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Comparison between Pancreatico-Jejunostomy V/S Pancreatico Gastrostomy in Pancreatic Resection (Retrospective Study of 30 Cases)

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Abstract | **Original Research Article**

Pancreaticoduodenectomy has been for long time a procedure with high postoperative morbidity and mortality.several complications after pancreatic resection are known hemorrhage, postoperativecollection/abscess, postoperative pancreatic fistula, billiary fistula, delayed gastric emptying. Postoperative pancreatic fistula is most severe complication. Avoiding the pancreatic fistula many surgical inovation came for the continuity after pancreatic resection.The aim of this retrospective study was to compare pancreatico jejunostomy vs pancreatico gastrostomy with regards to postoperative complications of pancreatic anastomosis.30 patients selected who were underwent pancreatico duodenectomy from 2017 september to 2018 september. Pancreatic anastomosis done by pancreatico jejunostomy(end to side duct to mucosa) in 15 cases and by pancreatico gastrostomy(invagination of pancreatic remnant into stomach-dunking method) in other 15 cases. There was no significant difference between the two groups (age, gender, socioeconomic status, symptoms and signs,comorbid conditions, preoperative diagnosis-ductal,ampullary, duodenal carcinoma).Comparison between two groups was made mainly analysing postoperative complication.hemorrhage is 6% in both pancreatico gastrostomy and pancreatico jejunostomy. Postoperative collection/abscess is 26.6% in pancreaticojejunostomy and 20% after pancreatico gastrostomy. Postoperative pancreatic fistula rate is 20% in both pancreatico jejunostomy and pancreatico gastrostomy and all are above 80 years ago with severe jaundice and weight loss are common finding in them but there is no sex preponderence.Postoperative billiary fistula rate is 6% and mortality rate 0% in both pancreatico jejunostomy and pancreatico gastrostomy. Mean hospital stay for pancreatico jejunostomy is 18.4 days and for pancreatico gastrostomy is 18.3 days. This study demonstrates no significant difference between postoperative complications of pancreatico jejunostomy and pancreatico gastrostomy.

Keywords: Pancreaticojejunostomy; Pancreaticogastrostomy; Pancreaticoduodenectomy; Postoperative pancreatic fistula.

INTRODUCTION

Pancreaticoduodenectomy (PD) is the standard surgical procedure for various malignant and benign conditions of the pancreas and periampullariy region and duodenum. With the advances in operative techniques, availability of newer instruments, better anaesthesia and post operative care, the mortality of PD has decreased to below 5%, but the morbidity still remains high (up to 40%) even in the best centres[1]. The most common complications after PD are pancreatic fistula; delayed gastric emptying, haemorrhage and infection. There are two methods for pancreatico enteric anastomosis. Pancreaticojejunal anastomosis (duct to mucosa, end to end, end to side and telescoping/invagination) is the most widely used method of reconstruction after PD, The main concern remains pancreatic leak after this procedure (2-20%) which often leads to, intra abdominal haemorrhage and sepsis resulting in prolonged hospitalization reoperation, increased cost and mortality[1]. Several technique modifications of pancreaticojejunal anastomosis such as placement of the stent, reinforcement of anastomosis with fibrin glue, pancreatic duct occlusion are used in order to decrease pancreatic fistula rate. Pancreaticogastric anastomosis is the other type of pancreaticoenteric anastomosis. It can be done either duct to mucosa or invaginating/dunking technique. the postoperative complications like post pancreatic fistula, biliary fistula, delayed gastric emptying, average length of hospital stay, mortality are equal to pancreaticojejunostomy in many studies, but some studies shows pancreaticogastrostomy is better in terms of delayed gastric emptying, length of hospital stay, billiary fistula.

Aim and Objectives

- To compare the complications of pancreatico-jejunostomy with pancreatico-gastrostomy like.
  - Post-operative pancreatic fistula
  - Billiary fistula formation
  - Delayed gastric emptying
  - Hemorrhage
  - Infection
- To compare mortality and morbidity rate between pancreatico-jejunostomy and pancreatico-gastrostomy.
- To compare length of hospital stay between pancreatico-jejunostomy and pancreatico-gastrostomy.

Historical Aspect

The first anatomical descriptions of the pancreas have been attributed to Herophilus of Chalcedon in the third century BC. The observation that it did not consist of cartilage or bone prompted Ruphos of Ephesus to name the organ “pancreas” (Greek “pan” means “all”; Greek “kreas” means “flesh”) two hundred years later [3].

In the 16th century, in the fifth book of his opus “De humani corporis fabrica” (Fabric of the Human Body), Vesalius referred to the pancreas as a “glandulous organ” postulating that it exerted a protective effect on the stomach by serving as a cushion. The main pancreatic duct was described by Wirsung in 1642, not understanding its function, and the accessory pancreatic duct by Santorini in 1775. In 1720, Vater described the duodenal ampulla and in 1887, Oddi the papillary sphincter. The first discoveries in pancreatic physiology were made in the late 17th century. In 1671, Sylvius de le Boe proposed in his work “Praxeos medicae idea nova”, that digestion was a multistep process including a fermentation through saliva in mouth and stomach, in a second phase involving the pancreas, followed by the passage of chyle into the lymphatic and the venous system, and eventually, into the right side of the heart . In contrast, Brunner proposed some years later that specialized duodenal glands were the major source of digestive juice secretion, and that the pancreas was not a vital organ. In 1682, Peyer concluded that the lymphatic nodules in the walls of the ileum and Brunner’s glands were main adjuncts to digestion, and the pancreas was a minor contributor. This reductionist modification of Silvius’ innovative theories delayed the progress of pancreatic research for years. In 1815, Marcet discovered lipase, and in 1876, Kuhne discovered trypsin and its role in the digestion of proteins. In 1843, Eberle showed that pancreatic juice emulsified fat, and one year later, Valentin demonstrated its activity on starch. In 1848, Bernard proposed that gastric digestion was "only a preparation act" and that pancreatic juice emulsified fatty foods. In addition, he revealed the pancreatic contribution to converting starch into sugar, and its solvent action on the "proteides that have not been cleaved in the stomach" [14]. The regulative concept of pancreatic secretion was initially addressed by Pavlov in “The Work of the Digestive Glands” in 1897, suggesting that the vagal nerve was a predominant neurological regulator [15]. In 1869, Langerhans had published his “Contribution to the Microscopic Anatomy of the Pancreas”, he was the first to describe the structure of the islet tissue, which Laguesse in 1893 named the islands of Langerhans. In 1902, Bayliss and Starling demonstrated that pancreatic secretion was controlled by chemical messengers, which led to the introduction of “hormones” (derived from the Greek “hormonos” meaning ‘I arouse to excitement’) and the putative agent "secretin" [16]. In 1922, Insulin was discovered and isolated [17]. The discovery of the serum amylase test by Elman in 1927 was a great contribution to the differential diagnosis of acute pancreatitis [18, 19]. Further developments included the discovery of CCK by Ivy and Oldberg in 1928 [20] and their understanding that pancreatic secretion was regulated by a complex chemical messenger system [3].

Surgical pioneers

Most of the early pancreatic surgeons resected only portions of the duodenum and pancreas. Allen Old father Whipple was the first surgeon to perform a complete resection of the duodenum and head of the pancreas; in 1935 in a two-stage, and in 1940 in a one-stage procedure [18]. The first pancreatic head resection with transection of the pancreatic duct was performed by Biondi in 1894, resecting a pancreatic fibroadenoma and re-approximating the duodenum and the pancreatic remnant. The postoperative course was complicated by biliary and pancreatic fistula which eventually resolved. In 1898, Codivilla performed the first reported pancreaticoduodenectomy (PD) on a 46 year old male with a locally advanced cancer, removing parts of the pancreas, duodenum, distal stomach and distal bile duct. Continuity was restored using a Roux-en-Y gastrojejunostomy and a cholecystojejunostomy excluding the pancreatic stump. The patient died at 18 days from steatorrhea-induced cachexia [21]. In 1898, Halsted performed the first successful resection for ampullary cancer by resecting portions of the duodenum and pancreas in a 60 year old female with painless jaundice. The operation included a CBD exploration, transduodenal papillectomy and reanastomosis of the pancreatic and bile duct. In 1905, Garre re-approximated the capsule of a traumatically cleaved pancreatic gland with silk sutures. The duct was not sutured and the result was a pancreatic fistula which resolved after two months. A similar technique was used in the first successful partial PD performed by Erhardt in 1907. In 1909, Kausch applied Kocher’s maneuver in a resection of the duodenum en bloc with a portion of the pancreas, establishing continuity by a pancreaticoduodenostomy. The patient recovered initially from a pancreatic fistula, but died nine months later due to cholangitis [22]. In 1912, Hirschel

performed a one-stage resection removing parts of the duodenum, ampulla, head of pancreas and the lower part of the CBD. Continuity was established by re-implanting the pancreatic duct into the duodenum, a posterior gastroenterostomy and bridging of the common bile duct to the duodenum by a rubber tube. The patients jaundice was relieved and he lived for one year. The cause of death or fate of the rubber tube was unknown as an autopsy was never performed [22]. In 1922, Tenani performed a successful two-stage resection for ampullary carcinoma in a 43-year-old male by a posterior gastroenterostomy and choledochoduodenostomy to the lower duodenum in a first stage, and excising portions of the duodenum, and pancreatic head in a second stage, establishing continuity by a pancreaticoduodenostomy. The patient recovered after a severe postoperative course and lived for 3 years [4].

The first complete duodenectomy and pancreatic head resection was reported in 1935 by Whipple, Parsons and Mullins from Columbia Presbyterian Hospital in New York who had operated three patients for ampulla cancer in a two-stage procedure including a radical resection of the duodenum and head of the pancreas for ampulla cancer. The third patient underwent a total duodenectomy and excision of a large portion of the head of the pancreas. The first patient died shortly after the operation due to consequences of anastomotic breakdown, the others lived for 9 and 24 months and died of cholangitis and liver metastasis, respectively [22, 23]. In 1937, Brunschwig performed the first radical anatomic pylorus-preserving PD with complete transection of the pancreatic head to the right of the SMV due to pancreatic carcinoma in two stages [24]. With the use of vitamin K to control hemorrhage in the presence of jaundice, and due to difficulties in dealing with adhesions at the time of the second stage operation, it became evident that one-stage operations for radical PD would have definite advantages [24]. In 1940 at New York's Presbyterian Hospital, Whipple performed a distal gastrectomy on a non-jaundiced patient thought to have a gastric carcinoma. A group of visiting European surgeons watched the operation. At laparotomy, palpation confirmed the presence of a tumor and the stomach was transected in its mid-portion. When the tumor was recognized as pancreatic tumor and having to make decisions on the spot, Whipple proceeded with a one-stage resection of the head of the pancreas, including distal gastrectomy and resection of the entire duodenum. The transected pancreatic duct was ligated. The tumor proved to be a malignant glucagonoma, and the patient survived for 9 years [25]. This procedure known to be the "Whipple operation" was reported five years later, and regarding the pancreatico-enteric reconstruction, Whipple recommended his then-current practice of duct re-implantation [22-27]. Unaware of the Whipple's procedure, Trimble performed a similar resection a few weeks after, adding a distal gastrectomy to avoid blow out of the duodenal stump [28]. In the same year, Hunt added a pancreaticojejunostomy (PJ) to avoid leakage of the pancreatic stump [29]. In 1946, Whipple published his 10-year PD experience. In this report he proposed several modifications to the original procedure and advocated a one-stage procedure; oozing and hemorrhage could be controlled by preoperative vitamin K therapy, and a single procedure with continuous anesthesia and blood transfusion was safer than two major procedures [22].

Some important contributions to the development of pancreatic surgery [4]

Gastrojejunostomy

C. Roux. De la gastroenterostomie Rev Gynecol Chir Abdom, 1, 1897 [30].

First pancreatic head resection

B. Dal Monte [31]. Galeati,

Partial pancreatic head resection

W.S. Halsted. Contribution to the surgery of the bile passages, especially of the common bile duct. Boston Med Surg J 141, 1899 [32].

Pancreatic head resection (twostage)

A. O. Whipple, W. B. Parsons and C. R. Mullins. Treatment of Carcinoma of the Ampulla of Vater. Ann Surg 102, 1935[23]

Pancreatic head resection (one-stage)

A. O. Whipple. Pancreatico duodenectomy for Islet Carcinoma: A FiveYear Follow-Up. Ann Surg 121, 1945 [22]

Pancreaticogastrostomy

M.Waugh, and O.T. Clagett.

Pancreaticojejunostomy

R.B. Cattell. A technic for pancreatoduodenal resection

Total pancreatectomy

L.S. Fallis, and D.E. Szilagyi

Mesenteric superior vein resection

G.E. Moore, Y. Sako *et al*. Radical pancreatoduodenectomy with resection and re-anastomosis of the superior mesenteric vein.

