Journal of the Egyptian Nat. Cancer Inst., Vol. 15, No. 4, December: 311-324, 2003

Pancreaticoduodenectomy for Pancreatic Head and Periampullary Adenocarcinoma Results of Surgical Treatment

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ABSTRACT

Background and Purpose: Surgery remains the mainstay therapy for pancreatic head (PH) and periampullary carcinoma (PC) and provides the only chance of cure. Improvements of surgical technique, increased surgical experience and advances in anesthesia, intensive care and parentral nutrition have substantially decreased surgical complications and increased the survival. The aim of this prospective study is to analyze the surgical procedures, mortality and morbidity and survival data after pancreaticoduodenectomy (PD) for PH and PC and to evaluate the benefit of preoperative biliary drainage (PBD) and the technique of pancreaticogastrostomy (PG) and pylorus preserving pancreaticoduodenectomy (PPPD).

Patients and Methods: From September 2000 to September 2003, 20 patients with PH and PC in NCI, Cairo University and South Egypt Cancer Institute (SECI), Assiut University were operated upon, (19 patients underwent pancreaticoduodenectomy while one patient underwent total pancreatectomy. Nine patients had pancreatic head tumors, 5 had ampullary tumors, 4 had tumors in the distal bile duct and 2 patients had tumors in the second part of the duodenum. Pylorus preservation was done in 7 patients. Pancreatic anastomosis was performed through pancreaticogastrostomy end to side in all cases except the case of total pancreatectomy (19), while biliary anastmosis was done as end-to-end choledecojejunostomy in 5 patients and end to side in 15 patients. Gastric anastmosis was fashioned as end-to-end gastrojejunostomy in 13 patients (including the 7 patients with pylorus preservation) and as end to side in 7 patients. Eight patients were subjected to preoperative biliary drainage with internal stents.

Results: The age of the patients ranged from 23 to 64 years and the mean age was 52.3 years. Twelve patients (60%) were males while 8 patients (40%) were females. Fourteen patients (70%) had stage I and II cancer while 5 had stage III disease (25%) and 1 case had stage IV disease. Three patients died in the perioperative period (15%) Postoperative morbidity in the form of, minor biliary leakage in 4 patients (20%); 3 healed conservatively. Leakage from gastrointestinal anastomosis occurred in 2 patients (10%); one healed conservatively and the other was explored and closure of the site of leakage was done. Five patients (25%) had mild wound infection (four of them with preoperative stenting). No complication was found in the pancreaticogastrostomy anastmosis. Delayed gastric emptying occurred in 6 patients (30%). The mean hospital stay was 17 days. The patients were followed up for a period ranged between 6 and 35 months. The median overall survival was 24 months while the median disease free survival was 22 month. At one year, the overall survival (OS) was 93.8% while, the disease free survival (DFS) was 92% while at 24 month, the OS was 47.7% and the DFS was 32%. During follow up 4 patients died: 2 with liver metastases and 2 due to unrelated causes, 1 patient is living with liver metastases and 2 living with recurrence. Ten patients (50%) were completely free at the end of follow up.

Conclusions: Surgical resection remains the only modality to offer the possibility of long-term survival. All patients deemed suitable for surgery should be accurately staged with a combination of enhanced helical CT, dynamic MRI and MRCP, endosonography and laparoscopy. Pylorus preserving pancreaticoduodenctomy can be performed for better physiological function and it does not compromise survival though is associated with more delayed gastric emptying. Pancreaticogastrostomy is easy to perform and safe as regards the incidence of pancreatic fistula. Preoperative biliary drainage does not influence the incidence of postoperative complications except wound infection in spite of it can be performed safely in jaundiced patients, it should not be used routinely.

Key Words: *Pancreaticoduodenectomy for Periampullary carcinoma.*

INTRODUCTION

Pancreatic head (PH) and periampullary adenocarcinoma (PC) including ampulla, distal bile duct and second part of the duodenum is an important health problem in many industrialized nations. Pancreatic cancer is the ninth most common cancer and is the fourth leading cause of cancer death causing about 29.000 deaths annually in USA [1]. The incidence in the US and Western Europe remained stable at 9 per 100.000 population [2]. In Japan a dramatic

increase has been observed during the last decade and the lower most incidences worldwide is seen in India and Middle East [2]. The site of origin of PC is often difficult to determine. Pathological examination of resected specimens showed that adenocarcinoma of the head of pancreas (40-60%) account for the vast majority of PC followed by the ampulla of Vater (20-40%), distal CBD 10% and duodenum 10% [2].

Most patients present at an advanced stage and only 10-20% are candidates for resection [3]. Pancreaticoduodenectomy is the only potentially curative treatment for PC and surgical resection remains the only modality to offer the possibility of long term survival [4]. The associated 5 year survival rates after resection varies between 1-39% [3]. Survival is more favorable in patients with ampullary carcinoma whereas in patients with pancreatic carcinoma, surgery was considered as a waste of resources by some authors [5] as the 5 year survival was 3.5% [6]. Despite a decrease in recent years, the postoperative mortality after PD remains as high as 8%. The median period of survival is 1.1 years and the overall 5 year survival rates is 15% and perioperative morbidity is about 50% [7-8].

Different approaches have been tried to improve the postoperative morbidity and mortality of PD including preoperative biliary drainage (PBD) in patients with jaundice using endoscopic biliary stent placement (EBS) which is still a subject for discussion [9]. Pylorus preserving pancreatico-duodenectomy (PPPD) with preservation of the stomach, antropyloric region and more limited dudenectomy was introduced for better physiological function instead of PD but was associated with increased morbidity and lesser lymphadenectomy [10,11,12]. Although some results suggest that resection may be curative, factors influencing survival in resectable patients are not clearly understood [13]. Factors that have been associated with improved survival in some studies include the absence of lymph node metastases [14-15], tumour size [14-16], tumour histological grade [14] and absence of tumour in surgical margin [15-17].

