Lessons Learned from 100 Personal Consecutive Cases of Pancreaticoduodenectomy at a University Hospital in Thailand

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Background: *Pancreaticoduodenectomy (PD) is a major operation with potential disastrous complications. Experience of the surgical team with high surgical volume is an important factor contributing to better outcome. The purpose of this study was to examine results of 100 consecutive cases of PD operated by the first author. Various aspects of this technically demanding operation related to our experience were discussed and reviewed.*

Material and Method: *A retrospective study of 100 patients who had undergone PD during a period of 20.5 years was presented. The indications for PD were periampullary neoplasms or other symptomatic lesions at the pancreatic head. All patients had preoperative CT scan to evaluate extent of the disease and resectability. Preoperative biliary drainage was performed in selected cases. The operations were conducted in the same manner in most cases. Before 2000, no external drainage of the pancreatic remnant was used. Since 2000, external drainage of the pancreatic remnant was routinely used, except in one patient who had total pancreatectomy. Postoperative complications and mortality were studied.*

Results: *Carcinoma of the ampulla of Vater and carcinoma of the head of the pancreas were the leading indications for PD (34% and 30%, respectively). No preoperative tissue diagnosis was made in patients who had carcinoma of the head of the pancreas. Two patients had emergency PD because of massive gastrointestinal bleeding. Sixty seven per cent underwent pylorus preserving PD (PPPD) and 33% underwent classical PD. Twenty eight patients had no external pancreatic drainage, 71 had external pancreatic drainage, and one had total pancreatectomy. The postoperative morbidity and mortality were 44% and 2%, respectively. The postoperative pancreatic fistula rate was higher in patients without external pancreatic stent but no statistical significance was detected (21.4% vs. 12.7%, NS). There was no mortality in patients aged >70 years (n = 29) while two patients aged <70 died (n = 71). The difference was not statistically significant.*

Conclusion: *PD could be safely performed with low pancreatic fistula and low mortality rate by experienced surgeons. Preoperative CT scan is extremely helpful in evaluation the extent of the disease and resectability. In patients with suspected carcinoma of the pancreatic head, PD should be performed without preoperative tissue diagnosis by experienced pancreatic surgeons. Elderly (aged >70 years) is not a contraindication for PD. We strongly recommend the use of external pancreatic stent to prevent pancreatic fistula.*

Keywords: *Periampullary neoplasm, Carcinoma of the head of the pancreas, Pancreaticoduodenectomy, External pancreatic stent, Pancreatic fistula*

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Pancreaticoduodenectomy (PD) is a complex surgical procedure well known to surgeons practicing in this area. Walter Kausch, a German surgeon first successfully performed this procedure for ampullary cancer in 1909 and reported in 1912[1]. PD was introduced and popularized in the United States by Allen Whipple in 1935[2]. Since then, it has been increasingly recognized and became a standard treatment for periampullary lesions. During the early period of this technically demanding operation, the morbidity and mortality were so high that acceptable results came only from institutions with extensive experience with pancreatic resection[3-5]. With improvement and advancement in modern surgical care, mortality has decreased to less than 5% but morbidity is still considerable, approximately 30 to 60%[6-8]. Although a large number of studies in several aspects on PD have been made, controversies still exist regarding the best method to minimize morbidity and

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mortality rate. One undeniable factor determining the surgical outcome is experience of the surgical team. It has been shown by some investigators that high volume surgical centers for PD had better results regarding postoperative mortality than low volume centers[9-11]. This implies the importance of familiarity of the surgical team to conduct a safe PD and reflects the ability to prevent and manage postoperative surgical complications of the high volume surgical centers. The first author has consistently performed PD during the last 20 years and believes that cumulative knowledge and learning obtained from such long period of study from various clinical situations will be beneficial to surgeons who deal with such a difficult operation.

The purpose of this study was to examine patients who underwent PD by the first author during the last 20 years. Details of study, which formed the basis of this report, included demographic data, indications for PD, operative techniques, postoperative morbidity, and mortality. Brief comments of some practical and importance issues on PD were also made.

Material and Method

All patients who had undergone PD by the first author between November 1991 and April 2012 at King Chulalongkorn Memorial Hospital, Bangkok, Thailand were reviewed and analyzed. The study was approved by the Institutional Review Board of Faculty of Medicine, Chulalongkorn University. During the study period, PD was performed in patients who had periampullary neoplasms or other symptomatic lesions at the pancreatic head. All patients had preoperative CT scan to evaluate extent of the disease and resectability. Endoscopy and biopsy were performed in patients who were suspected of carcinoma of the ampulla of Vater and carcinoma of the duodenum, and in four patients who had carcinoma of the stomach. Endoscopic biliary drainage was performed in selected patients with obstructive jaundice. The decision to perform endoscopic biliary drainage depended on clinical situation and opinion of the gastroenterologists. Some patients had preoperative percutaneous transhepatic biliary drainage (PTBD) when decreasing bilirubin level deemed necessary and endoscopic biliary drainage was considered unsuitable or was not possible. Patients who were suspected of having carcinoma of the head of the pancreas and those who had symptomatic masses or cysts at the pancreatic head underwent PD without preoperative tissue biopsy or other cytological diagnosis. Preoperative evaluation of the cardiovascular system was routinely performed. Some patients who had significant coronary artery disease underwent coronary artery bypass grafting before PD. Almost all operations were performed on elective basis. Exceptions were two patients who had emergency PD because of the presentation of massive gastrointestinal bleeding.