First larger series without mortality

J. M. Howard. Pancreaticoduodenectomy: forty-one consecutive Whipple resections without an operative mortality. Ann Surg 168, 1968 [23]

Pylorus preserving resection

L.W. Traverso and W.P. Longmire, Jr. Preservation of the pylorus in pancreaticoduodenectomy a follow-up evaluation

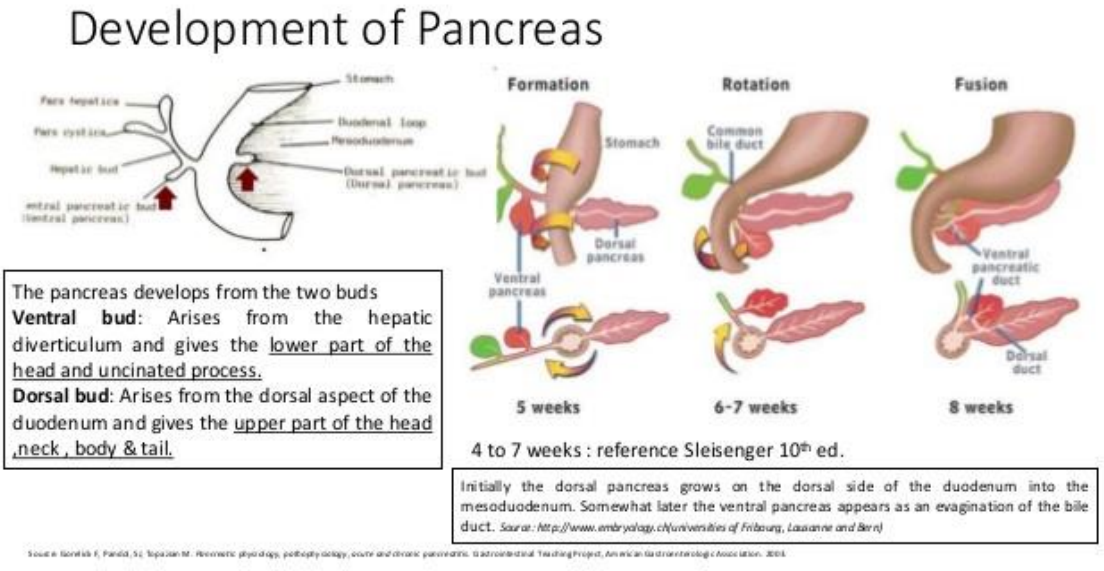
Extended resections

J.G. Fortner. Surgical principles for pancreatic cancer: regional total and subtotal pancreatectomy.

REVIEW OF LITERATURE

Anatomical aspects [5]

The pancreatic gland is a retroperitoneal organ centrally located in the upper abdomen and ventral to the mesenteric vessels, extending from the pancreatic head in the C-loop of the duodenum to the pancreatic tail in the splenic hilum. In an adult, the pancreas is 15-20 cm long and weighs 75-100 g. The fact that even a minor surgical trauma to the pancreas can result in the release of pancreatic enzymes and cause pancreatitis, illustrates the importance of anatomic knowledge of the pancreatic gland and its surrounding structures for surgeons.

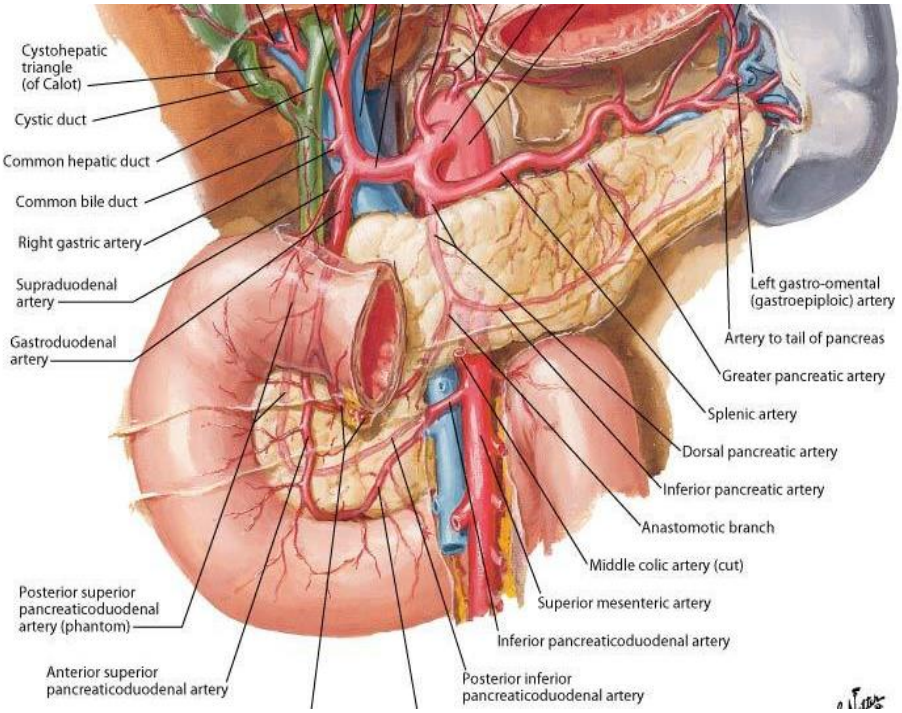


The pancreatic gland develops in the fourth week of fetal life by a fusion of the dorsal and ventral pancreatic bud from the caudal part of the foregut. With gut rotation, the ventral bud rotates around the posterior side of the duodenum to fuse with the dorsal bud. In the adult pancreas, both the caudal head portion and the uncinate process are derived from the ventral bud, whereas the cranial head portion, body and tail are derived from the dorsal bud. The ducts of the dorsal and ventral pancreas join to form the main pancreatic duct (duct of Wirsung); a smaller part of the dorsal duct persists in the pancreatic head as an accessory duct (duct of Santorini). In 5–15% of the population, the ventral and dorsal ducts fail to fuse resulting in a pancreas divisum and pancreatic drainage mainly through the duct of Santorini and through the minor papilla into the duodenum [6].

The pancreatic regions and their blood supply

Pathological lesions in the pancreas are typically described in relation to four pancreatic regions (head, neck, body, and tail). The pancreatic head with the uncinate process lies within the C-loop of the duodenum and is associated medially to the mesentery of the transverse colon. The retroperitoneum behind the head of the pancreas contains the caval vein with the left renal vein and the aorta with the right renal artery.

The neck of the pancreas lies over the mesenteric root, where the splenic vein and superior mesenteric vein (SMV) join to continue in the hepatoduodenal ligament as the portal vein (PV). At the inferior border, the inferior mesenteric vein (IMV) joins the splenic vein near its junction with the SMV, or the SMV directly. The superior mesenteric artery (SMA) leaves the aorta above the crossing of the left renal vein and continues in the root of the mesentery to the left of the SMV. The inferior pancreaticoduodenal artery branches from the SMA and divides into the anterior and posterior inferior pancreaticoduodenal arteries which form the arterial pancreatic arcade giving off numerous branches to the duodenum and pancreas. The pancreatic head contains the most distal part of the common bile duct (CBD). The intra-pancreatic CBD joins the main pancreatic duct at the ampulla of Vater. The uncinate process and the head of the pancreas wrap around the right side of the SMV/PV. Venous branches draining the pancreatic head and uncinate process enter along the right lateral and posterior sides of the SMV/PV. As there are usually no anterior venous tributaries, a dissection plane can be developed between the neck of the pancreas and the SMV/PV.

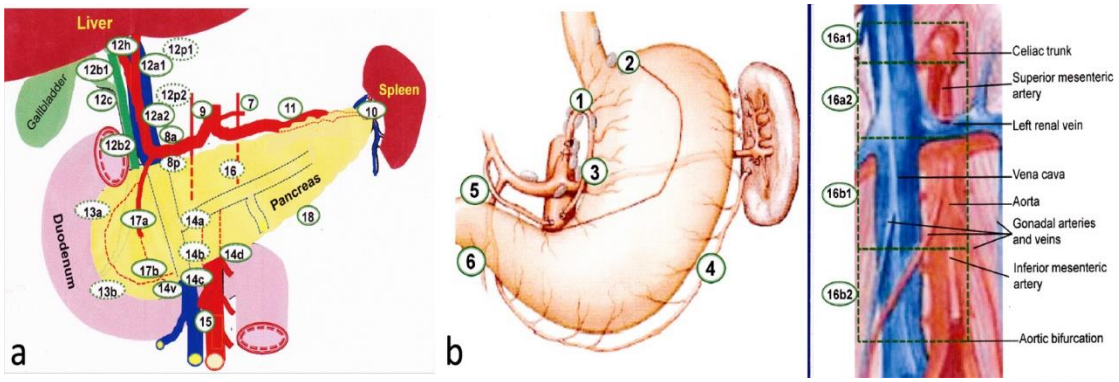


The gastroduodenal artery (GDA) leaves from the common hepatic artery and continues as the superior pancreaticoduodenal artery behind the first portion of the duodenum. It branches into the anterior and posterior superior pancreaticoduodenal arteries. It is not possible to respect the pancreatic head without devascularizing the duodenum, unless a rim containing the pancreaticoduodenal vascular arcade is preserved. Variations in the anatomy of the right hepatic artery, common hepatic artery, or GDA occur in 20% of patients, and the preoperative knowledge of the individual anatomy regarding the arterial liver supply is important for surgical and oncological reasons.

Once the gastrocolic omentum is divided and the omental bursa is opened, the body and tail of the pancreas is visible posterior to the stomach, and anterior to the splenic artery and vein. Multiple small venous branches from the pancreatic body and tail drain to the splenic vein running in a groove on the posterior aspect. The splenic artery branches from the celiac trunk and continues superior to the vein along the posterior superior edge of the pancreatic body and tail. The body of the pancreas is situated ventral to the aorta at the origin of the SMA and the neck of the pancreas ventral to the vertebral body of L1 and L2. Blunt anteroposterior trauma can compress the neck of the pancreas against the spine and cause a pancreatic "fracture" with parenchymal and/or ductal injury. The pancreatic tail contains the portion from anterior to the left kidney to the hilum of the spleen. The body and tail of the pancreas are supplied by multiple branches of the splenic artery. The inferior pancreatic artery, ordinarily branching from the SMA, runs along the inferior border of the body and tail of the pancreas, parallel to the splenic artery, forming arcades within the body and tail of the pancreas and accounting for the rich blood supply of the organ. The venous drainage of the pancreas follows a similar pattern.

Lymphatic drainage and innervation [9]

The widespread and diffuse lymphatic drainage from the pancreas contributes to early lymphatic invasion and dissemination in pancreatic cancer. The profuse network of lymph node stations has been mapped systematically. The pancreatic lymphatic system communicates with lymph nodes in the mesentery of the transverse colon and the proximal jejunum. In the pancreatic parenchyma, the acinar cells responsible for exocrine secretion and the islet cells responsible for endocrine secretion are stimulated by parasympathetic and inhibited by sympathetic nerves. In several studies about pancreatic nociception, the rich supply of afferent sensory fibers in the pancreatic parenchyma has been made responsible for the intense pain associated with advanced pancreatic cancer, as well as acute and chronic pancreatitis [5, 33].



Japan Pancreas Society nomenclature for perigastric, peripancreatic and para-aortic lymph nodes potentially removed during a standard or extended lymphadenectomy. Lymph node stations: along the left gastric artery (7); along the common hepatic artery (8a, 8p); around the celiac trunk (9); at the splenic hilum (10); along the splenic artery (11); along the proper hepatic artery (12a); along the bile duct (12 b); along the cystic duct (12c); behind the portal vein (12p); hilar area (12h); on the posterior surface of the pancreatic head (13a, 13b); at the origin of the superior mesenteric artery (SMA) (14a); on the right side of the SMA (14b); on the anterior surface of the SMA at middle colic artery (14c); on the left side of the SMA (14d); along the middle colic vessels (15). On the anterior surface of the pancreatic head (17a, 17b); along the inferior border of the body and tail of the pancreas (18). Peripancreatic arteries in red, mesenteric-portal trunk in bleu, biliary tree in green. b. Left: perigastric lymph node stations: right paracardial (1); left paracardial (2); along the lesser curvature (3); along the greater curvature (4); suprapyloric (5); infrapyloric (6). Right: para-aortic nodes: from diaphragm to celiac trunk (16a1); from celiac trunk to left renal vein(16a2); from left renal vein to inferior mesenteric artery (16b1); from inferior mesenteric artery to aortic bifurcation (16b2).

Physiological aspects

The endocrine (2% of the cells in the pancreatic gland) and exocrine (85%) functions of the pancreatic gland are not functionally separated but components of a single complex regulatory feedback system for digestive enzyme and hormone secretion. Although it is possible to live without the pancreas if insulin and digestive enzymes are substituted, the loss of the pancreatic regulation after a total pancreatectomy leads to severe impairments in digestive function. Although only 20% of the normal pancreatic parenchyma is required to prevent functional insufficiency [6], many patients undergoing pancreatic resection have pancreatic remnants with impaired endocrine and exocrine function, and 511% develop pancreatic fibrosis and atrophy due to malfunction of the pancreatico-enteric anastomosis or insufficient pancreatic stimulation.

Exocrine function [6]

The external secretion of the pancreas is stimulated by the hormones secretin and cholecystokinin (CCK) and by parasympathetic vagal discharge. Pancreatic juice is an alkaline (pH 7.0–8.3) and isosmotic solution of 1–2 liters per day containing the secretions of acinar and duct cells. The acinar cells secrete amylase, proteases and lipases, enzymes responsible for the digestion of carbohydrate, protein, and fat, respectively. Unlike the endocrine islet cells that specialize in the secretion of one hormone type, individual acinar cells are capable of secreting all enzyme types. Due to a sequential regulation of secretion, the ratio of different enzymes secreted can be adjusted to the mix of food being digested. Pancreatic juice helps to neutralize gastric acid in the duodenum and adjusts luminal pH to a level that provides optimal conditions for the catalytic activity of the enzymes. Lipase and amylase are stored and secreted in active forms. Pancreatic amylase completes the digestive process that was started by salivary amylase. Phospholipase A and the proteases are secreted as an inactive proenzyme and activated in the duodenum.