As such, this prospective study was designed to assess the technique of PD, analyze mortality and morbidity and assess the association of survival after resection with pathological and operative features.

PATIENTS AND METHODS

From September 2000 to September 2003, 20 patients with PH and PC in NCI, Cairo University and SECI, Assiut University were operated upon with PD.

A- *Patients selection:*

All patients fulfilled the Following:

- Age less than 70 years in both sexes.
- Clinically diagnosed PH and PC which included:
  1- Carcinoma of the pancreatic head: 9 cases.
  2- Ampullary carcinoma (any tumor arising within 1 cm of the ampulla of Vater): 5 cases.
  3- Carcinoma of the distal common bile duct CBD: 4 cases.
  4- Carcinoma in the second part of duodenum around the ampulla 2 cases.
- Adequate hepatic, renal and bone marrow reserve, guided by liver function, serum Creatinine and CBC.

No history of chemotherapy or radiotherapy. No history of cardiac disease.

B- *Methods:*

A- *Pre-operative staging:*

Trans-abdominal ultrasonography was the initial imaging modality to exclude cholelithiasis and confirm obstruction to the extra-hepatic biliary tree. In addition, the presence of a large pancreatic mass lesion, portal vein thrombosis, extra-pancreatic lymphadenopathy and hepatic metastases are usually indicative of incurable disease.

Computed tomography with contrast enhanced triple phase helical CT scan was carried out to provide arterial and venous phase cross sectional imaging (Fig. 1). It was used in evaluating operability and preoperative staging as it gives better assessment of invasion or compression of vessels and adjacent organs.

Resectability of the tumor by CT was established by absence of liver metastases and absence of distant malignant adenopathy, encasement of the celiac or superior mesenteric arteries, or encasement-thrombosis of the superior mesenteric or portal vein.

B- *Surgery:*

Skin incision:

Bilateral sub-costal incision was made in all cases and this provides adequate access and exposure.

At the time of surgery, patients were explored with intent for curative resection.

Patients was initially explored to examine:

1- The presence of previously undetected metastases in the liver, mesentry, or peritoneum.
2- The involvement of major vessels; portal vein, superior mesenteric vein (SMV), superior mesenteric artery, hepatic artery and celiac axis.

Preliminary duodenal and pancreatic exposure:

The superior mesenteric vein (SMV) and the anterior surface of the head and neck of the pancreas were exposed by mobilization of the hepatic flexure and right half of the transverse colon, which are reflected downwards towards the midline.

Kocherisation of the duodenum and pancreatic head:

The duodenum was kocherised from the patient right side to expose the infra-hepatic IVC, left renal vein and infra-renal aorta (Fig 3).

The lymphatics encountered anterior to the IVC and aorta were reflected up with the duodenum and head of pancreas to be included with the specimen.

Resectability relative to the SMA was confirmed by lifting the head of the pancreas in left hand between the fingers posteriorly and thumb anteriorly, to ensure the tumor is clear of the SMA.

Exposure of SMV/uncinate process mobilization:

The plane between the third part of the duodenum and transverse mesocolon was developed by dissection along the inner aspect of duodenal loop toward the root of the small bowel mesentry guided by middle colic vein. This process exposes the right lateral aspect of the SMV, which was then followed up towards the neck of the pancreas. The retro-pancreatic tunnel anterior to the SMV is then developed (Fig. 4).

Having established that there is no major venous encroachment by the tumor, exposure of the supra-duodenal portal vein and placing a sling around the neck of the pancreas was done.

Hepatoduodenal dissection/exposure of portal vein:

The gastrohepatic ligament was divided close to its insertion into the liver. This dissection was continued to expose the main portal inflow structures. The gall bladder was mobilized, fundus first from the hepatic fossa using diathermy dissection. The cystic artery was ligated and divided, leaving the gall bladder in continuity with the main bile duct to provide traction during mobilization of the bile duct and lymphatics off the portal vein. The main bile duct was divided above the insertion of the cystic duct. The distal duct was ligated with a 2/0 silk tie and the proximal common hepatic duct was left unclamped to drain into a small swab (Fig. 5).

The distal duct and associated soft tissue and lymphatics are mobilized off the portal vein and dissection continued between the common hepatic artery and superior border of pancreas to free the neck of the pancreas.

Gastric transection:

Having placed a sling around the pancreatic neck, the lesser curve of the stomach was prepared for transection and the greater omentum was divided and an area cleared on the greater curvature by division of gastro-epiploic vessels. The stomach was divided and the antrum was rotated to the right to expose the head and the neck of the pancreas. The proximal stomach was packed away into the left upper quadrant. In 7 cases pylorus preservation was done and division was carried out in the duodenum 2 cm distal to the pylorus (Fig.6).

Pancreatic resection:

The sling elevates the pancreatic neck and 4 stay sutures were inserted into the superior and inferior borders of the pancreas. These sutures were placed for haemostasis by suture ligation of the marginal pancreatic arteries. The duct was identified and small bleeding vessels within the pancreatic parenchyma are controlled with interrupted 5/0 Monocryl absorbable suture.

DJ flexure mobilization:

The proximal jejunum and ligament of Treitz were mobilized by division of the lateral peritoneal attachments. The inferior mesenteric vein runs parallel to the DJ flexure and should be preserved. The jejunum was divided 15 cm beyond the ligament of Treitz (Figs. 7 ,8).