The operations were conducted in the same manner in most cases. Pylorus preserving PD (PPPD) was employed in the majority of patients. When PPPD was considered inappropriate, the classical PD was performed. Reconstruction of pancreatico-biliary-duodeno (in PPPD) or gastro (in classical PD) - enteric anastomoses were performed by using a retrocolic jejunal limb with end to end pancreaticojejunostomy (invagination method), end to side hepaticojejunostomy, and end to side duodenojejunostomy (in PPPD) or Billroth II type gastrojejunostomy (in classical PD), respectively. These methods of anastomoses were used in 90 patients (90%). The remaining 10 patients were eight who had end to side pancreaticojejunostomy, one who had total pancreatctomy (no pancreaticojejunostomy anastomosis), and one with carcinoma of the ampulla of Vater who had undergone bypass Billroth II gastrectomy with Roux-en-Y choledochojejunostomy without tumor resection at a hospital elsewhere. This palliative bypass patient subsequently underwent successful PD at our institution two years later and reconstruction of the pancreatic stump was performed with end to end pancreaticojejunostomy method. Before 2000, no external drainage of the pancreatic remnant (external pancreatic stent) was used. Since January 2000, all patients who had undergone PD by the first author had insertion of the external pancreatic stent (Fig. 1, 2).

The external drainage was performed by using a pediatric feeding tube number 5 French (for small pancreatic duct) or 8 French (for large pancreatic duct) inserted into the pancreatic duct and brought out of the abdominal wall through the jejunal loop (Fig. 3). This external drainage was then connected to a urine bag for closed system collection. The drainage tube was temporarily fixed to the pancreatic stump by two absorbable 5-0 sutures. This external drainage was removed from the patient at approximately three to four weeks following the operation, the estimated time from previous observation that the absorbable sutures dissolved and no longer held the drainage tube to the pancreatic stump.

Immediate postoperative care was carried out in the same way as with other major abdominal

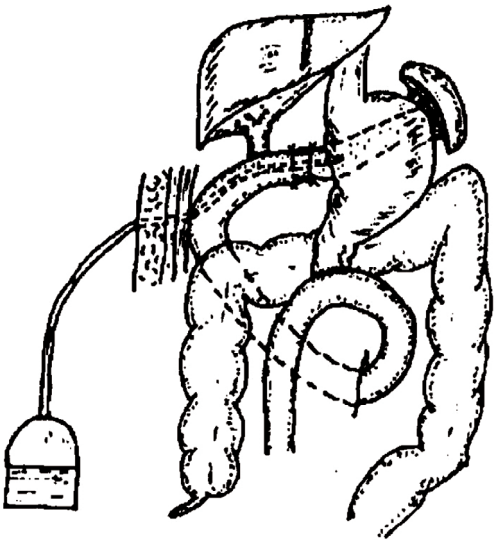

Fig. 1 Drawing demonstrates method of reconstruction after pylorus preserving PD with external pancreatic stent.

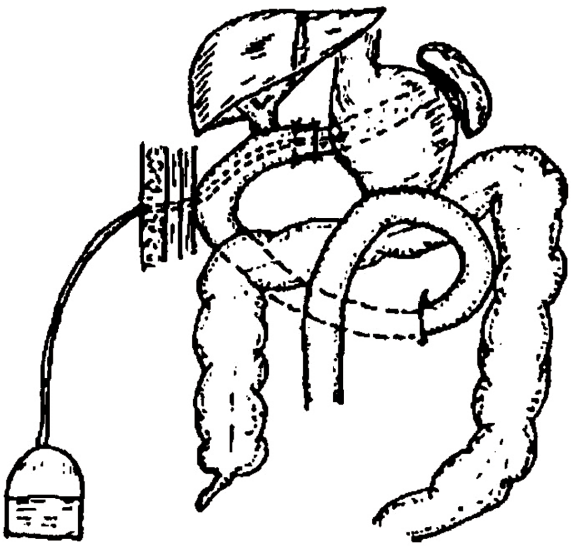

Fig. 2 Drawing demonstrates method of reconstruction after classical PD with external pancreatic stent.

operations without administration of octreotide for prophylaxis of pancreaticojejunostomy anastomotic leakage or pancreatic fistula. Complications after PD were examined and reported. Pancreatic fistula was diagnosed when drainage fluid from abdominal drains contained amylase more than three times the serum amylase level after postoperative day 3[12]. Delayed gastric emptying was defined as either (a) duration of nasogastric tube placement >10 days or (b) its re-insertion because of vomiting after initiation of oral intake[13-15]. Management of postoperative complications was as followed. Intra-abdominal collection was treated by percutaneous drainage. Pancreatic fistula was treated conservatively with interval re-evaluation. Further management depended on clinical status after re-evaluation. Reoperation was performed when significant intra-abdominal bleeding was suspected or diagnosed and when intra-abdominal sepsis was diagnosed with failure of other non-surgical treatments. Operative mortality was defined as death within one month after the operation.

Univariate analysis was performed to compare significance of variables using Fisher's exact test. A p-value of <0.05 was considered significant.

