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Research Article

Comparative study between invagination and duct-to-mucosa pancreaticojejunostomy after pancreaticoduodenectomy

Saleh K. S. Ibrahim[1*], Nasser M. Zaghloul [1], Ehab M. Sabry[2], Tohamy A. Tohamy[1] and Mohammed M. Mohammed[1]

[1] Department of General surgery and laparoscopy, Faculty of Medicine, Minia University, Egypt
[2] Hepatopancreatobiliary surgery unit, El Maadi military hospital, Egypt

Abstract

Background; Pancreaticoduodenectomy (PD) is the commonest utilized standard surgery for both malignant and benign disorders in the pancreatic head. After the resection, pancreaticojejunostomy (PJ) is taken in to consideration as the most vital and problematic method. **Methods;** this prospective randomized controlled study had been performed in surgery department El Minia University and El Maadi military hospital including 80 patients in 2 groups indicated for PD (40 cases with duct to mucosa PJ (group 1) and 40 cases with invaginations PJ (group 2)) in the period between January 2018 and January 2021 after acceptance from the IRB and obtaining informed agreement from all cases including approval of protocol of treatment. **Result;** Nonsignificant changes among the study groups regarding the median hospitalization time, the median time to resume oral intakes and drain elimination. POPF happened in 9 (22.5%) cases in group 1 and 15(37.5%) cases in group 2. The POPF severity was detected more in group 1 with nonsignificant variances (Table 3). The in hospital mortalities in this work was 11 (13.75%) cases (8 (20%) cases in group 1 vs. 3 (7.5%) cases in group 2, **Conclusion;** Duct-to-mucosa method for anastomosis must possibly be the 1st choice. However, among cases who possess too small pancreatic duct, invaginations are mostly the securer and easier to perform procedure. Increased incidence of postoperative pancreatitis, steatorrhea and DM is observed in duct to mucosa PJ.

Keywords: post operative pancreatic fistula, pancreaticojejunostomy, Pancreaticoduodenectomy, invagination, duct to mucosa.

Introduction

Pancreatic tumor is the 7th most common reason of mortality from tumors all over the world. In spite of the current developments in treatments, the 5-year relative survival rate still about 6 percent. At primary presentations, about 50 to 55% of the cases are revealed to have metastatic diseases, 20 to 25% have local progressive diseases and only 20% have resectable diseases. **(1)**

Pancreaticoduodenectomy (PD) is a complex surgery that is frequently done for cases with pancreatic duct adeno-carcinoma and other malignant or benign diseases in the head of the pancreas. It may be performed with lower morbidity and death rates, mainly when done at high-volume hospitals and surgeons. Whereas it was conservatively reserved for cases with earlier stages malignant diseases, it is being utilized progressively for cases with local extensive cancers who have experienced neoadjuvant treatment and down-staging. **(2)**

Greater than 80 various approaches of pancreaticoenteric reconstructions were utilized, showing the complexity of operative methods in addition to the absence of the golden standard method. Several influences accompanying with an elevated occurrence of its complications

have been recognized. Between them, a small pancreatic duct sizes with a soft pancreas makes one of the procedural hurdles to the accomplishment of the anastomosis and is identified to be a risk-factor for main leak. [(3)]

Numerous approaches and techniques of pancreatic anastomosis were suggested post PD to decrease the incidence of POPF counting the use of an exterior or interior pancreatic stents, isolated loop PJ (IPJ), pancreaticogastrostomy, binding PJ, or administrations of post-operative somato-statin. The secure pancreatic re-construction post PD remains to be a challenge at the high-volume hospitals. The diversity of re-construction is an echo of the absence of the optimum one. [(4)]

While several operating techniques were created to progress the outcomes of pancreatoduodenectomy, PJ is the commo-nest digestive tract reconstructions, and duct-to-mucosa and invaginations anasto-mosis are 2 main procedures for PJ. [(5)]

Patients and methods

This prospective randomized controlled research had been performed in surgery department El Minia University and El Maadi military hospital including 80 patients in 2 groups indicated for PD (40 cases with duct-mucosa PJ **(group 1)** and 40 cases with invaginations PJ **(group 2)**) in the period between January 2018 and January 2021 thereafter acceptance from the IRB and getting knowledgeable consent from all participants including approval of protocol of treatment.

Successive cases managed by PD (Standard) at our centers were randomly allocated into 2 group comparing duct-mucosa and invaginations PJ, by means of the closed envelopes technique. The envelopes were selected and opened by a nurse in the operative room thereafter pancreatic resections.

The main outcome measure will be the rate of post-operative pancreatic fistula (POPF); secondary outcomes comprise; surgical period, days to resume oral intake, post-operative morbidity and death, exocrine and endocrine pancreatic function.

