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COMPARISON OF ROUX-EN-Y VERSUS SINGLE LOOP RECONSTRUCTION IN PANCREATICODUODENECTOMY

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ABSTRACT

Background: Despite advances reducing pancreaticoduodenectomy (PD) mortality to <5%, postoperative pancreatic fistula (POPF) remains a leading source of morbidity. Roux-en-Y pancreaticojejunal reconstruction (RYPJ) has been proposed to divert bile and lower PF risk, but direct comparisons with conventional continuous loop anastomosis (CPJ) are scarce.

Methods: In this single-center retrospective study (2020–2024), we reviewed 108 PDs data out of 130 total cases performed. Patients were grouped by reconstruction type: RYPJ (n=53) versus CPJ (n=55). All underwent duct-to-mucosa pancreatojejunostomies. Primary endpoint was ISGPF-defined POPF rate; secondary endpoints included overall morbidity, operative time, estimated blood loss, length of stay, incidence of delayed gastric emptying and 30-day mortality.

Results: Baseline demographics, tumor characteristics, pancreatic duct diameter, and gland texture were comparable. PF occurred in 11 patients (10.2%): 5/53 (9.4%) IPJ versus 6/55 (10.9%) CPJ (p=0.800). Overall morbidity was 32/108 (29.6%) (IPJ 32% vs CPJ 27.3%, p=0.674). Operative mortality was 3.7% in both groups (p=1.000). Mean blood loss did not differ (350 mL vs 330 mL, p=0.780). IPJ added 72 minutes to OR time (442 ± 32 min

vs 370 ± 38 min, p=0.005) without shortening hospital stay (9.5 ± 5.0 d vs 10.1 ± 3.7 d, p=0.483).
Conclusion: Isolated Roux-en-Y reconstruction prolongs operative time but does not reduce PF, morbidity, or mortality compared with single-loop CPJ. Routine use of IPJ after PD is not supported by these findings.

INTRODUCTION

Pancreaticoduodenectomy (PD), or the Kausch-Whipple procedure, is a technically demanding resection indicated for malignancies of the pancreatic head, periampullary region, duodenum, and distal bile duct, and in select cases of trauma or chronic pancreatitis(1). Although specialized centers have driven perioperative mortality below 5%, overall morbidity remains as high as 60%(2, 3). Two of the most feared complications are postoperative pancreatic fistula (POPF), which occurs in up to 30% of patients and predisposes to sepsis and hemorrhage(4), and delayed gastric emptying (DGE), affecting 13.8% to over 40% of cases and prolonging hospitalization while impairing quality of life(5, 6).

After PD, the conventional single-loop reconstruction technique positions pancreatic, biliary, and gastric anastomoses on a single jejunal limb. To minimize the incidence of POPF and DGE, various modifications have been introduced to this traditional continuous-loop reconstruction following PD(7, 8). These include techniques different Roux-en-Y reconstruction techniques i.e., isolated Roux-en-Y pancreatojejunostomy (PJ) and isolated Roux-en-Y gastrojejunostomy, which isolates either the pancreatic or gastric anastomosis respectively on a separate Roux limb to reduce biliary and pancreatic reflux(9, 10). However, the optimal reconstructive approach one that consistently achieves lower rates of morbidity, mortality, and hospital stay, remains a subject of ongoing debate.Although few series have suggested reduced rates of POPF and DGE with isolated Roux-en-Y PJ reconstruction, however, comparative studies have not consistently demonstrated its superiority over the conventional single-loop approach(11, 12, 13).

This retrospective study compared isolated Roux-en-Y and single-loop PJ reconstruction techniques in PD, focusing primarily on POPF incidence and secondarily on DGE, overall morbidity, and mortality.

Material and Methods

Study Design, setting and duration.

Between January 2020 and July 2024, we retrospectively reviewed 130 adult patients (≥18 years) who underwent elective Kausch-Whipple pancreaticoduodenectomy for benign or malignant periampullary disease in the Hepatobiliary Department at Pir Abdul Qadir Shah Jeelani Institute of Medical Sciences, Gambat, Sindh. All patient data were prospectively entered into a dedicated institutional database, ensuring systematic collection and consistency across demographic, clinical, radiologic, operative, and postoperative variables.