Surgical Reconstruction:

Pancreatic anastmosis:

An end to side pancreaticogastrostomy is the most proximal anastmosis. It was done for all cases. The technique of performing pancreaticogastrostomy was as follows: Antrectomy of the stomach was performed, to leave a large residual stomach for insertion of the pancreatic stump into the gastric lumen. The pancreatic remnant was freed from the retroperitoneal space for about 3 cm. A corresponding transverse opening was made on the posterior gastric wall (Fig. 9). The anastomosis was performed with an interrupted row of 3/0 silk suture. Each stitch was passed through the pancreas and through the full thickness of the stomach. The pancreatic remnant was then immediately introduced into the stomach and the outer row of anastomosis was fashioned using full thickness sutures, which was tied from outside. A stent tube was inserted and fixed to the pancreatic duct and brought through the stomach to the abdominal wall in the first 4 cases and removed after 12 to 14 days (Fig. 9).

Biliary anastomosis:

An end-to-side choledecojejunostomy was done in 15 cases using single layer of interrupted 4/0 resorbable sutures (PDS) or vicryl. In 5 cases the CBD was so dilated that, end to end choledecojejunostomy was done (Fig. 10, Table 3).

Gastric anastomosis:

An end-to-side gastroenterostomy was fashioned 50 cm downstream from the biliary anastomosis in 2 layers using 3/0 PDS. In 7 cases PPPD was performed in 7 cases with end to end duodenojejunostomy and in 6 cases end to end gastrojejunostomy was done (Table 3).

After surgery, the patients were followed up to detect complications, local recurrence and distant metastasis.

Survival was estimated by Kaplan Meier and comparison of curves by Log Rank test. p value < 0.05 significant.

RESULTS

The mean age of the patients was 52.3 years (range 23-64 years). Twelve patients were male (60%) while 8 patients were female (40%). The common presenting symptoms were Jaundice 70%, weight loss 50%, abdominal pain 30% (Table 1). Fourteen patients (70%) had stage I and II cancer while five patients (25%) had stage III and one patient (5%) with single liver metastasis peripherally situated and 1 x 0.5 cm in segment 5 (stage 4). Nine patients had pancreatic head cancer (45%), five had ampullary tumors (25%), four had tumors of the distal CBD (20%) and two patients (10%) had tumors of the second part of the duodenum (Table 2).

Patients were older than 40 years except one case who was 23 years and he presented with pancreatic head mass with single liver metastasis. A palliative resection was done for this patient because of severe epigastric pain radiating to the back.

Pancreaticogastrostomy was done in all the cases.

The postoperative mortality included three patients (15%); one due to reactionary hemorrhage from the portal vein, one due to severe hematemesis of unknown cause on the 3rd postoperative day and the third died after one month due to uncontrolled diabetes (total pancreatectomy). Postoperative morbidity in the form of biliary leakage in 20% that healed conservatively in three patients (15%) and required guided percutaneous CT drainage in one patient (5%). Leakage from gastrointestinal anastomosis occurred in two patients (10%); one healed conservatively and the other was explored with closure of the site of leakage (Fig. 12). Delayed gastric emptying occurred in six patients (30%) (In 4 patients with pylorus preservation and in two patients without pylorus preservation), wound infection occurred in 5 patients (25%): 4 patients with PBD and in one patient without PBD (Table 4).

The mean hospital stay was 17 days. The median overall survival (OS) was 24 months, and disease free survival DFS was 22 months for 17 patients excluding the three cases of perioperative mortality. At one year the OS was

93.8% while DFS was 92% and at 2 year the OS was 47.7% and DFS was 32% (Fig. 14). During follow-up 4 patients died: 2 with liver metastases and 2 of unrelated causes, one patient is living with liver metastases and 2 with local recurrence & 10 patients were completely free.

Type of operation (PPPD), stenting (PBD), periampullary tumours (Ampulla, CBD and duodenum), -ve nodes and grade I tumours had better OS and DFS than PD, no stenting, pancreatic head cancer, +ve nodes and grade II and III tumours but not reaching statistical significance due to small number of cases.

Table (1): Patients demography and characteristics.

	Pancreatic head	Ampulla	CBD	Duodenum	Total
No.	9	5	4	2	20 (100%)
Gender:					
Male	6	3	2	1	12 (60%)
Female	3	2	2	1	8 (40%)
Age:					
Median	44	51	52.5	54.5	
Range	23-64	42-59	45-58	48-61	
Jaundice	6	4	3	1	14 (70%)
Pain	4	1	1	0	6 (30%)
Weight loss	5	3	2	0	10 (50%)
Pale stool	5	4	2	1	12 (60%)
Pruritus	3	2	2	0	7 (35%)
Diabetes	2	1	1	0	4 (20%)

Table (2): Pathological characteristics and staging.

		Pancreatic	Ampulla	CBD	Duodenum	Total
I- *Pathology:*						
T	T1	1	1	3	0	5 (25%)
	T2	6	3	1	2	10 (50%)
	T3	2	1	0	0	3 (15%)
N	N0	4	3	2	1	10 (50%)
	N1	5	2	2	1	10 (50%)
M	M0	8	5	4	2	19 (95%)
	M1	1	0	0	0	1 (5%)
II- *Stage:*						
	I	4	3	3	1	11 (55%)
	II	0	2	1	0	3 (15%)
	III	4	0	0	1	5 (25%)
	IV	1	0	0	0	1 (5%)
III- *Resection Margins*:						
	-ve	7	5	4	2	18 (90%)
	+ve	2	0	0	0	2 (10%)
IV- *Tumor differentiation:*						
	Low	2	3	2	1	8 (40%)
	Intermediate	5	2	1	0	8 (40%)
	High	2	0	1	1	4 (20%)

Table (3): Preoperative and operative procedures.