Inclusion criteria: Patients having pancreatic head mass or peri-ampullary carcinoma presented for Whipple surgery.

Exclusion criteria: Unfit patients for surgery due to severe medical illness, inoperable patients by imaging studies**,** irresectable tumors after laparotomy or diagnostic laparoscopy, presence of distant metastasis and patients refused to participate in the thesis.

Preoperative: The patient should be informed of the potential for surgical complications, as well as the possibility that pancreatic resection may not be possible if unrecognized metastatic or locally advanced unresectable disease is identified.

All Patients was underground:

1- Detailed history taking including: Age, sex, time of symptoms onset and time of presentation: jaundice, abdominal pain, loss of weight, steatorrhea, BMI, history of DM, Hypertension and other comorbidities and their response to treatment and history of ERCP either patients stented or not or PTD: Preoperative biliary drainage was for patients whose serum bilirubin concentration exceeds 12 mg/dL, for those in whom surgery will be delayed for longer than two weeks, and in those with debilitating pruritus or cholangitis

2- General examination stressing on: Detection of jaundice · Examination of left supraclavicular lymph node group.

3- Abdomial examination stressing on: Detection of Grey Turner sign, detection of Cullen sign and Detection of umbilical nodules

4- Investigations: Lab. Investigations: CBC, coagulation profile (PT, PC and INR), urea & Creatinine levels, blood glucose level, Liver functions test (total and direct bilirubin, s.albumin level, ALT, AST, alkaline phosphatase, gamma glutamyl transpeptidase (GGT)), Serum albumin if <3 g/dL, or if surgery must be delayed for more than two weeks, we prescribe supplemental nutrition), tumour

markers (CEA, CA19-9), serum amylase, serum lipase, CRP, sodium and potassium and HbA1C.

Imaging studies: Abdominal ultrasound, chest CT to role metastatic disease in lung, ECG, Echocardiography, MRCP, CT (multidetector computerized tomography (CT) angiography, within 4 weeks of surgery, acquiring thin, preferably submil-limeter section by means of a pancreatic procedure, EUS was done for all patients. Tumors with be classified into resectable, borderline resectable and non resectable in addition to usual TNM classification and Biopsy either radiological guided or EUS if needed.

Operative technique:

Patient selection: This study included 80 patients of presented with periampullary carcinoma candidate for Whipple operation divided into 2 groups. Knowledgeable written agreement was attained from every patient. All the patients received prophylactic antibiotic prior to open surgery.

Operative technique: All investigative operations have been performed under general anesthesia and nasogastric tube was presented to reduce the volume of the stomach and to decrease the distensions of small bowels. A Foly's urethral catheter was injected to be detached in the recovery room, diagnostic laparoscopy is usually performed. Our method uses two-sided sub-costal incisions (Chevron incisions). The liver and peritoneal superficial is sensibly tested to eliminate the existence of metastatic diseases, and intra-operative US of liver and pancreas is done. Then extended Kocherisation is performed by side duodenal ligament which exposes SMV, IVC and aorta partially. Invasions or encasements of these vessels avoids from advancing with resections; just critical bypass will be enough. **Fig. (1)**

Dissections in this zone is performed sensibly and gently as venous tear results in torrential hemorrhage and has been time wasting to control hemorrhage. Duodenum is freed above up to foramen Winslow. Gastro-hepatic ligaments is separated to recognize appropriate hepatic artery thereafter incision of the peritoneum over it. Any lymph nodes recognized are took down in the direction of the sample. Once dis-section proceeded medially, frontal superficial of the portal vein is recognized; frontal surface frequently being avascular is dis-sected softly among it and neck of the pancreas down-wards; likewise, one more index finger is passed from below within SMV and neck of the pancreas up-wards to sense the other finger from above. But this is insufficient to approve the invasions; finger had to be passed under the second portion of the Kocherised duodenum with Thumb in anterior to sense for Right gastric artery is as well separated which is much lesser than the gastro-duodenal artery. Incisions of the peritoneum over the CBD permits clearance of the lymph nodes in the porta hepatis. **Fig. (2, 3)**

Divisions of the pancreas performed now or afterward the mobilization of the duodenojejunal loop and transporting the loop to right under the major mesenteric vessels. Pancreas is sensibly moved to the left of the portal vein and SMV at minimum for 30 mm.

Anastomoses Parts: Distal transected jejunal loop is taken via the crosswise mesocolon window to pancreatic area. First pancreaticojejunal anastomosis is perfor-med frequently as end to lateral; then hepaticojejunostomy is performed; after antecolic gastrojejunostomy is performed.