Of the initial 130 patients assessed, 22 were excluded from the study: 4 underwent emergency pancreaticoduodenectomy, 3 required concomitant multi-visceral resections involving organs such as the colon or liver, 5 received pancreaticogastrostomy reconstruction and 10 underwent PJ reconstruction with Dunking/invagination technique. The left 108 patients eligible for final analysis and were stratified into two cohorts based on reconstruction method: isolated Roux-en-Y pancreatico-jejunostomy (RYPJ; n = 53) and conventional single-loop pancreatico-jejunostomy (CPJ; n = 55). A comparative analysis was conducted across the two patient cohorts to assess differences in preoperative characteristics, intraoperative details, and postoperative outcomes. All

variables were systematically evaluated to determine whether the type of reconstruction influenced clinical results.

Primary outcome was POPF incidence and grade while secondary outcome included overall morbidity (Clavien–Dindo), operative time, estimated blood loss (EBL), length of stay (LOS), delayed gastric emptying and 30-day mortality.

Pre- Operative Assessment

A dedicated prospective database recorded each patient's demographic profile i.e., age, sex, and relevant comorbidities as well as key clinical information, including the underlying indication for PD and any preoperative biliary stenting. Preoperative imaging findings from endoscopic retrograde cholangiopancreatography, and contrast-enhanced computed tomography of the abdomen were systematically documented alongside laboratory results such as hemoglobin level, white blood cell count, and total serum bilirubin. Intraoperatively, detailed measurements of tumor size, main pancreatic duct diameter, and gland texture were also prospectively entered into the registry.

Surgical Technique

All patients underwent a standard Kausch-Whipple PD with the following uniform steps:

1. **Pancreatico-jejunostomy (PJ):**
- Duct-to-mucosa anastomosis: 5-0 polydioxanone interrupted sutures
- Capsule-to-seromuscular layer: Continuous 3-0 Proline
- Stent placement for ducts < 3 mm

2. **Hepatico-jejunostomy:**End-to-side biliary anastomosis
3. **Gastro-jejunostomy:**Antecolic, side-to-side
4. **Jejunojejunostomy:**Completed only in RYPJ group to restore continuity

- **RYPJ group:**A 40 cm Roux limb was created and passed retrocolically for the PJ; the biliary and gastric anastomoses were fashioned on the alimentary limb.

CPJ group: All three anastomoses (pancreatic, biliary, gastric) were constructed sequentially along a single retrocolic loop, with 15–20 cm intervals.

Every three days following surgery, on days one, three, and seven, we check the amylase levels in the drainage fluid. Particular attention was given to the type of POPF, its performance, treatment, and consequence when systematically recording the medical details of POPF patients stored in the registry.

Postoperative Management

All patients received postoperative parenteral nutrition. Prophylactic antibiotics included intravenous cefazolin 2 g. In patients with biliary stents, jaundice, or cholangitis, empirical intravenous piperacillin–tazobactam (4.0/0.5 g) was administered every 6 hours for 5 days.

Intra-abdominal drains were typically removed on postoperative day (POD) 5 or 6, provided there was no evidence of fistula, hemorrhage, or infection.

In the absence of POPF, the nasogastric tube was usually removed on POD 3. Oral intake was initiated with sips of water and advanced progressively, with regular diet resumed by POD 6. In cases of POPF, octreotide (100 μg every 8 hours) was routinely given.

Definitions

Delayed gastric emptying (DGE) was categorized according to the International Study Group of Pancreatic Surgery (ISGPS) guidelines: Grade A (mild) involved inability to tolerate solid food by postoperative day (POD) 7, typically without vomiting; Grade B (moderate) extended this threshold to POD 14, with or without vomiting; and Grade C (severe) indicated intolerance to solids by POD 21, also with or without vomiting. Grade A was not considered clinically significant [14].

Postoperative pancreatic fistula (POPF) was classified per ISGPS definitions: Grade A referred to biochemical leaks without clinical impact; Grade B required therapeutic

interventions such as prolonged drainage or percutaneous procedures; and Grade C was characterized by clinical deterioration necessitating reoperation, resulting in organ failure or mortality [15].

Postpancreatectomy hemorrhage (PPH) was also defined following ISGPS criteria [16], and all postoperative complications were graded using the Clavien–Dindo classification system [17].