Proteolysis and lipolysis

The conversion of trypsinogen into active trypsin and the inactive cleavage product trypsinogen activation peptide (TAP) occurs at the intestinal brush border, catalyzed by enterokinase, an enzyme which is produced by the duodenal mucosal cells [8]. Trypsin, in turn, activates other proteolytic enzymes. The separate storage of proteases from other cell proteins, the secretion of proenzymes that require activation, and the presence of proteolytic enzyme inhibitors in the pancreatic juice and in the pancreatic parenchyma prevent the pancreas from autodigestion. A failure to express the pancreatic secretory trypsin inhibitor (PSTI), also known as serine protease inhibitor Kazal-type 1 (SPINK1) or tumor-associated trypsin inhibitor (TATI), is one of the causes of hereditary pancreatitis. Trypsinogen is expressed in several isoforms. Trypsinogen1, also known as cationic trypsinogen, is the main isoform of trypsinogen and encoded by the PRSS1 gene. Mutations on the cationic trypsinogen gene can result in the premature intrapancreatic activation of trypsinogen, which accounts for about two thirds of cases of hereditary pancreatitis. Trypsin

activates chymotrypsin, elastase, carboxypeptidase A and B, and phospholipase, which together with other pancreatic lipases (pancreatic triglyceride lipase, carboxylester lipase) hydrolyze phospholipids and triglycerides into the end products glycerols and free fatty acids. Trypsin, chymotrypsin and elastase cleave bonds between amino acids within a target peptide chain and carboxypeptidase A and B cleave amino acids at the end of peptide chains. The individual amino acids and small dipeptides are then actively transported into the intestinal epithelial cells. Pancreatic lipase hydrolyzes triglycerides to 2-monoglyceride and fatty acid and phospholipase A2 hydrolyzes phospholipids. All lipases require bile salts to be active and are enhanced by co-lipase. Fat is hydrolyzed by carboxylic ester hydrolase and cholesterol esterase and packaged into micelles for transport into the intestinal epithelial cells, where the fatty acids are reassembled and packaged inside chylomicrons for transport through the lymphatic system into the blood.

Acinar secretion [7]

An acinus consists of about 40 acinar cells. The duct cells, located near the center of the acinus (centroacinar cells), are responsible for the secretion of fluid and electrolyte in the pancreatic juice and contain carbonic anhydrase, an enzyme needed for bicarbonate secretion. Secretin-stimulated bicarbonate secretion buffers the acidic fluid entering the duodenum from the stomach. Chloride secretion varies inversely with the bicarbonate secretion. Sodium and potassium levels in the pancreatic secretion are constant and independent of the secretory rate. CCK stimulates bicarbonate secretion to a much lesser extent than secretin but potentiates secretin-stimulated bicarbonate secretion and augments the secretion of insulin. Somatostatin, pancreatic polypeptide (PPP) and glucagon of the endocrine pancreas inhibit exocrine secretion [9]. The acinar cells release pancreatic enzymes into the lumen of the acinus, where they join with the fluid and bicarbonate secretions of the centroacinar cells. The pancreatic juice drains into small intercalated ducts and interlobular ducts, where fluid is added and electrolytes are adjusted, and into side branches that empty into the main pancreatic duct. Recurrent inflammation, trauma or manipulation, contributes to destruction of the branching structure and together with acinar or mesenchymal cell damage to the development of inter-, intralobular fibrosis and exocrine pancreatic insufficiency [34, 35].

Pancreatic Enzymes

Enzyme	Zymogen	Activator	Action
Trypsin	Trypsinogen	Enterokinase	Cleaves internal peptide bonds
Chymotrypsin	Chymotrypsinogen	Trypsin	Cleaves internal peptide bonds
Elastase	Proelastase	Trypsin	Cleaves internal peptide bonds
Carboxypeptidase	Procarboxypeptidase	Trypsin	Cleaves last amino acid from carboxyl-terminal end of polypeptide
Phospholipase	Prophospholipase	Trypsin	Cleaves fatty acids from phospholipids such as lecithin
Lipase	None	None	Cleaves fatty acids from glycerol
Amylase	None	None	Digests starch to maltose and short chains of glucose molecules
Cholesterolesterase	None	None	Releases cholesterol from its bonds with other molecules
Ribonuclease	None	None	Cleaves RNA to form short chains
Deoxyribonuclease	None	None	Cleaves DNA to form short chains

Endocrine function

There are at least one million islets of Langerhans in the normal adult pancreas. Larger islets are located in proximity to the major arterioles and smaller islets are embedded in the pancreatic parenchyma. Most islets contain 3000 to 4000 cells of five major types: alpha cells that secrete glucagon, beta cells that secrete insulin, delta cells that secrete somatostatin, epsilon cells that secrete ghrelin and PP cells that secrete PPP.

Insulin [6]

Stored insulin can be released rapidly during a first secretion phase. The second phase is a sustained release due to ongoing production of new insulin. Insulin synthesis is regulated by plasma glucose levels, neural signals and the paracrine influence of other islet cells. Glycogenolysis, fatty acid breakdown, ketone formation and hepatic glucose production is inhibited by Insulin, whereas protein synthesis is stimulated and glucose transport into cells facilitated. There is a considerable amount of functional reserve in insulin secretory capacity. If the remaining portion of the pancreas is healthy, about 80% of the pancreas can be resected without the patient becoming diabetic; however, in chronic pancreatitis or other disease conditions, even smaller pancreatic resections can result in diabetes. Insulin deficiency (type I diabetes) results

in an up-regulation of insulin receptors, leading to an enhanced insulin sensitivity. Type II diabetes is associated with insulin resistance, down-regulation of insulin receptors and relative hyperinsulinemia.

Glucagon, somatostatin and pancreatic polypeptide

Glucagon is a peptide that promotes hepatic glycogenolysis and gluconeogenesis and counteracts the effects of insulin. Insulin and somatostatin inhibit glucagon secretion in a paracrine fashion within the islets. The same neural impulses that regulate insulin secretion also regulate glucagon secretion, so that the two hormones work together in a balance of actions to maintain glucose levels. Somatostatin is a peptide with a wide anatomic distribution and is important in many regulatory processes throughout the body. Endocrine release of somatostatin occurs during a meal by intraluminal fat and the acidification of the gastric and duodenal mucosa. Acetylcholine from the cholinergic neurons inhibits somatostatin release. Pancreatic polypeptides (PPP), discovered during the process of insulin purification [36], are known to inhibit bile secretion, gallbladder contraction, and secretion by the exocrine pancreas. A number of studies suggest that PPP control glucose levels through the regulation of hepatic insulin sensitivity at the transcriptional level [37, 38]. Deficiencies in PPP secretion due to proximal pancreatectomy or severe chronic pancreatitis are associated with diminished hepatic insulin sensitivity due to a reduced number of hepatic insulin receptors [39].

Indications for pancreatico duodenectomy

PD is nowadays indicated for curative resection of malignancies of the periampullary region, i.e. pancreatic head, ampulla of Vater, duodenum and distal bile duct. It may also be used in chronic pancreatitis to relieve pain, to relieve obstructive symptoms related to chronic pancreatitis and when cancer cannot be excluded. It may occasionally also be indicated in cases of trauma.

Role of various resections of the pancreatic head

Pancreaticoduodenal resection with antrectomy

Resection of the head of the pancreas, which is commonly called pancreaticoduodenectomy, has been performed for many decades as a two-stage operation. Nowadays, PD is performed as a onestage operation, mainly for periampullary suspected malignant or pre-malignant tumours and chronic pancreatitis. It is performed either through a midline upper abdomen or transverse subcostal incision [10]. Prospects for performing curative resection can be determined preoperatively by laparoscopy [14]. Peroperatively after mobilizing the duodenum and visualizing the pancreatic head, the lymphatic nodes can be palpated. Invasion of the tumour to the portal or mesenteric vein or extension behind the mesenteric artery or vein is considered an ominous sign [40]. The transection of the stomach is performed at the distal or midportion. The right gastric artery and the gastroduodenal artery are divided and ligated. The common hepatic duct is divided above the entrance of the cystic duct and a cholecystectomy is performed. The ligament of Treitz is exposed following reflection of the transverse colon superiorly. The ligament is divided, the third and fourth portions of the duodenum are dissected from the posterior abdominal wall and the jejunum is interrupted distal to the ligament. The vessels are divided close to the bowel wall to avoid damage of the superior mesentery artery and vein. The pancreatic neck anterior to the superior mesenteric vein is usually the site of pancreatic division. The resection line is extended to the left if the frozen-section examination shows that the tumour reaches the transection line. Branches of the superior mesenteric vein to the pancreatic head and the uncinate process are carefully ligated. The extension of the dissection may be limited to the peripancreatic nodes, which are removed together with a specimen of the PD or possibly extended system to the retroperitoneal tissue behind the pancreatic head removing distal lymph nodes, such as the periaortic nodes, from the celiac trunk to the renal arteries, the pericaval nodes, and the nodes around the superior mesenteric artery [10].

Reconstruction

A variety of reconstructive methods have been proposed. In most institutions, pancreaticojejunal anastomosis is the current mode of management, but other methods have also been reported, as pancreaticogastrostomy and occlusion of the pancreatic duct, thus avoiding pancreatic anastomosis. According to a meta-analysis, both anastomoses provide equally good results [41].

Table-1 provides a broad overview of the various types of pancreatico-enteric anastomosis. Fingerhut and colleagues have advised that the appropriate nomenclature when describing pancreatico-enteric anastomosis should be such that if the duct is joined to the mucosa of the bowel, then the anastomosis should preferably be referred to as pancreatico-enteric. Alternatively, if ductal sutures are not included, then the term pancreato-enteric anastomosis is sufficient.

Table 1 Types and techniques of Pancreatico-enteric anastomoses

Type of anastomosis	Surface involved in anastomosis	Technique of anastomosis	Technique first described by	Reference
PJ	End-to-end	Direct suturing	Child CG III	(29)
		Invagination/dunking	Aston & Longmire	(30)
	End-to-side	Invaginating	Aston & Longmire	(30)
		Duct-to-mucosa	Whipple AO	(31)
PG	End-to-side	Direct suturing	Waugh & Clagett	(26)
		Invaginating/telescoping	Wells *et al.*	(32)
			Mackie *et al.*	(33)
		Duct-to-mucosa	Telford & Mason	(34)

PJ, Pancreatojejunostomy; PG, pancreaticogastrostomy.

The duct-to-mucosa PJ [5] has certainly evolved over the decades from the initial reports wherein the duct was anastomosed to the jejunum over a tube with the rest of the pancreas parenchyma sutured off/oversewed with mattress sutures, to the current two concentric layered anastomosis including the rest of the pancreatic parenchyma in the anastomosis without the need for duct intubation described by Blumgart. The end-to-side PJ is generally performed as a four-layered anastomosis approximating pancreatic capsule and parenchyma to the seromuscular layer of the jejunum in the first and fourth layers and duct to mucosa in the middle two layers. The only major difference in the inversion or invaginating end-to-side anastomosis (Figure-1) and the duct-to-mucosa end-to-side anastomosis is in the size of the jejunal opening—a wide jejunal opening matching the diameter of the cut surface of the pancreas in the former and a 'pin-hole' opening in the jejunum in the latter (Figure- 2). The authors have successfully resorted to the use of an interrupted end-to-side invaginating PJ using just the two outer layers in high risk anastomoses (soft texture with a small unidentifiable duct in which placement of ductal sutures is not feasible)

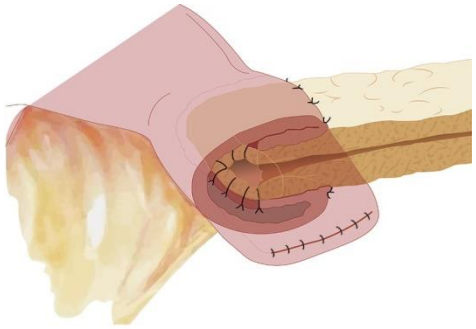


Fig-1: End to side invaginating pancreatico jejunostomy

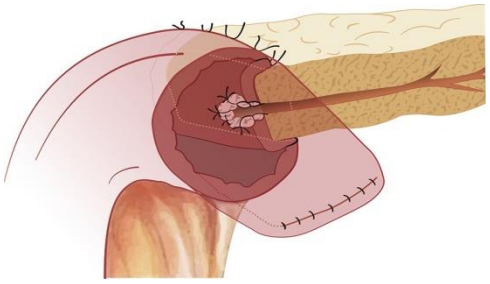


Fig-2: Duct to mucosa pancreatico jejunostomy

Variations in the performance of PJ and PG

Numerous variations to both, the PJ and PG, have been described largely because the ideal anastomotic technique for a soft/fatty or even brittle pancreas with a small duct (<3 mm) remains elusive. Shinchi and colleagues described the use of a single layer of transfixing sutures between the pancreatic remnant and the posterior gastric wall to reinforce the duct-to-mucosa PG. Shuyou Peng described his 'binding' PJ technique in 2002 to help overcome the problems of a soft pancreas. The technique involved several specific steps, namely, isolating the pancreatic remnant for 3 cm, everting and ablating (electro-coagulation or chemical) the distal 3 cm of the exposed

mucosa of the cut end of jejunum, suturing the pancreas to the jejunal mucosa (avoiding the seromuscular layer) with intermittent or continuous silk, wrapping the pancreatic stump with the everted jejunum and securing it in place with a few sutures, and finally looping a catgut tie 1 cm from the cut end of jejunum. The anastomosis is then tested to ensure water-tight closure. While Peng initially reported a 0% POPF rate from 150 patients in whom he performed the 'binding' PJ, by 2011, he himself reported that the technique was fraught with two risks, namely, a size discrepancy between pancreas stump and jejunum, and the risk of the pancreatic fixation sutures leading to exudation of pancreatic juice into the abdominal cavity. Thus prompting him to propose his 'binding' PG which involved isolating the pancreatic stump for 2 cm, excising a piece of seromuscular layer of the posterior gastric wall (the size being equivalent to pancreatic stump and the location corresponding to it, as well,) with a preplaced purse-string seromuscular suture and the pancreatic stump is then invaginated through a small incision in the mucosal layer. Using an anterior gastrotomy, the edge of the mucosal opening at the posterior gastric wall is held up by forceps forming a mucosal tube, around which the second purse-string suture is pre-placed. Finally, the two purse-string sutures are tied around the pancreas that is drawn into the gastric lumen.

