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The Optimal Management of Distal Pancreatic Stump After Pancreatico-Duodenectomy: Different Indications for Gastric and Jejunal Anastomoses

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Rezumat

Tratamentul optim al bontului pancreatic distal după duodenopancreatectomia cefalică: anastomozele cu jejunul și cele cu stomacul au indicații diferite

Introducere: Tratamentul optim al bontului pancreatic distal după duodenopancreatectomia cefalică (DPC) rămâne neclar. Studiul îşi propune să compare rezultatele postoperatorii imediate după anastomozele pancreasului distal cu jejunul vs. anastomozele cu stomacul într-o serie relativ mare de pacienți cu DPC.
Pacienți şi Metodă: Au fost re-evaluate datele tuturor pacienților cu DPC operați în perioada 1 octombrie 2016 – 1 octombrie 2021: s-au făcut comparații între grupul pacienților cu anastomoze ale bontului pancreatic distal cu jejunul (grupul PJ) şi grupul pacienților cu anastomoze gastrice (grupul PG).
Rezultate: S-au efectuat 360 DPC: anastomoze ale bontului pancreatic cu jejunul (grupul PJ) – 293 pacienți (81,4%) şi cu stomacul (grupul PG) – 67 pacienți (18,6%). Nu s-au constatat diferențe semnificative statistic între cele două grupuri de pacienți în ceea ce priveşte complicatiiile postoperatorii imediate (valori $p \geq 0.065$), cu excepția stazei gastrice clinic manifeste care a fost semnificativ mai mare în grupul pacienților cu anastomoze cu stomacul (38,8% vs. 25,9%, $p = 0,049$). În grupul anastomozelor cu stomacul au fost semnificativ statistic mai mulți pacienți cu prezervare de pilor (19,4% vs. 8,2%, $p = 0,012$), pancreas cu textura moale (76,1% vs. 34,4%, $p < 0,001$), duct Wirsung mic (4 mm (0 – 25) vs. 3 mm (1 – 10), $p < 0,001$) şi scoruri intermediare şi de risc crescut pentru fistulă pancreatică (83,6% vs. 52,6%, $p < 0,001$).

Concluzii: Nici una dintre tehnicile chirurgicale efectuate nu scuteşte pacientul de complicații postoperatorii. Pentru pacienții cu textura tare a pancreasului şi duct Wirsung dilatat anastomoza „duct-to-mucosa" a bontului pancreatic distal cu jejunul ar trebui să fie prima opțiune, în timp ce pentru pacienții cu textura moale a pancreasului şi duct Wirsung de mici dimensiuni anastomoza bontului pancreatic distal prin invaginație cu stomacul ar fi de preferat.

Cuvinte cheie: duodenopancreatectomie cefalică, pancreatico-jejunoanastomoză, pancreato-gastroanastomoză, complicații postoperatorii, risc crescut de fistulă pancreatică, fistulă pancreatică

Abstract

Background/Aim: The optimal management of distal pancreatic stump after pancreatico-duodenectomies (PD) remains unclear. The study aims to assess the early outcomes after anastomoses with jejunum vs. stomach of the distal pancreatic stump in a relatively large series of patients with PD.

Patients and Methods: All patients with PD performed between Oct 1, 2016, and Oct 1, 2021, were retrospectively assessed: anastomoses with the jejunum (PJ group) vs. with the stomach (PG group). Results: A number of 360 PD: PJ group – 293 patients (81.4%) and PG group – 67 patients (18.6%). No statistically significant differences were observed between the groups regarding the early outcomes (p values ≥ 0.065), except for the clinically relevant delayed gastric emptying higher rates in the PG group (38.8% vs. 25.9%, $p = 0.049$). In the PG group there were statistically significant higher rates of pylorus-preservation (19.4% vs. 8.2%, $p = 0.012$), soft pancreas texture (76.1% vs. 34.4%, $p < 0.001$), small Wirsung ducts (4 mm (0-25) vs. 3 mm (1-10), $p < 0.001$) and intermediate and high-risk fistula scores (83.6% vs. 52.6%, $p < 0.001$).

