Impact of combined preoperative and postoperative biliary drainage on outcome of pancreaticoduodenectomy

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Background
There is controversy about the effect of biliary drainage (BD) on the postoperative outcome of pancreaticoduodenectomy (PD). Preoperative BD can be achieved by endoscopic stent or ultrasound-guided percutaneous transhepatic drainage (PTD). There is no clear consensus on whether to manage malignant obstructive jaundice with preoperative BD prior to operative intervention or to proceed directly to resection. This is a retrospective study comparing patients who proceeded directly to PD surgery versus those who received a preoperative PTD to be continued postoperatively as regards the postoperative outcomes, mainly postoperative pancreatic fistula (POPF).
Aim
To elucidate the role of BD continued postoperatively on surgical outcomes after PD, mainly POPF.
Patients and methods
In total, 40 patients underwent PD with Kakitta pancreaticojejunostomy anastomosis for malignant jaundice, 11 received PTD as a preoperative BD continued postoperatively, while 29 patients proceeded directly for surgery.
Results
Both groups were comparable as regards major surgical outcomes, except for POPF, which was statistically lower in those who received PTD before surgery.
Conclusion
In patients with malignant jaundice requiring surgery, preoperative BD group continued postoperatively had significantly less POPF than the group that was managed with direct surgery without BD.

Keywords:
biliary drainage, pancreaticoduodenectomy, postoperative pancreatic fistula

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Introduction

Surgical resection by pancreaticoduodenectomy (PD) provides the only definite cure for tumors obstructing the distal common bile duct (CBD). The surgical outcome of PD has improved radically over the last few years due to advances in surgical techniques, anesthesia, and perioperative care. PD is still a major operation that can be associated with many complications, including postoperative pancreatic fistula (POPF) [1].

The harmful effects of prolonged and progressive obstructive jaundice include hepatic dysfunction, defective wound healing, superadded infection, hemostatic defects, renal failure, and altered body immunity. Preoperative biliary drainage (BD) has been developed since the 1960s to improve the postoperative morbidity and mortality rates of jaundiced patients with pancreatic and biliary cancers [2]. Preoperative BD can be performed by percutaneous transhepatic drainage (PTD) under radiological guidance or by endoscopic retrograde cholangiopancreatography (ERCP) stent placement.

The preference for choosing either preoperative percutaneous drainage or endoscopic drainage remains unclear due to different advantages and disadvantages of each method.

Preoperative biliary drainage (PBD) using endoscopic stenting has the advantage of avoiding skin and liver punctures in patients with deep jaundice and underlying coagulopathy, and tumor seedlings, but unfortunately may result in bacterial contamination of the bile ducts, cholangitis, gastrointestinal tract bleeding, duodenal perforation, and incidence of stent occlusion.

PBD by percutaneous transhepatic technique has the advantage of being more simple, cheap, and can be used for diagnostic purposes postoperatively to diagnose a leaking hepaticojejunostomy.

In comparison with preoperative drainage by stenting where the stent has no postoperative advantage as it is usually removed with the specimen, PTD can be used postoperatively to divert bile away from the biliary anastomoses allowing better healing. PTD insertion in case of leak from the pancreaticoenteric anastomosis can divert bile away from the pancreatic enzymes, which may prevent the progression of a biochemical pancreatic leak to a clinically relevant POPF [3,4].

Numerous studies have reported increased risk of postoperative infectious complications independent of the specific type and number of biliary-drainage procedures performed [5–7]. On the other hand, some studies have reported no difference in outcomes in patients undergoing BD prior to PD [8]. However, the potential benefit of BD on postoperative outcomes after PD remains controversial and needs further study.

The aim of this study was to elucidate the role of PBD continued postoperatively on surgical outcomes after PD, mainly POPF.

Patients and methods

The present study included 40 patients with resectable tumors obstructing the distal CBD documented on multidetector computed tomography admitted at the Hepato-biliary-pancreatic Surgical Unit of the Alexandria Main University Hospital, Alexandria, Egypt, in the period of December 2019–December 2021.