Fernandez-Cruz and colleagues proposed the construction of an end-to-side, duct-to-mucosa anastomosis (with an internal pancreatic duct silastic stent) of the transected pancreas to a tube of stomach they termed 'gastric partition' following a pylorus-preserving PD. The 'Gastric partition' is carried out using two endo-GIA staplers along the greater curvature of the stomach, 3 cm from the border after preserving the gastroepiploic arcade. The resultant gastric segment of 10 to 12 cm length is placed in close proximity to the cut edge of the pancreatic stump to facilitate the anastomosis. The duodeno-jejunostomy and hepaticojejunostomy are then constructed downstream [3,4].

To facilitate the performance of a duct-to-mucosa PJ even in patients with small pancreatic ducts, the authors have previously proposed the use of the 'duct evagination' technique which involves the placement of interrupted 5-0 suture ties around the entire circumference of the pancreatic duct.

Zhang and colleagues have described their 'papillary-like main pancreatic duct invagination' technique in which 1 to 1.2 cm of the pancreatic duct is isolated from the surrounding parenchyma is moulded into a 'fish mouth-like' shape with the pancreatic duct protruding out of the stump. The pancreatic stump (excluding the protruding duct) is then closed with interrupted inverting sutures. The anastomosis thereafter essentially proceeds like a duct-to-mucosa four layered anastomosis with the duct invaginating into the jejunum.

Another variation to PJ is the performance of the anastomosis of the pancreas to an isolated Roux limb of jejunum with an aim to divert the biliary secretions away from the PJ and ensure that even if a POPF does develop after the anastomosis, the effluent from the leak will consist of 'pure', unactivated, and thus harmless pancreatic juice .

Anastomosis over stents

Anastomosing the pancreatic duct to the jejunum or stomach was performed over an internal (rubber tube) stent by Whipple and Wells. Thereafter, surgeons attempted to perform the anastomoses over stents that were exteriorised (controlled fistula). Today, most surgeons would perform an anastomosis without a stent, although, the use of stents is not uncommon. Some surgeons have even attempted, rather unsuccessfully, to develop biodegradable internal stents.

Use of supporting/reinforcing material

Tashiro and colleagues proposed the use of a fibrin glue biological adhesive as a reinforcing layer to the PJ in order to reduce the risk of POPF. Moriura and colleagues instead suggested that wrapping the PJ as well as the retroperitoneal vessels had the potential to reduce the incidence of POPF as well prevent haemorrhage from the vessels in case the anastomosis did leak.

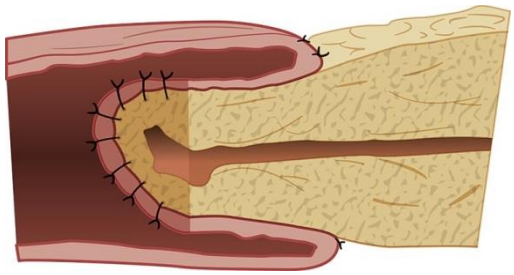


Fig-3: End to end invaginating/dunking pancreatico jejunostomy

The most commonly performed pancreatico-enteric anastomosis around the world is the PJ (88.7%) followed by the PG (9.7%). The most commonly performed variations of the two-main anastomoses include the duct-to-mucosa, end-to-side PJ, followed by the invaginating end-to-side or end-to-end PJ(figure 3),

, and the invaginating or duct-to-mucosa, end-to-side PG (Figures-4,5). The use of stents, as well as, reinforcements is highly variable.

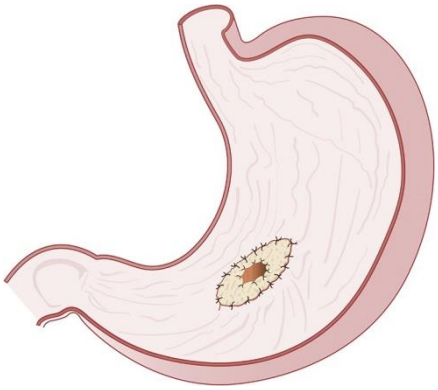


Fig-4: Duct to mucosa pancreatico gastrostomy

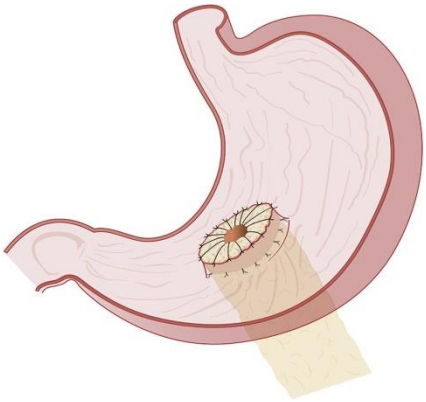
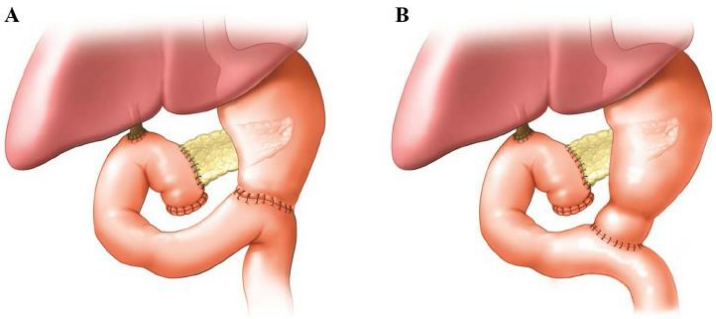


Fig-5: Invaginating end to side pancreatico gastrostomy

The effect of the type of suture material (absorbable versus non-absorbable) used to perform the pancreatico-enteric anastomosis, as well as, the technique of suturing has also been analysed with respect to the development of POPF. Suture material induces changes in the pancreas akin to acute pancreatitis thus supporting the rationale for thinner, and fewer, sutures. While there exists significant variability in the type of material used amongst surgeon around the world, an absorbable monofilament (e.g., polydioxanone, Maxon, Monocryl) is favoured for the inner layer of a duct-to-mucosa anastomosis, while the non-absorbable braided (e.g., silk, polyester) and absorbable monofilament sutures are equally favoured for the outer layer of the anastomosis. There is evidence from a single study to suggest a lower severity of POPF with the use of non-absorbable sutures versus absorbable sutures. In fact, polyester resulted in a significantly lower POPF rate compared to polydioxanone (12% *vs.* 32%; P<0.01). Studies comparing the performance of a continuous versus an interrupted suture anastomosis favour the use of the continuous technique for PJ.

Hepaticojejunostomy is usually performed end to side using interrupted one-layer sutures. The gastrojejunal anastomosis is usually performed last, and is usually placed about 40 cm distal to the biliary anastomosis in order to promote neutralization of the gastric-acid secretion. The entero-enteroanastomosis in the jejunal loop prevents reflux of the bile and pancreatic fluid to the stomach.

Pylorus-preserving pancreaticoduodenal resection

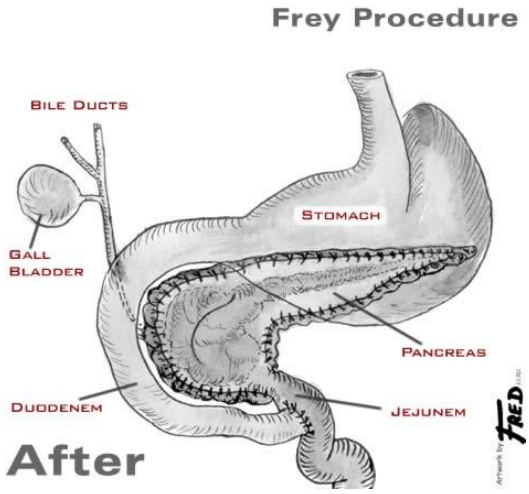


(A)-Classical whipples
(b)-Pylorus preserving pancreaticoduodenectomy

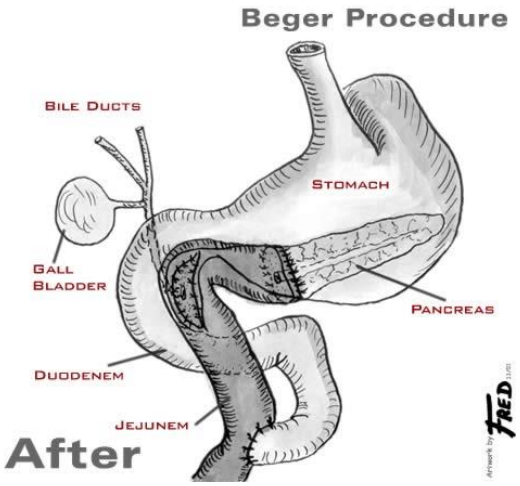
Pylorus-preserving pancreaticoduodenectomy (PPPD) was first performed in 1944 by Watson. He assumed that preserving the antrum, pylorus and one inch of the duodenum would allow better digestion and would prevent jejunal ulceration. This report remained an exceptional individual opinion until 1978, when Traverso and Longmire reported their experience of PPPD in two patients. In this procedure, the gastroduodenal artery is divided, whereas the right gastric artery is usually preserved. Preservation of 5 cm of the duodenum is sometimes possible, but in case of malignancy preservation of only 2 cm seems to be appropriate. PPPD is contraindicated if the tumour involves the duodenopancreatic angle and if the patient has previously undergone vagotomy. Both PD and PPPD alter normal upper gastrointestinal protective mechanisms, but there are only retrospective studies of marginal ulceration. Some series suggest that a higher rate of marginal ulceration is associated with PPPD

Duodenum-preserving resections of the pancreatic head

In the treatment of chronic pancreatitis operative interventions are indicated when severe pain and local complications are resistant to conservative and endoscopic treatment or potential malignancy is present. An ideal procedure should be easy to perform, have a low morbidity and mortality rate, provide long-lasting pain relief, and not exacerbate exocrine or endocrine insufficiency. No operation fulfils this ideal. It is not always clear what the cause of pain is in chronic pancreatitis, but ductal pressure and peripancreatic inflammation are often involved. Recently there have also been studies of the role of pancreatic neuropathy, either in the pancreatic or peripancreatic nerves, as a cause of pancreatic pain.



Two operations have been developed to reduce ductal hypertension by excising the inflammatory mass of the head of the pancreas. These operations can only be performed, however, if malignancy can be excluded. They are local resection of the head of the pancreas combined with longitudinal pancreaticojejunostomy (LR-LPJ, Frey's operation) and duodenumpreserving resection of the head of the pancreas (DPPHR, Beger's operation). In Frey's operation diseased tissue in the head of the pancreas is resected, the main duct in the neck, body and tail is opened and thus the entire main pancreatic duct is either decompressed or resected. One Roux-en-Y limb is used to drain the body and tail of the pancreas.



Beger's operation is indicated especially when the inflammatory process is located in the pancreatic head and in cases with portal hypertension due to inflammatory mass. After resecting the pancreatic head through the uncinate process, a jejunal loop is excluded and interposed, needing two pancreatic anastomoses, one for the pancreatic tail and the other to cover the resected head. In cases with an intrapancreatic severe stenosis of the common bile duct due to inflammation, an additional internal biliary anastomosis between the common bile duct and jejunal loop has to be carried out.

Total pancreatectomy [3-5]

Total pancreatectomy for pancreatic cancer was first reported by Billroth in 1884, and re-introduced in 1954 by Ross and in 1958 by Porter, to avoid pancreatic anastomosisrelated complications. The indications are chronic pancreatitis with intractable pain, familial pancreatic adenocarcinoma, neuroendocrine tumours and main duct type intraductal papillary mucinous neoplasms. Despite the absence of pancreaticoduodenal anastomosis, total pancreatectomy has even higher early postoperative mortality than subtotal pancreatectomy, which precludes the consideration of total pancreatectomy as a routine treatment of sporadic pancreatic adenocarcinoma. Serious postoperative complications following total pancreatectomy include intra-abdominal abscess and sepsis, intra-abdominal bleeding and gastrointestinal bleeding.

These patients have a five-year survival similar to that seen in patients who have undergone partial pancreatectomy. Total pancreatectomy leads to diabetes by complete insulin deficiency and to steatorrhoea. Such diabetes is considered to be of the brittle type, characterized by supranormal sensitivity to insulin, probably reflecting a lack of glucagon. Another metabolic consequence of the apancreatic state is the development of steatohepatitis with progressive liver failure. This may be a result of progressive fat deposition in the liver following impaired hepatic stimulation by glucagon. Also, these patients are at increased risk of developing peptic ulcer disease secondary to lack of bicarbonate secretion. Exocrine pancreatic insufficiency is obvious after total pancreatectomy regardless of the primary diagnosis. Patients tend to have steatorrhoea even after aggressive enzyme supplementation. According to a single-centre retrospective study, there were no subjective or objective differences in the balance of post-pancreatectomy diabetes as a whole when compared to type 1 diabetes patients. Good balance was more often achieved in patients with malignancy than in those with chronic pancreatitis.

Currently, total pancreatectomy is appropriate in patients in whom complete removal of the pancreas is required for oncologic, technical, prophylactic or complication-related reasons. In pancreatic cancer this means that it has a place in those cases where the tumour extends throughout the main duct, as evaluated intraoperatively by frozensection examination or when the remaining part of the pancreatic body or tail is too frail for a safe anastomosis to be attempted. As it has unavoidable metabolic sequelae and does not decrease the recurrence rate of malignancies, total pancreatectomy is nowadays rarely used when compared to PD.