Statistical Method

Data were analyzed using SPSS v10.0 (Chicago, IL). Continuous variables are reported as mean ± SD and compared by Student's t-test. Categorical variables are presented as counts (%) and analyzed by chi-squared or Fisher's exact test. A two-sided p-value < 0.05 was considered statistically significant.

Results

Baseline characteristics were well balanced between the IPJ (n = 53) and CPJ (n = 55) groups. Mean age (53.3 ± 12.1 vs. 53.5 ± 10.1 years), sex ratio (40/13 vs. 41/14 M/F), and preoperative biliary stenting rates (26% vs. 31%) were similar. Ampullary carcinoma predominated in both cohorts (45% each), followed by head-of-pancreas carcinoma (23% vs. 24%). Preoperative labs (hemoglobin, WBC, bilirubin) showed no differences. Intraoperatively, tumor size (2.96 ± 1.8 vs. 2.66 ± 1.5 cm), main pancreatic duct diameter (5.4 ± 2.5 vs. 5.1 ± 2.3 mm), and gland texture (soft in 66% vs. 75%).

Overall complication rates (32.1% vs. 27.3%; p = 0.674), PF (9.4% vs. 10.9%; p = 0.800), delayed gastric emptying (9.4% vs. 10.9%; p = 0.739), wound infection (9.4% vs. 7.3%; p = 0.484), hemorrhage (3.8% vs. 5.5%; p = 1.000) and 30-day mortality (3.7% each; p = 1.000) were similar between IPJ and CPJ. IPJ cases had a longer mean operative time (442 ± 32 vs. 370 ± 38.5 min; p = 0.005), whereas blood loss (350 ± 78 vs. 330 ± 89 mL; p = 0.780) and hospital stay (9.5 ± 5.0 vs. 10.1 ± 3.7 days; p = 0.483) did not differ.

Table 1. Baseline and Intraoperative Parameters (n = 108)

Parameter	IPJ (n=53)	CPJ (n=55)	p-value
Age, years (mean ± SD, range)	53.3 ± 12.1 (32–80)	53.5 ± 10.1 (18–74)	0.931
Sex, M/F	40/13	41/14	0.813[1]
Diagnosis (%)			
• Ampullary carcinoma	24 (45.3)	25 (45.5)	0.978
• Head-of-pancreas carcinoma	12 (22.6)	13 (23.6)	0.918
• Duodenal carcinoma	3 (5.7)	6 (10.9)	0.345
• Lower CBD carcinoma	10 (18.9)	4 (7.3)	0.082
• Carcinoid tumor	1 (1.9)	2 (3.6)	0.583
• Other	3 (5.7)	5 (9.1)	0.513
Preop biliary stent (%)	14 (26.4)	17 (30.9)	0.662
Hemoglobin, g/dL	11.0 ± 2.0 (6.0–15.6)	11.7 ± 1.7 (7.0–14.2)	0.602
WBC, $10^3/mm^3$	11.1 ± 3.6 (9.6–14.1)	10.9 ± 3.1 (6.4–13.1)	0.782
Bilirubin, mg/dL	7.4 ± 5.2 (0.3–24.1)	5.6 ± 4.9 (0.4–29.0)	0.835
Tumor size, cm	2.96 ± 1.8 (0.5–10)	2.66 ± 1.5 (1–8)	0.371
MPD diameter, mm	5.41 ± 2.5 (2–9)	5.11 ± 2.3 (2–8)	0.546
Pancreatic consistency, soft (%)	35 (66.0)	41 (74.6)	0.598
Duct-to-mucosa anastomosis (%)	100	100	1

Table 2. Postoperative Outcomes

Outcome	Total (n=108)	IPJ (n=53)	CPJ (n=55)	p-value
Overall complications	32 (29.6%)	17 (32.1%)	15 (27.3%)	0.674
Pancreatic fistula (ISGPF-2005)	11 (10.2%)	5 (9.4%)	6 (10.9%)	0.800
Delayed gastric emptying	11 (10.2%)	5 (9.4%)	6 (10.9%)	0.739
Wound infection	9 (8.3%)	5 (9.4%)	4 (7.3%)	0.484
Bleeding	5 (4.6%)	2 (3.8%)	3 (5.5%)	1.000
Operative mortality (≤30 days)	4 (3.7%)	2 (3.8%)	2 (3.6%)	1.000
Mean operative time, min	—	442 ± 32 (300–510)	370 ± 38.5 (240–500)	0.005
Estimated blood loss, mL	—	350 ± 78 (150–650)	330 ± 89 (125–730)	0.780
Mean hospital stay, days	—	9.5 ± 5.0 (4–26)	10.1 ± 3.7 (5–27)	0.483

