female)	12:6 (67%:33%)	16:6 (73%:27%)
Body mass index (kg/m^2)	23 (17–31)	23 (17–29)
Alcohol consumption		
Occasionally	7 (39%)	6 (27%)
Weekly	1 (6%)	4 (18%)
Daily	2 (11%)	4 (18%)
Amount (g alcohol/mo)	12.2 (0–1,140)	21.4 (0–798)
Current smoking status	13 (72%)	16 (73%)

Data are medians (with ranges) or numbers of patients (with percentages).

the 2 study groups (Beger $n = 15/18$ [83%], Berne $n = 15/22$ [68%]; $P = .46$). In the Beger group, 1 patient with steatorrhea did not take supplemental pancreatic enzymes. An additional 5 patients had ongoing clinical signs of pancreatic insufficiency, ie, steatorrhea and/or diarrhea despite enzyme supplementation. In the Berne group, 6 patients who were supplemented with pancreatic enzymes had ongoing diarrhea and/or steatorrhea, whereas all patients without enzyme supplementation denied any clinical signs of pancreatic insufficiency. In line with these results, median stool frequencies per day were similar in the 2 groups (Beger 2 [0–7], Berne 2 [1–8]; $P = .42$).

Regarding new onset of diabetes mellitus since the index operation, there was no difference between the groups (Beger $n = 6/18$ [33%], Berne $n = 12/22$ [55%]; $P = .31$). Among the patients with diabetes mellitus, only 1 from the Beger group had had pre-existing diabetes mellitus before the index operation. All of the other patients developed their diabetes mellitus afterwards, and all but 1 in each group were insulin-dependent.

Endoscopic interventions and redo operations. The number of patients undergoing ≥1 ERCP

Table II. Quality of life data (last available follow-up)

	Beger (n = *18*)	*Berne* (n = *22*)	P *value*
EORTC QLQ-C30			
Functioning scale			
Physical functioning	100.0 (60–100)	80.0 (33.3–100)	.38*
Role functioning	100.0 (0–100)	100.0 (0–100)	.32*
Emotional functioning	75.0 (8.3–100)	70.8 (0–100)	.85*
Cognitive functioning	100.0 (0–100)	100.0 (16.7–100)	.69*
Social functioning	66.7 (0–100)	91.7 (0–100)	.48*
Global health status/quality of life	66.7 (16.7–100)	70.8 (8.3–100)	.99*
Symptom scale/item			
Fatigue	33.3 (0–100)	33.3 (0–100)	.95*
Nausea and vomiting	0 (0–66.7)	0 (0–33.3)	.92*
Pain	33.3 (0–100)	0 (0–100)	.28*
Dyspnea	33.3 (0–100)	0 (0–100)	.09*
Insomnia	33.3 (0–100)	33.3 (0–100)	.73*
Loss of appetite	0 (0–100)	33.3 (0–100)	.39*
Constipation	0 (0–100)	0 (0–33.3)	.87*
Diarrhea	33.3 (0–100)	33.3 (0–100)	.61*
Financial problems	0 (0–100)	16.7 (0–100)	.55*
EORTC QLQ-PAN26			
Pancreatic pain	25.0 (0–100)	16.7 (0–75)	.82*
Digestive symptoms	16.7 (0–100)	25.0 (0–100)	.67*
Altered bowel habit	33.3 (0–100)	25.0 (0–100)	.91*
Hepatic symptoms	0 (0–100)	0 (0–50)	.40*
Body image	33.3 (0–100)	16.7 (0–100)	.58*
Satisfaction with health care	66.7 (0–100)	66.7 (0–100)	.20*
Sexuality	33.3 (0–100)	66.7 (0–100)	.24*
Index operation improved quality of life‡	16 (89%)	15 (68%)	.15†

*Mann-Whitney *U* test.
†Fisher exact test.
‡Additional question to EORTC questionnaires.
Data are medians (with ranges) or numbers of patients (with percentages). Scores range from 0–100, with a greater score representing a greater level of functioning or severity of symptoms.
EORTC QLQ-C30, Quality of life questionnaire of the European Organization for Research and Treatment of Cancer; *EORTC QLQ-PAN26*, the EORTC QLQ for patients with chronic pancreatitis.

procedure(s) during the follow-up period was similar in the 2 groups (Beger $n = 4/18$ [22%], Berne $n = 4/22$ [18%]; $P = 1.00$). Stent implantation was performed in 3 patients for treatment of persistent stenosis of the distal bile duct and cholestasis (Beger $n = 2/18$ [11%], Berne $n = 1/22$ [5%]; $P = .58$).

