Evaluation of surgical outcomes between isolated hepaticojejunostomy reconstructions versus conventional reconstruction after pancreaticoduodenectomy

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Background
Pancreaticoduodenectomy (PD) is one of the major and challenging abdominal operations, associated with morbidity rate 40–50% and mortality rate less than 5%.
Aim
To evaluate surgical outcomes between isolated hepaticojejunostomy reconstruction after PD versus conventional reconstruction after PD as regards postoperative morbidity and mortality.
Patients and methods
This is a prospective cohort study conducted at Ain Shams University Hospitals, in the period from October 2016 to May 2020. Sixty patients with malignant masses in pancreatic head, periampullary, or duodenum, were recruited for this study. Ethical approval was obtained from Al Demerdash ethical committee.
Results
Our study included 60 patients who underwent PD, our mean age was 57.22±10.07 years (40–82 years). In group I (the conventional group), five (16.7%) cases had pancreatic fistula, while group II (isolated hepaticojejunostomy) had only one (3.3%) case, although higher incidence in group I of postoperative pancreatic fistula but *P* value 0.085. Group I had seven (23.3%) cases, while group II had no cases of biliary reflux with *P* value 0.005. Delayed gastric emptying in group I had four (13.3%) cases, while group II had three (10%) cases with *P* value 0.68. The mean operative blood loss was 523.00±92.14 ml (300–700 ml). The mean hospital stay was 10.14±2.28 days (7–18). The overall percentage of wound complications was 23.3%. The overall mortality was 1.7%.
Conclusion
Isolated hepaticojejunostomy reconstruction after PD associated with a low rate of postoperative pancreatic fistula and no biliary gastric reflux, but needs longer time than conventional reconstruction after PD. Further studies are needed to confirm the results.

Keywords:
conventional pancreaticoduodenectomy, isolated hepaticojejunostomy, wipple's operation

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Introduction

Kausch [1] is the first surgeon who underwent the first successful pancreaticoduodenectomy (PD) in Berlin in 1912. While Whipple *et al.* [2] were responsible for populating the operation in 1935.

PD was one of the most major and complex surgeries used for management of benign and malignant masses in pancreatic head, periampullary, or duodenal mass [3,4].

PD is one of the major and challenging abdominal operations, associated with morbidity rate 40–50% and mortality rate less than 5% in specialized centers [3–6].

PD is associated with a high rate of postoperative complications that account 40–50% [7].

Previous studies reported that postoperative pancreatic fistula (POPF) and delayed gastric emptying (DGE) were the most common complications after PD [7,8].

POPF is one of the most serious complications after PD ranging from 5 to 25% in specialized centers [9].

Multiple methods of digestive tract reconstruction after PD were developed to reduce the rate of postoperative complications differently than conventional reconstruction, like isolated gastrojejunostomy, pancreaticogastrostomy, or isolated pancreaticojejunostomy [10–13].

Previous studies reported that isolated gastrojejunostomy and isolated pancreaticojejunostomy associated with less postoperative complications than conventional PD [14,15].

Kaman *et al.* [16] suggested separation of bile from pancreatic secretions to minimize the pancreatic enzyme activation to reduce the risk of POPF that may reduce morbidity and mortality.

Other studies reported that there is no difference between different techniques of digestive tract reconstruction as regards postoperative complications [11,16–18].

In this study, we underwent isolated hepaticojejunostomy reconstruction after PD to reduce postoperative biliary reflux and minimize pancreatic enzyme activation by bile acids to reduce POPF.

Aim

To evaluate surgical outcomes between isolated hepaticojejunostomy reconstruction after PD versus conventional reconstruction after PD as regards postoperative morbidity and mortality.

Patients and methods

Patients

This is a prospective cohort study conducted at Ain Shams University Hospitals, in the period from October 2016 to May 2020. We notify all patient with written consent about the research and procedure and postoperative complications. Sixty patients with malignant masses in pancreatic head, periampullary or duodenum, were recruited for this study. Ethical approval was obtained from Al Demerdash ethical committee