The patients were divided into two groups based on BD: group A (those who did direct surgery without BD) and group B (those who received preoperative BD by PTD before surgery and continued postoperatively).

Informed consent for the surgical procedures was obtained from each patient. This study was approved by the Alexandria University. Preoperative assessment included clinical assessment, routine laboratory investigations, and radiological investigations (ultrasound, magnetic resonance cholangiopancreatography, and abdominal computed tomography).

Preoperative BD was done by PTD inserted by the interventional radiologist through either the right or left ductal systems and reaching the common hepatic duct just below the confluence of the right and left hepatic ducts. This drain was kept throughout the operation and was used for stenting the hepaticojejunostomy for 2 weeks postoperatively.

The indications for preoperative biliary decompression in the present study included patients whose bilirubin has exceeded 20 mg/dl (342 μmol/l) [9], patients with cholangitis, or an expected delay in operative intervention.

All patients were operated on by experienced surgeons in our unit. Classic PD was performed. Pancreatic reconstruction was performed by pancreaticojejunostomy using Kakitta technique, BD was performed by retrocolic end-to-side hepaticojejunostomy. Gastric drainage was done by retrocolic gastrojejunostomy.

Postoperatively, all patients were admitted to the ICU at least overnight. Postoperative pain was controlled via epidural analgesia. All patients received total parental nutrition, sandostatin, and thromboprophylaxis. Clear oral liquids were started on the fifth postoperative day. Drain amylase content was measured on the third and seventh postoperative days.

Assessment was done for the postoperative outcome, including POPF or any other complications. Postoperative complications were defined according to the International Study Group of Pancreatic Fistula [10].

Results

In total, 40 patients were diagnosed with distal biliary obstruction by resectable tumors and eligible for PD. The groups were comparable with no significant difference between them as regards the patient demographics, associated comorbidities, or previous surgeries. The overall incidence of patients' demographics is shown in Table 1.

Dedicated preoperative computed tomography workup for the cases is summarized in Table 2.

Intraoperatively, there was no difference in pancreatic texture, liver status, CBD diameter, pancreatic-duct

Table 1 Distribution of the studied cases according to demographic and clinical data (*N*=40)

Demographic and clinical data	*n* (%)
Age (years)	56.83 ± 9.11
Sex	
Male	19 (47.5)
Female	21 (52.5)
BMI (kg/m^2)	30.25 ± 3.44
Normal (18.5–24.9)	2 (5)
Overweight (25–29.9)	24 (60)
Obesity class I (30–34.9)	13 (32.5)
Obesity class II (35–39.9)	1 (2.5)
Obesity class III (morbidly obese) (≥40)	0

diameter, blood loss, or operative time between the two groups. This is shown in Table 3.

Postoperative outcome

POPF developed in 18 of group-A patients, all were grade A (one patient of them was discharged with pancreatic wound discharge, which did not affect his postoperative course), while none of group-B patients developed POPF that was statistically significant.

Bile leak occurred in five patients of group A. Patients with bile leak were monitored and initial conservative management was done, this succeeded to treat bile leakage in three patients and ultrasound-guided PTD was inserted in the other two patients, which helped successfully to divert bile away from the biliary anastomosis and so treating the bile leak.

BD was not associated with infective complications or mortality. This is shown in Table 4.

There was no significant difference between the two groups regarding the incidence of delayed gastric emptying, postpancreatectomy hemorrhage, hospital stay, or overall mortality.

Table 2 Distribution of the studied cases according to radiological preoperative assessment (*N*=40)

Radiological preoperative assessment	*n* (%)
Lesion site	
Head	16 (40)
Periampullary	20 (60)
Cholangiocarcinoma	3 (7.5)
Associated GB disease	
Free GB	34 (85)
GB stones	5 (12.5)
Adenomyomatosis	1 (2.5)
LN enlargement by CT	6 (15)
CBD diameter (mm)	15.11 ± 4.26
Pancreatic-duct diameter (mm)	5.73 ± 1.90

CBD, common bile duct; CT, computed tomography; GB, gall bladder; LN, lymph node.