Pancreaticojejunostomy is done by either duct to mucosa or invaginations methods: Duct-mucosa anastomosis: 30-50 mm distal to the affixed line along the antimesenteric boundary, Jejunostomy was done matched to the pancreatic ductal diameter; previous to enterotomy interru-pted sutures are located amid the later capsule of the pancreas and the seromuscular coating of the later share of the suggested enterotomy location on the jejunum (subsequent to enterotomy) by means of 4-zero polypropylene material. 5-6 such sutures are desirable. Pancreatic ducts are sutured to the complete thickness

jejunum as interrupted sutures by means of 5 /0 polypropylene material (8 to 12 stitches). Zoom lens is beneficial for ductal anastomosis. Frontal pancreatic capsules to seromuscular jejunal episodic sutures are located similar to anterior wall. This technique may be utilized only for end-side anastomosis. **Fig. (4, 5)**

Invagination technique: The PJ invagination has been done as an end-side. The pancreatic capsules and the jejunal serosa have been inosculated via an episodic prolene sutures 3/0 to form the external layer in the frontal as well as posterior wall of the anastomosis. Jejunostomy has been performed matching to the pancreatic base diameter. The internal layer has been done with 5/0 prolene amid the pancreatic parenchyma and sheath. The channel has been taken from posterior and anterior to jejunal mucosa. A pancreatic ductal stent has been injected throughout anastomosis and detached at the end of taking the sews. **Fig. (6)**

Hepaticojejunal anastomosis was performed as end-side of the jejunal loop on to its anti-mesenteric boundary. Jejunum was unlocked at anti-mesenteric boundary 150 mm from the PJ location; incisions must be slightly ≤ that of hepatic channel. Anastomosis was performed by means of episodic 4-zero vicryl suture; later layer suture was located 1st with knots out-side; 1st all later sutures bites were taken and then knots are knotted at the termination. Frontal layer suture was done with external knots. Every 0.3 cm break sutures must be located. **Fig. (7)**

Gastrojejunostomy is performed 200 mm distal to the hepaticojejunostomy as an antecolic inosculation. As previously stomach is divided with stapling device early throughout operation, gastrojejunostomy was performed by means of linear stapling device just proximal and later to the stapling line. One layer 3-zero vicryl hand sewn anastomosis as well may be performed. **Fig. (8)**

Post-operative: Nasogastric pipe is eliminated in 3-day; feeding was begun in the 3rd day. Anti-biotics are taken. TPN can be wanted. Everyday monitoring with liver functions, kidney functions, hemogram (with platelet counts) and prothrombin time were wanted. CVP line was superior for all these needs, immediate post-operative interval in spite of fewer hemorrhage on table.

Assessment of post-operative data: Hospitalizations, POPF (elevation of the drain amylase levels 3-fold more than the serum in POD3), pancreatitis, biliary leakage (defined as bilious discharge from intraabdominal drain) and overdue gastric voidance (recognized as the need for naso-gastric tube for >10 days because of persistent vomiting or sluggish intestinal movement)

Whipple specimen: Specimen orientation by direct communication between the pathologist and surgeon for proper orientation and margin identification.

Follow-up has been performed at 1-wk, 3-mths, 6-mths and 1-yr post operation.

Statistical Analysis: collected data was analyzed via IBM-SPSS-25 program. Comparison of mean±SD of 2 groups of quantitative data was done via student T test (assuming data was normally distributed). The non-parametric Mann Whitney U testing was utilized will be used if we couldn't assume such normal distribution.

Results

The study flowing chart was showed in of 80 successive cases with periampullary cancer seen throughout the study interval experienced PD, (10 (12.5%) women and 70 (87.5%) males) were enrolled in the work. The median age was 56.79-yrs. (Table 1)

The intra-operative results were similar in the studied groups regarding tumor dimensions, liver functions, and pancreatic duct width, constancy of pancreas, the median intra-operative bleeding and blood transfusions. The mean operation period was 5.20-hrs in group 1 vs. 4.84-hrs in group 2 (P=.003). The mean operation period for the pancreatic anastomosis was

39.13-mins in group 1 versus 24.30-mins in group 2 (P value=0.001). (Table 2)

Nonsignificant changes among the study groups regarding the median hospitalization, the median period for recover oral intakes and drain elimination (Table 2). POPF advanced in 9 (22.5%) cases in group 1 and 15(37.5%) cases in group 2, P=0.336. The severity of POPF was observed higher in group 1 with nonsignificant changes. The inhospital death in this work was 11 (13.75%) cases (8 (20%) cases in group 1 versus 3 (7.5%) cases in group 2 (P=0.529). The reasons of mortality were liver cell failures as a consequence of associating liver cirrhosis, pulmonic embolism, and septic shocks as a result of PF (Table 3).