Results

One hundred patients entered into the present study. Fifty six per cent were male and 44% were female. Number of patients who underwent PD each year of study is shown in Fig. 4. The age ranged from

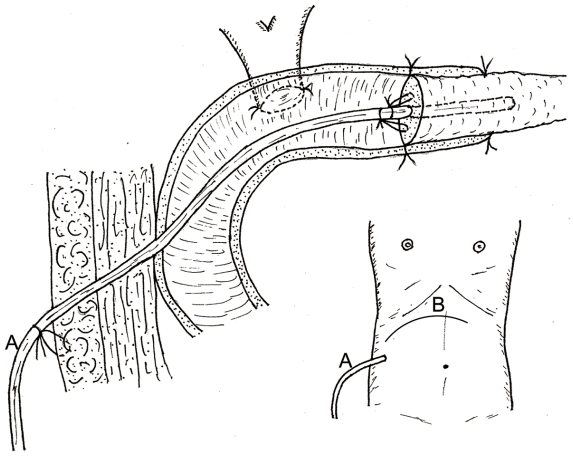

Fig. 3 Drawing demonstrates method of insertion of external pancreatic stent (A) in detail (B = incision for PD).

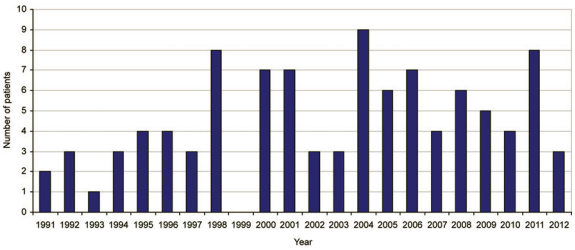

Fig. 4 Bar diagram showing number of patients who underwent PD in each year of study.

Table 1. Demographic data of 100 patients

Age (year)				
Mean±SD	61.2±15.1			
Median	63			
Range	21-92			
Number of patients grouped by age (year)				
Age	<60	60-70	71-80	>80
No. of patients	38	33	19	10
Gender				
Male	56			
Female	44			

21 to 92 years (mean 61.2±15.1, median 63). Thirty eight percent of patients were aged <60 years, 33% were 60 to 70 years, 19% were 71 to 80 years, and 10% were >80 years (Table 1). Indications for PD (pathology or conditions) were carcinoma of the ampulla of Vater (34%), carcinoma of the head of the pancreas (30%), carcinoma of the common bile duct (6%), carcinoma of the duodenum (4%), cystic neoplasms of the pancreas (6%), other malignancies (13%), and other benign conditions (7%) (Table 2). Two patients (2%) underwent emergency PD because of massive gastrointestinal bleeding, one was caused from carcinoma of the duodenum and one from infection at the pancreatic head (preoperative diagnosis was bleeding from pancreatic cancer). Sixty seven per cent underwent PPPD and 33% underwent classical PD. Twenty eight patients had been operated before 2001 without external pancreatic drainage. The remaining 72 patients had been operated since 2001 with insertion of external pancreatic drainage tube in all except one who had undergone total pancreatectomy. The operative time ranged from 270 to 780 minutes (mean 444±97, median 420). The operative blood transfusion ranged from 0 to 12 units (mean 3±2, median 3). Reconstruction of the pancreaticojejunostomy anastomosis was performed by end to side method in eight patients, end to end method (invagination technique) in 91, and none (total pancreatectomy) in one (Table 3).

The postoperative morbidity and mortality rate in 100 patients were 44% and 2%, respectively. In patients who had been operated before 2000 (no external pancreatic drainage), the pancreatic fistula rate was 21.4%, overall complication 50% with one death (3.6%). The cause of death was massive intra-abdominal bleeding after occurrence of pancreatic fistula. In 72 patients who had been operated since 2000, 71 had external pancreatic drainage and one had total pancreatectomy. The pancreatic fistula occurred in nine patients (12.7%), overall complications 41.7% with one death (1.4%). The patient who died had immediate postoperative bleeding from the pancreatic stump and branches of the superior

Table 2. Indications for PD (pathology or conditions) in 100 patients

Pathology or conditions	Percent
Ca ampulla of Vater	34
Ca head of the pancreas	30
Ca distal common bile duct	6
Ca duodenum	4
Cystic neoplasms of the pancreas	6
Ca stomach	4
Ca gall bladder	2
Ca hepatic flexure of the colon	1
Sarcoma of the pancreas	2
Leiomyosarcoma of the duodenum	1
Neuroendocrine tumor of the pancreas	2
Metastatic hepatocellular Ca to the pancreas	1
Trauma	3
Pancreatitis	3
Infection	1
Total	100

Table 3. Operative data in 100 patients

Operative time (minute)	
Mean±SD	444±97
Median	420
Range	270-780
Operative blood transfusion (unit)	
Mean±SD	3±2
Median	3
Range	0-12
Type of PD	
Classical PD	33
PPPD	67
Management of pancreatic stump (n = 100)	
No external pancreatic drainage (before 2000)	28
External pancreatic drainage (since 2000)	71
No pancreatic stump (total pancreatectomy)	1
Method of reconstruction of pancreaticojejunostomy anastomosis (n = 100)	
End to side pancreaticojejunostomy	8
End to end pancreaticojejunostomy	91
No anastomosis (total pancreatectomy)	1

mesenteric artery (SMA) in remnant of the uncinate process of the pancreas. The bleeding stopped after one reoperation and two consecutive angiography with embolization but she died three weeks later from multiple system organ failure (MSOF). The overall pancreatic fistula rate in 100 patients was 15%. The fistula rate in non-external drainage vs. external drainage patients were 21.4% vs. 12.7% (p = 0.349, NS). Details of complications are shown in Table 4.