	Pancreatic head	Ampulla	CBD	Duodenum	Total
Preop stenting	3	3	1	1	8 (40%)
Pancreatico-duodenectom	5	2	3	2	12 (60%)
Pylorus preserving PD (PPPD)	3	3	1	0	7 (35%)
Total pancreatectomy	1	0	0	0	1 (5%)
Method of reconstruction duodenojej	3	3	1	0	7 (35%)
Gastrjej:					
End to end	4	1	1	0	6 (30%)
End to side	2	1	2	2	7 (35%)
Choledochojejunosotomy:					
End to end	3	1	1	0	5 (25%)
End to side	6	4	3	2	15 (75%)

Table (4): Post operative mortality and complications.

Comp.	No.	%
Death	3	15
Biliary leak	4	20
Gastro intestinal leak	2	10
Delayed gastric emptying	6	30
Wound infection	5	25

Fig. (1): Preoperative CT with pancreatic head mass and visible stent.

Fig. (2): Intrahepatic biliary dilatation.

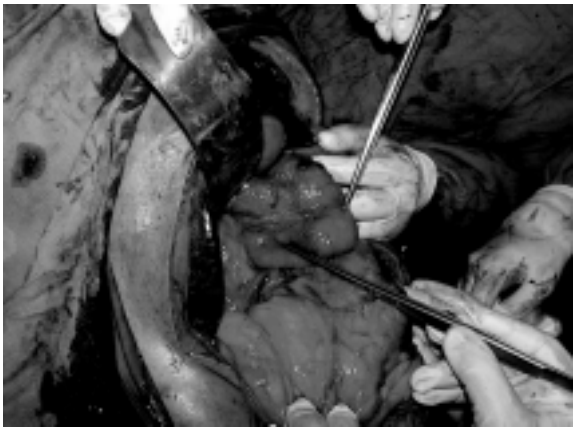

Fig. (3): Kocherisation of the duodenum.

Fig. (4): Exposure of SMV, splenic and portal veins.

Fig. (5): Stent inside CBD.

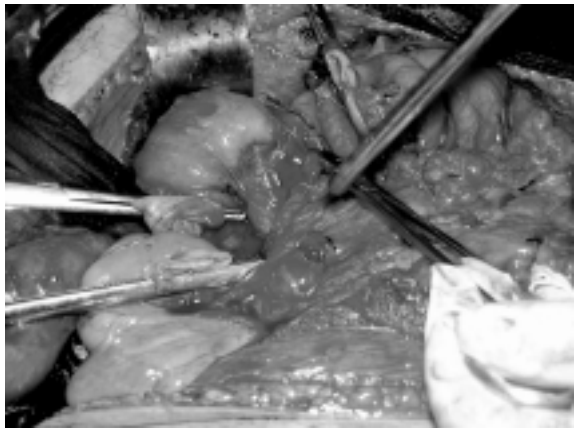

Fig. (6): Pylorus preservation.

Fig. (7): Transection of the jejunum.

Fig. (8): Extent of resection.

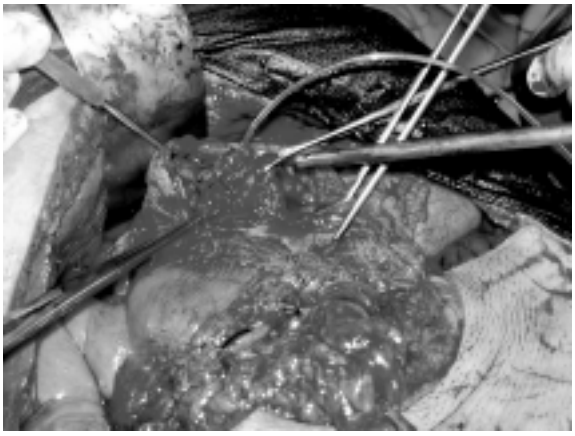

Fig. (9): Pancreaticogastrostomy with stent inside the pancreatic duct.

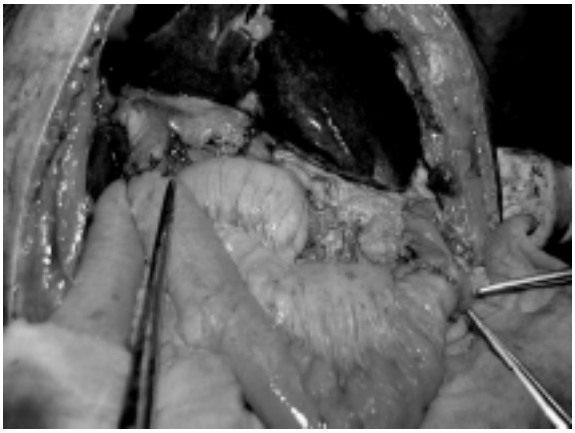

Fig. (10): Choledecojejunostomy and gastroenterostomy.

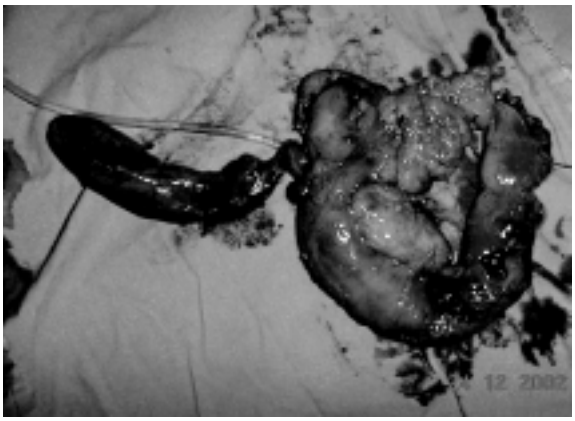

Fig. (11): The specimen of PD with CBD stent.