18/32 (56.2%) cases presented with post-operative steatorrhea after 1-yr in group 1 versus 16/37 (43.2%) cases in group 2 (P=0.003). 16/ 32 (40%) cases presenting with post-operative DM after 1-yr in group 1 versus 17/ 37(42.5%) patients in group 2. (Table 3)

Table 1: Demographic data

Variables	Total	Duct to mucosa PJ Group 1	Invaginated PJ Group 2	P-Values
Mean age (years)	56.79(42-76)	51.79 (42 -76)	61.78 (44.74)	**0.179**
Sex female	10 (12.5%)	3 (7.5%)	7 (17.5%)	**0.144**
Male	70 (87.5%)	37 (92.5%)	33 (82.5%)	
Symptoms				
Jaundice	72 (90%)	36 (90%)	36 (90%)	**0.113**
Abdominal pain	50 (62.5%)	22 (55%)	28 (70%)	**0.272**
Loss of weight	64 (80%)	32 (80%)	32 (80%)	**0.233**
Preoperative steatorrhea	25 (31.25%)	10 (25%)	15 (37.5%)	**0.136**
Preoperative DM	30 (37.5%)	14 (35%)	16 (40%)	**0.115**
Preoperative BMI				
<25	63 (78.755)	31 (77.5%)	32 (80%)	**0.221**
>25	17 (21.25%)	9 (22.5%)	8 (20%)	
Mean preoperative albumin (gm%)	4.14 (3-5)	4.03 (3-5)	4.24 (3-5)	**0.166**
Mean preoperative bilirubin (mg%)	10.52 (4-34)	9.28 (4-34)	11.75 (4-27)	**0.216**
Preoperative biliary drainage (ERCP/PTD)	30 (37.5%)	14(35%)	16 (40%)	**0.176**

Table (2): Operative data.

Variables	Total	Duct to mucosa PJ Group 1	Invaginated PJ Group 2	P - Values
Cirrhotic liver	9 (11.25%)	4 (10%)	5 (12.5%)	**0.163**
Mass Mean (cm)	3.66 (1.50-7)	3.56 (1.50 -7)	3.76 (2-6)	**0.192**
<2 cm	7 (8.75%)	3 (7.5 %)	4 (10%)	**0.175**
>2 cm	73 (91.25%)	37 (92.5%)	36 (90%)	
Pancreatic duct diameter (mm)				
Mean (mm)	5.78 (2-12)	6.5 (2-12)	5.05 (2 -12)	**0.472**
<3 mm	8 (10%)	3 (7.5%)	5 (12.5%)	**0.133**
>3 mm	72 (90%)	37 (92.5%)	35 (87.5%)	
Relation of pancreatic duct to the posterior border				
Mean (mm)	6.87 (2-15)	7.35 (2 -15)	6.38 (2-15)	**0.331**
<3 mm	8 (10%)	1 (2.5%)	7 (17.5%)	**0.122**
>3 mm	72 (90%)	39 (79.5%)	33 (82.5%)	
Pancreatic consistency				
Firm	34 (42.5%)	15 (37.5%)	19 (47.5%)	**0.792**
Soft	46 (57.5%)	25 (62.5%)	21 (52.5%)	
Mean total operation period (hours)	5.02 (3-8)	5.20 (3-8)	4.84 (3.5-7)	**0.003**
Mean operation period for PJ anastomosis (minute)	31.72 (20-60)	39.13 (30-60)	24.30 (20-45)	**0.001**
Mean blood loss (ml)	786.75 (300-3000)	973.5 (500 -3000)	600 (300-2600)	0.791

Table (3): Postoperative data.

Variables	Total	Duct to mucosa PJ Group 1	Invaginated PJ Group 2	P - Values
Hospitalizations (days)	15.22 (7-35)	16.03 (7-35)	14.40(7-35)	0.739
Drain removal (days)	10.02 (6-20)	11.85 (7-20)	8.18 (6-14)	0.643
Amount of draining (ml)	14625 (5000-8000)	11200 (5000-20000)	18050(5000-80000)	0.736
Time starting oral (days)	3.37 (3-4)	3.38 (3-4)	3.35 (3-4)	0.629
Drain amylase				
First day	3024.13(45-22000)	3107.75(50-22000)	2940.50(45-8000)	0.439
Third day	237.32(20-1800)	258 (20-1800)	216.63(45-1000)	0.446
POPF	24 (30%)	9 (22.5%)	15 (37.5%)	0.336
Grade A	6 (7.5%)	1 (2.5%)	5 (12.5%)	0.429
Grade B	11 (13.75%)	2 (5%)	9 (22.5%)	
Grade C	7 (8.75%)	6 (15%)	1 (2.5%)	
Pancreatitis	16 (15%)	12 (30%)	4 (10%)	0.076
serum amylase				
serum amylase POD 1	325.8 (44 -2500)	434.95 (56 -2500)	216.65 (44-800)	0.326
serum amylase POD 3	130.06 (18 -900)	191.38(20 -900)	68.73 (18-300)	
Biliary leakage	20(25%)	14 (35%)	6(15%)	0.236
Delayed gastric emptying	22(27.5%)	14(35%)	8(20%)	0.346
Internal hemorrhage	10(12.5%)	8 (20%)	2(5%)	0.416
Wound infection	14(17.5%)	10 (25%)	4(10%)	0.225
Pulmonary complications	11(13.75%)	8(20%)	3(7.5%)	0.439
Re-exploration	20(25%)	15(37.5%)	5(12.5%)	0.364
Mortality	11(13.75%)	8(20%)	3(7.5%)	0.529
Pulmonary embolism	4	3	1	
SIRS	6	5	1	
Liver insult	1	0	1	