Postoperative complications [2-4]

- Anastomotic Leakage,
- Haemorrhage,
- Abscesses And
- Delayed Gastric Emptying (Dge)

Haemorrhage can be divided into early postoperative bleeding and delayed haemorrhage after two or three weeks, which may be a result of a pseudoaneurysm, the reason for which may be anastomotic fistula. These pseudoaneurysms are treated angiographically with coils if the patient is clinically stable; otherwise they need immediate surgical treatment. Delayed haemorrhage has been reported in between 5 and 16 % but may occur in up to 60 % of cases of pancreatic leakage

Septic complications and intra-abdominal abscesses are usually a result of anastomotic fistulas or leakages. Abscesses are seen in about 3 to 10 % after PD and are most often located in the right subhepatic region or under the left diaphragm. These can be drained under ultrasonographic or CT guidance, and additionally antibiotics are given intravenously. If there is no clinical improvement, surgical reintervention must be considered

Differing definitions for DGE have been proposed, but patients undergoing pancreaticoduodenal resection are at high risk of developing it.

to the International Study Group of Pancreatic Surgery

DGE grade	NGT required	Unable to tolerate solid oral intake by POD
A	4–7 days or reinsertion > POD 3	7
B	8–14 days or reinsertion > POD 7	14
C	>14 days or reinsertion > POD 14	21

DGE, delayed gastric emptying; NGT, nasogastric tube; POD, post-operative day.

The range is from 4 to 70 %. It does not increase mortality but results in prolonged hospitalisation, impaired quality of life and increased hospital costs. Its pathogenesis remains unclear, but the most important risk factor is the presence of other intra-abdominal complications, such as pancreatic fistula or anastomotic leakage. One explanation may also be gastric atony resulting from disruption of the gastroduodenal neural network. Small doses of erythromycin, which is an agonist of motilin, a hormone produced in the duodenum and proximal jejunum, have been reported to reduce DGE by 75 %.

Pancreatic leakage is the major factor most strongly implicated in death in most PD series. It is considered a serious, life-threatening event that may prolong hospital stay and increase costs. It has been assumed that the variety of different incidence rates of pancreatic fistula may be a result of the absence of a general definition [3]. Also, in the literature different terms can be found referring to the same complication, e.g. fistula, leak, leakage, focal postoperative pancreatitis, anastomotic failure or anastomotic insufficiency. This condition may be suspected on the basis of the amount of drain fluid on or after postoperative day 3, and an amylase activity greater than three times the upper normal serum value. Associated clinical findings may include abdominal pain and signs of infection.

An international panel of pancreatic surgeons developed and proposed a definition of postoperative pancreatic fistulas (POPF):

Grade A: Transient fistula with no clinical impact
Grade B: Requires a change in management and leads to a delay in discharge or readmission
Grade C: A major change in clinical management occurs, and clinical stability may be borderline. The patient needs extended hospital stay and reoperation may be needed. Serious postoperative complications and mortality may be associated

Grade	A	B	C
Clinical conditions	Well	Often well	Ill appearing/bad
Specific treatment[a]	No	Yes/no	Yes
US/CT (if obtained)	Negative	Negative/positive	Positive
Persistent drainage (after 3 weeks)[b]	No	Usually yes	Yes
Reoperation	No	No	Yes
Death related to POPF	No	No	Possibly yes
Signs of infections	No	Yes	Yes
Sepsis	No	No	Yes
Readmission	No	Yes/no	Yes/no

ISGPS denotes International Study Group of Pancreatic Surgery; US: ultrasonography; CT: computed tomographic scan; POPF: post-operative pancreatic fistula. Reproduced from Bassi et al., Surgery 2005 [7].
[a]Partial (peripheral) or total parenteral nutrition, antibiotics, enteral nutrition, somatostatin analog and/or minimal invasive drainage.
[b]With or without a drain *in situ*.

To minimize the risk of anastomotic leakage, different techniques have been proposed. Most authors recommend duct to mucosa pancreaticojejunal anastomosis [42-46], regardless of the reconstruction method used. Many retrospective studies consider PG superior to PJ but the results of level 1 data show that both anastomoses are equally effective and they do not have significant differences in fistula rates [47]. In a dual-institutional prospective randomized trial, 197 patients were stratified by pancreatic texture and randomized to an end-to-side invagination or duct-to-mucosa anastomosis [48]. There was a 24 % pancreatic fistula rate in the duct-to-mucosa cohort and a 12 % fistula rate in the invagination cohort ($p < 0.05$). The investigators suggested that the greatest risk factor for pancreatic fistula was soft gland texture. Adams [49] found over 1700 publications on pancreatic anastomosis. He concludes that the choice of pancreatic anastomotic technique should be based on individual experience.

Use of stents and drains in protecting the anastomosis

Different kinds of stents have been tested for protecting the anastomosis against both leakage and stricture. These drain the anastomosis either internally or externally, in case of early protection. To protect the anastomosis, many use a small plastic tube intraluminally. Protection of the anastomosis has also been reported when an externally directed drain has been used.

Use of intraperitoneal drains has been considered routine after pancreatic resections. Their purpose is to remove accumulating blood, bile, pancreatic juice, and also serve as a warning of haemorrhage or anastomotic leakage.

The use of somatostatin in preventing postoperative pancreatic anastomotic fistulas has been controversial. Two systematic reviews and meta-analyses have been performed. According to Alghamdi *et al*. [50], use of octreotide is associated with a significant reduction in the incidence of pancreatic fistulas after elective pancreatic surgery but not with postoperative mortality. Zeng *et al*. [51], on the other hand, did not find use of octreotide to result in reduction of the incidence of pancreatic fistula, pancreas-specific postoperative complications or mortality.

MATERIALS AND METHODS

Materials

- Study Settings: Department of General Surgery in a large teaching public health hospital.
- Study period : One year
- Sample Size : 30 Cases
- Study Type : Retrospective Study

Inclusion criteria

- Patients of both genders, with confirmed or suspected neoplasm of head of pancreas, periampuallary or duodenal tumours were included.
- Patients who give informed consent.

Exclusion criteria

- Patient with chronic pancreatitis, pancreatic pseudocyst, pancreatic trauma were excluded
- Patients with uncorrected coagulopathies.

Are excluded from the study

Methods

All the patients fulfilling the inclusion criteria will be admitted. A detailed history of the symptoms like jaundice, weight loss and abdominal pain. Will be taken. Collection of blood will be done and detailed haematological and biochemical investigation will be done like haemoglobin, total and differential counts, serum bilirubin, SGPT, Alkaline phosphatases, serum blood urea nitrogen, serum total proteins, serum creatinine, coagulation profile.

X-Ray chest and abdomen, will be done in all cases and findings will be noted. CECT neck thorax and abdomen will be done in selected patients to look for obvious pathology. The following format will be used to collect data about the participants of the study.

Proforma

1. Personal details

A. Name
B. Age
C.sex
D.residence
E.occupation
F.indoor no
G.date of admission
H.date of discharge

2. Chief complains

A)jaundice:
Mode of onset
Duration
B)nausea
C)vomiting
Onset
Frequency
Content
Colour
D) itching:
E) pale stool:
F) weight loss
Other complains if any and their characteristics

3. Past history

Similar complains in past
Tuberculosis
Diabetes mellitus

Hypertension
Jaundice
Gall stone
Surgery

4. Family history

5. Personal history
Diet
A) vegetarian
B) non vegetarian
C) mixed

Sleep a) adequate
B) inadequate

Apetite
A) normal
B) decreased

Bowel habits
A) regular
B) altered

Bladder habits
Addiction

6. Obstretic history

7. Menstrual history
Last menstrual period date
Menstrual complains

Examination findings
A) general examination
Consciousness and orientation
Nourishment
Temperature
Pulse
Blood pressure
Respiratory rate
Pallor +/-
Oedema +/-
Lymphadenopathy +/-
Icterus +/-
Cyanosis +/-
Clubbing +/-
Bone/joint/spine

B) systemic examination
A) per abdominal examination-
1) inspection-
Contour and shape
Bilateral symmetry
Umbilicus
Veins/arteries
Peristalsis
Respiratory movements

Any visible fullness or swelling

2) palpation-
Temperature
Tenderness
Rigidity/guarding
Organomegaly- liver/spleen/kidney
Ascitis
Hernial sites
External genitalia
Any other significant findings

3) percussion

4) auscultation
B) rectal examination per rectal examination
Proctoscopy examination
C) cardiovascular system
D) respiratory system
E) central nervous system

Investigations

A) blood investigations-
1. Hb
2. Tc
3. Dc
4. Esr
5. Rbs
6. S.creatinine
7. Blood urea
8. Rvd testing
9. Hbsag
10. Liver function test-

S. Bilirubin-total - increased/decreased
Direct - increased/decreased
Indirect - increased/decreased
S.g.p.t. - increased/decreased
S. Alkaline phosphatase - increased/decreased
Coagulation profile-

PT
INR
APTT
11. S.lipase
12. S.amylase
13. S.sodium
14. S.pottasium

B) radiological investigation
1. X-ray chest
Abdomen
Standing
Lying
2. Usg
Abdomen
Cect abdomen

C) other investigation
1) upper gastro intestinal endoscope and biopsy

Operative procedure

Pancreatico-jejunostomy or pancreatico-gastrostomy

Investigations

Usg findings in case of peri-ampullary mass and pancreatic mass and duodenal mass:

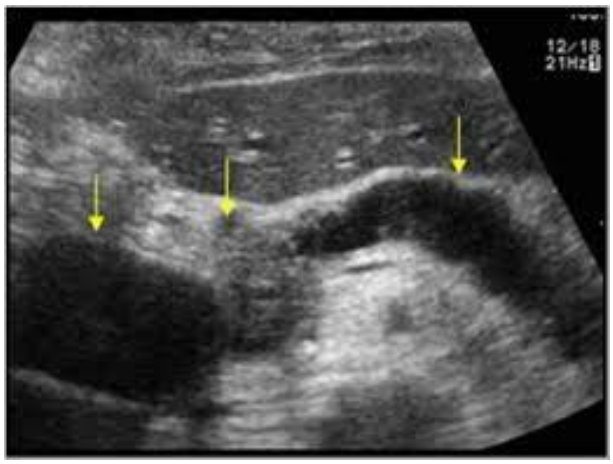


Fig-1: Carcinoma pancreatic head

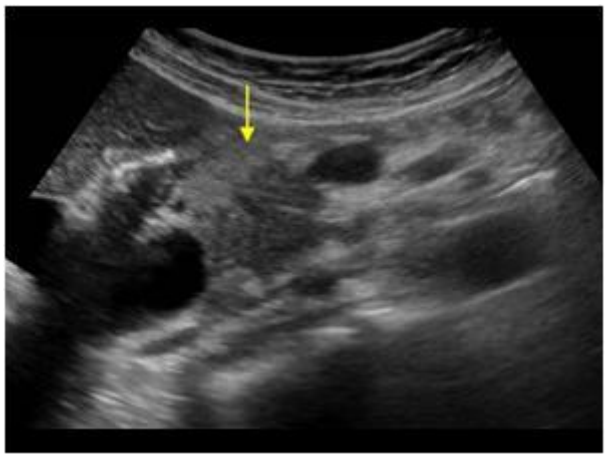


Fig-2: Carcinoma ampulla of vater

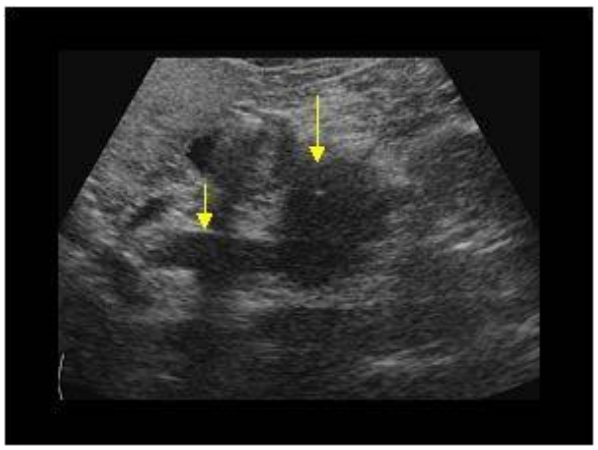


Fig-3: Duodenal mass

Ct findings in case of peri-ampullary mass and pancreatic mass and duodenal mass:

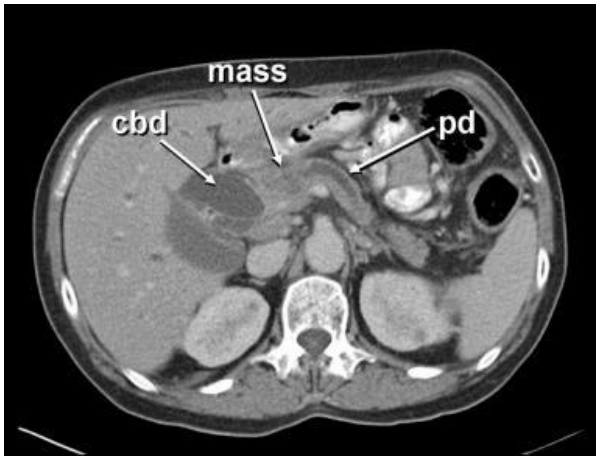


Fig-4: Carcinoma head of pancreas

Fig-5: Carcinoma ampulla of vater

Fig-6: Duodenal carcinoma

Oprative procedure

Pancreatico jejunostomy, gastrojejunostomy, choledochojejunostomy

The pancreatico jejunostomy done by end to side duct to mucosa four layered anastomosis approximating pancreatic capsule and parenchyma to the seromuscular layer of the jejunum(with 3-0 silk interrupted sutures) in the first and fourth layers and duct to mucosa(pancreatic duct and full thickness of jejunum using interrupted 5-0 maxon) in the middle two layers . Hepaticojejunostomy is usually performed end to side using interrupted one-layer sutures. The gastrojejunal anastomosis is usually performed last, and is usually placed about 40 cm distal to the biliary anastomosis in order to promote neutralization of the gastric-acid secretion.