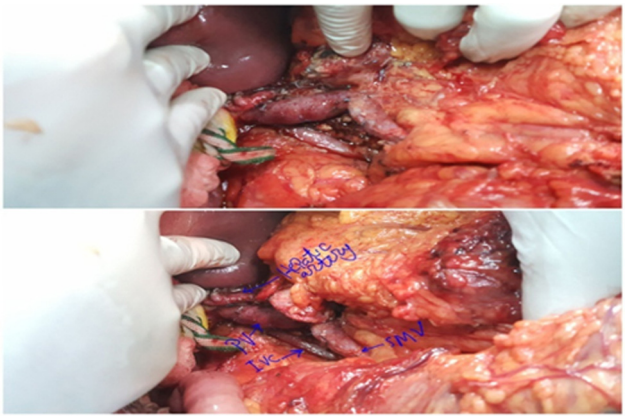
Operative details

In isolated biliary limb PD, after the end of resection, the reconstruction started by the pancreaticojejunostomy. The proximal end of the jejunum was passed retrocolic in a window of the transverse mesocolon and connected to the remnant of the pancreas in a double-layer end-to-side pancreaticojejunostomy by PDS 4/0 with the inner layers holding the pancreatic duct to the jejunal edge (double-layered duct to mucosa) without stent.

Then the second anastomosis is the gastrojejunostomy that was done just after the pancreaticojejunostomy in a side-to-side fashion by endo-GIA 75 mm. After that, the jejunal loop was followed till it passed under the transverse colon was then cut by an endo-GIA stapler. The distal end usually passed in the same window in the transverse mesocolon and anastomosed with the common hepatic duct in an end-to-side hepaticojejunostomy by interrupted PDS 4/0 sutures. The last connection was usually done by side-to-side jejunostomy usually 45 cm distal to the hepaticojejunostomy (Roux loop 45 cm) (Figs 1–3).

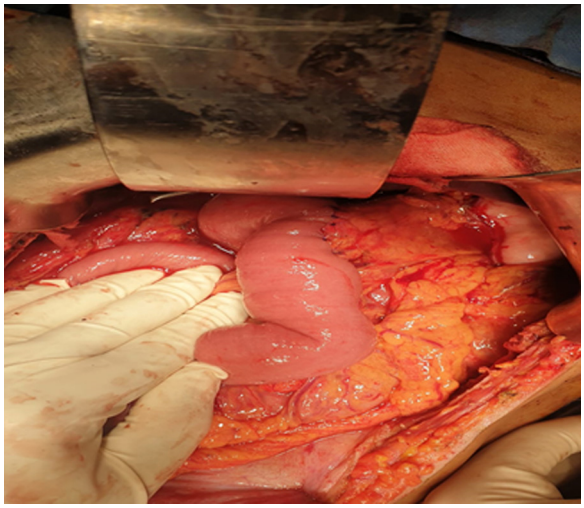
For the conventional group, the anastomosis started by the pancreaticojejunostomy. The proximal end of the jejunum was passed in the retrocolic space and anastomosed with the pancreas in an end-to-side double-layered duct to the mucosa with PDS 4/0, which is the same as that previously described, followed by the hepaticojejunostomy in an end-to-side interrupted PDS 4/0 followed by the gastrojejunostomy that was done by side-to-side fashion in an anticolic position 45 cm away from the hepaticojejunostomy (Figs 1 and 4).

Figure 1



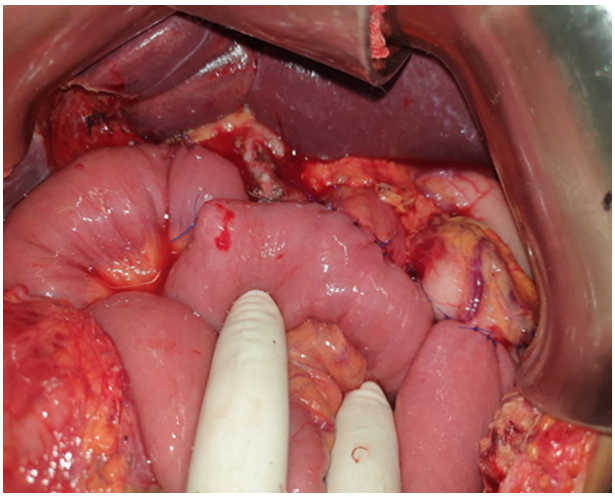
Pancreaticoduodenectomy.