Fig (1): Incision in pancreaticoduodenectomy: Bilateral subcostal incision

Figure (2): Incision layers of the abdominal wall

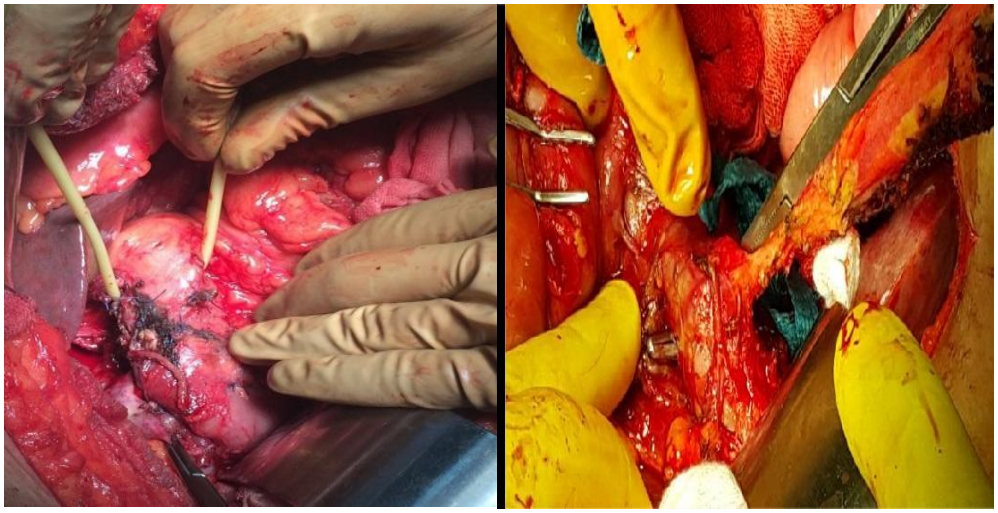

Fig (3): Mobilized pancreas before division

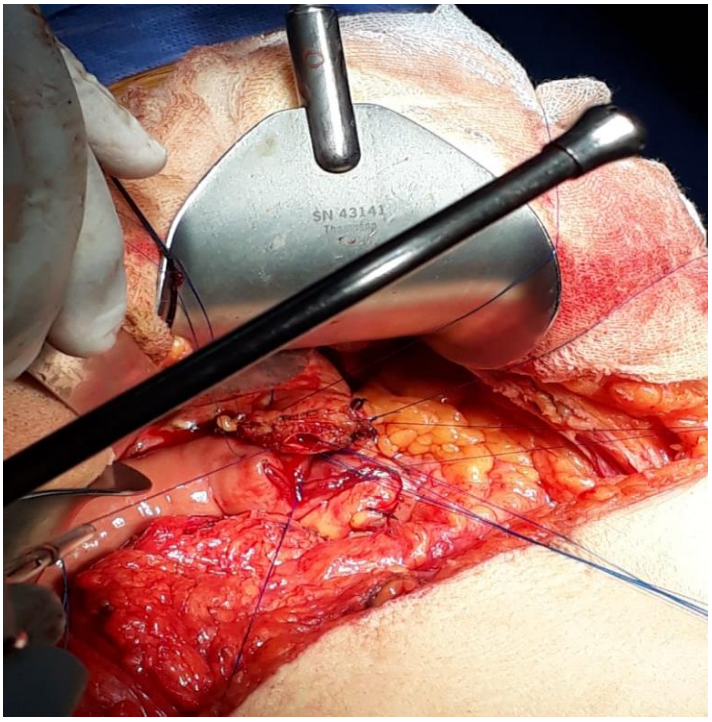

Fig (4): Pancreatic duct anastomosis (duct to mucosa anastomosis)