Conclusions: No particular anastomotic technique can avoid postoperative complications. In patients with hard pancreas texture and dilated Wirsung duct, a duct-to-mucosa PJ anastomosis should be the first option, while for patients with small Wirsung duct and soft pancreas texture, an invagination PG anastomosis should be preferred.

Key words: pancreatico-duodenectomy, pancreatico-jejunal anastomoses, pancreatico-gastroanastomoses, high-risk fistula scores, morbidity, pancreatic fistula

Introduction

Pancreatico-duodenectomy (PD) is a complex surgical procedure that is widely accepted to be associated with increased rates of postoperative complications and non-neglectable mortality rates related to the surgical technique. Thus, even in very high-volume centers, the postoperative in-hospital mortality rates after PD varies between 1.7% and 3.9%, while the morbidity rates vary between 40 % to 73% (1-7). Although patient characteristics and the quality of pre and postoperative management are essential determinants of morbidity and mortality after PD, the surgical technique remains an important source of postoperative complications and one of the leading causes of postoperative death (1;3-5).

Postoperative pancreatic fistula (POPF) represents one of the most critical sources of morbidity and mortality after PD (1-7). A clinically relevant POPF may lead to other severe complications such as postoperative delayed gastric emptying (DGE), pancreatic hemorrhage (PPH), and sepsis, including multiple organ dysfunctions and death (4;8;9). Thus, optimal distal pancreatic stump management is of utmost importance to mitigate the clinical consequences of a POPF after PD.

Nowadays, there are two main approaches

for the distal pancreatic stump after PD: anastomoses with the jejunum or with the stomach. It is still unclear which of the two methods is the safest in terms of early postoperative outcomes because the data from current literature comparing the two approaches reached conflicting results (10-12). Thus, the debate regarding the best anastomosis of the distal pancreatic stump after PD remains open.

The present study aims to assess the early outcomes after distal pancreatic stump anastomoses with the jejunum vs. distal pancreatic stump anastomoses with the stomach in a relatively large series of patients with PD performed in a single surgical center.

Patients and Methods

The data of all patients with PD performed between Oct 1, 2016, and Oct 1, 2021, in our surgical center were retrospectively assessed from a prospectively maintained electronic database established in Fundeni Clinical Institute and the Romanian National Registry of Pancreatic Resections (13). Patients with total pancreatectomies were excluded, and those with PD without distal pancreatic stump digestive anastomoses.

The analyzed data included preoperative (demographics, indications of surgery, comorbidities), intraoperative parameters (operative time, blood loss, details of technique), and early postoperative outcomes. The early morbidity and mortality were defined as in-hospital. The Dindo classification and grading of postoperative complications were used (14). A complication grade 3 or 4 was considered a severe complication (14). For the specific post-pancreatectomy complications such as POPF (15), PPH (16), and DGE (17), the definitions and grading of the International Study Group for Pancreatic Surgery were used.

The patients were split into two groups: patients with distal pancreatic stump anastomoses with the jejunum (PJ group) and patients with distal pancreatic stump anastomoses with the stomach (PG group). The choice of the stomach or jejunum of the distal pancreatic stump anastomoses was made mainly according to the surgeon's expertise and preference. The two groups of patients' pre, intra, and postoperative data were comparatively assessed.

Statistical Analysis

Data are expressed as number (percentage) for the categorical variables and as median (range) for the continuous variables. The comparisons between the groups were made using the Mann-Whitney test (for the continuous variables) and the Fisher's exact test, two-tailed (for the categorical variables). P values less than 0.05 were considered statistically significant.

Results

During the analyzed period, in our center, there was performed a number of 363 PD. The analyses excluded three patients without distal pancreas stump digestive anastomoses. Thus, the cohort included a number of 360 patients with PD that were split into two groups: the PJ group – 293 patients (81.4%) and the PG group – 67 patients (18.6%).