Discussion

Prolonged obstructive jaundice has major disadvantages, the most important is uncontrolled coagulopathy due to vitamin-K malabsorption, defective healing power, and renal impairment secondary to hepatorenal syndrome [11,12].

There are different methods of BD, either internal (by ERCP) or external (by PTD). In 1935, A.O. Whipple was the first to introduce the concept of preoperative BD by performing a staged PD: application of a cholecystogastrostomy to reduce jaundice was followed by resection at a later stage, depending on the severity

Table 3 Comparison between the two studied groups according to operative details (*N*=40)

Kakitta group (*N*=40)	PTD insertion				Test of significance	*P*
	No PTD (*N*=29)		PTD (*N*=11)			
	n	%	*n*	%		
Lesion site						
Head	11	37.9	5	45.5	χ^2=0.188	^{FE}P=0.728
Periampullary	17	58.6	4	36.3	χ^2=0.084	^{FE}P=1.000
Cholangiocarcinoma	1	3.4	2	18.2	χ^2=2.495	^{FE}P=0.178
CBD diameter (mm)						
Not dilated	8	27.6	4	36.4	χ^2=0.293	^{FE}P=0.704
Dilated	21	72.4	7	63.6		
Mean±SD	13.43 ± 3.36	20.14 ± 2.19	*U*=8.0*	<0.001*		
Median (minimum–maximum)	13 (8–19)	21 (17–22)				
Pancreatic-duct diameter (mm)						
Not dilated	21	72.4	8	72.7	χ^2=0.000	^{FE}P=1.000
Dilated	8	27.6	3	27.3		
Mean±SD	6.0 ± 2.20	5.0 ± 0.0	*U*=10.50	0.697		
Median (minimum–maximum)	5 (4–10)	5 (5–5)				
Pancreatic texture						
Soft	22	75.9	11	100.0	χ^2=3.218	^{FE}P=0.159
Firm	7	24.1	0	0.0		
Hard	0	0.0	0	0.0		
Total operative time (h)						
Mean±SD	5.37 ± 0.65	5.19 ± 0.65	*U*=128.0	0.338		
Median (minimum–maximum)	5.50 (4.50–6.40)	5.10 (4.50–6.30)				

χ^2, χ^2 test; CBD, common bile duct; FE, Fisher exact test; PTD, percutaneous transhepatic drainage; *U*, Mann–Whitney test.
P: *P* value for comparing between the studied categories.
*Statistically significant at *P* value less than or equal to 0.05.

Table 4 Comparison between the two studied groups according to postoperative pancreatic fistula and bile leak (*N*=40)

Kakita group (*N*=40)	PTD insertion [*n* (%)]		χ^2	FE*P*
	No PTD (*N*=29)	PTD (*N*=11)		
Postoperative pancreatic fistula				
No fistula	11 (37.9)	11 (100.0)		
Biochemical leak (grade A)	18 (62.1)	0	12.414*	<0.001*
Grade-B fistula	0	0		
Grade-C fistula	0	0		
Biliary leak				
No	24 (82.8)	11 (100.0)	2.167	0.298
Yes	5 (17.2)	0		

χ^2, χ^2 test; FE, Fisher exact test; PTD, percutaneous transhepatic drainage.
P: *P* value for comparing between the studied categories.
*Statistically significant at *P* value less than or equal to 0.05.

of jaundice. In the mid-1960s, a nonoperative external biliary-drainage procedure was devised: percutaneous transhepatic cholangiography was performed using the Chiba needle. Internal drainage came up in the seventies when the concept of stent insertion by ERCP was introduced [11].

Although both procedures draining the biliary system, the pathophysiologic consequence of ERCP is different from PTD in terms of restoration of enterohepatic circulation, inflammatory reaction, and colonization of biliary system. The drawbacks of ERCP have become clear: biliary stent encourages bacterial contamination, cholangitis, liable to obstruction, and generates severe inflammation and thickening in the wall of CBD, which increases the risk of bile leakage of hepaticojejunostomy; on the contrary, the PTD has an advantage of being used as a postoperative stent diverting bile away from the anastomosis, enhancing chances of rapid healing [4,13].