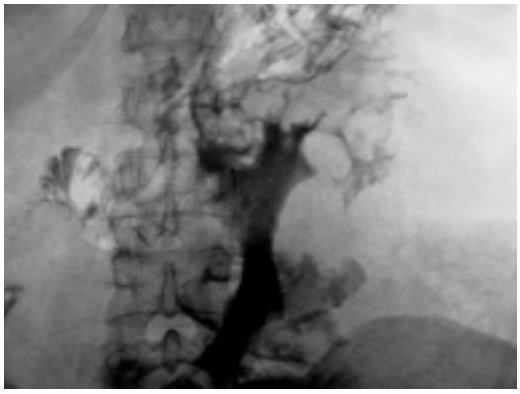

Fig. (12): Postoperative gastrographin showing intraperitoneal leakage.

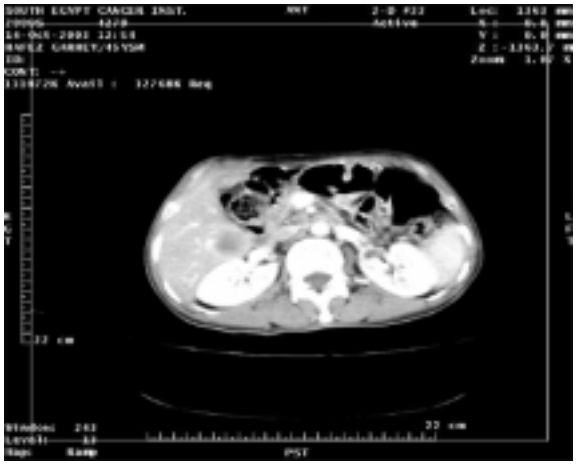

Fig. (13): Postoperative CT showing liver metastasis after PD.

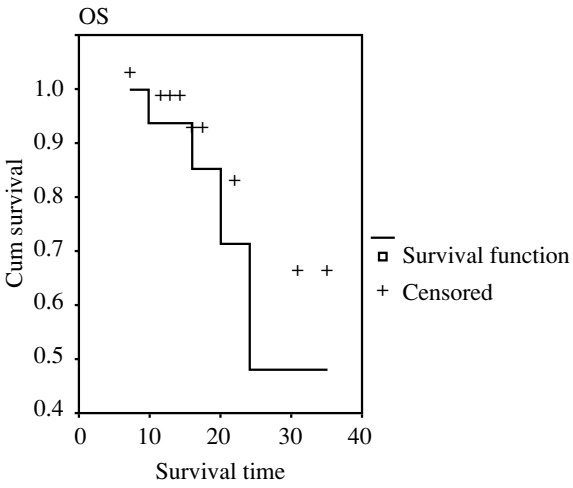

Fig. (14): OS (for 17 patients) excluding perioperative deaths after 24 months.

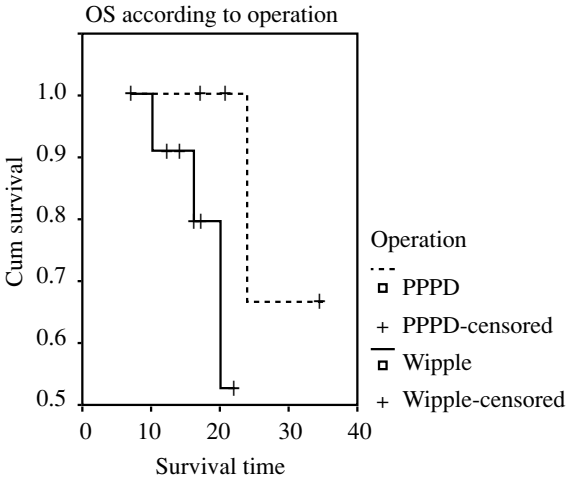

Fig. (15): OS (for 17 patients) excluding perioperative deaths after 24 months according to type of operation.

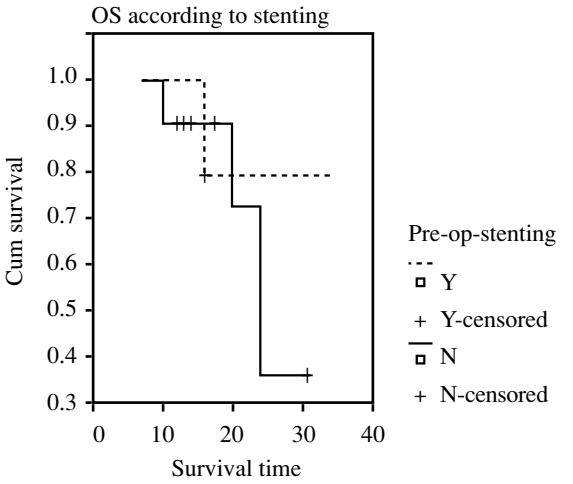

Fig. (16): OS (for 17 patients) excluding perioperative deaths after 24 months according to stenting (PBD).