Demographics and Preoperative Parameters

No statistically significant differences were observed between the PJ and PG groups of patients regarding the main demographics and preoperative parameters (p values ≥ 0.103), as shown in *Table 1.*

Intraoperative Data

No statistically significant differences were observed between the PJ and PG groups of patients regarding the indication for PD from the point of view of pathology, associated procedures, use of Wirsung duct stents, operative time, and estimated blood loss (p values ≥ 0.218), as shown in *Table 2.*

Preservation of the pylorus rate during PD was statistically significantly higher in the PG group of patients compared with the PJ group

Table 1. Comparative analyses of demographics and pre-operative parameters between the PJ and the PG groups of patients with PD (293 patients vs. 67 patients)

Parameter	PJ group (293 patients)	PG group (67 patients)	P value
Age, years	63 (26 – 82)	64 (37 – 77)	0.596, ns
Male sex	182 patients (62.1%)	40 patients (59.7%)	0.780, ns
Body mass index, kg/ m2	24.5 (15.1 – 49.6)	25.2 (19.3 – 42.8)	0.152, ns
Smoking	86 patients (29.4%)	21 patients (31.3%)	0.767, ns
Alcohol abuse	72 patients (24.6%)	16 patients (23.9%)	1, ns
Cardiovascular co-morbidities	155 patients (52.9%)	43 patients (64.2%)	0.103, ns
Diabetes mellitus	68 patients (23.2%)	14 patients (20.9%)	0.748, ns
Jaundice at the time of resection	132 patients (45.1%)	31 patients (46.3%)	0.892, ns
Pre-operative biliary drainage	72 patients (24.6%)	16 patients (23.9%)	1, ns
Neoadjuvant treatment	9 patients (3.1%)	0 patients (0%)	0.219, ns
ASA score ≥ 3	143 patients (48.8%)	34 patients (50.7%)	0.782, ns
Emergency surgery	6 patients (2%)	3 patients (4.5%)	0.645, ns

PJ – distal pancreatic stump anastomoses with the jejunum; PG – distal pancreatic stump anastomoses with the stomach; ASA – American Society of Anesthesiologists; PD – pancreaticoduodenectomy

Table 2. Comparative analyses of intraoperative parameters between the PJ and the PG groups of patients with PD (293 patients vs. 67 patients)

Parameter	PJ group (293 patients)	PG group (67 patients)	P value
Pylorus-preserving PD	24 patients (8.2%)	13 patients (19.4%)	0.012
Venous resection	53 patients (18.1%)	2 patients (3%)	< 0.001
Associated procedures	39 patients (13.3%)	9 patients (13.4%)	1, ns
Duct-to-mucosa anastomosis Invagination	254 patients (85.3%) 39 patients (14.7%)	3 patients (10.4%) 64 patients (89.6%)	< 0.001
Use of Wirsung duct stents	171 patients (58.4%)	33 patients (49.3%)	0.218, ns
Soft pancreas texture	124 patients (34.4%)	51 patients (76.1%)	< 0.001
Wirsung duct diameter, mm	4 (0-25)	3 (1 – 10)	< 0.001
Operative time, min	300 (135 – 630)	300 (120 – 620)	0.312, ns
Estimated blood loss, ml	400 (150 – 18 500)	400 (150 – 2100)	0.502, ns
Malignant pathology	232 patients (79.2%)	58 patients (74.6%)	0.230, ns
Intermediate and high-risk fistula scores (18)	154 patients (52.6%)	56 patients (83.6%)	< 0.001

PJ – distal pancreatic stump anastomoses with the jejunum; PG – distal pancreatic stump anastomoses with the stomach; PD - pancreaticoduodenectomy

of patients (19.4% vs. 8.2%, p = 0.012) (*Table 2, Fig. 1*).

Associated venous resection rate during PD was statistically significantly higher in the PJ group of patients compared with the PG group of patients (18.1% vs. 3%, p < 0.001) (*Table 2, Fig. 1*).