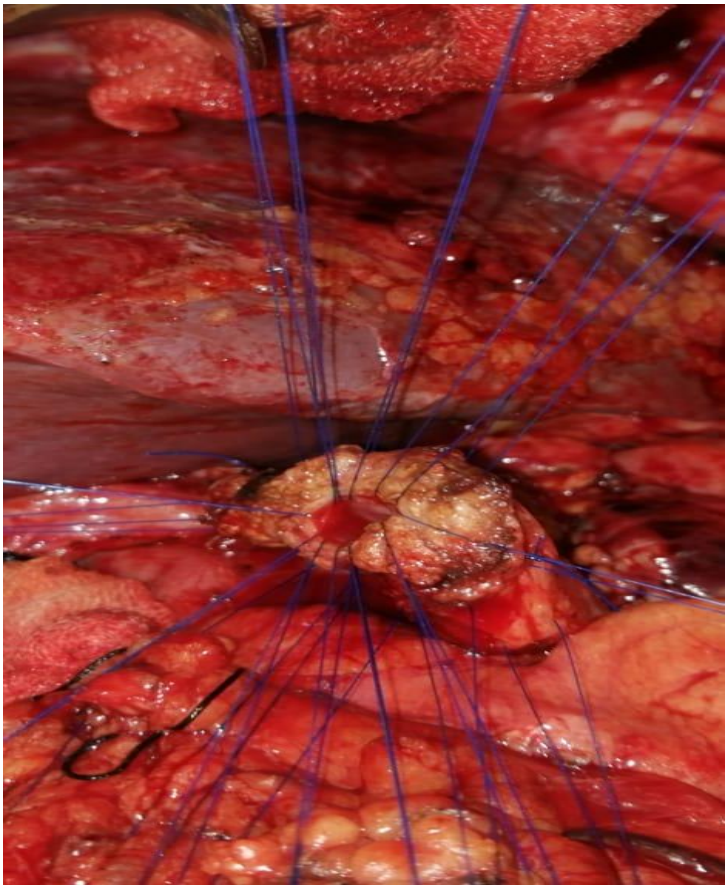

Fig (5): Pancreatic duct anastomosis (duct to mucosa anastomosis)

Fig (6): Invagination technique

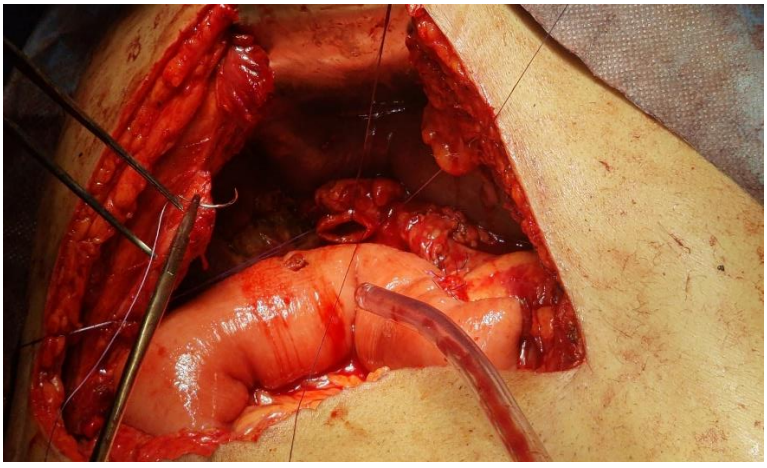

Figure (7): Divided CBD prepared for hepaticojejunostomy

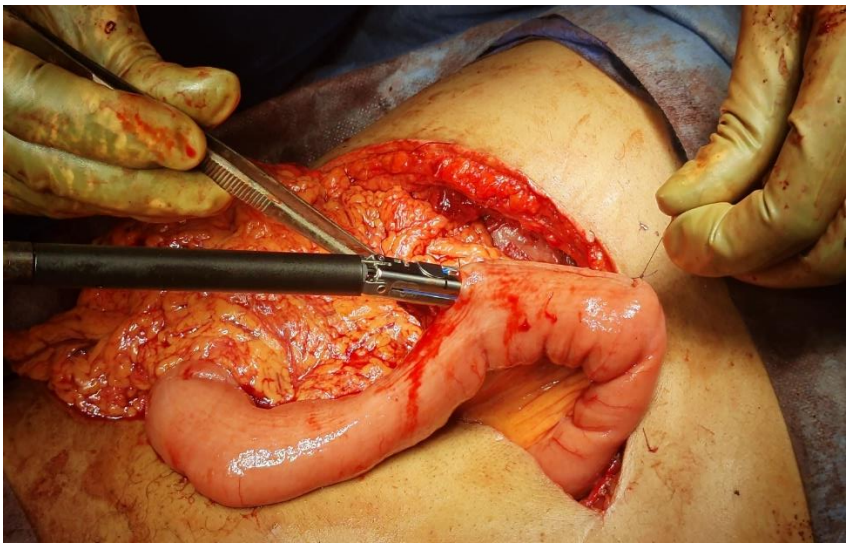

Fig (8): Gastrojejunostomy anastomosis

Table (4): Functional changes.

