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Research Article

Pancreatic Stump Management Following Pancreatico Duodenectomy- A Tertiary Centre Experience

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ABSTRACT
Aims: Primary aim is to analyse the outcome of pancreatic stump anastomosis of various types in relation to major morbidities and mortality. Secondary end point of the study is to analyse and compare Isolated PJ technique outcome to conventional methods
Methods: Retrospective analysis of prospectively collected data from 2010 to 2014 march on patients underwent Whipple procedure done – 138 patients have undergone Whipple procedure. Patients underwent Pancreatic stump anastomosis have been categorised into three groups. A- PG, B-PJ, C- Isolated PJ. C group later categorised into Dunking type C1 and C2- Duct to mucosa type. Major complications are analysed in relation to anastomotic techniques.
Results: When comparing between the three groups undergoing PG, CPJ, IPJ the incidence of delayed gastric emptying in the PG group was 38.46%, the incidence in the CPJ group was 40.98% and in the isolated loop pancreatico jejunostomy group was 44.73%. When comparing the incidence of leak between the three groups it was about 33% in the PG and 29.5% in the CPJ group and 15.78% in isolated PJ group.Duct to mucosa (C1) showed a leak percentage of 9.09% compared to Dunking method (C2) which showed a leak rate of 37.5%. The mortality rate in our study was 5.7%.
Conclusion: Among various techniques of pancreas stump reconstruction (PG/PJ /Isolated PJ) none of them showed statistical significant morbidity or mortality of the existing standard. But isolated loop PJ has had statistically significant lower grade leak and increased DGE. Subgroup analysis within the isolated loop has no difference in outcome.

Keywords: Pancreatic Stump; Whipples Procedure; Conventional loop; isolated loop; Post-operative pancreatic Fistula.

INTRODUCTION

In most patients, accurate preoperative staging of periampullary and pancreatic cancer is achieved by multi detector CT with three dimensional reconstruction. A resectable tumour is characterized by lack of evidence of metastatic disease, a clear tissue (fat) plane between the tumour and visceral arteries (celiac axis and superior mesenteric artery), and less than or equal to 180-degree-circumferential involvement of the superior mesenteric vein-portal vein confluence.
Surgical resection remains the only potentially curative therapy for periampullary and pancreatic cancer. Only a few patients currently diagnosed with pancreatic cancer are candidates for curative resection Approaches for resection are based on tumour location and extent. Resection of right-sided tumours typically requires pancreatico duodenectomy. In many instances, preoperative biliary decompression is unnecessary and may result in increased postoperative complications.

Background

Pancreatic stump anastomosis is the Achilles heel after Whipple's Procedure. The morbidity (40-60%) and mortality following Whipple Procedure is related to the outcome of anastomosis. Effects to improvise the anastomostic techniques and thereby outcome of Whipple procedure is still evolving. Though many randomized and prospective studies are

available till date no simple best technique had been recommended.

Aim of the Study

Primary aim is to analyse the outcome of pancreatic stump anastomosis of various types in relation to major and minor morbidities and mortality. Secondary end point of the study is to analyse and compare isolated loop Pancreatico Jejunostomy (IPJ) technique outcome to conventional methods. The aftermath of a pancreatic leak can be devastating, particularly when it results in retroperitoneal sepsis. This is found to be a major cause of mortality in whipples procedure [1]. Mere occlusion of the duct has been shown to result in higher fistula rates, along with increasing risk of pancreatic exocrine and endocrine insufficiency. Drainage of the pancreatic remnant to the gastrointestinal tract is an important step, but it runs the risk of anastomotic breakdown. The pancreatico enteric anastomosis has grabbed the attention of surgeons, causing a search for a more reliable technique to avoid this dreaded complication of anastomotic leak. Several techniques have been described, and the literature will continue to report novel techniques promising to be even safer. Rather than the choice of anastomotic technique, however, the successful management of the pancreatic anastomosis depends more on the surgeon's meticulous execution of the technique with which he or she is familiar [2]

Techniques in Pancreatic Stump Management:

As long as the basic rules of a safe anastomosis are followed, including careful handling of the pancreatic tissues, a tension-free approximation, ensuring good blood supply, and no distal obstruction, any pancreatico enteric anastomotic technique can have a good outcome. One of the most commonly employed technique is a Pancreatico Jejunal (PJ) anastomosis. This anastomosis is done by invaginating the transected pancreas into the end of the jejunum, also known as **dunking method**; another variation is to anastomose the pancreatic duct directly to an opening in the jejunum, called the **duct-to-mucosa technique**. Another technique is to anastomose the pancreatic stump to the stomach known as Pancreatico Gastrostomy (PG).