Soft pancreas texture and small Wirsung ducts rates were statistically significantly higher in the PG group of patients compared with the PJ group of patients (76.1% vs. 34.4%, p < 0.001 and 4 mm (0-25) vs. 3 mm (1 -10), p < 0.001, respectively) (*Table 2, Fig. 1-2*). Furthermore, statistically significant higher

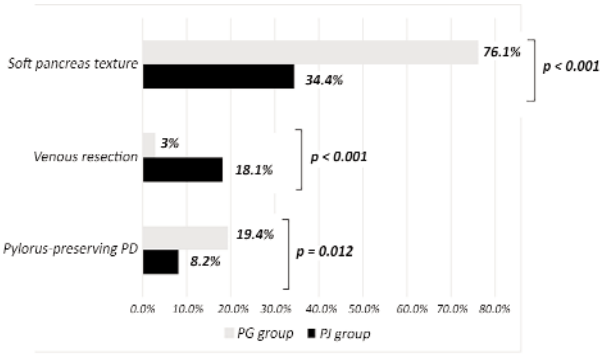

Figure 1. Comparative analyses of the soft pancreatic texture, venous resection and pylorus preservation between the PJ and the PG groups of patients with PD (293 patients vs. 67 patients) (PJ – pancreatico-jejunal anastomoses; PG -pancreatico-gastroanastomoses; PD – pancreatico-duodenectomy)

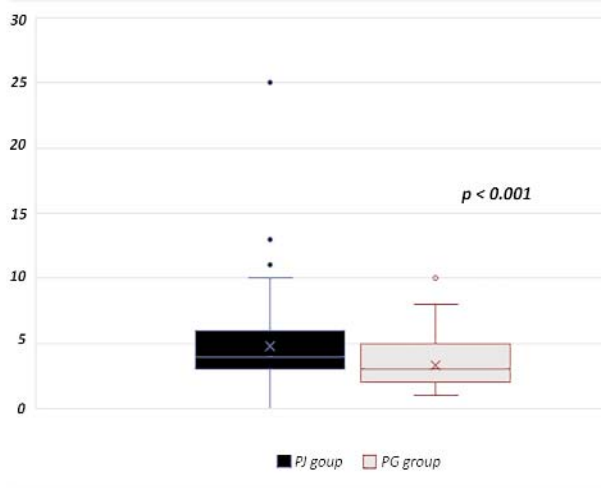

Figure 2. Comparative analyses of the Wirsung duct diameter between the PJ and the PG groups of patients with PD (293 patients vs. 67 patients) (PJ – pancreatico-jejunal anastomoses; PG -pancreatico-gastroanastomoses; PD – pancreatico-duodenectomy)

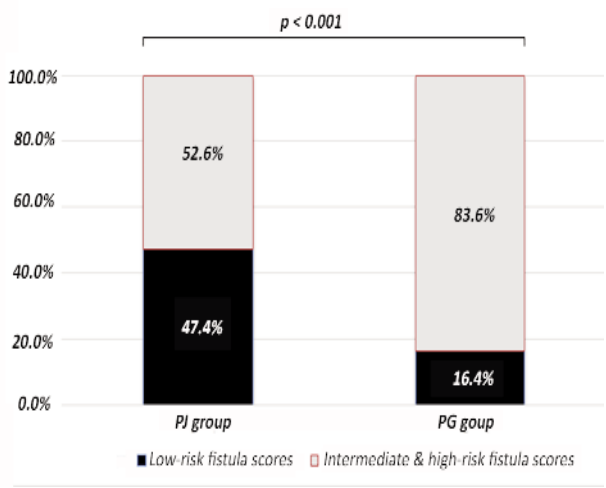

Figure 3. Prevalence of low-risk and intermediate & high-risk fistula scores in the PJ and the PG groups of patients with PD (293 patients vs. 67 patients) (PJ – pancreatico-jejunal anastomoses; PG -pancreatico-gastroanastomoses; PD – pancreatico-duodenectomy)

rates of patients with intermediate and high-risk fistula scores (18) were in the PG group compared with the PJ group of patients (83.6% vs. 52.6%, p < 0.001) (*Table 2, Fig. 3*).

It is worth mentioning also that, from a technical point of view, there were few statistically significant differences between the PJ and the PG groups of patients (p < 0.001) (*Table 2*). Thus, when the distal pancreatic stump was anastomosed with the jejunum, the preferred technique was duct-to-mucosa (254 patients – 85.3%), while when the stomach was considered, the invagination technique was predominantly used (64 patients – 89.63%), as shown in *Table 2* and *Fig. 4*.