Five redo operations were performed in 4 patients, all of them in the Berne group (Beger $n = 0$, Berne $n = 4/22$ [18%]; $P = .11$). Importantly, each of these patients had been treated per protocol and thus, in fact, had undergone the Berne modification as index operation. Two of the procedures took place within the first 24 months after the index operation. Between 9 and 36 months after the Berne procedure, PD was performed for treatment of ongoing episodes of pancreatitis in 3 patients. One of these 3 patients underwent low anterior rectal resection for rectal carcinoma about 8 years after PD. During the postoperative course, the patient developed necrotizing pancreatitis of the tail of the pancreas, requiring relaparotomy and necrosectomy. The 4th patient also suffered ongoing CP and underwent the Beger procedure approximately 7 years after the Berne modification.

DISCUSSION

This 10-year follow-up is the first study presenting long-term RCT data comparing the Beger procedure and the Berne modification for operative treatment of CP. In the long-term, the 2 treatments yielded similar results regarding quality of life, pain relief, occupational disability, exocrine and endocrine pancreatic function and endoscopic interventions; redo operations were, however, more common after the Berne procedure.

Quality of life was improved for the majority of patients, as represented by high scores on

Table III. Functional outcome parameters and reinterventions (last available follow-up)

	Beger (n = *18*)	*Berne* (n = *22*)	P *value*
Average daily pain§			
At rest	1.6 ± 2.6	1.0 ± 1.4	.89*
In motion	1.3 ± 2.2	1.2 ± 2.2	.94*
No pain	10 (56%)	12 (55%)	.94‡
Regular analgesic medication	6 (33%)	8 (36%)	.84†
New onset of diabetes mellitus	6 (33%)	12 (55%)	.31‡
Exocrine pancreatic insufficiency‖	15 (83%)	15 (68%)	.46†
Supplementation of pancreatic enzymes	14 (78%)	15 (68%)	.72†
Steatorrhea	4 (22%)	4 (18%)	1.00†
Diarrhea	2 (11%)	4 (18%)	.67†
Daily stool frequency	2 (0–7)	2 (1–8)	.42*
ERCP performed	4 (22%)	4 (18%)	1.00†
Stent implantation performed	2 (11%)	1 (5%)	.58†
Redo operations	0 (0%)	4 (18%)	.11†
Occupational disability	3 (17%)	3 (14%)	1.00†

*Mann-Whitney *U* test.
†Fisher exact test.
‡χ^2 test.
§Numerical rating scale ranging from 0 (no pain) to 10 (worst possible pain).
‖Defined as need for pancreatic enzyme supplementation and/or presence of steatorrhea and/or diarrhea.
Data are means (with standard deviations), medians (with ranges), or numbers of patients (with percentages).
ERCP, Endoscopic retrograde cholangiopancreatography(ies).

functioning scales and low scores on symptom scales/items in both groups. Given that the validated EORTC questionnaires used in this study are regarded as the best available instruments for quality of life assessment in pancreatic research,[20,23] quality of life is one of the most valid and relevant end points of this study.

In line with the 2-year follow-up results,[16] EORTC QLQ-C30 scores were similar in the 2 groups 10 years after the Beger and Berne procedures, the superiority shown by the Berne group in terms of EORTC QLQ-PAN26 scores 2 years after the index operation was no longer present at 10 years. The long-term functioning and symptom scale scores compare well with those reported by Strate et al[14] in patients 8 years after the Beger and Frey procedures.

More than half of the patients in this study were completely pain free, which is in line with other studies reporting the pain status after PD and DPPHR.[24] Moreover, compared with the natural course of CP which is characterized by ongoing pain in the majority of patients after more than 10 years,[25] these findings underscore that patients with pain benefit from DPPHR.

Quality of life and pain relief are regarded commonly as the main criteria for a successful operations for CP, because good long-term quality of life and permanent pain relief are considered of paramount importance for patients undergoing DPPHR for treatment of CP.[6,15] Within this context, the results of this study showing low pain ratings as well as good and postoperatively improved quality of life in both groups underpin the impact of pain on quality of life, justifying pain relief and improvement of quality of life as the principal aims of operative intervention for this indication.