Management of complications was as follows. Successful conservative management of pancreatic fistulas with spontaneous closure was done in 13 out of 15 patients (86.7%). Successful percutaneous drainage of intra-abdominal collection was done in four out of six patients (66.7%). All patients with wound infection (n = 8), bile fistula (n = 2), early delayed gastric emptying (n = 6), acute coronary syndrome (n = 1), and gastrointestinal bleeding (n = 1) were successfully managed by supportive treatment. Re-laparotomy was required in nine patients, the indications were intra-abdominal bleeding (n = 4), gastric outlet obstruction (n = 1), biliary obstruction (n = 1), pancreatic fistula with sepsis (n = 1), and intra-abdominal collection with sepsis (n = 2). Details of re-laparotomy are shown in Table 5. When pancreatic fistula was classified according to the clinical impact on the patient's clinical course, 13 (86.7%) were grade A, and two (13.3%) were grade C[12]. In patients without external pancreatic drainage, five (83.3%) had grade A pancreatic fistula and one (16.7%) had grade C. In patients with external pancreatic drainage, eight (86.7%) had grade A and one (11.1%) had grade C. There was no statistical significance of grade A and grade C pancreatic fistula in patients without and with external pancreatic drainage (grade A, p = 0.50; grade C, p = 0.48) (Table 6). In this study, both patients who died age <70 years (n = 71). There was no mortality in patients aged >70 years (n = 29), (p = 1.00, NS) (Table 4).

Discussion

Indications for PD

It is generally accepted that PD is a standard procedure for periampullary neoplasms. The decision

Table 4. Complications after PD in 100 patients

Complications	Before 2000 no external pancreatic stent (n = 28)	Since 2000 71 patients with external pancreatic drainage 1 patient with total pancreatectomy	p-value
Pancreatic fistula	6 (21.4%)*	9 (12.7%)	0.349 (NS)
Wound infection	2	6	
Bile fistula	0	2	
Intra-abdominal collection	2	4	
Early delayed gastric emptying	2	4	
Gastric outlet obstruction	1	0	
Biliary obstruction	1	0	
Acute coronary syndrome	0	1	
Gastrointestinal bleeding	0	1	
Intra-abdominal bleeding	0	3**	
Overall complications	14 (50.0%)	30 (41.7%)	0.596 (NS)
Re-laparotomy	5 (17.9%)	4 (5.6%)	0.111 (NS)
Death	1 (3.6%)	1 (1.4%)	0.483 (NS)
Total pancreatic fistula rate in 100 patients		15%	
Total complication rate in 100 patients		44%	
Total death rate in 100 patients		2%	
Age ≤70 (n = 71), No. of death 2; Age >70 (n = 29), No. of death 0			1.000 (NS)

* Cause of death in 1 patient, ** Cause of death in 1 patient

Table 5. Re-laparotomy after PD in 100 patients (n = 9)

Indication for re-laparotomy	Operative procedures	Results
Before 2000 (no external pancreatic drainage)		
1. Bleeding after occurrence of pancreatic fistula	Suture stop bleeding	Death
2. Gastric outlet obstruction	Revision of gastrojejunostomy anastomosis	Good recovery
3. Biliary obstruction	Revision of choledochojejunostomy anastomosis	Good recovery
4. and 5. Intra-abdominal collection with sepsis	Removal of infected fluid, irrigation, and drainage	Good recovery
Since 2000 (routine insertion of external pancreatic drainage tube)		
1. Bleeding from a branch of short gastric vessels	Suture stop bleeding	Good recovery
2. Bleeding from remnant of uncinate process of the pancreas	Suture stop bleeding	Good recovery
3. Bleeding from pancreatic stump and branches of SMA in remnant of the uncinate process of the pancreas	Suture stop bleeding	Death
	Removal of infected materials, irrigation, and drainage	Good recovery
4. Pancreatic fistula with sepsis		

Table 6. Analysis of pancreatic fistula[12]

Pancreatic fistula	Patients without external pancreatic drainage (n = 28)	Patients with external pancreatic drainage (n = 71)	p-value
Grade A	5	8	0.50 (NS)
Grade C	1	1	0.48 (NS)
Total	6	9	

to perform PD is clearly made when preoperative diagnosis is confirmed by tissue biopsy, which is usually obtained in carcinoma of the ampulla of Vater and carcinoma of the duodenum. Four patients in our case series had carcinoma of the stomach, which were also diagnosed preoperatively from gastroscopy and biopsy. However, no preoperative tissue diagnosis was made for carcinoma of the pancreatic head in the presented patients. The authors do not attempt to perform preoperative or intra-operative pancreatic biopsy in resectable pancreatic head lesions, instead, we usually proceed to do PD. The reasons for such practice are as follows. Firstly, tissue biopsy either needle or open method may give a false negative result. Secondly, tissue biopsy may cause seeding of the tumor cells when pancreatic cancer is present. Thirdly, the authors believe that PD is a very effective procedure for relieving biliary and gastric outlet obstruction in patients with a mass at the pancreatic head, as long as the procedure is safely performed with low morbidity and mortality. This resulted in a few benign pathology in our patients presented with pancreatic head mass since chronic pancreatitis could not be diagnosed until after careful examination of tissue obtaining from PD in this small group of patients. Performing pancreaticoduodenectomy of unproved malignancy in patients with pancreatic head mass by experienced pancreatic surgeons when pancreatic carcinoma cannot be excluded was previously recommended[16]. For carcinoma of the distal common bile duct, preoperative tissue biopsy was not required either. The indication for operation based on findings of intraluminal mass in the distal common bile duct from CT scan in patients with obstructive jaundice.