Early Postoperative Outcomes

No statistically significant differences were observed between the PJ and PG groups of patients regarding the early postoperative outcomes (p values ≥ 0.065), except for the clinically relevant DGE rates, which were statistically significantly higher in the PG group of patients compared with the PJ group of patients (38.8% vs. 25.9%, p = 0.049) (*Table 3, Fig. 5*).

Subgroup analyses of early postoperative outcomes of patients with high-risk fistula scores

A comparative analysis of the early outcomes between the PJ and PG anastomoses was made in the subgroup of patients with high-risk fistula scores. In the whole cohort, a number of 22 patients (6.1%) have been classified as having high-risk fistula scores

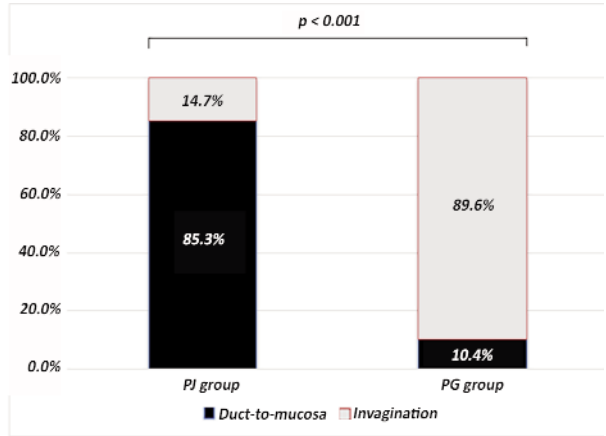

Figure 4. Prevalence of the type of anastomosis (duct-to-mucosa and invagination) in the PJ and the PG groups of patients with PD (293 patients vs. 67 patients) (PJ – pancreatico-jejunal anastomoses; PG -pancreatico-gastroanastomoses; PD – pancreatico-duodenectomy)

Table 3. Comparative analyses of early postoperative outcomes between the PJ and the PG groups of patients with PD (293 patients vs. 67 patients)

Parameter	PJ group (293 patients)	PG group (67 patients)	P value
Overall complications	212 patients (72.4%)	55 patients (82.1%)	0.121, ns
Severe complications (i.e., grade 3-4 Dindo)	51 patients (17.4%)	9 patients (13.4%)	0.585, ns
In-hospital mortality	26 patients (8.9%)	7 patients (10.4%)	0.643, ns
Clinically relevant POPF (i.e., grade B-C)	95 patients (32.4%)	21 patients (31.3%)	1, ns
Clinically relevant DGE (i.e., grade B-C)	76 patients (25.9%)	26 patients (38.8%)	0.049
Clinically relevant PPH (i.e., grade B-C)	34 patients (11.6%)	12 patients (17.9%)	0.161, ns
Re-laparotomy for complications	40 patients (13.7%)	9 patients (13.4%)	1, ns
Postoperative hospital stays, days	16 (1 – 123)	18 (1 – 60)	0.065, ns

PJ – distal pancreatic stump anastomoses with the jejunum; PG – distal pancreatic stump anastomoses with the stomach; POPF – postoperative pancreatic fistula; DGE – delayed gastric emptying; PPH – post pancreatectomy hemorrhage; PD - pancreaticoduodenectomy