Proponents of the Pancreatico Gastrostomy cite various reasons [3] first, it is easier to perform, because of the close proximity of the stomach to the pancreas. Second, rich gastric blood supply makes this anastomosis less prone to ischemia. Third, because the exocrine enzymes encounter an acidic environment, the leak rate is theoretically lower as the enzymes do not get activated. The last statement has been disproved, however.

In a prospective randomized trial comparing pancreatico jejunostomy (PJ) with pancreaticogastrostomy(PG), the leak rates were not significantly different [pancreaticojejunostomy 11%; pancreaticogastrostomy 12%)[4,5].Yeo et al has concluded that pancreatic fistula is a common complication after pancreatico duodenectomy, with an incidence most strongly associated with surgical volume and underlying disease and the data do not support the hypothesis that pancreatico gastrostomy is safer than pancreaticojejunuostomy or is associated with a lower incidence of pancreatic fistula.

In a meta-analysis by Wente MN and Shrikande SV et al [6], they concluded that all nonrandomized observational clinical studies have reported superiority of pancreaticogastrostomy over pancreaticojejunostomy but all randomized controlled studies has shown equally good results. In a study by H Ramesh et al results suggested that pancreaticogastrostomy deserves wider application [7]. In another prospective randomized trial Bassi et al has showed that both types of anastamosis does not influence significantly the risk of overall complications or the incidence of pancreatic fistula. However, significant decreases in the risk of associated complications, biliary fistulas, postoperative collections and DGE were observed using pancreatico gastrostomy. A Chinese meta-analysis of all four randomized controlled trials has evidence suggesting that pancreaticogastrostomy is better than pancreaticojejunostomy after pancreaticoduodenectomy.

Conventional Loop Pancreatico Jejunostomy

This traditional method of reconstruction involves reconstruction in the fashion of Billroth 2 reconstruction in which the proximal jejunum is brought in a retrocolic fashion and anastomosed to the pancreatic stump and bile duct as shown in **Figure 1.a**. The same loop

of the jejunum is then anastomosed to the remaining stomach.

Isolated loop Pancreaticojejunostomy

An ideal reconstructive technique should not only minimize the risk of Pancreatic Fistula (PF) formation, but should also ensure that, should a pancreatic fistula form, its complications are prevented or minimized. An isolated jejunal loop for Pancreatico enteric anastomosis is theoretically expected to achieve these desired endpoints. Previous studies, using an isolated jejunal loop for pancreatoenteric anastomosis can minimize the risk of Pancreatic Fistula, although its effect in terms of reducing pancreatic fistula related morbidity is not clear.[8-14] Advocates of this technique believe that diverting bile away from the pancreaticojejunostomy site minimizes the pancreatic enzyme activation and hence reduces the risk of pancreato enteric anastomotic fistula[15].Another argument cited in favour of using a Roux loop in Pancreaticojejunostomy relies on the belief that, if a pancreato enteric anastomotic fistula forms, it will be a 'pure' pancreatic fistula and these fistulae cause lesser complications compared with complex PF, in which the bile activates the pancreatic juice, with further repercussions.

The isolated Roux loop pancreaticojejunal end-to-side anastomosis was initially described by Funovics et al. [16] who described 48 patients with double Roux loops to separate the pancreatic and hepatic anastomoses, which resulted in a pancreatic fistula rate of 18.6% but a mortality of only 2%. Sutton CD et al in 2004 reported a series of 61 patients with zero postoperative pancreatico enteric leaks and mortality rate of 5%. [17].However, recent studies have not borne out this promise of better results .In a recent randomised controlled trial, El Nakeeb et al analysed 90 patients randomly assigned to isolated Roux loop pancreaticojejunostomy with those of pancreaticogastrostomy after pancreaticoduodonectomy. They concluded that Isolated loop Pancreaticojejunal anastomosis was not associated with a lower rate of post-operative pancreatic fistula , but was associated with a decrease in the incidence of postoperative steatorrhea and the technique allowed for early oral feeding and the maintenance of oral feeding even if post-operative pancreatic fistula developed.[18]. A recently published RCT from Japan by K.Tami et al between Conventional and Isolated Roux En Y loop Reconstruction among 153 patients showed that Isolated Roux En Y Reconstruction does not reduce the risk of Pancreatic Fistula compared with conventional technique. [19]

Operative details of isolated Roux loop pancreaticojejunal anastomosis: (IPJ)

A 40-cm long isolated loop of jejunum is fashioned and passed in the retrocolic plane through the mesocolon for pancreaticojejunal anastomosis. The anastomosis is done by a duct to mucosa technique or a dunking technique using 3'0/4'0 prolene interrupted sutures for the anastomosis. **(Figure 1.b)**