In patients with cystic lesions at the pancreatic head, if malignancy or premalignant lesion cannot be definitely excluded, the authors also recommend PD. Large symptomatic cyst at the pancreatic head can also be effectively treated by PD. Of the six patients who had cystic lesions at the pancreatic head in the present report, five (80%) had malignancy or premalignant lesions. The oldest patient in this group aged 92 years at the time of surgery. She presented with a 8 cm in diameter cystic lesion at the pancreatic head. The postoperative pathological report was mucinous cystadenoma of the pancreatic head. She is now 100 years old and is still healthy. In one patient (20%) who had a benign epithelial cyst (pathological report after PD) and presented with obstructive jaundice, the authors believed that PD was an appropriate surgical procedure for such symptomatic cyst. The operation was successfully performed without complication.

In one peculiar circumstance, the authors encountered a 58-year end-stage renal failure patient. He was in the waiting list for renal transplantation. The authors were consulted for management of massive upper gastrointestinal bleeding, which was thought to be caused by a large pancreatic head mass mimicking unresectable pancreatic cancer from CT scan. The bleeding failed to stop after two consecutive angiography and embolization. The authors decided to perform a palliative PD for bleeding control. The patient had an uneventful recovery. The pathological report was acute infection of the pancreatic head probably from hematogenous seeding of the bacteria during hemodialysis. He subsequently underwent a successful renal transplantation two years later. He is now alive, eight years after an emergency PD. Another patient that underwent emergency PD because of massive gastrointestinal bleeding had carcinoma of the duodenum. This patient is still alive and well, without evidence of recurrence, 12 years after the operation.

Resectability

Resectability is very important when PD is being considered in patients with periampullary neoplasms. This is particularly emphasized in patients with suspected carcinoma of the head of the pancreas, since approximately 80% of carcinoma of the pancreas are unresectable at the time of diagnosis[17,18]. Without precise preoperative information of resectability, the patients are at higher risk of undergoing a microscopically positive (R1) or a grossly positive (R2) resection margin after PD. Palliative PD renders the patients for surgical morbidities without obvious survival benefit[19,20]. Furthermore, palliative PD has been reported to impair quality of life compared to bypass surgery in carcinoma of the head of the pancreas[21]. Such decision making to perform PD in the unresectable tumor frequently occurs when operative procedures reach "the point of no return", i.e. after transection of the pancreatic neck or body. Fortunately, we less frequently encounter that ambiguous situation because the current three-dimensional CT scan can accurately determine the resectability of carcinoma of the pancreatic head in most patients preoperatively. The tumor is usually resectable when the celiac axis, common hepatic artery, and SMA are not involved by the tumor (Fig. 5). Involvement of superior mesenteric and/or portal vein is not a contraindication for resection[22-24].

Is the patient too old for PD?

Periampullary neoplasms are frequently diagnosed in aging patients. Since the magnitude of PD and its potential morbidity and mortality are enormous, surgeons sometimes are reluctant to perform this operation in the elderly. Our practice in this group of patients is careful evaluation of medical status including preoperative diagnosis and resectability. If diagnosis and resectability are confirmed and there are no serious medical problems impeding operation, PD is scheduled. In the current report, 38% of the patients were <60 years, 33% were 60 to 70 years, 19% were 71 to 80 years, and 10% were >80 years (Table 1). The oldest patients in our case series aged 92 years. The only two patients who died after PD in our study were 33 and 70 years. There was no mortality in patients aged more than 70 years, which comprised 29% of patients in the present study (Table 4). Although there was no statistical significance of the difference, this finding supported the safety of PD in the elderly. Performing a safe PD in the elderly has been reported by several investigators[25,26].

Classical PD or PPPD?

The authors would prefer to do PPPD whenever possible because it is technically easier and postoperative nutritional status is superior when the gastric antrum is spared[27-29]. The only contraindication for PPPD is when oncologic safety for tumor margin is compromised. In the present study, 67% of patients underwent PPPD and only 33% underwent classical PD. PPPD is safe even in patients with adenocarcinoma

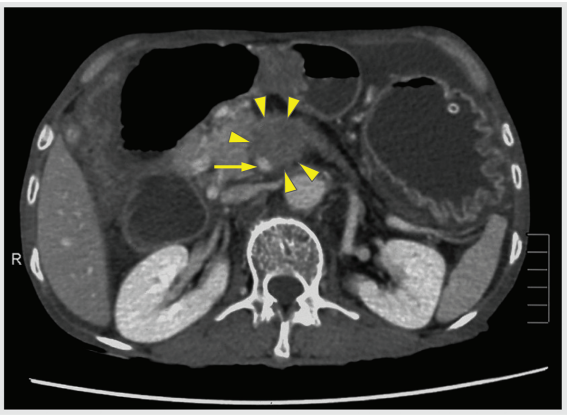

Fig. 5 CT scan demonstrating a low density tumor (arrowheads) causing encasement of the superior mesenteric artery (arrow). The tumor was considered unresectable and surgical bypass was performed for duodenal obstruction.

of the head of the pancreas. Of the 30 patients who had adenocarcinoma of the head of the pancreas in the present study, 22 (73.3%) underwent PPPD, all of them had free duodenal margin for microscopic involvement of the tumor on pathologic examination. Another interesting point reserves to be discussed is the occurrence of early delayed gastric emptying (early DGE) following PPPD. This complication is common after PPPD and the reported incidence varied between 15% and 50%[13,27,28,30,31]. The authors had early DGE in only 7.5% of patients who underwent PPPD in our case series (5 out of 67 patients). Probably, avoidance of postoperative intra-abdominal complications by various means is the key factor to lessen this disturbing morbidity[32].