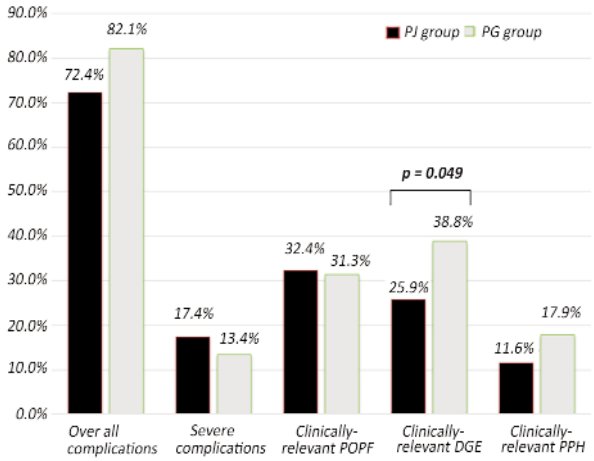

Figure 5. Comparative analyses of the overall and severe complications, clinically relevant POPF, DGE and PPH between the PJ and the PG groups of patients with PD (293 patients vs. 67 patients) (PJ – pancreatico-jejunal anastomoses; PG -pancreatico-gastroanastomoses; POPF – postoperative pancreatic fistula; DGE – delayed gastric emptying; PPH – post-pancreatectomy hemorrhage; PD – pancreatico-duodenectomy)

(18): 16 patients (5.5%) in the PJ group and six patients (9%) in the PG group (p = 0.266, ns). No statistically significant differences were observed between the PJ and PG groups of patients regarding the early outcomes (p values ≥ 0.333) (*Table 4*).

Discussions

A recent meta-analysis including 63 229 patients with PD has shown in-hospital mortality rates between 1.8% and 3.7% and overall morbidity rates between 46.4% and 62.8% (19). However, real-world data show even higher postoperative mortality rates after PD, up to 15.5% (9,20-22). The relatively high rates of in-hospital mortality in the present cohort might be explained by the heterogeneity of the operating surgeons

Table 4. Comparative analyses of early postoperative outcomes between the PJ and the PG groups of patients with PD in the subgroup of patients with high-risk fistula scores (16 patients vs. 6 patients)

Parameter	PJ group (16 patients)	PG group (6 patients)	P value
Overall complications	15 patients (93.8%)	5 patients (83.3%)	0.480, ns
Severe complications (i.e., grade 3-4 Dindo)	3 patients (18.8%)	0 patients (0%)	0.532, ns
In-hospital mortality	6 patients (37.5%)	1 patient (16.7%)	0.615, ns
Clinically relevant POPF (i.e., grade B-C)	8 patients (50%)	1 patient (16.7%)	0.333, ns
Clinically relevant DGE (i.e., grade B-C)	7 patients (43.8%)	2 patients (33.3%)	1, ns
Clinically relevant PPH (i.e., grade B-C)	3 patients (18.8%)	0 patients (0%)	0.532, ns
Re-laparotomy for complications	5 patients (31.3%)	1 patient (16.7%)	0.634, ns
Postoperative hospital stays, days	19 (1 – 52)	18 (10 – 30)	0.582, ns

PJ – distal pancreatic stump anastomoses with the jejunum; PG – distal pancreatic stump anastomoses with the stomach; POPF – postoperative pancreatic fistula; DGE – delayed gastric emptying; PPH – post pancreatectomy hemorrhage; PD – pancreaticoduodenectomy

regarding the expertise for such a complex procedure. Surgeons' experience with PD is highly correlated with postoperative outcomes even in a high-volume center (3,23).

In the present study, there were no statistically significant differences between the PJ and PG groups of patients regarding postoperative mortality. This feature might be explained by the fact that there were no significant differences between the two groups regarding factors that are widely considered to be associated with mortality after PD, such as obesity, ASA score ≥ 3, smoking status, advanced age, female sex, neoadjuvant therapies, non-malignant indications for surgery, clinically-relevant POPF and PPH (4;5;24;25) (*Table 1-2*).

POPF remains a leading and potentially harmful complication after PD, with clinically relevant rates around 20% (8,26-28) and a significant cause of postoperative mortality (4,18). The source of POPF after PD is mainly related to the distal pancreatic stump digestive anastomosis.