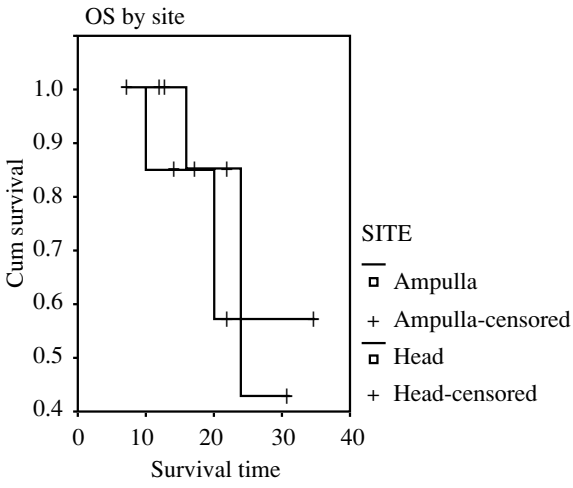

Fig. (17): OS (for 17 patients) excluding perioperative deaths after 24 months according to the site. Ampulla = Ampulla of vater+CBD+duodenum.

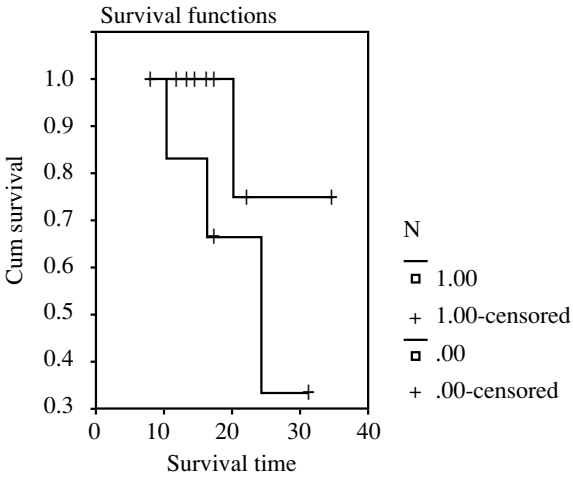

Fig. (18): OS (for 17 patients) excluding perioperative deaths after 24 months according to lymph node involvement.

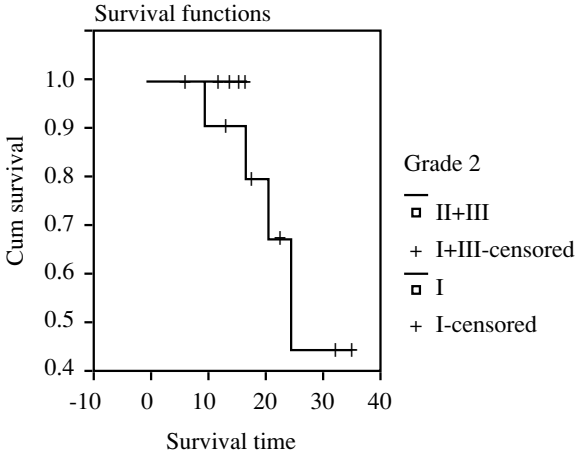

Fig. (19): OS (for 17 patients) excluding perioperative deaths after 24 months according to histologic grade.

DISCUSSION

Surgery remains the mainstay for PH and PC and surgical resection of the tumor provides the only chance of cure. Improvements of surgical technique, increased surgical experience and advances in preoperative intensive care and parenteral nutrition have substantially decreased the risk of pancreaticoduodenectomy in recent years. This was reflected in a decrease in the operative mortality rate from over 20% to below 5% in several large centers throughout the world [18]. In this study all patients were subjected to a standard PD removing only the peripancreatic lymph nodes (LN) en bloc with the specimen and 35% underwent PPPD. We did not try to perform a radical (extended PD) which entails the standard resection with distal gastrectomy and retroperitoneal lymphadenectomy. One patient underwent total pancreatectomy because the pancreas was soft and friable that would make the anastmosis hazardous. The appropriate extent of resection: standard versus radical remains controversial particularly as concerns survival benefit. Past reports have suggested that the more extensive resection is attended by negative functional outcomes (diarrhea and weight loss) and poorer quality of life (QOL) diminishing the impact of any possible survival advantage [19,20].

In 2002 Yeo and colleagues [21], analyzed 294 patients with peripancreatic carcinoma (146 standard vs. 148 radical), all patients in the radical group underwent distal gastric resection while 86% of patients in the standard group underwent PPPD. They found that radical PD can be done with similar mortality but with increased morbidity (43% vs. 29%) compared to standard PD and there was no survival benefit from the addition of distal gastrectomy and retroperitoneal lymphadenectomy. Though the mean total number of resected nodes was higher in the radical group, yet the number of positive nodes and resection margins were similar. In 2003 Nguyen et al. [22] studied the QOL and functional status including the physical, social, emotional and functional well being for the 2 groups of patients (55 with a standard dissection and 50 with radical dissection). The results showed no significant difference in long term and in the QOL.

Pylorus preserving pancreaticoduodenectomy (PPPD) was performed in 7 patients leaving functioning pylorus at the gastric end. It was first reported by Watson in 1944 [23] who performed duodenojejunostomy. Traverso and Longmire [24] suggested that preservation of the distal stomach, pylorus and proximal duodenum might improve postoperative gastrointestinal function and eliminate the side effects of gastric resection (dumping and malnutrition). Pylorus preserving pancreatico-duodenectomy can be used for malignant tumors that do not invade the first portion of the duodenum and the perigastric lymph nodes such as periampullary tumors and stage I and II pancreatic carcinoma.

In this study, patients who underwent PPPD showed better OS and DFS but it was not statistically significant due to the small number of cases (p value 0.17, 0.23) respectively. Long term follow-up of these patients tends to show better gastrointestinal function than after PD [25] Roder evaluated PPPD in 62 patients in comparison to 48 who underwent PD and there was no difference in mortality and morbidity but he found better survival for patients with pancreatic carcinoma who underwent PD [26]. In another study, the results of 32 patients subjected to PPPD were compared to 28 patients treated with PD. The operative length, mortality rate, specific morbidity and frequency of delayed gastric emptying were similar in the two groups. The prognosis was the same as regards metastasis, local recurrence and survival [27].