Variables	Duct to mucosa PJ Group 1	Invaginated PJ Group 2	P-Values
Preoperative Steatorrhea	10/40(25%)	15/40 (37.5%)	0.812
Postoperative steatorrhea	18 /32(56.2%)	16/37 (43.2%)	0.003
p* value	0.002	0.423	
Preoperative albumin	4.18(2-6)	4.76 (3-6)	0.226
Postoperative albumin	3.58 (1-4)	3.71 (3-5)	0.212
P* value	<0.001	<0.001	
Preoperative weight	83.78 (60-125)	74.29 (52-114)	0.163
Postoperative weight	76 (58 -80)	70.82 (52-105)	0.112
p* value	0.001	0.001	
Preoperative fasting blood sugar	115.03 (71-410)	124.22 (70-231)	0.931
Postoperative fasting blood sugar	141 (71-450)	146(75-239)	0.002
P value	0.001	0.792	
Preoperative DM	14 / 40 (35%)	16/40 (40%)	0.952
Postoperative DM	16/ 32 (40%)	17/ 37(42.5%)	0.413
P value*	0.001	0.236	

Discussion

PD is the commonest utilized standard surgery for both malignant and benign conditions (e.g tumors) in the pancreatic head. After the resections, PJ is measured as the most critical and difficult method [6].

In this study, 80 consecutive patients with periampullary tumor are treated by PD, and it was found that 10 patients (12.5%) were females and 70 patients (87.5%) were males which is partially matched with Osman and Abd El Maksoud,[7] study who reported that more than 78% from total cases were obtained from female patients and 21% were obtained from males. This is no evidence of PD to be more prevalent in females more than males but many studies performed by Hua et al.,[8] found the same data.

The median age of total tested cases was 56.79-yrs old that was matched with Zhang et al.,[9] who tested against different patients (both men and women) with mean age 59-yrs old, and the same results were discussed by Nanashima et al.,[10] who investigated 104 patients with mean age (66.1±12.5) years old.

From total 80 patients (70 males and 10 males), the significant change among Group 1 and Group 2 cannot be confirmed because of the mismatching and unequal number of two genders obtained during this study, that is why El Serafe et al.,[11] found that there are no significant differences between both genders in the PJ.

Jaundice is reported in this study with 90%. Only more than 60% of patients with abdominal pain, and 31% with steatorrhea. It was found that the PJ symptoms were approximately the same (nonsignificant change) in both studied groups.

The intra-operative parameters in the study groups were comparable regarding; tumor volume, liver condition, pancreatic duct width, constancy of pancreas, the median intra-operative bleeding and blood, but there is significant change (P value less than or equal 0.05) in mean operation period as the mean total operation period was 5.20 hours in group 1 vs. 4.84 hours in group 2 (P=0.003). The mean operation period for the pancreatic anastomosis was 39.13 mins in group 1 vs. 24.30 mins in group 2 with significant statistical difference (P=0.001). The median hospitalizations, the median time to recover oral intakes and drain elimination had no significance between two groups. The same data were in agreement to other studies

like; Noun et al.,[12] who found that hospitalization in his study on 92 randomized patients was (23.1±13.9 versus 17.0±8.0 days; P value<0.05).

The International Study Group on Pancreatic Fistulas (ISGPF) currently defines a PF as "the output of any measurable size of drain fluids on or afterward 3rd day postoperatively via an operatively located drain (or a later located, percutaneous drain) with an amylase content >3 times the upper limit ordinary serum value. The ISGPF also offers a grading system, with A, B, and C grades representing the severity of PFs, with A being the least severe and C being the most severe. This classifying method takes into consideration the clinical state, the treatment employed, imaging findings, chronic drainage, re-operation, mortality, infections symptoms, and readmissions. [13]

Post-operative pancreatic fistula (POPF) which is a common severe complication post-pancreatic operation. POPF advances as a result of pancreatic juice leakages from a operatively exfoliated surface and/or anastomotic stump, which occasionally result in intra-peritoneal abscesses and consequent lethal haemorrhage and remain the most important source of increasing mortality rates in patients[10]. The POPF severity (type c) has been noted more in group 1 with nonsignificant difference when compared to group 2. US directed tubal drainage was needed in 6 cases in group 1 versus 9 cases in group 2 with intraabdominal collections.

In our work nonsignificant change regarding POPF in the study groups in contrast to Lavu et al.,[14] study who presented those cases underwent a PJ by duct-to-mucosa or invaginations vary regarding pre-operative and intra-operative parameters. The POPF severity was noted higher in duct to mucosa PJ with nonsignificant changes. In a single-institution retrospective research, the DmPJ group had a 3.2 percent risk of POPF and the IJP group had a 17.5 percent risk, with no significant differences in mortality. [15]

Tang T et al., [21] reported that operation time of PD was increased in patients with high BMI. High BMI was a non-dependent risk-factor for the incidence of CR-POPF post-PD.