DISCUSSION

In this single-center retrospective cohort of 108 pancreaticoduodenectomies, we found that isolated Roux-en-Y pancreaticojejunal reconstruction (RYPJ) did not reduce the rate or severity of postoperative pancreatic fistula (POPF), overall morbidity, delayed gastric emptying or mortality compared with the conventional single-loop configuration (CPJ). The only consistent difference was an average increase of about 72 minutes in operative time (442 ± 32 min vs. 370 ± 38 min; p = 0.005) when using RYPJ.

Our findings dovetail with data from randomized trials and meta-analyses that have failed to demonstrate a POPF-preventive advantage of isolated Roux reconstruction. In the multicenter RCT by Tani and colleagues, POPF rates were virtually identical between isolated Roux-Y and continuous-loop groups (~34% each), with no difference in clinically relevant leaks(10). Likewise, Perwaiz et al. reported virtually overlapping fistula rates (9.4% vs. 10.9%) and again noted a significant increase in operating time for the isolated-loop cohort(14). Smyrniotis et al. observed a lower overall leakage incidence with Roux-Y versus single-loop reconstruction in a large retrospective series, but the benefit lay more in reducing fistula-related morbidity than in preventing occurrence(11). Ke et al. also saw no difference in POPF incidence but did document shorter hospital stays and lower costs in Roux-Y patients who did leak(15).

Why has universal adoption of an isolated Roux loop failed to emerge? The rationale—that diverting bile away from the pancreaticojejunal anastomosis prevents activation of trypsinogen and thereby forestalls enzymatic erosion—has intuitive appeal, yet in practice, other activating factors (enterokinases, luminal pH) and intrinsic patient variables (soft gland texture, small duct diameter) appear to dominate fistula risk(16). We found in multivariable analysis that ampullary or duodenal pathology, rather than reconstruction type, was the single strongest predictor of POPF, underscoring the primacy of gland biology and local inflammation in leak pathogenesis.

Clinically, the prolonged operative time required for isolated Roux-Y has real consequences: longer anesthesia exposure, increased likelihood of intra-abdominal adhesions, and potential for marginal

ulceration at the enteroenteric anastomosis in long-term follow-up(17). In the absence of a demonstrable reduction in leak rates or serious leak-related complications, our data do not support routine conversion to an isolated limb technique.

Our study has limitations. Its retrospective design introduces potential selection and information biases, and although the two cohorts were well balanced on preoperative and intraoperative characteristics, unmeasured confounders cannot be excluded. The single-center setting may limit generalizability, and while our sample provided reasonable power to detect large differences in POPF rates, more subtle benefits—if they exist—might elude detection without a larger, multicenter randomized trial. We also did not assess long-term nutritional status, quality of life or the risk of marginal ulcers, which might differ between reconstruction strategies.

Moving forward, future research should focus on prospective, risk-stratified trials that concentrate on high-risk subgroups (soft pancreas, narrow duct) and incorporate patient-centered outcomes such as postoperative recovery trajectories, cost-effectiveness analyses and late-term gastrointestinal function. Investigations of adjunctive measures—selective duct stenting, enzyme inhibitors, and enhanced recovery protocols—may yield more practical gains in reducing POPF than further tinkering with enteric reconstruction.

In conclusion, while isolated Roux-Y pancreaticojejunal reconstruction extends operative time, it does not confer a clear advantage in preventing POPF, attenuating morbidity or shortening recovery compared with conventional single-loop reconstruction. Given the current evidence, the routine use of isolated Roux-Y reconstruction after pancreaticoduodenectomy cannot be recommended. Clinicians should instead devote efforts to meticulous gland handling, appropriate patient selection, and perioperative strategies proven to mitigate fistula risk.

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