In the present study, delayed gastric emptying occurred in 4 of 6 (66,7%) patients (Table 4). All cases improved conservatively without interference. Delayed gastric emptying was defined as the need for post operative nasogastric decompression for more than 10 days and it occurs in 30% of patients following PPPD and its pathogenesis is unclear [28].

Kimura [29] studied 25 patients who underwent PPPD and he found delayed gastric emptying in 13 (52%) of them and 10 patients developed postoperative septic complications including leak and wound infection. Sepsis was a highly significant cause of delayed gastric emptying.

In the present study, preoperative biliary drainge (PBD) using stents was performed in 8 patients (40%): for 3 patients with pancreatic head cancer, 3 ampulla, 1 CBD and 1 with duodenal carcinoma (Table 3). The mean biliru-

bin level for them was 17 mg/dl, 3 patients had repeated stenting and 3 had no improvement. The mean duration between stenting and operation was 28 days. Wound infection occurred in 4 patients (50%) who underwent PBD associated with biliary leak in 2 patients and one with GIT leak. Though patients with preoperative stenting showed better OS and DFS than non stented, it was not statistically significant again due to small number of patients. Operations on patients with obstructive jaundice carry an increased risk of post-operative complications [30]. The concept of PBD has been developed to reduce the morbidity and mortality, though, its value is still questioned [31]. Internal biliary drainge has a beneficial effect by restoring the nutritional status and immune functions [32] and by reducing endotoxemia [33]. The drawbacks of PBD include: induction of bacterial contamination and cholangitis. It also generates a severe inflammatory response in the wall of the bile duct increasing the risk of bile leak after anastomosis [34]. Pisters et al. [35] evaluated 300 consecutive patients who underwent PD including 172 (57%) stent group, 35 patients (12%) biliary bypass before surgery, 93 (31%) no stent group and they found no difference in the incidence of complications between the stent and non-stent groups except that wound infection was more common in the stent group.

In the present study, 50% patients with PBD had wound infection versus 8.3% in the non-stented group and the overall morbidity was 71% in the stented versus 37% in the non-stented patients, though was statistically insignificant. In another study in Netherlands, on 232 patients with PBD prior to PD (divided into 3 groups) according to severity of jaundice and on 58 patients who underwent immediate surgery, there was no difference in overall morbidity among the drained groups and there was no significant difference in morbidity between patients with and without PBD [36]. In 2002, Saleh [37] revised the results of 8 retrospective studies and 2 prospective randomized controlled trails including 1008 patients with pre-operative stents and 412 patients without stents and he found no effect of stenting in the outcome of surgery.

In this study, pancreatico-digestive reconstruction was performed through pancreaticogastrostomy for all cases. Pancreatic anastomosis is the Achilles heal of the operation. The most severe complication of PD is leakage of pancreatic anastomosis which can lead to severe pancreatitis, bleeding from adjacent large vessels, peritonitis and sepsis. Pancreaticogastrostomy (PG) was first used in 1940 [38] and it has been adopted by several groups [39-40]. It has recently been reintroduced as a useful procedure associated with lower incidence of pancreatic fistula than pancreatico-jejunostomy (PJ) [41-42].

PG has the advantage that pancreatic juice is neutralized by gastric juice. Reconstruction by PG divides the flow of pancreatic juice and bile. The pancreas secretes in the stomach which represents a large reservoir that is additionally decompressed by gastric tube causing no risk of internal pressure on pancreatic anastomosis [43]. Pancreaticogastrostomy is also favored because of the proximity of the stomach to the pancreas and its large lumen makes obstruction less likely. The gastric wall is thick with better blood supply than the intestine. Even if leak occurs it does not lead to life threatening complications because pancreatic enzymes are not activated [43].

In the present study, the incidence of pancreatic fistula was zero (no leak). Takano [43] analyzed the results of 73 cases of PG and 69 of PJ. Intra-abdominal hemorrhage and abscesses occurred in 4% and 6% respectively with 2 deaths after PJ but these complications did not occur after PG. In another study of 441 patients who underwent PD with PG in 250 patients and PJ in 191 patients, the leakage rate of pancreatic anastmosis was 2.4% in PG while it was 12.6% after PJ (statistical significance). The mortality rate was 1.6% after PG and 5.2% after PJ and this difference was also statistically significant [44]. Zenilman [45] revised 841 cases of PG reported in the literature and found that the leak rate was 3.1% and death rate was 2.6%. In a recent study [46], comparing 97 patients with PJ and 177 patients with PG following PD, the 30 day mortality was significantly higher in the PJ group versus the PG group and there was a significantly large number of biliary leaks in the PJ group whom required larger number of C.T guided drainge to control infection and also required a large number of re-exploration to control bleeding and infection.

Many studies have reported a reduction in the incidence of pancreatic fistula when a pancreatic duct stent is used in pancreatic anastomosis. This stent is especially useful in patients with no dilated duct [47]. We have used this technique in the first 4 cases of this study. The endocrine function appears to be similar after PG and PJ but the exocrine function may be worse after PG because the pancreatic enzymes are not readily activated and the pancreatic duct may be occluded by the gastric mucosa which may result in impaired digestion and absorption [48].