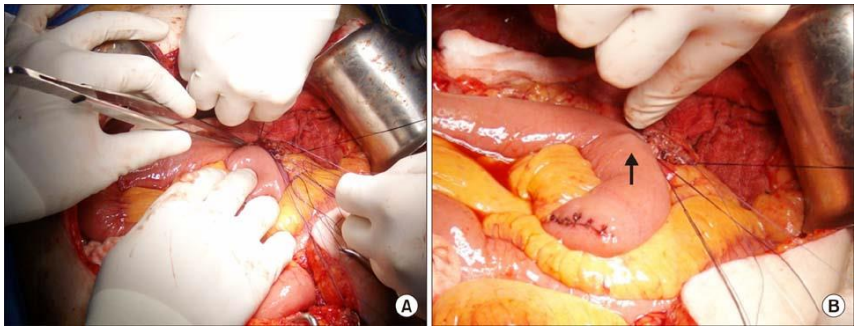


Fig-7: Pancreatico jejunostomy

Pancreaticogastrostomy, gastrojejunostomy, choledochojejunostomy

Pancreatico gastrostomy done by anastomosing remnant of pancreas after pancreatic resection to the posterior wall of stomach with invagination of pancreas into stomach(Dunking method).It is done in two layers.outer layer interrupted silk sutures and inner layer with interrupted absorbable 3-0 sutures. Hepaticojejunostomy is usually performed end to side using interrupted one-layer sutures. The gastrojejunal anastomosis is usually performed last, and is usually placed about 40 cm distal to the biliary anastomosis in order to promote neutralization of the gastric-acid secretion.

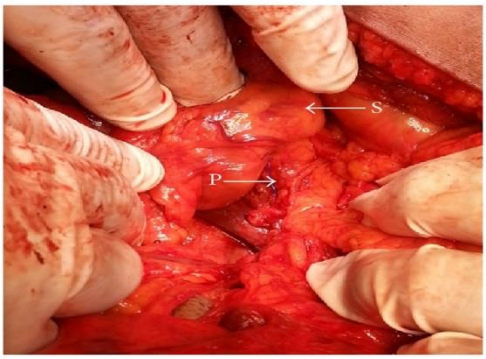


Fig-8: Pancreaticogastrostomy

Post operative complications

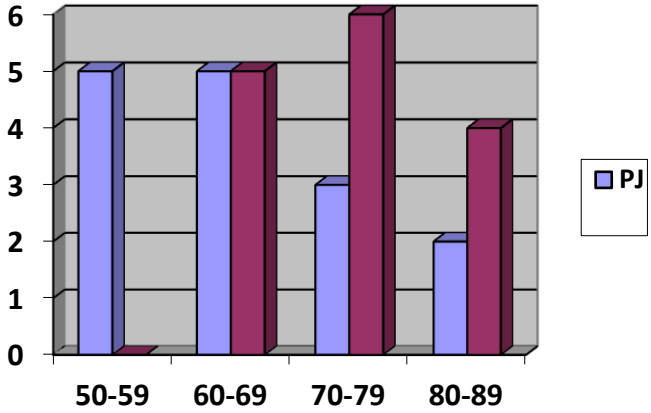
- Hemorrhage Post pancreatectomy hemorrhage is bleeding within 24 hours from operated site
- Abscess/postoperative collection It is the infection and postoperative intra-abdominal collection
- Postoperative pancreatic fistula it is the drain output of any measurable volume of fluid on or after post-operative day 3 with amylase content greater than three times with an amylase activity. Three different grades of POPF (grades A, B, C) are defined according to the clinical impact on the patient's hospital course.
- Billiary fistula bile leakage was defined as bilirubin concentration in the drain fluid at least 3 times the serum bilirubin concentration on or after postoperative day 3 or as the need for radiologic or operative intervention resulting from biliary collections or bile peritonitis.
- **Grade A** bile leakage causes no change in patients' clinical management. A **Grade B** bile leakage requires active therapeutic intervention but is manageable without relaparotomy, whereas in **Grade C**, bile leakage relaparotomy is required.
- Delayed gastric emptying DGE is defined as gastric stasis requiring nasogastric tube insertion for more than 7 days, more or less associated with vomiting and reinsertion of nasogastric tube after failure of post-operative feeding
- Morbidity and mortality
- Long hospital stay

OBSERVATIONS AND RESULTS

This retrospective study includes 30 randomly selected operable patients, in which 15 patients under went pancreaticojejunostomy and other 15 pancreaticogastrostomy. In PJ group there were 8 males amd 7 females with men age of the group was 68 years. In the PG group, 8 patients were male and 7 were females with mean age are 72 years. There was no statistically significant difference between the 2 groups.

Table-1: Age group distribution

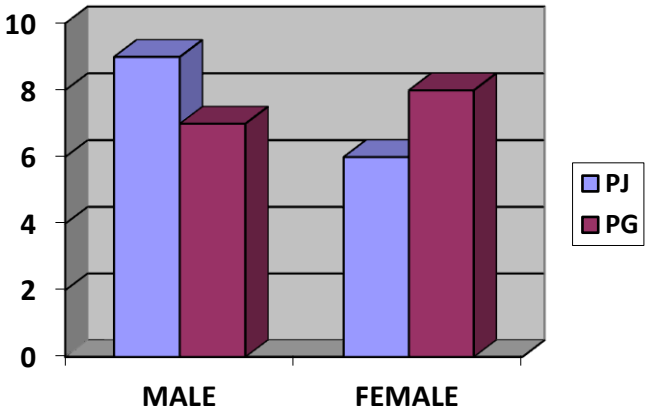
Age groups	Pancreatico jejunostomy	Pancreatico gastrostomy
50-59	5	0
60-69	5	5
70-79	3	6
80-89	2	4



In pacreaticojejunostomy 5 patients between 50-59 age groups,5 patients between 60-69 age groups, 3 patients between70-79 age groups,2 patient between 80-89 age groups. This shows carcinomas related to pancreatic head region is more diagnosed in old age.

Table-2: Gender distribution

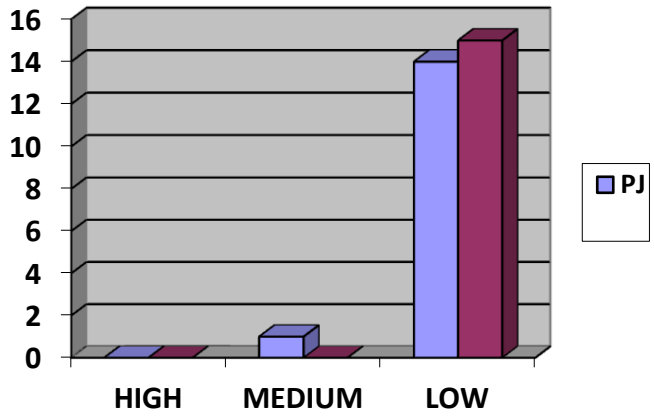
Gender	PJ stomy	PGstomy
Male	9	7
Female	6	8



In present study out of 15 patients in PJ stomy 9 were males and 6 were females. Where as in PG stomy 7 were males and were females. There is no significant difference in gender for operative procedure

Table-3: Socioeconomic status

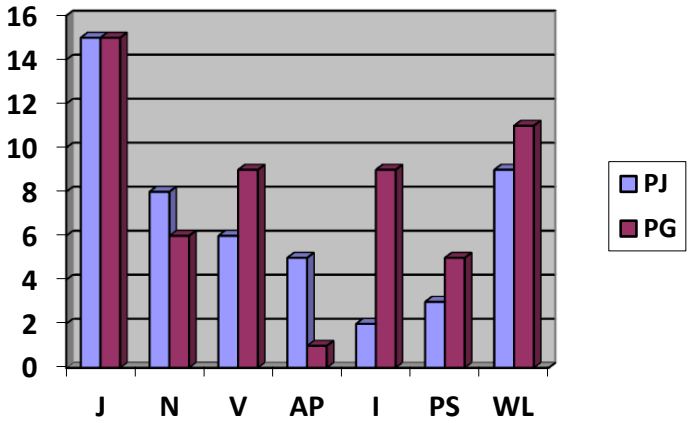
Socioeconomic Status	PJ anastomosis	PG anastomosis
High	0	0
Medium	1	0
Low	14	15



This show carcinoma head of pancreas, periampullary region are presented more in low socioeconomic status people.in present study out of 30 patients 29 were in low socio economic status

Table-4: Clinical features

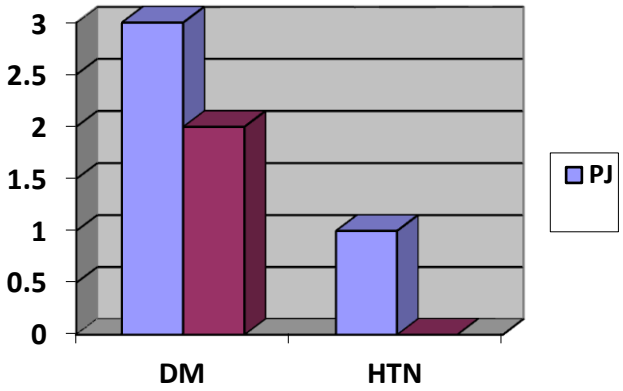
Clinical features	PJ stomy	PG stomy
Jaundice	15	15
Nausea	8	6
Vomiting	6	9
Abdominal pain	5	1
Itching	2	9
Pale stool	3	5
Weight loss	9	11



Most common symptom is jaundice.all patient presented with jaundice.second most common symptom is weight loss.20 patient having weight loss. Then vomiting, presented in 15 patients. Itching presented in 11 patients.

Table-5: Comorbid conditions

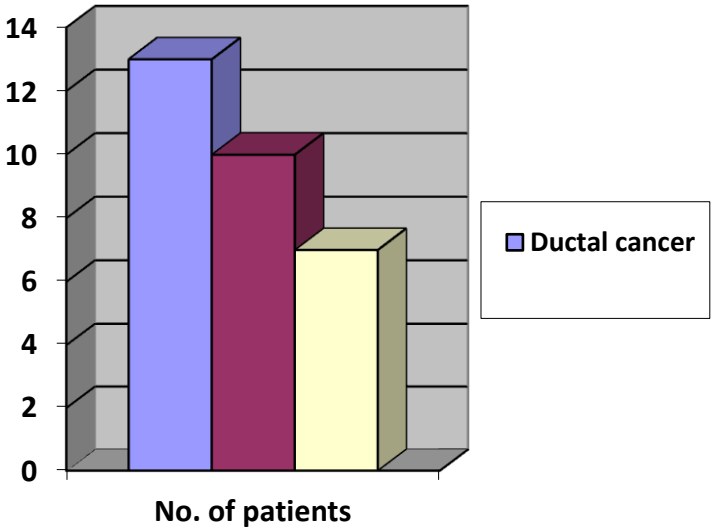
Comorbidity	PJ stomy	PG stomy
Diabetis mellitus	3	2
Hypertension	1	0



Out of 30 patients 5 patients having diabetis mellitus.of which 3 patients underwent PJ stomy,and 2 patients underwent PG stomy.these patients also has abscess formation post operatively.only 1 patient has hypertension and she underwent PJ somy.

Table-6: Preoperative diagnosis (basis of usg and ct scan)

Diagnosis	No. of patients
Ductal cancer	13
Ampullary cancer	10
Duodenal cancer	7

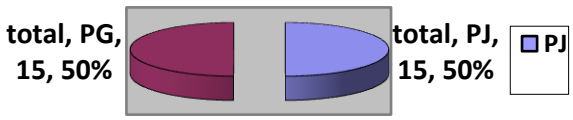


Preoperative diagnosis made by blood investigations, mainly raised bilirubin, raised direct bilirubin, raised sgpt, usg abdomen show mass lesion, ct abdomen shows mass lesion, and upper GI endoscope diagnosed duodenal mass. In patient with ductal cancer 7 underwent PJ stomy and 6 underwent PG stomy.In patients with

Ampullary cancer 5 underwent PJ stomy and 5 underwent PG stomy.In patients with duodenal cancer 3patients underwent PJ stomy and 4 Patients underwent PG stomy.This shows ductal cancer is more common.

Table-7: Operative procedure

Total patients	PJ stomy	PG stomy
30	15	15



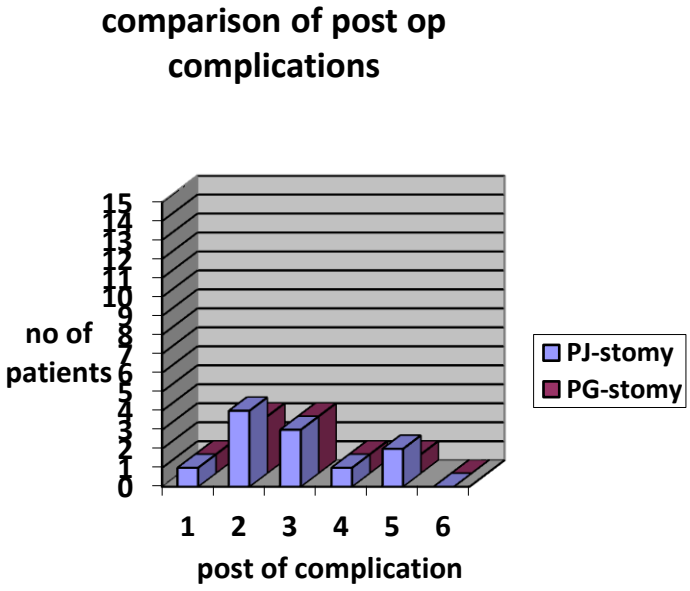
Out of 30 patients 15 patients' uderwent pancreaticojejunostomy and 15 patients underwent pancreatico gastrostomyoperative procedure selected randomly.