Figure 2



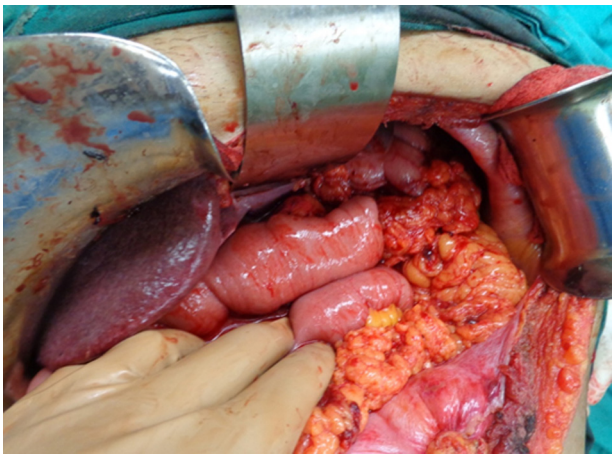
First step (pancreaticojejunostomy).

Figure 3



Isolated hepaticojejunostomy reconstruction.

Figure 4



Conventional reconstruction after pancreaticoduodenectomy.

Results

Data were collected, revised, coded, and entered to the Statistical Package for Social Science (IBM SPSS), version 23. Statistical analysis was done using IBM SPSS statistics for windows, Version 23.0. Armonk, NY: IBM Corp. The quantitative data were presented as mean, SDs, and ranges when parametric. Also, qualitative variables were presented as number and percentages. The comparison between groups with qualitative data was done by using χ^2 test. The comparison between two groups with quantitative data and parametric distribution was done by using independent t test. The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the P value was considered significant at the level of P value less than 0.05.

No significant statistical difference between the two groups was found regarding patients' age, mean=57.43 ±9.92 years (range, 40–80 years) and 57.00±10.39 years (range, 40–82 years) in group I (the conventional Whipple's) and group II (the isolated limb), respectively (Table 1).

For the sex distribution, group I (the conventional Whipple's), 14 (46.7%) cases were males and group II (the isolated limb) showed seventeen cases who were males with 56.7% of the whole group with no statistical difference between the two groups as regards the sex distribution, P value of 0.438 (Table 1).

As regards the original pathology, for group I (the conventional group), 15 (50%) cases were pancreatic head cancer, 14 (46.7%) cases were periampullary carcinoma, and one (3.3%) case was duodenal carcinoma. On the other hand, group II (the isolated limb), 17 (56.7%) cases were pancreatic head adenocarcinoma, 11 (36.7%) cases were periampullary carcinoma, and two (6.7%) cases were duodenal carcinoma with no statistical significant difference between the two groups as regards the main pathology, P value 0.538 (Table 1).

As regards POPF, group I had five (16.7%) cases, while group II had only one (3.3%) case, although higher incidence in group I of POPF, but it is still statistically nonsignificant with P value 0.085 (Table 1).

For biliary reflux, group I had seven (23.3%) cases, while group II had no cases of biliary reflux with a high statistically significant difference between the two groups with P value 0.005 (Table 1 and Fig. 5).

For DGE, group I had four (13.3%) cases, while group II had three (10%) cases with no statistical significant difference between the two groups as regards DGE, P value 0.68 (Table 1).

The mean common bile duct diameter was 1.52±0.34 cm (range, 1–2.2 cm). In group I, it was 1.46±0.38 cm (range, 1.3–2.1 cm) compared with group II with no statistical significant difference, P value 0.786 (Table 1).

Pancreatic duct diameter was 0.7±0.06 and 0.8±0.02 in group I and group II, respectively, with no statistical significance, P value 0.421 (Table 1).

Two (6.67%) patients in group I had soft pancreas, while three (10%) patients had soft pancreas in group II with no statistical significance, P value 0.073 (Table 1).

Operative time shows a significant statistical difference between the two groups, mean=5.33±0.64 h (range,