Surgical techniques

The authors usually use the right subcostal incision with extension to the left beyond the midline of linea alba for approximately 5 cm (Fig. 3). The key points of successful outcome, i.e. minimal morbidity and minimal mortality, are precise and careful surgical techniques. There is no room for error in this complex surgical procedure. What seems to be minor complication may lead to catastrophic event resulting in serious morbidity or even mortality. Complete hemostasis is the rule. All named vessels should be doubly ligated. Details of the operation have been well described in the literature. One important surgical anatomy that should be carefully looked for during dissection at the hepatoduodenal ligament is a replaced or accessory right hepatic artery and sometimes, aberrant common hepatic artery (Fig. 6). A replaced or accessory right hepatic artery is present in 10% to 18% of the population[33,34]. This aberrant hepatic artery arises from the SMA and emerges in the posterior aspect of the hepatoduodenal ligament to supply the liver. Inadvertent injury to this artery may cause massive hemorrhage, leakage, or late stricture of the biliary enteric anastomosis after PD[35,36]. Care should be taken to preserve this blood supply of the liver and bile duct. When ligation and resection of this artery is necessary to achieve an adequate oncologic margin such as in patient with carcinoma of the pancreatic head, the accessory hepatic artery may be safely ligated. For a replaced right hepatic artery, the hepatic blood flow may be maintained after resection by re-anastomosing to the gastroduodenal artery stump[37,38].

After complete resection and the tumor with the duodenum is removed, two sites that may cause postoperative bleeding should be carefully inspected and any potential bleeding vessels should be suture-ligated with fine polypropylene suture (No. 4.0 or 5.0). The first site is the cut surface of the pancreatic stump and the second ones are branches of the SMA behind the superior mesenteric vein and closed to the main trunk of the SMA (remnant of the uncinate process of the pancreas). The only one death in the patients with external pancreatic drainage died from MSOF, three weeks after immediate postoperative massive bleeding from both sites. This was the case number 54 from 100 cases in our series. Since then, the authors had routinely performed careful hemostasis with fine polypropylene sutures at both areas (pancreatic stump and branches of the SMA in the remnant of the uncinate process of the pancreas) and have not encountered such a dangerous situation any more.

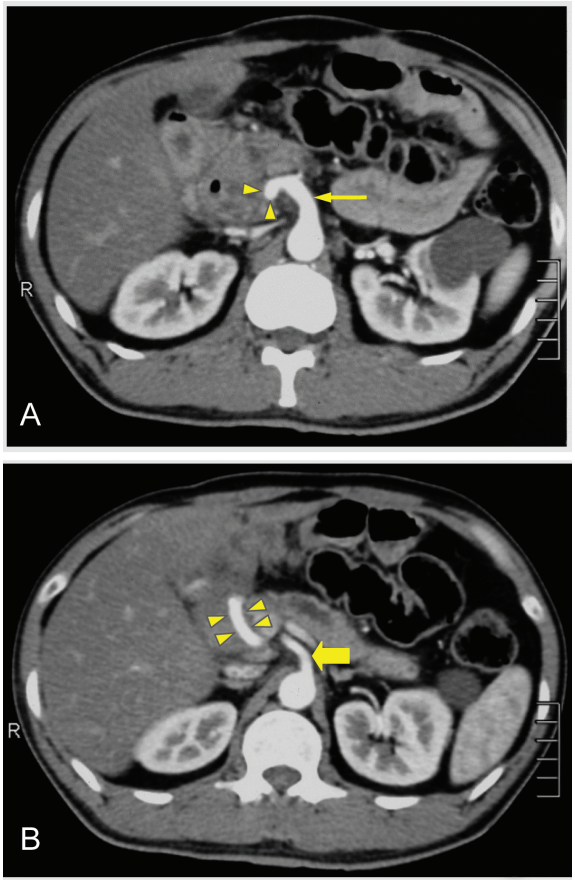

Fig. 6 (A and B) CT scan demonstrating aberrant com mon hepatic artery (arrowheads in A and B) originating from the superior mesenteric artery. (long arrows in A = superior mesenteric artery; short, thick arrows in B = celiac artery).