In the present study, there were no differences between the PJ and PG groups of patients regarding the clinically relevant POPF, PPH, overall and severe morbidity rates (*Table 3, Fig. 5*). Although there were no significant differences between the groups for a few well-known predictors of morbidity after PD such as sex, age, body mass index, diabetes mellitus, ASA classification, neoadjuvant therapy, preoperative biliary drainage, blood loss and pathology (9,24,26,28) (*Tables 1, 2*), however, these findings are exciting taking into consideration the fact that the PG group of patients have had statistically significantly higher rates of soft pancreas (76.1% vs. 34.4%, $p < 0.001$), small Wirsung duct (4 mm (0 – 25) vs. 3 mm (1 – 10), $p < 0.001$) and intermediate and high-risk fistula scores (83.6% vs. 52.6%, $p < 0.001$), compared with the PJ group of patients (*Table 2*, Figs. 1-3). A strong correlation was observed between the fistula risk score and the development of clinically relevant POPF after PD. Thus, patients with intermediate and high-risk fistula scores exhibit increased rates of clinically relevant POPF after PD, up to 100% (18;20). Soft pancreas and small Wirsung duct are widely accepted risk factors for postoperative morbidity after PD, particularly for POPF (24,26-29). Taking into consideration the aspects mentioned earlier, one might consider that PG anastomoses are associated with better early postoperative outcomes than PJ anastomoses after PD for patients with intermediate and high-risk fistula scores, particularly for patients with small Wirsung duct and soft pancreas.

Interestingly, the associated venous resection rate during PD was statistically significantly higher in the PJ group of patients compared with the PG group of patients (18.1% vs. 3%, $p < 0.001$) (*Table 2, Fig. 1*). Thus, one might expect to have in the present cohort higher rates of morbidity and mortality rates in the PJ group of patients. A recent meta-analysis associated venous resection during PD with increased rates of morbidity and mortality (30). However, our previous studies failed to show any statistically significant differences in overall and severe morbidity and mortality rates between the patients with PD with and without venous resection (31).

In the present study, the patients of the PG group have had statistically significantly higher rates of clinically relevant DGE compared with the PJ group of patients (38.8% vs. 25.9%, $p=0.049$) (*Table 3, Fig. 5*). One explanation of this finding may be related to the statistically significantly higher rates of pylorus-preserving PD in the PG group of patients, compared with the PJ group (19.4% vs. 8.2%, $p = 0.012$). (*Table 2, Fig. 1*). A meta-analysis by Huttner and co-workers associated pylorus-preservation with increased rates of DGE after PD (32). However, recent data have shown no correlation between pylorus preservation during PD with increased rates of DGE (33). Nevertheless, recent data from the German Pancreas Registry have associated PG anastomoses with increased rates of clinically relevant DGE, as was the case in the present study (33). It is worth mentioning that a study published in 2017 by Vandermeeren and co-workers associated PG anastomoses with decreased rates of DGE (34).

Few previously published studies compare PJ and PG anastomoses during PD, with conflicting reporting results (10-12). Thus, a recent review has analyzed the results of the randomized controlled trials and the meta-analyses of randomized controlled trials comparing PJ with PG anastomoses during PD, showing that in three of the randomized controlled trials, the POPF rates were significantly lower for the PG anastomoses while in the other seven trials there were no significant differences. Interestingly, the meta-analyses published before 2016 showed significantly lower rates of POPF for PG anastomoses, while the meta-analyses published after 2016 showed no significant differences. The overall morbidity and mortality rates were not significantly different between PG and PJ anastomoses (22), as in the present study (*Table 3*). Recent data from a randomized clinical trial (35) and a meta-analysis (36) comparing PJ and PG anastomoses during PD did not find any significant differences in overall complications, POPF, DGE, PPH, and reoperation rates. It is worth mentioning that a recent Swedish Nationwide Register-based study has found the PJ anastomoses as an independent risk factor for POPF after PD (9), while PG anastomoses were associated with increased rates of PPH in a recent meta-analysis (10).

Most of the previously published studies comparing PJ and PG anastomoses during PD included heterogeneous groups of patients concerning potential factors that could alter the outcomes, including technical issues, characteristics of the pancreatic gland, and perioperative management (37). Only a few studies included patients with high-risk only fistula scores. Thus, in a recent randomized controlled trial comparing the outcomes of PJ and PG anastomoses in the group of patients with PD and high-risk fistula scores, no significant differences were observed for the clinically relevant POPF, DGE, and re-laparotomy rates (20), as it was the case in the present study (*Table 4*). At odds with our study, the previously published study has observed statistically significant higher rates of severe complications and clinically relevant PPH in the PG group of patients (20). A case-matched study published in 2022 by Garnier and co-workers did not find any significant differences between PG and PJ groups of patients with high-risk fistulas scores for overall severe morbidity, clinically relevant POPF, DGE, PPH, and reintervention rates (38), as it was the case in the present study (*Table 4*).