The results of this study are also in line with the literature with regard to exocrine and endocrine pancreatic function, indicating that in the long term, the loss of exocrine and endocrine function cannot be halted, regardless of the resection procedure and despite the organ-sparing character of DPPHR—although endocrine function is retained longer.[14] The impact of an operative intervention on exocrine and endocrine pancreatic function may be ameliorated in the future by operating earlier in the disease course.[26] Beyond this, due to variability in definitions and assessment of exocrine and endocrine insufficiency, interstudy heterogeneity must be considered when comparing existing evidence.

In contrast to other long-term follow-up studies reporting reoperation in 12–13% of patients up to 14 years after the Beger procedure,[14,27] none of the evaluable patients in our study's Beger group and 4 patients of the Berne group (18%) underwent a redo operation for treatment of recurrent or persistent symptoms of CP. The fact that all

four of these patients had been treated per protocol raises the question of whether inflamed pancreatic tissue remained after the Berne procedure.

As histopathologic or appropriate radiologic examinations giving insights into the postoperative state of the remaining pancreatic tissue do not exist, a clear differentiation between symptoms due to residues of chronic inflamed tissue and a recurrence of pancreatitis in previously unaffected pancreatic tissue is not possible in these patients. Two of these patients remained recurrence free for about 1 and 6 years after the Berne procedure, respectively. In contrast, the 2 other patients reported ongoing abdominal pain and showed signs of CP in computed tomography examinations 5 and 9 months after the index operation, respectively.

Thus, considering the organ-sparing character of the procedure, residual CP seems probable and clinically relevant in these patients. However, this finding must be interpreted cautiously because trials of greater sample sizes would be needed.

A potential limitation of the present study is the fact that the outcome parameters were assessed by means of questionnaires, implying a certain degree of bias due to the subjective character of the patient's answers. To counteract other relevant sources of bias, such as detection bias, the investigator responsible for the assessment of data was blinded to group allocation. A further shortcoming of this study in common with previous studies providing long-term data on RCTs investigating DPPHR,[14,24,27,28] derives from the fact that not all of the patients in the initial study groups were available for long-term follow-up.

Consequently, the statistical analysis was performed by descriptive and not confirmative methods. This approach means that although they formally attain statistical significance, the differences in rates of mortality must be interpreted with caution. Furthermore, CP-associated mortality was confirmed in only 2 patients of the Beger group and 1 patient of the Berne group, which underlines the absolute necessity of following up patients undergoing DPPHR for treatment of CP, which is a risk factor for pancreatic carcinoma.[25]

In conclusion, this study presents the first long-term data comparing the outcomes of the Beger procedure and the Berne modification. The data indicate that both approaches provide good long term quality of life and pain relief, the main goals of operative intervention in patients with CP. Thus, these follow-up results reinforce the existing evidence of beneficial short-term and long-term results of the various forms of DPPHR for treatment of CP.

The outstanding results of the multicenter ChroPac trial, investigating the quality of life after DPPHR compared with PD in a total of 250 patients, will add to this evidence.[29] Importantly, in view of the complex nature of the disease and the demanding technical steps of these DPPHRs, variation in techniques of DPPHR seems justified to ensure safe and effective treatment of patients with CP.

In this context, aside from the original Beger procedure and the Berne modification, the Frey procedure also shows beneficial short- and long-term results[12-15,30] and represents another important treatment option in duodenum-preserving pancreatic operations; these subtotal resections round the armamentarium in today's high-volume centers—with preference of the Frey procedure in the United States and Asia and the Beger and Berne procedures are performed more widely in Europe. This "Atlantic divide" may have historic and pathomorphologic reasons, because in Europe, patients with CP present more often with pancreatic head masses compared with most patients in North America.[31]

To account for the importance of the various operative approaches, in the multicenter ChroPac trial aiming at identifying the best operative strategy in the treatment of CP, patients allocated to DPPHR were treated by the Beger procedure or its modifications according to either Frey and Smith[9] or Gloor and coworkers[11] from Berne—depending on the surgeon's preference and the individual patient. Thus, debate on the best operative strategy has not been determined as of yet, and there remains controversy over which modification to perform as long as evidence on long-term data of DPPHR is lacking.

This RCT shows superior short-term results of the Berne modification in terms of operation time and duration of hospital stay; as such, the Berne operation probably should be preferred to the Beger procedure whenever possible, depending on the individual surgeon's expertise and the intraoperative findings.

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