Table 1 Patients' characteristics, operative data, and postoperative data

	Conventional Whipple's [*n* (%)] *N*=30	Isolated limb [*n* (%)] *N*=30	Test value	*P* value	Significance
Age					
Mean±SD	57.43±9.92	57.00±10.39	0.165[a]	0.869	NS
Range	40–80	40–82			
Sex					
Female	16 (53.3)	13 (43.3)	0.601[b]	0.438	NS
Male	14 (46.7)	17 (56.7)			
Final pathology					
Periampullary	14 (46.7)	11 (36.7)			
Pancreatic head	15 (50.0)	17 (56.7)	1.239[b]	0.538	NS
Duodenal carcinoma	1 (3.3)	2 (6.7)			
Postoperative pancreatic fistula					
No	25 (83.3)	29 (96.7)	2.963[b]	0.085	NS
Yes	5 (16.7)	1 (3.3)			
Biliary reflux					
No	23 (76.7)	30 (100.0)	7.925[b]	0.005	HS
Yes	7 (23.3)	0			
Delayed gastric empting					
No	26 (86.7)	27 (90.0)	0.162[b]	0.688	NS
Yes	4 (13.3)	3 (10.0)			
CBD diameter (cm)					
Mean±SD	1.52±0.34	1.46±0.38	0.163[a]	0.786	NS
Range	1–2.2	1.3–2.1			
Pancreatic duct diameter (cm)					
Mean±SD	0.7±0.06	0.8±0.02	0.832[a]	0.421	NS
Range	0.3–1	0.4–1.1			
Soft pancreas					
No	28 (93.33)	27 (90)	2.874[b]	0.073	NS
Yes	2 (6.67)	3 (10)			
Wound complication					
No	22 (73.3)	24 (80.0)	0.398[b]	0.820	NS
Wound infection	5 (16.7)	4 (13.3)			
Wound hematoma	3 (10.0)	2 (6.7)			
Hospital stay					
Mean±SD	10.38±2.36	9.90±2.20	0.820[a]	0.416	NS
Range	7–18	7–17			
Operative time					
Mean±SD	5.33±0.64	5.74±0.60	–2.547[a]	0.014	S
Range	4.5–7	4.75–7			
Operative blood loss					
Mean±SD	500.00±82.93	523.00±92.73	0.000[a]	1.000	NS
Range	300–700	300–700			
Mortality					
No	29 (96.7)	30 (100.0)	1.017[b]	0.313	NS
Yes	1 (3.3)	0			
Reoperation					
No	29 (96.7)	30 (100.0)	1.017[b]	0.313	NS
Yes	1 (3.3)	0			

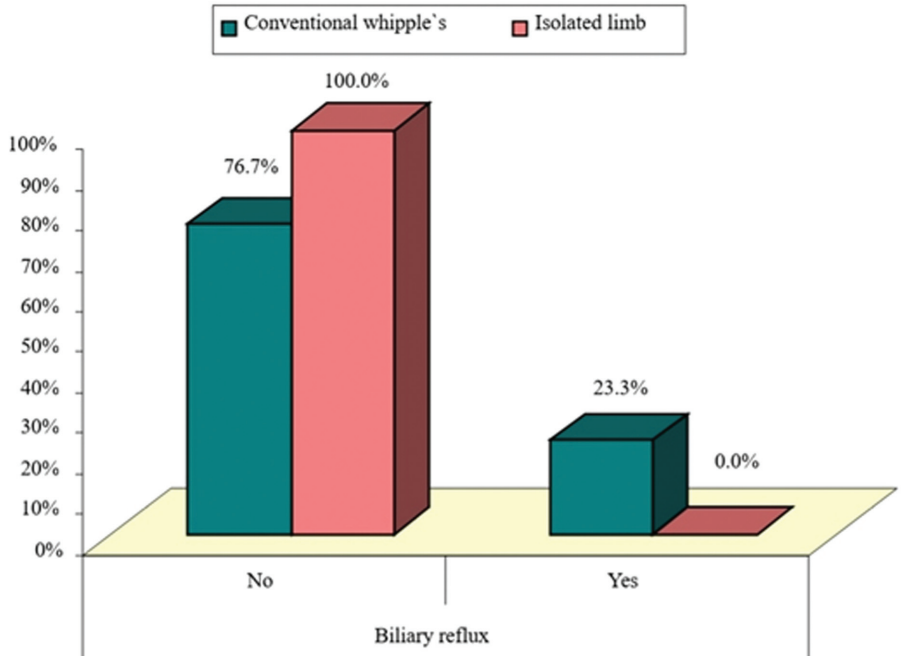
CBD, common bile duct. [a]Independent *t* test. [b]χ^2 test. *P* value more than 0.05: nonsignificant (NS); *P* value less than 0.05: significant (S); *P* value less than 0.01: highly significant (HS).

4.5–7 h) and 5.74±0.60 h (range, 4.75–7 h) in group I and group II, respectively, with *P* value 0.014 (Table 1) (Fig. 6).