MATERIALS AND METHODS

Retrospective analysis of prospectively collected data from Department of Surgical Gastroenterology, Government Villupuram medical college hospital, Government Coimbatore medical, College Hospital and Rajiv Gandhi government hospital,Chennai, from 2016 to 2024 march on patients underwent Whipple procedure done – 108 patients have undergone Whipple procedure.. Preoperative, Intraoperative and postoperative variables were taken for this study. All patients admitted with a diagnosis of periampullary carcinoma or carcinoma head of pancreas were evaluated by imaging studies and those patients found to have a resectable disease were selected for study. All data were collected prospectively and the clinical parameters were noted in a proforma. Details noted included age, gender, chief complaints, co-morbid illness, nature of diet, habit of smoking and alcohol consumption .The Clinical findings on physical examination such as jaundice, pallor, pedal edema and signs of liver failure were all noted. Clinical examination of the abdomen was done to look for a palpable gallbladder, hepatomegaly, and free fluid and per rectal deposits. Basic biochemical and hematologic investigations including a complete blood count, renal function tests and Liver function tests were noted. Coagulation profile and serum tumour marker study was done for all patients. The tumor markers that were done include CEA and CA 19-9. After an initial ultrasonogram of abdomen, an upper GI endoscopy and contrast enhanced computerised tomography was done for all the patients.

Reconstruction of the distal pancreatic remnant (i.e) pancreatico enteric anastamosis was done either in the form of a

Pancreaticogastrostomy, Conventional Loop pancreaticojejunostomy or isolated loop pancreatico jejunostomy as per the choice of operating surgeon. Patients underwent Pancreatic stump anastomosis have been categorised into three groups.

A- Pancreatico Gastrostomy (PG)
B- Conventional loop Pancreatico Jejunostomy (CPJ)
C- Isolated Pancreatico jejunostomy (IPJ) (Figure 2)

- **C group later categorised into Duct to mucosa (C1) and Dunking (C2) type.**

Major complications like leak (Major/Minor), Haemorrhage (Early/late), DGE (Primary and secondary), Intra-abdominal abscess have been taken in relation to anastomotic techniques. Minor morbidities like Pneumonitis, UTI, wound infection also taken into account. Mortality also related to type of anastomosis.

Statistical Analysis

The data collected in the proforma were entered in an excel sheet of Microsoft Office software and inference obtained after statistical analysis. The mean and standard deviation were reported for continuous variables and for categorical variables proportions were computed. To compare and find the statistical significance between the two group proportions chi square test was used and to compare between the two group means independent t-test was used. The P-values <0.05 were considered as statistical significant.

RESULTS

Among the one hundred and thirty eight patients included in the study 62% were male and 38% were female patients. The minimum age was 30 and maximum age was 72 with a mean age of 51.7 .On clinical presentation 90% had jaundice, 86% had abdominal pain, 84% had weight loss, 56% had pruritus, 11% had fever, 12% had cholangitis and 28% had other symptoms such as nausea, vomiting, loss of appetite and constipation.

On examination, 81.15% were icteric and 27.53% had pallor. Gallbladder was palpable in 71.01% of patients and liver was palpable in 40.57% of patients. Liver echoes were found to be normal in 92% of patients. Intrahepatic biliary radical dilatation was found in 96% and Common bile duct was dilated in 92% of the patients.

Periampullary 102 (79.68%), Pancreatic cancer 15 (11.7%) Distal CBD growth 6 (6%) and duodenal growth 5 cases were analysed.

Among them after resection the following are the various reconstruction techniques:

- PG (A)-done for 39 cases.
- CPJ(B)- done for 61 cases and
- Isolated PJ (C) done for 38 cases.

Here we analysed the four major complications like Delayed Gastric Emptying (DGE), Haemorrhage, Post-Operative Pancreatic Fistula (POPF) and Intra-abdominal Collections.

Delayed Gastric Emptying (DGE) is the most common complication 44% (57). Overall complications include- pancreatic leak-30.96%, haemorrhage- 5.4%, and Intra-abdominal collection-5%. **(Table 1 and Figure 3)**

Delayed Gastric Emptying

When comparing between the three groups undergoing PG, CPJ, IPJ the incidence of delayed gastric emptying in the PG group was 38.46%, the incidence in the CPJ group was 40.98% and in the isolated loop pancreaticojejunostomy group was 44.73%. The mean duration of nasogastric tube removal was 7.5 days in the PG group and 7.8 days in the CPJ group and 7.0 in Isolated PJ group .The maximum days we have retained the nasogastric tube was for 26 days. We have managed the patients with prokinetics and maintaining them on enteral feeding through feeding jejunostomy

Hemorrhage

The incidence of haemorrhage was 7.6% in the PG group, 6.5% in the CPJ group and nil in the isolated PJ group. (Table 2)

All the patients with Mild haemorrhage are managed conservatively. One patient with severe haemorrhage had an urgent endoscopy and we could not find any bleeding points except for clots. Patient was on ventilator with haemodynamic support and could not be shifted for angioembolisation. We reopened and explored but could not find the source and patient succumbed with multiorgan failure.