In this study 3 patients died in the postoperative period (15%): one due to reactionary haemorrhage from the portal vein, one due to haematemsis and the third (the case of total pancreatectomy) due to uncontrolled diabetes on the thirtieth day. Postoperative complications occurred in 12 patients (60%) who had 20 complications (Table 4). Wound infection occurred in 5 patients (25%): four of them had PBD. This finding was evident in other studies [34-35]. It was associated with bile leak in 40% of cases and with PD in 4 cases and the case of total pancreatectomy but not with PPPD. This is in agreement with other studies [27-49-50] and in contrast to another [29]. In this study 6 patients (30%) had leak: 4 had biliary leak and 2 had GIT leak. All patients improved conservatively except one with biliary leak who required guided percutaneous CT drainage and one with GIT leak who required re-exploration. Major morbidity after PD is often managed by the aid of interventional radiologist [51]. In a study of 1061 patients who underwent PD, 590 patients (56%) had no interventional procedures where 471 (44%) had interventional procedures: 32% PBD and 129 12% required postoperative interventional procedures including percutaneous aspiration, drainage for abscess, biloma, anastomotic leak of disruption or bile stent dislodgement. Patients who required interventional procedures had higher incidence of complications including fistula, bile leak and wound infection [51]. In a recent study in 134 patients who underwent PD, the mortality was 3.7% and 60 major complications occurred in 38 patients (28%) which included pancreatic fistula (5.2%) bile leak (7%), anastomotic leak (1.3%) intraabdominal abscess (8.2%), intraabdominal bleeding (3%), upper GIT bleeding (3.7%) and delayed gastric emptying in (17.9%). Reoperation was required in 5 patients (3.7%) [52]. In our study, anastomotic GIT leak occurred in 2 patients (10%) and one patient (5%) required reoperation and another patient (5%) had GIT bleeding from the pancreatic stump and managed with cautery through endoscopy. Haemorrhage occurs in 5 to 10% of patients and is usually from gastrojujnostomy or PJ or PG [21].

In this study, node -ve patients, grade 1, ampullary carcinoma, patients with PBD and patients with PPPD had better OS and DFS after 1 year and 2 year than node +ve patients, grade 2 and 3, pancreatic head cancer, patients without stenting and those with standard PD as illustrated in (Table 5, Figs. 16-19) with *p* values not reaching statistical significance due to small number of cases. Although some results suggest that resection may be curative. Factors influencing survival in resectable patients were not year clearly understood. Factors that have been associated with improved survival included absence of LN metastases [14-15], tumour size [16] tumour grade [14] and -ve margins [17].

In the present study the median OS was 24 months and the median DFS was 22 months. At one year the OS was (93.8%) and DFS was (92%) and dropped after 24 months to be (47.7%) and (32.7%) respectively (done for 17 patients only excluding 3 patients who died postoperativly. The high mortality (15%) in this study was due to improper selection of patients (2 of them had cirrhosis with low prothrombin concentration) and due to small number of cases. Similar figures were reported by Wagle who revised 45 patients with PD and found mortality 11%, morbidity 46% and wound infection was the most common complication. The 1 and 2 year survival rates were 61%, 39% for periampullary carcinoma vs. 57%, 36% for pancreatic cancer respectively (53). In another study on 308 patients undergoing PD, Shyr et al., found the overall surgical mortality, morbidity and leakage 12.7%, 47.7% and 14.9% respectively and compared the results before and after 1990, the mortality decreased from 17.1% to 8.7% but the morbidity and leak did not change significantly. The 5 year survival rate for all was 23% highest for the ampulla (32.7%) and lowest for pancreatic head (5.5%) and was significant [54]. In another study in Netherlands on 204 patients who underwent standard PD, the median survival was 16, 25 and 24 months for the

pancreatic head, CBD and ampulla respectively ($p = 0.008$) [13]. Cameron et al., reported a 19% actuarial 5 year survival in 89 patients undergoing PD. They suggested that tumour size > 2.5 cm, +ve nodes and vessel invasion were associated with poor survival [55]. In another study, an actuarial 5 year survival was 24% of 146 patients undergoing PD and +ve nodes, tumours with high grade, size > 2.5 cm were poor prognostic variables [14]. Willet et al., had an overall 5 year actuarial survival of 13% with -ve margin being significant predictor of survival [17]. A study from Mayo Clinic reported an actuarial 5-year survival of 6.8% after pancreatic resection [16]. Complete resection with -ve nodes and no evidence of perineural or duodenal invasion resulted in 5-year survival of 23% [16]. Tumour size < 3 cm, -ve nodes and -ve resection margin were +ve predictors for long term survival in another study from John Hopkins [15]. Actuarial 5-year survival rates of 21% and 10.2% after PD were reported by others [56-60]. In another study of 116 patients with PD, operative mortality was 3%, the median survival after surgery was 16 months. The 1,3,5 and 7 year survival rates were 60%, 23%, 19% and 11%. For those who received adjuvant therapy were 69%, 28%, 23% and 18% compared to 20% and 0% for patients who did not receive adjuvant therapy. The 1,3,5,7 y survival rates for patients with -ve nodes were 73%, 38%, 26% and 22% compared with 52%, 14%, 14% and 9% in patients with +ve nodes ($p = 0.01$) [57]. The GI study group report found a survival benefit for patients with completely resected pancreatic CA who received adjuvant PO radio therapy with 5 FU compared with surgical controls [58-59]. In contrast, a recent randomized study revealed no similar benefit of either therapy [60] and supported by other studies [14-17-55].

In conclusion, despite advances in perioperative management, survival after PD for PC is still limited. Nonetheless, PD is the only possibility of cure of patients with these tumours. Together with the limited morbidity and mortality of these surgical procedures in centres with experience, PD can be considered the treatment of choice for patients with PC. However a combination of surgery and adjuvant therapy could hopefully lead to an approach in the treatment with better survival.

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