There is a wide controversy in the literature regarding the efficacy of use of BD before PD. Lygidakis *et al*. [14] in a prospective randomized study supported BD (by ERCP) and reported less postoperative complications in the BD group (16 vs. 70%) and increased hospital mortality in the non-BD group (0 vs. 2/19) [14], while Dorcaratto *et al*. [15] assessed the clinical outcome of various preoperative biliary-drainage methods in patients undergoing PD in a meta-analysis of 13 retrospective studies, including 2334 patients, and their findings suggested that the use of percutaneous BD was associated with less postoperative and procedural complications compared with the use of endoscopic BD, but there was no significant difference between a percutaneous BD and an endoscopic BD in major postoperative complications, including POPF and mortality rates [15].

Povoski *et al*. [5] conducted a retrospective review of 240 cases of PD (endoscopic or percutaneous) with intraoperative bile-culture data, and showed that PBD was associated with increased rates of positive intraoperative bile culture and infectious-related complications, leading to a four-times greater mortality rate. In another retrospective review of 567 patients who had undergone PD, Sohn *et al*. [16] in their study where preoperative biliary stenting was performed in 408 patients (64% had stents placed via a percutaneous approach and 36% had stents placed endoscopically), whereas the remaining 159 (28%) patients did not undergo biliary stenting. In the stented group, they found that PBD was associated with an increased rate of wound infection and pancreatic fistula, however, the overall complication and mortality rates did not differ according to the procedure. In 2001, Pisters *et al*. [17] reported a retrospective review of 300 cases of malignant obstructive jaundice in which 57% received PBD (either by ERCP or percutaneous transhepatic cholangiography or both), 12% underwent surgical bypass, and 31% received no PBD. Moreover, PBD was associated with an increased risk of wound infection, however, the overall complication rate did not differ between groups.

In the present study, for patients where the decision to place a preoperative BD, a percutaneous BD was the method of choice due to several justifications; PTD drainage preoperatively (in view of our long-term experience in our surgical unit) has the benefit of diverting bile externally and thus reducing the incidence of cholangitis and thus the incidence of postoperative septic complications (due to infected bile), a PTD can be beneficial both preoperatively and postoperatively contrary to endoscopic stenting, which is beneficial preoperatively and has no benefit postoperatively as it is usually removed with the operative specimen. The presence of a percutaneous drain postoperatively allowed for biliary diversion from the peritoneal cavity if bilioenteric anastomotic leak occurred. This is especially important if a POPF is present as well. Also, PTD helps in the diversion of

bile postoperatively from a leaking pancreaticojejunal anastomosis that might prevent the progression of a biochemical leak to a clinically relevant POPF. Finally, the insertion of a PTD is a much cheaper procedure than the insertion of an endoscopic BD.

Physiologically, there is a correlation between the level of bile acids and pancreatic enzyme level and activity. Physiological bile-acid concentrations seem to be necessary to exert an inhibitory effect on stimulated pancreatic-enzyme output, while concentrations higher than physiological may enhance basal and stimulated pancreatic secretion [18]. This explains in our study the significance of preoperative insertion of a transhepatic drain diverting bile away from the pancreatic anastomosis (and thus always lowering the amount of bile in contact with the pancreatic secretions and thus minimizing the incidence and possibly severity of POPF if occurred).

PTD insertion diverts bile away from the hepaticojejunostomy anastomosis, allowing its better healing, and consequently away from the pancreatic stump, preventing activation of pancreatic enzymes and subsequently decreasing POPF incidence and/or severity if happened. Also, PTD insertion served as a postoperative stent diverting bile away from the hepaticojejonostomy anastomosis. In case of bile leak after PD, PTD insertion can be a modality of treatment.

Conclusion

PTD as a method of biliary diversion if continued postoperatively was associated with less incidence of POPF after PD if compared with PD without preoperative drainage. But there is yet no optimal BD method because of the small sample size. It is recommended for further studies with a large number of patients to reach a precise guideline for the use of BD before PD.

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Conflicts of interest

No conflict of interest.

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