In group I, the average blood loss was 500 ml, while in group II, the average was 523 ml with no statistically significant difference, *P* value was 1.0 (Table 1).

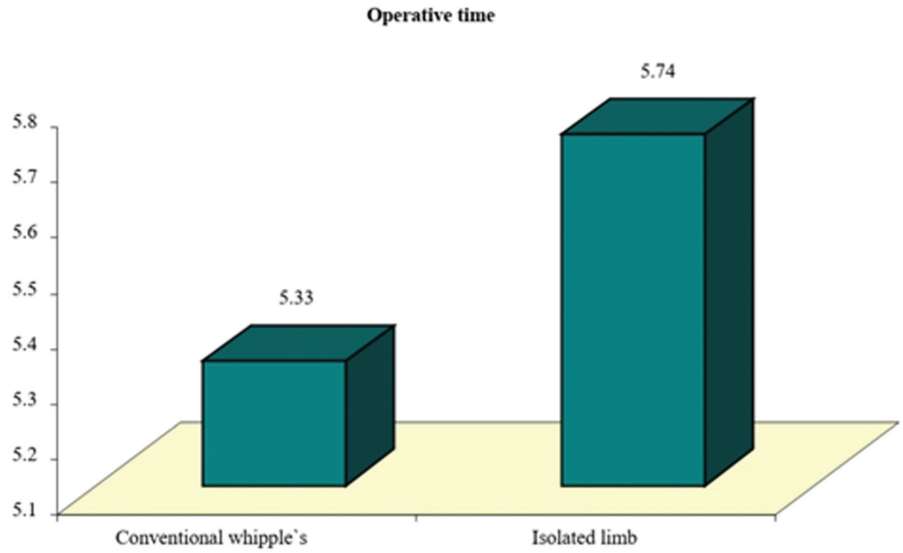
Group I had eight (26.7%) cases of wound complications, either hematoma or infection, while group II had six (20%) cases with

Figure 5



Postoperative biliary reflux.

Figure 6



Operative time.

no statistically significant difference, *P* value 0.82 (Table 1).

The mean hospital stay for group I was the range between 7 and 18 days and mean 10.38 days and SD 2.6, while group II was ranging from 7 to 17 days with mean 9.9 days with SD 2.2, there is no statistically significant difference between the two groups with *P* value 0.416 (Table 1).

One case of group I needed exploration for drainage and wash because of sepsis related to POPF (clavian Dinido type 4 complication), while in group II, no cases needed exploration with no statistically significant difference between the two groups, *P* value 0.313 (Table 1).

One case from group I required vascular reconstruction of the portal vein, as there was side-wall invasion.

Reconstruction was done by complete clamping of the portal vein proximal and distal of the area of invasion, removal of the tumor and part of the side wall of the portal vein longitudinally, followed by reconstruction in a transverse fashion by 6/0 prolene continuous sutures. In group II, we had one case that required reconstruction of the superior mesenteric vein (SMV) as the tumor was in the uncinate process with side-wall invasion, fist clamping of portal, splenic, and SMV followed by removal of the mass with side wall of the SMV followed by reconstruction in a transverse fission by 6/0 prolene continuous sutures (Fig. 7).

As regards mortality, group I had one (3.3%) reported mortality due to pulmonary embolism, while group II showed no mortality with *P* value 0.31 (Table 1).

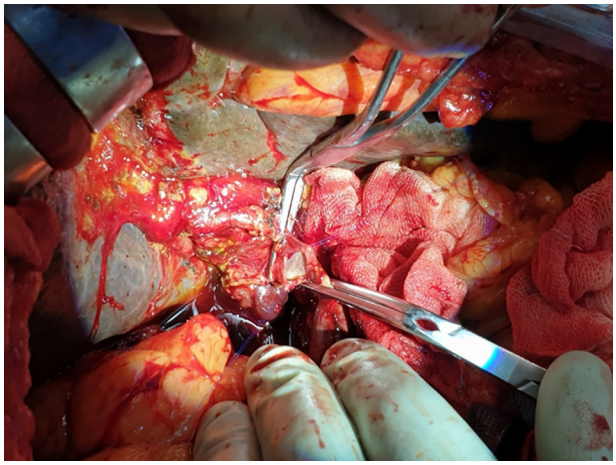
In group I, three cases had preoperative mild pancreatitis mainly after endoscopic retrograde cholangiopancreatography (ERCP) treated by conservative treatment by intravenous fluids and sandostatin, while in group II, four cases had preoperative pancreatitis that was treated by the same conservative treatment using sandostatin, no statistically significant difference between the two groups as regards preoperative pancreatitis, *P* value 0.62.