The present study has a few limitations: its retrospective design, the heterogeneity of surgeon's experience for PD, the choice for PJ or PG anastomoses was mainly done based on the surgeon's preference and expertise and not on objective criteria, the small number of patients in the analyzed subgroups of patients with high-risk fistula scores (*Table 4*) and the heterogeneity of both PJ and PG anastomoses (including duct-to-mucosa and invagination techniques all together). In the present study, there were significant differences in duct-to-mucosa and invagination techniques in both PJ and PG groups of patients (*Table 2, Fig. 4*). Invagination was associated with statistically significantly lower rates of POPF compared with the duct-to-mucosa anastomosis in a meta-analysis of randomized controlled trials published by Cao and co-workers in 2020, particularly in patients with soft pancreas texture (39). However, Li and co-workers published a meta-analysis of randomized controlled trials in 2022, showing no significant differences between duct-to-mucosa and invagination techniques concerning POPF, DGE, PPH, and reoperation rates after PD (36).

Conclusions

Distal pancreatic stump anastomoses remain the Achilles' heel of PD. The surgeon's expertise highly influences the choice of PG or PJ anastomoses. However, a tailored approach to the patient's profile is recommended because no particular method is optimal for all conditions, and no particular anastomotic technique can avoid postoperative complications, including postoperative mortality.

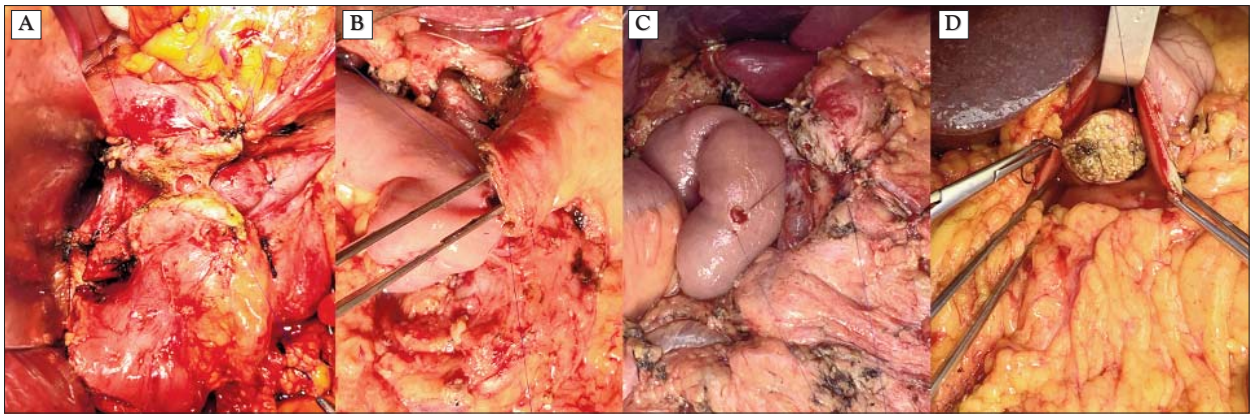

Figure 6. Intraoperative aspects of a duct-to-mucosa pancreatico-jejunal anastomosis in a patient with hard pancreas texture and dilated Wirsung duct (**A-C**) and an invagination pancreato-gastrostomy in a patient with soft pancreas texture and small Wirsung duct diameter (**D**)

Different anastomotic techniques for the distal pancreatic stump during PD have both advantages and disadvantages. Based on our experience, including the results of the present study, a few recommendations might be suggested: in patients with hard pancreas texture and dilated Wirsung duct, a duct-to-mucosa PJ anastomosis should be the first option of reconstruction, while for patients with small Wirsung duct and soft pancreas texture an invagination PG anastomosis should be preferred (*Fig. 6*).

Conflicts of Interests

The authors declare that they have no conflict of interest.

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