According to Kawaida H et al., [16], POPF is an extremely severe post-operative complication and still has deep influence on cases because of its accompanying clinical manifestation as late gastric emptying, abscesses, haemorrhage, septicemia, and mortality even if in high-volume hospital. Moreover, POPF results in to elevated health care charges and extended hospitalizations. Wang et al.,[17] review reported that there were nonsignificant changes between binding PJ, DTM-PJ, invagination PJ, and PG in the avoidance of POPF.

According to Li Y and Hua R [18] there were nonsignificant changes between PJ DTM, PJ Invagination in the avoidance of POPF, clinically related POPF, biliary leak, DGE, interior haemorrhage and re-operation.

Binziad S et al., [19] demonstrated that PJ duct-to-mucosa anastomosis was secure, produced minimum pancreatic leak and minimum bleeding in comparison to the other approaches of reconstructions.
Sert OZ et al.,[20] concluded that pre-operative elevated ALP, AST, ALT, GGT values, low haemoglobin levels and soft texture of remnant pancreatic tissues were revealed to be connected with PF that happens post-PD.

Some retrospective reports revealed that the duct-mucosa PJ was accompanying with an inferior POPF rate in the low-risk cases with dilated pancreatic duct or secure pancreas, while the invagination PJ method was more-safe in the risky cases with small pancreatic duct or soft pancreas. [22]

Many prospective randomized reports revealed that a lower POPF in duct-mucosa PJ group than in the invagination-PJ group, Berger et al., reveled a significantly elevated PFs rates and of clinically related PFs in cases managed with duct-to-mucosa

anastomosis in comparison to those managed with invagination. [23]

Hirono S et al., [24] his study reported that among 2762 patients underwent PD, 46 cases (1.7%) developed Grade-C POPF post-PD. The death rate of the 46 cases with Grade-C POPF was 37.0%. On the multivariate analyzing, 6 nondependent risk-factors for Grade-C POPF were detected; BMI ≥ 25.0 kg/m2, chronic steroid usage, pre-operative S. albumin <3.0 mg/dL, soft pancreas, operation period ≥480 mins, and intra-operative blood transfusions. The c-statistic of the current risk scoring system for Grade-C POPF by means of these risk-factors was 0.77. The score was significantly elevated in Grade-C POPF than in Grade-B POPF (P value < .001) or none/bio-chemical leakage (P value< .001).

Zhang S et al.,[9] concluded that the studied techniques post-PD were similar according to post-operative pancreatic fistula occurence and other factors.
Williamsson C et al.,[25] revealed that an elevated BMI, a PJ and post-operative weight gains were risk factors for evolving POPF. DM or pre-operative biliary drainages was protecting.

Fu et al., [26] found that bleeding ≥ 500 ml, pancreatic duct width ≤ 0.3 cm and pancreaticojejunostomy kind were nondependent risk factors of PF post-PD. PF was connected with elevated death rates, extended hospitalizations, and other complications.
According to the ISGPS, no single anastomosis plan can remove clinically related pancreatic fistula. [27]
Significant difference was found in the usage of drain fluids amylase in the treatment and timing of operative drain elimination after pancreatoduodenectomy. Clinical outcome was better when drain fluids amylase is low and surgically located drains were detached by POD 3. [28]

In our study, drain removal done in average 11 days postoperative in group 1, while in group 2 removed in 8 days in average. Maehira H et al.,[29] reported that the drain itself can play as a foreign body, resulting in an inflammation responding and infections. Un-drained peripancreatic fluids collections throughout the early post-operative interval are common and was accompanying with the advance of CR-POPF.

Xu W, Peng X[30] demonstrate that hypoalbuminemia after PD shouldn't be measured as a marker but somewhat a consequence of poor prognosing. WBCs, particularly neutrophils, are elaborate in decreasing post-operative ALB levels. Infusions of exogenous ALB to preserve ALB > 30 g/L couldn't progress clinical outcome.

Kang MJ et al.,[31] revealed that >40% of cases with pre-operative DM show resolutions post-PD. Reduced insulin resistance and supposed greater glucose stimulated insulin secretions lessening PP2 contributed to better glucose homeostasis post-PD. BMI wasn't related to DM resolutions, showing that PD-accompanied physio-anatomical variations can aid resolve DM non-dependent of weight.

Conclusion

Duct-to-mucosa method for anastomosis must probably be the 1st choice. However, among cases that possess too small pancreatic ducts, invagination is mostly the securer and easier to perform procedure. Increased incidence of postoperative pancreatitis, steatorrhea, and DM is observed in duct to mucosa PJ.

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