Discussion

PD is one of the major and challenging abdominal operations, associated with morbidity rate 40–50% and mortality rate less than 5% in specialized centers [3–6].

PD is associated with a high rate of postoperative complications that account 40–50% [7].

Figure 7



Portal vein reconstruction.

Previous studies reported that POPF and DGE were the most common complications after PD [7,8].

POPF is one of the most serious complications after PD ranging from 5 to 25% in specialized centers [9].

We underwent isolated hepaticojejunostomy to reduce postoperative biliary reflux and minimize pancreatic enzyme activation by bile acids to reduce POPF and compare surgical outcomes with conventional technique of reconstruction after PD.

No significant statistical difference between the two groups was found regarding patients' age, mean=57.43 ±9.92 years (range, 40–80 years) and 57.00±10.39 years (range, 40–82 years) in group I and group II, respectively, which is consistent with the demographic data published by Ke *et al.* [11] and Shimoda *et al.* [19].

Operative time shows a significant statistical difference between the two groups, mean=5.33±0.64 h (range, 4.5–7 h) and 5.74±0.60 h (range, 4.75–7 h) in group I and group II, respectively.

In our study, there were no statistical differences between the two groups as regards hospital stay, the mean hospital stay was 10.14±2.28 days (range, 7–18 days) that was similar to data published by Ke *et al.* [11], Shimoda *et al.* [19], and Busquets *et al.* [20].

The rate of wound complications showed no statistical difference between the two groups in our study; surgical-site infection was 15% and wound hematoma 8.3% more than that reported by Cameron and He [21]. The rate of wound infection was 7.2%.

In our study, six (10.0%) patients developed POPF, the rate of POPF is variable between centers that ranges from 13 to 35% [21–24].

In our study of five (16.7%) patients in group I and one (3.3%) patient in group II, there is no statistical difference between the two groups in our study, but there is a low rate of POPF in group II as isolated hepaticojejunostomy minimizes pancreatic enzyme activation by bile acids, which leads to reduction of POPF.

POPF is one of the most serious complications after PD that may be associated with hemorrhage, intraabdominal collection, and abscess formation.

Many techniques have been used to decrease POPF such as pancreatic stenting [25] or fibrin [26] and other

methods of modified jejunal anastomosis [27], but the optimum technique is still debatable.

Chhaidar *et al.* [28] and Singhal *et al.* [29] reported a low rate of POPF with isolated pancreaticojejunostomy reconstruction after PD than conventional pancreaticojejunostomy reconstruction after PD.

Ke *et al.* [11] reported that the rate of POPF in the isolated pancreaticojejunostomy reconstruction after the PD group was higher than that in the conventional pancreaticojejunostomy reconstruction after the PD group.

In our study, a significant statistical difference between the two groups was found regarding biliary reflux as there is no biliary reflux in group II, while seven (23.3%) patients have biliary reflux in group I, as isolated hepaticojejunostomy reconstruction prevents biliary reflux after PD.

DGE is one of the most frequent complications after PD that accounts 13.5–40% [30,31].

In our study, there were no statistical differences between the two groups as regards DGE occurring in 11.7% that was similar to other studies reported by Wente *et al.* [30] and Malleo and Vollmer [31].

There is debate regarding DGE in isolated gastrojejunostomy reconstruction after PD versus conventional pancreaticojejunostomy after PD.

A meta-analysis, including three studies, reported the low rate of DGE after conventional pancreaticojejunostomy reconstruction after PD than isolated gastrojejunostomy reconstruction after PD [32].

In our study, one case of group I needed exploration for drainage and wash because of sepsis related to POPF (clavian Dinido type 4 complication), while in group II, no cases need re-exploration with no statistically significant difference between the two groups.

As regards mortality in this study, group I had one (3.3%) reported mortality due to pulmonary embolism, while group II showed no mortality, the overall mortality rate in the study was 1.7%.

Conclusion

Isolated hepaticojejunostomy reconstruction after PD associated with a low rate of POPF and no biliary gastric reflux, but needs a longer time than conventional reconstruction after PD. Further studies are needed to confirm the results.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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