The post-operative complications like hemorrhage, abscess formation, post-operative pancreatic fistula, billiary fistula, delayed gastric emptying, mortality, and length of hospital stay are compared. The charesterics of these studies are shown in table 4.

Table-8: Post-op complications (total patients – 30)

Post op complication	Pancreatico-Jejunostomy (no of patients -15)	Pancreatico-Gastrostomy (no of patients –1 5)
(1)Hemorrhage	1(6%)	1(6%)
(2)Abscess	4 (26.6%)	3 (20%)
(3)POPF	3 (20%)	3 (20%)
(4)BF	1(6%)	1(6%)
(5)DGE	2(12%)	1 (6%)
(6)Mortality	0	0
(7)Avg hospital stay	18.4 days	18.3 days

(POPF-post operative pancreatic fistula,BF-billiary fistula, DGE-delayed gastric emptying)



1-hemorrhage, 2-abscess, 3-POPF, 4-BF, 5-DGE, 6-mortality

The post operative course showed complications in 11 patients. (36%) that included 6 patients (40%) in PJ group and 5 patients (33%) in PG group (p= not significant). 7 patients (23.3%) had more

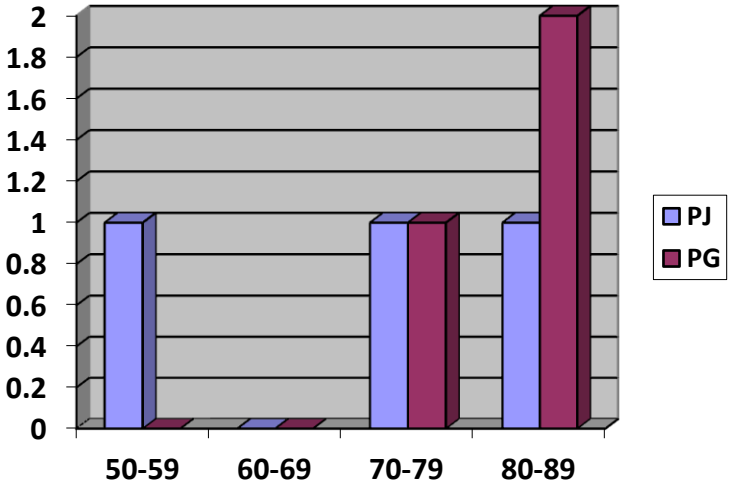
than 1 complications. This include 4(26%) in PJ group and 3 (20%) in PG group

Post operative pancreatic fistula (POPF)

Developmemt of clinically signifiant pancreatic fisstula, was observed in (20%) patients. 3(20%) in PJ group and 3 (20%) in PG group.A POPF represents a failure of healing/sealing of Pancreatic-enteric anastomosis or a parenchymal leak not directly related to anastomosis.An all-inclusive definition is a drain output of any measurable volume of fluid on or after postoperative day 3 with amylase content greater than 3 times the serum amylase activity. Three different grades of POPF (grades A, B, C) are defined according to the clinical impact on the patient's hospital course.

Table-9: Postoperative pancreatic fistula vs age group

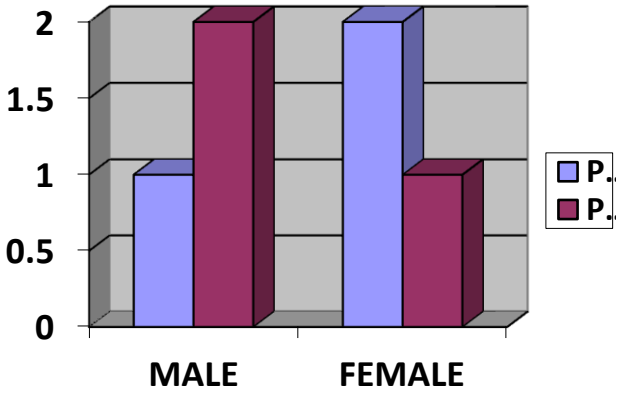
Age group	POPF in PJ	POPF in PG
50-59	1	0
60-69	0	0
70-79	1	1
80-89	1	2



The above figure shows post-operative pancreatic fistula more in old age (80-89) groups. Below 70 years of age only 1 POPF noted and above 70 years 5 POPF noted.

Table-10: Postoperative pancreatic fistula vs gender

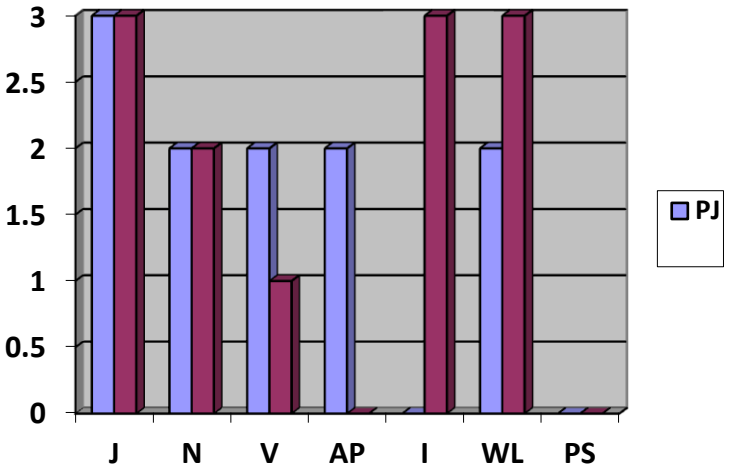
Gender	POPF in PJ	POPF in PG
Male	1	2
female	2	1



There is no significant difference between male and female in POPF.

Table-11: POPF vs clinical features

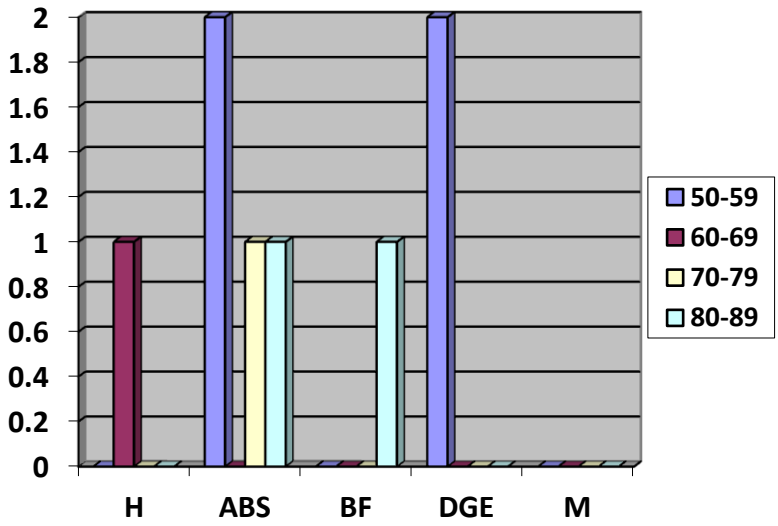
Clinical features	POPF in PJ	POPF in PG
Jaundice	3	3
Nausea	2	2
Vomiting	2	1
Abdominal pain	2	0
Itching	0	3
Weight loss	2	3
palestool	0	0



Every patient had jaundice, so popf presented in jaundice also. Cachexia is more in patient with POPF. Nausea, vomiting, itching are also symptoms present in patient with POPF.

Table-12: Other postoperative complications in PJ vs age group

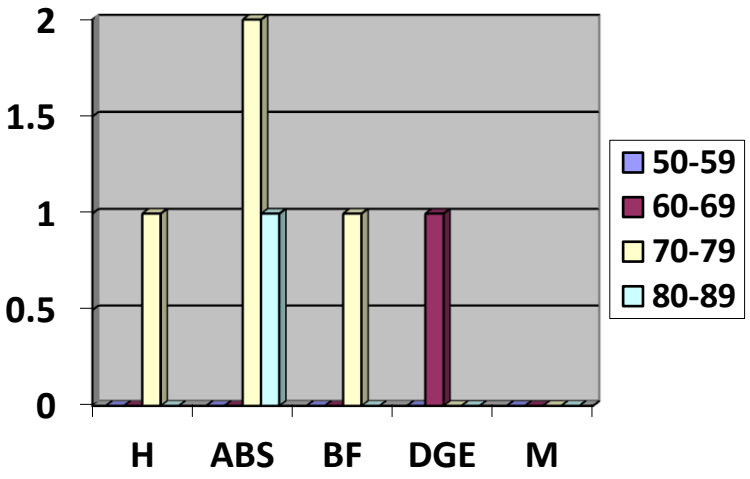
Age group	Heamorrhage	abscess	Biliary fistula	DGE	Mortality	Avg length of hospital stay
50-59	0	2	0	2	0	19days
60-69	1	0	0	0	0	15.8days
70-79	0	1	0	0	0	16.3days
80-89	0	1	1	0	0	26days



In PJ group hemorrhage noted in 60-69 group, abscess 2 in 50-59 group,1 each in 70-79,80-89 groups, biliary fistula in 80-89 group Delayed gastric emptying in younger groups, average length of hospital stay is 26 in old age group(80-89) where a below 20 day in less than 0 years group.

Table-13: Post-operative complication in PG vs age groups

Age group	Heamorrhage	abscess	Biliary fistula	DGE	Mortality	Avg length of hospital stay
50-59	0	0	0	0	0	nil
60-69	0	0	0	1	0	17.6days
70-79	1	2	1	0	0	18days
80-89	0	1	0	0	0	19.7days



In PG group hemorrhage noted in 70-79 groups, abscess 2in 70-79 groups and 1 in 80-89 groups, biliary fistula 1 in 70-79 group. DGE in 60-69 groups, average length of hospital stay more in above 0 groups. So both in PJ and PG length of hospital stay increase with age, DGE seen in less than 70 years age

Post-operative biliary fistula

Bile leakage was defined as bilirubin concentration in the drain fluid at least 3 times the serum bilirubin concentration on or after postoperative day 3 or as the need for radiologic or operative intervention resulting from biliary collections or bile peritonitis. Using this criterion severity of bile leakage was classified according to its impact on patients' clinical management.

Grade A bile leakage causes no change in patients' clinical management. A Grade B bile leakage requires active therapeutic intervention but is manageable without relaparotomy, whereas in Grade C, bile leakage relaparotomy is required. In present study biliary fistula rate was 6% (1/15) in PJ groups and 6% (/15) in PG groups. This suggests there is no significant difference between PJ and PG group for Billiary fistula.

Delayed gastric emptying (DGE)

DGE is defined as gastric stasis requiring nasogastric tube insertion for more than 7 days, more or less associated with vomiting and reinsertion of nasogastric tube after failure of post-operative feeding.

The DGE rate was 12% (2/15) in PJ group and 6% (1/15) in PG group.

Mortality

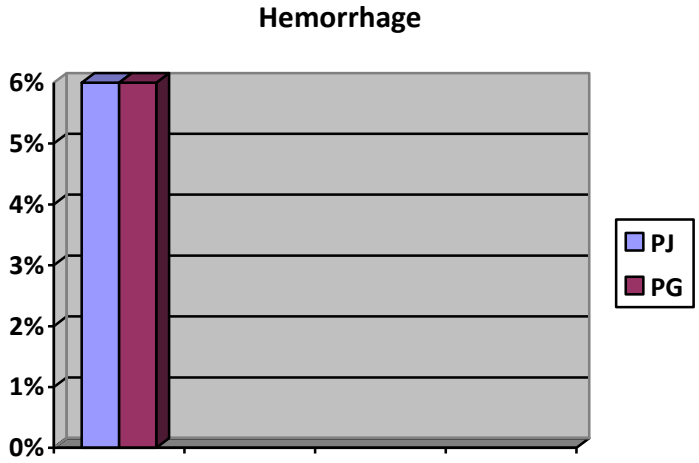
The mortality rate was 0% in both of group. Shows no significant difference in the post-operative mortality rate between the OG nd PJ groups

The length of hospital stay

It was the mean of total days of hospital stay. It was 18.3 days in PG groups and 18.4 days in PJ groups. There is no significant difference in the length of hospital stay between PG and PJ.

Table-14: Hemorrhage

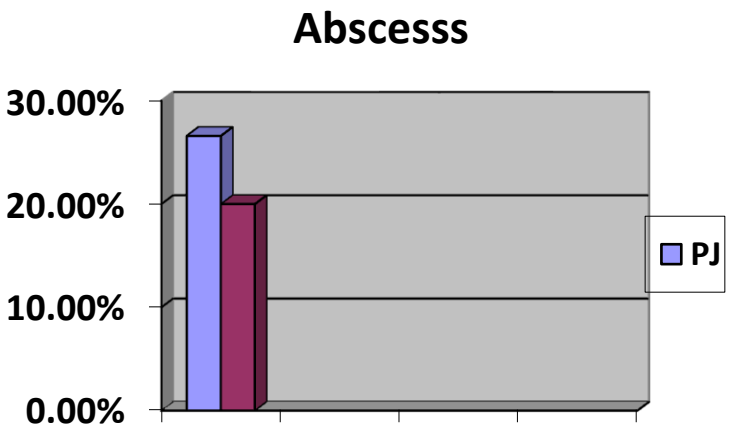
	PJ	PG
hemorrhage	1/15 (6%)	1/15 (6%)



Post pancreatectomy hemorrhage is 6% (1/15) in both PG and PJ groups. There is no significant difference in the Post pancreatectomy hemorrhage between PJ and PG in present study

Table-15: Abscess

	PJ	PG
Abscess	4/15(26.6%)	3/15(20%)



Abscess or post-operative fluid collection is 4/15 (26.6%) in PJ group whereas 3/15 (20%) in PG group. Shows no significant difference in the Abscess or post-operative fluid collection between PJ and PG.