Prevention of pancreatic fistula

Leakage of pancreaticojejunostomy anatomosis or pancreatic fistula is a serious complication following PD, which may lead to other morbidity or even mortality. Delayed gastric emptying, hemorrhage, intra-abdominal abscess or collection, sepsis, or death are deleterious consequences that may develop after such anastomotic leakage or pancreatic fistula[39-42]. Prolonged hospital stay, increased hospital costs, and increased workload of health personnel are also unavoidable when pancreatic fistula occurs. All these sequelae carry a major burden to hospitals and patients who undergo PD. Several methods of surgical procedures including administration of some pharmacologic agents such as octreotide have been advocated to prevent or lessen the occurrence of pancreatic fistula with variable outcomes. Among them, external drainage of the pancreatic remnant has been introduced with satisfactory results[43-46]. Such drainage is an attractive procedure to protect pancreaticojejunostomy anastomotic suture line. The simple explanation for such protection is to drain pancreatic enzyme away from pancreaticojejunostomy anastomosis, hence, digestion is not activated near the suture line. Approximately 200 to 300 ml per day of pancreatic enzyme was drained outside the body in patients who underwent PD with external pancreatic drainage[47]. The authors did not observe any untoward effects of losing this volume of pancreatic enzyme in our patients. On the other hand, this amount of digestive enzyme might be harmful to the vulnerable anastomosis of the pancreas and the jejunum. Other explanations for protective mechanisms of external pancreatic drainage include prevention of pancreatitis of the remaining pancreas caused by edema, allowance of more precise sutures to the pancreatic anastomosis and decompression of the jejunal loop[40]. Despite a logical reason to divert the pancreatic enzyme away from the pancreaticojejunostomy anastomosis in order to prevent anastomotic leakage, few studies have supported its use. Recent studies, including one from our institution, have shown that external drainage of the pancreatic remnant following PD is beneficial[47-49]. The low occurrence of pancreatic fistula (12.7%) in patients who had external drainage of the pancreatic remnant in the current study has confirmed the effectiveness of external pancreatic drainage. Furthermore, the reliability of external drainage of the pancreatic remnant in prevention of pancreatic fistula is augmented by the fact that no prophylactic octreotide was used in the present study.

The pediatric feeding tube used for external pancreatic drainage is readily available in every operating room. It can be used in both normal and fibrotic pancreas associated with chronic pancreatitis. In normal pancreatic parenchyma with a small duct of Wirsung, a small tube (number 5 French) is used. In fibrotic pancreas with large pancreatic duct, a number 8 French tube is more appropriate. Some investigators recommended the use of external pancreatic drainage only in normal pancreatic parenchyma with a small pancreatic duct. They believed that in fibrotic pancreas with large pancreatic duct, the external drainage was not necessary. Marcus et al reported that the rate of pancreatic fistula was 36% in patients with soft pancreas and non-dilated pancreatic duct but only 2% in patients with fibrotic pancreas[50]. In the presented case series, the authors used the external pancreatic drainage in all texture of pancreatic remnant or routinely since leakage of pancreaticojejunostomy anastomosis or pancreatic fistula may lead to catastrophic event that one should keep its occurrence as low as possible. Although external pancreatic drainage is our recommended method to prevent occurrence of pancreatic fistula, there was no statistical significance of postoperative pancreatic fistula in the presented patients without and with external pancreatic drainage (Table 4). Subgroup analysis of patients with the pancreatic fistula also revealed no statistical significance (Table 6).

Conclusion

The authors present our experience with 100 consecutive cases of PD over a period of 20.5-years. The operations could be safely performed with low pancreatic fistula and low mortality rate. Proper indications and careful preoperative evaluation is of utmost importance. Preoperative CT scan was invaluable for determining resectability of periampullary and pancreatic head lesions. Elderly is not a contraindication for PD. Meticulous surgical techniques are required in every step of the operation. External drainage of the pancreatic remnant after PD is an effective method to prevent leakage of pancreaticojejunostomy anastomosis or pancreatic fistula. Although statistical significance could not be demonstrated in this study, insertion of an external pancreatic stent is inexpensive, simple, and practical to employ. The authors strongly recommend its use when performing PD.

Potential conflicts of interest

None.

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บทเรียนที่ได้รับจากการผ่าตัดแพนครีเอติโคดูโอเดเนกโตมี่ โดยผู้นิพนธ์หลักจำนวน 100 รายติดต่อกันที่โรงพยาบาลมหาวิทยาลัยแห่งหนึ่งในประเทศไทย

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ภูมิหลัง: *การผ่าตัดแพนครีเอติโคดูโอเดเนกโตมี่ เป็นการผ่าตัดใหญ่ที่อาจมีภาวะแทรกซ้อนเป็นอันตรายถึงชีวิต ประสบการณ์ของทีมผ่าตัดและการผ่าตัดอย่างสม่ำเสมอเป็นปัจจัยสำคัญที่ทำให้ผลการรักษาดี วัตถุประสงค์ของรายงานนี้เพื่อศึกษาถึงผลการผ่าตัดแพนครีเอติโคดูโอเดเนกโตมี่ในผู้ป่วยจำนวน 100 รายติดต่อกันของผู้นิพนธ์หลัก และวิเคราะห์ถึงการผ่าตัดชนิดนี้ในแง่มุมต่าง ๆ ร่วมกับค้นคว้าบทความวิจัยที่เกี่ยวข้อง ประกอบในการเขียนรายงานให้มีความสมบูรณ์สามารถนำไปปฏิบัติได้*