DISCUSSION

There are multiple studies which compared PJ and PG. Three studies are single centered, one is multicentered. Fernandez-Cruz *et al*. were the first to adopt the ISGPS definition a and classification of POPF. It compared PJ and PG with gastric partition. In the rest of the studies, PG was considered the intervention and PJ the control. All studies had the rate of POPF as primary outcome. Regarding the underlying disease, carcinoma of pancreatic head was the most frequent. There was lack of uniformity between the studies regarding the technique of PG and PJ anastomoses. Both PG and PJ could be performed in either a telescoped or duct to mucosa manner.

Table-A: Comparison between mean age

Study	PJ (in years)	PG (in years)
Bassi	55	59
Fernandez cruz	63	63
Figueras	65	67
Wellner	64	67
Present study	68	72

The mean age groups of defferent study [1,2,4] on comparison with present study there is no significant difference in age grous of PJ and PG.

Table-B: Comparison between genders

Study	PJ(Male/Female)	PG (Male/Female)
Bassi	35/33	44/25
Fernandez cruz	38/17	29/24
Figueras	37/21	44/21
Wellner	29/28	27/32
Present study	9/6	7/8

In PJ present study has 60%male,40%female, in Bassi51%males and 49%females,infernandez cruz 69% males and 31% females, in Figures 63% males and 37% females, in Wellner 51% males and 49% females. In PG groups present study has 46%males and 54 % females, in Bassi 65%males and 35% females, in Fernandez cruz 53%males and 47% females, in Figueras 76% males and 24 %females, In Wellner 47% males and 53% females. This shows no significant difference in the gender in PG group and PJ group.

Table-C: Comparison socioeconomic status

Study	Low	Medium	High
Shapro (2015)	72%	12%	16%
Present study	96%	4%	0%

In my study 96% patients are in low socioeconomic status where as in Shapro study it is 72% which suggest periampullary mass more common in low socioeconomic status.

Table-D: Comparison of pre-operative diagnosis

Diagnois	Present study (30cases)		Bassi (151 cases)	
	PJ(15)	PG(15)	PJ(82)	PG(69)
Ductal carcinoma	7	6	28	32
Duodenal carcinoma	3	4	1	1
Periampullary carcinoma	5	5	11	13
others	0	0	42	23

Most common diagnosis is ductal carcinoma. In present study 13/30(43.3%) patient had ductal carcinoma. bassi also noted 60/151 (40%) ductal carcinoma in his study. next common is periampullary carcinoma. there is no any relation between operative technique (PJ or PG) with pre-operative diagnosis.

Table-E: Comparison between pancreatic fistulas in different studies

Study	PJ		PG		ODDS Ratio	Percentage (%)
	POPF	Total	POPF	Total		
Bassi 2005	13	82	9	69	0.8	7.9%
Fernandez-cruz 2008	10	55	3	53	0.27	12%
Figueras 2013	20	58	10	65	0.35	24%
Wellner 2012	7	57	6	59	0.81	11%
Present study	3	15	3	15	1.0	20%

Regarding the rate of POPF [1,2,4], In Bassi (12/151) 7.9% ,in PJ (13/82) 15%, PG (9/69) 13%. in Fernandez cruz (13/108) 12%, PJ (10/55) 18%, PG(3/53) 5.6%. in Figueras (30/123) 24%, PJ ((20/58) 34%, PG (10/65) 15%. in wellner (13/116) 11%, PJ(7/57)12%, PG(6/59) 10%. present study (6/30) 20%, PJ (3/15) 20%, PG(3/15) 20% and the odds ratio for present study is 1.0.Bassi,Wellner ,Present study shows no significant difference in rate of POPF between PJ and PG.

Table-F: Comparison of popf vs mean age

Study	POPF
Present study	72.8 years
Rungsakilkij (2017)	59years
Bassi (2005)	64years

In present study POPF seen in old age groupwith mean age 72.8 years. Other study it is 59 years, so the reason could be delayed diagnosis or delayed operative intervention due to lack of facilities and surgical expertise.

Table-G: Comparison of popf with gender

Study	Male	Female
Present study 6 POPF	3/6 (50%)	3/6 (50%)
Rungsakilkij (2017) 88 POPF	46/88 (52%)	42/88 (48%)

There is no significant difference in gender for post-operative pancreatic fistula

Table-H: Comparison of popf with jaundice

Study	Mean total bilirubin	Percentage of patient with POPF with jaundice
Present study 6 POPF patient	3.8mg/dl	100%
Rungsakilkij 2017 88 POPF patients	1.3mg/dl	98%

Mean total bilirubin is 3.8 mg/dl in in present study, but 1.3 in other study which suggest there is no direct relation between jaundice and pancreatic fistula. findins are comparable to above mention study.

Table-I: Comparison between biliary fistula in different studies

Study	PJ		PG		ODDS Ratio	Percentage%
	Biliary fistula	Total	Biliary fistula	Total		
Bassi 2005	7	82	0	69	0.07	4%
Fernandez-cruz 2008	1	55	0	53	0.34	0.9%
Figueras 2013	6	58	1	65	0.14	5.6%
Wellner 2012	0	57	0	59	Not Estimable	0%
Present study	1	15	1	15	1.0	6%

Regarding the rate of billiary fistula/leak [1,2,4], in Bassi (7/151)4%, PJ(7/82) 8%, PG 0%, In Fernandez cruz (1/108) 0.9%, PJ (1/55) 1.8%, PG 0%.In Figueras (7/123) 5.6%, PJ (6/58) 10%, PG (1/65) 1.5%, In Wellner 0% billiary fistula, in present study (2/30) 6%, PJ (1/15)6%, PG (1/15) 6% and odds ratio for present study is 1.0.Bassi, Fernandez cruz, Wellner, present study shows no significant difference in rate of billiary fistula between PJ and PG. Present study biliary fistula rate is comparable to above mentioned study

Table-J: Comparison between delayed gastric emptying in different studies

Study	PJ		PG		ODDS Ratio	Percentage%
	DGE	Total	DGE	Total		
Bassi 2005	10	82	2	69	0.21	7.9%
Fernandez-cruz 2008	8	55	2	53	0.23	9%
Figueras 2013	15	58	19	65	1.18	27%
Wellner 2012	9	57	14	59	1.66	19.8%
Present study	2	15	1	15	2.15	10%

Regarding DGE [1, 2, 4] in Bassi (12/151) 7.9%, PJ (10/82) 12%, PG (2/69) 2.8%, In Fernandez cruz (10/108) 9%,PJ (8/55) 14%, PG (2/53) 3.7%, In Figueras (34/123) 27%, PJ (15/58) 25.8%, PG (19/65) 29%., in Wellner (23/116) 19.8%, PJ (9/57) 15%, PG (14/59) 23%, in present study (3/30) 10%, PJ (2/15) 113%, PG (1/15) 6% and the odds ratio for present study is 2.15. Figueras, Wellner, Present study shows no significant difference in DGE between PJ and PG. Present study delayed gastric emptying is comparable to other studies.

Regarding mortality rate present study has zero mortality rate [1,2,4], in Bassi (1/151) 0.6%, PJ (1/82) 1.2%, PG 0%, in Fernandez cruz mortality rate is zero, in Figueras (5/123) 4%,PJ (2/58) 3.4 %, PG (3/65) 4.6%, in Wellner (2/116) 1.7%, PJ (1/57)1.75, PG (1/59) 1.6%. Figueras, Wellner, Present study shows no significant difference in mortality between PJ and PG. Present stydy mortality rate is comparable to above studies (Table-K).

Table-K: Comparison between mortality in different studies

Study	PJ		PG		ODDS Ratio	Percent Age%
	Mortality	Total	Mortality	Total		
Bassi 2005	1	82	0	69	0.39	0.6%
Fernandez-Cruz 2008	0	55	0	53	Not Estimable	0%
Figueras 2013	2	58	3	65	1.35	4%
Wellner 2012	1	57	1	59	0.97	1.7%
Present Study	0	15	0	15	Not Estimable	0%

Table-L: Comparison between lengths of hospital stays in different studies

Study	PJ		PG		Mean difference
	Mean	Total	Mean	Total	
Bassi 2005	15.4	82	14.2	69	-1.20
Fernandez-cruz 2008	16	55	12	53	-4.0
Figueras 2013	0	58	0	65	Not Estimable
Wellner 2012	20	57	19	59	-1.0
Present study	18.4	15	18.3	15	-.0.1

Regarding length of hospital stay[1,2,4] the mean days in Bassi PJ-15.4days, PG-14.2 days, in Fernandez cruz PJ 16 days, PG 12 days, in Figueras not estimable ,the study was multicentric. In Wellner PJ-20 days, PG-19 days present study PJ-18.4 PG-18.3.this shows there is no significant difference in length of hospital stay between PJ and PG.

The safe reconstruction of pancreatic gastrointestinal continuity after pancreatic resection continues to be a challenge for the pancreatic surgeon. POPF formation is the most important cause of morbidity and mortality after PD. Despite recent improvement this complication still occurs in 30% of cases. Other complications after pancreatic resection such as biliary fistula formation and delayed gastric emptying are also concerning.

Numerous PJ anastomotic techniques have been described, using end to end or side to end anastomosis, with or without invagination of pancreas into the digestive tract in a single or double layers. In present study conventional PJ as end to side, double layer, duct to mucosa anastomosis technique taken.

Present study compare PG carried out by invaginating or dunking method to PJ carried out by end to side, duct to mucosa anastomoses.

Summary

This retrospective study of 30 random operated patients over 1 year (September 2017 to September 2018) in large teaching hospital

- 15 patient underwent PJ and 15 underwent PG
- Age group of patient is 50-89 years suggest carcinoma pancreas occur in old age group
- Mean age for PJ is 68years and PG is 72 years
- Gender distribution for PJ and PG is equal
- Majority of patients (14/15) from low socio economic status
- All the patient presented with jaundice and 20 out of 30 patient had weight loss, and 15 out of 30 patient had vomiting
- Comorbid condition includes diabetes mellitus presented in 5 patient and 3 of them underwent PJ and other 2 underwent PG
- The preoperative diagnosis includes ductal carcinoma diagnosed in 13 patients(7 PJ/6PG), ampullary carcinoma in 10 patients(5 PJ/5PG), duodenal carcinoma in 7 patients(3 PJ/4PG)
- Hemorrhage is 6% in both Pancreaticojejunostomy and Pancreaticogastrostomy groups where as post operative abscess/infection was 26.6% (4/150) in group Pancreaticojejunostomy and 20% (3/15) in Pancreaticogastrostomy group.
- Pancreatic fistula rate is 20% (3/15) in both Pancreaticogastrostomy and Pancreaticojejunostomy groups.All the 3 are in 80-89 age group and there is no sex preponderence for PPOPF.All 6 POPF patients had jaundice,5 had weight loss.
- Post-operative biliary fistula rate is same in both groups. 6%(1/15)
- Mortality rate is 0% in Pancreaticogastrostomy and Pancreaticojejunostomy group.
- Mean hospital stay difference is not significant between Pancreaticojejunostomy (18.4 days) and Pancreaticogastrostomy (18.3 days).
- Post-operative pancreatic fistula is the most important cause of morbidity and mortality after pancreaticoduodenectomy.

These shows there are no significant difference between Pancreaticojejunostomy and Pancreaticogastrostomy regarding post-operative complications.

There are several ways of doing pancreatic anastomosis as opposed to the other depends upon comfort and training of operating surgeon in addition to other factors.

Adopting and mastering another way of doing the same task when surgeon is comfortable with one way is not always easy and may not reproduce the same result as proposed by other surgeons. This is why same technique has different rate of pancreatic fistula reported from different centers.

Other than conventional technique, there are reported improvisations with promising results, but not all of these have been studied in randomized controlled trials comparing pancreaticogastrostomy with pancreaticojejunostomy. Soft texture of pancreas is an established risk factor for Postoperative pancreatic fistula.

CONCLUSION

This retrospective study demonstrates no significant difference between the post-operative complications of two operative procedures for periampullary mass. i.e between Pancreatico-jejunostomy and Pancreatico-gastrostomy.

- Pancreatcojejunostomy and Pancreaticogastrostomy did not differ significantly in terms of postoperative pancreatic fistula, hemorrhage from anastomotic site, intra-abdominal fluid collection, biliary fistula, delayed gastric emptying, overall morbidity and mortality, average length of hospital stay.
- Some study suggested pancreatico-gastrostomy is better than pancreatico-jejunostomy in post-operative complications and also in terms of easiness of technique.
- But according to present study both operative procedures have almost equal rate of post-operative complications.
- But this study has small sample size and limited availability of surgical expertise so we need larger study for drawing any convincing conclusion regarding the choice of operative procedure for periampullary mass.

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Abbreviation

AP	– Abdominal pain
J	– Jaundice
I	– Itching
N	– Nausea
V	– Vomiting
PS	– Pale stool
WL	– Weight loss
DM	– Diabetes mellitus
HTN	– Hyper tension
P	– Pallor
I	– Icterus
C	– Cyanosis
C	– Clubbing
L	– Lymphadenopathy
E	– Edema
PD	– Pancreatic dissection
H	– Hemorrhage
A	– Abscess
POPF	– Post operative pancreatic fistula
BF	– Biliary fistula
M	– Mortality
D	– Death
P	– Present
A	– Absent
P/A	– Per abdomen
P/R	– Per rectal examination
NAD	– No abnormality detected
ABD	– Abdomen
CXR	– Chest x ray
CBD	– Common bile duct
MPD	– Main pancreatic duct
IVC	– Inferior vena cava
GB	– Gall bladder
ERCP	– Endoscopic retrograde cholangio- pancreatography
ISGPF	– International study group of pancreatic fistula