วัสดุและวิธีการ: *เป็นการศึกษาย้อนหลังในผู้ป่วยจำนวน 100 ราย ที่ได้รับการผ่าตัดแพนครีเอติโคดูโอเดเนกโตมี่ ในช่วงเวลา 20 ปี 6 เดือน ข้อบ่งชี้ของการผ่าตัดได้แก่ มะเร็งบริเวณรอบ ๆ แอมพูลล่า อ็อฟ วาเตอร์ และส่วนหัวของตับอ่อน รวมถึงพยาธิสภาพอื่น ๆ บริเวณส่วนหัวของตับอ่อน ผู้ป่วยทุกรายได้รับการตรวจเอกซเรย์คอมพิวเตอร์ของช่องท้องเพื่อดูความรุนแรงของโรคและเพื่อประเมินว่าจะสามารถตัดเนื้องอกออกได้โดยปลอดภัยหรือไม่ ผู้ป่วยบางรายได้รับการใส่ท่อระบายน้ำดีก่อนผ่าตัดถ้ามีความจำเป็น เทคนิคการผ่าตัดทำคล้ายกันเกือบทุกราย ก่อนปี พ.ศ. 2543 ไม่มีการใส่ท่อระบายน้ำย่อยตับอ่อนออกนอกร่างกาย ตั้งแต่ปี พ.ศ. 2543 ผู้ป่วยทุกรายได้รับการใส่ท่อระบายน้ำย่อยตับอ่อนออกนอกร่างกาย ยกเว้นผู้ป่วย 1 ราย ที่ได้รับการตัดเอาตับอ่อนออกทั้งหมด หลังการผ่าตัดได้ศึกษาโดยละเอียดถึงภาวะแทรกซ้อนและอัตราตาย*

ผลการศึกษา: *มะเร็งของแอมพูลล่า อ็อฟ วาเตอร์ และมะเร็งของส่วนหัวของตับอ่อนเป็นข้อบ่งชี้ของการผ่าตัดที่บ่อยที่สุด (ร้อยละ 34 และร้อยละ 30 ตามลำดับ) ผู้ป่วยที่เป็นมะเร็งที่ส่วนหัวของตับอ่อนทุกรายได้รับการผ่าตัดโดยไม่มีผลการวินิจฉัยทางพยาธิวิทยาก่อนผ่าตัด ผู้ป่วย 2 ราย ได้รับการผ่าตัดฉุกเฉินเนื่องจากมีเลือดออกรุนแรงในระบบทางเดินอาหาร ผู้ป่วยร้อยละ 67 ได้รับการผ่าตัดชนิดเก็บหูรูดของกระเพาะอาหาร และผู้ป่วยร้อยละ 33 ได้รับการผ่าตัดชนิดตัดกระเพาะอาหารส่วนปลายออก ผู้ป่วย 28 ราย ไม่ได้รับการใส่ท่อระบายน้ำย่อยตับอ่อนออกนอกร่างกาย ผู้ป่วย 71 ราย ได้รับการใส่ท่อระบายน้ำย่อยตับอ่อนออกนอกร่างกาย ผู้ป่วย 1 ราย ได้รับการตัดตับอ่อนออกทั้งหมด ผู้ป่วยร้อยละ 44 มีภาวะแทรกซ้อนหลังผ่าตัด และร้อยละ 2 เสียชีวิต ผู้ป่วยที่ไม่มีท่อระบายน้ำย่อยตับอ่อนออกนอกร่างกาย มีภาวะน้ำย่อยตับอ่อนรั่วร้อยละ 21.4 ซึ่งสูงกว่าผู้ป่วยที่มีท่อระบายน้ำย่อยตับอ่อนออกนอกร่างกาย (ร้อยละ 12.7) แต่ความแตกต่างนี้ไม่มีนัยสำคัญทางสถิติ ผู้ป่วยที่อายุมากกว่า 70 ปี จำนวน 29 ราย ไม่มีผู้ใดเสียชีวิต ผู้ป่วยที่อายุ 70 ปีและน้อยกว่า จำนวน 71 ราย มี 2 ราย เสียชีวิต (ไม่มีความแตกต่างอย่างมีนัยสำคัญทางสถิติ)*

สรุป: *การผ่าตัดแพนครีเอติโคดูโอเนกโตมี่สามารถทำได้อย่างปลอดภัยโดยศัลยแพทย์ที่มีประสบการณ์ โดยมีภาวะน้ำย่อยตับอ่อนรั่วและอัตราตายต่ำ การตรวจโดยเอกซ์เรย์คอมพิวเตอร์ของช่องท้องมีประโยชน์อย่างมากในการประเมินความรุนแรงของโรค และช่วยในการพิจารณาถึงโอกาสที่จะตัดเนื้องอกออกอย่างปลอดภัย ผู้ป่วยที่มีก้อนที่ส่วนหัวของตับอ่อนและสงสัยว่าอาจเป็นมะเร็งควรได้รับการผ่าตัดแพนครีเอติโคดูโอเดเนกโตมี่ โดยไม่ต้องรอพิสูจน์ทางพยาธิวิทยาก่อนผ่าตัดถ้าแพทย์ผู้ผ่าตัดมีประสบการณ์และความชำนาญมากพอ ผู้ป่วยที่มีอายุมาก (มากกว่า 70 ปี) ไม่ได้เป็นข้อห้ามของการผ่าตัด ผู้นิพนธ์มีความเห็นว่าการใส่ท่อระบายน้ำย่อยตับอ่อนออกนอกร่างกายมีส่วนช่วยในการป้องกันภาวะน้ำย่อยตับอ่อนรั่วหลังผ่าตัด*