Post Operative Pancreatic Fistula: (POPF)

When comparing the incidence of leak between the three groups it was about 33% in the PG and 29.5% in the CPJ group and 15.78% in isolated PJ group.

For Post Operative Pancreatic Fistula (POPF), the definition is a drain output of any

measurable volume of fluid on or after postoperative day 3 with an 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. [20]

Pancreatic leak occurred in 39 patients with grade A leak in 20(15.62%), grade B leak in 12(9.37%) and grade C leak in 7(5.46%) patients. All patients with pancreatic leak

Were managed by non-operative means. Grade a leaks were managed conservatively and grade B leaks required supportive care in the postoperative ward with drainage tube retained for a prolonged period and grade C leaks were managed aggressively in the ICU with one or more image guided percutaneous drainage tubes and nutritional support. We have not reoperated for a suspected leak.

Subgroup analysis between C1 and C2 with regards to anastomotic leak was analysed. Duct to mucosa (C1) showed a leak percentage of 9.09% compared to Dunking method (C2) which showed a leak rate of 37.5%.

Intra-Abdominal Collections

The incidence of intra-abdominal collection in the PG group was 10[25.64%], in the CPJ group it was 7[11.47%] and in the isolated PJ group was 6[15.78%]

All the cases underwent Percutaneous USG guided drainage.

The mean postoperative hospital stay was 12.6 days in the PG group and 13.1 days in the CPJ group and 11.2 in isolated PJ group.

The mortality rate in our study was 5.7% (5.1% in PG group and 4.9% in PJ group, 7.8% in isolated loop PJ group). The mortality rate in the literature is in the range of 3-5%.

In our study the reason for mortality in six cases were due to cardio respiratory impairment due to myocardial infarction and other two cases were due to haemorrhage and metabolic encephalopathy respectively.

Two of these in the isolated limb PJ group died of multiorgan failure and sepsis.

Both of these patients did not have pancreatic anastomotic leak .One in the PG group succumbed to severe hemorrhagic complication and died.

In summary, there is no significant difference in mortality rate between the three types of anastomosis. The incidence of higher grade fistulae and fistula related mortality was lower in isolated loop. The incidence of delayed gastric emptying was higher and hospital stay was longer with isolated loop anastomosis.

DISCUSSION

This study has demonstrated that the pancreatic fistula rate after PD with IPJ reconstruction is similar to that following CPJ. It was expected in most studies that the pancreatic fistula rate would be lower in the IPJ group. By isolating bile, pancreatic enzymes cannot become activated at the site of the pancreatico jejunostomy[21]. As the distance between the pancreatico jejunostomy and hepaticojejunostomy is very near in CPJ, anastomotic dehiscence of the pancreatico jejunostomy can lead to leakage of bile in the operative field, leading to further destruction of the surrounding tissues by pancreatic enzymes. Phospholipase A2 is activated by bile and has cytotoxic activity. Also the contaminated bile resulting from obstruction of the biliary tract can contain bacteria with lipopolysaccharide (LPS). LPS is also a potent activator of pancreatic enzymes [22] Isolation of the bile flow might not necessarily prevent leakage at the pancreaticojejunostomy, but rather minimize the sequelae of a leak. If a small defect of the pancreaticojejunostomy exists, the surrounding tissues will become contaminated by bile, leading to further tissue injury in conventional pancreatico jejunostomy.

In contrast to published prospective studies we have analysed the outcome of isolated PJ anastomosis and also compared it with Conventional PG and PJ methods. In our study though we found no overall difference in the morbidities between the techniques, severity of complications is lesser with isolated loop technique. Pancreatic leak occurred in 39 patients with grade A leak in 20(15.62%), grade B leak in 12(9.37%) and grade C leak in 7(5.46%) patients. All patients with pancreatic leak were managed by non-operative means. Grade a leaks were managed conservatively and grade B leaks required supportive care in the postoperative ward with drainage tube retained for a prolonged period and grade C leaks were managed aggressively in the ICU with one or more image guided percutaneous drainage tubes and nutritional support. We have not re operated for a suspected leak. We also observed that it has demerits like long operating hours and increased incidence of DGE. In the subgroup analysis between Dunking method (C1) and Duct to mucosa (C2) anastomosis technique there is no

difference between the techniques. Mortality is comparatively more than other methods but it has no statistical difference.

CONCLUSION

Among various techniques of pancreas stump reconstruction (PG/CPJ /Isolated PJ) none of them showed statistical significant morbidity or mortality of the existing standard. But isolated loop PJ has had statistically significant lower grade leak and increased DGE. Subgroup analysis within the isolated loop has no difference in outcome. Pancreatic stump management has to be individualised. Surgeon should be familiar with all techniques. Isolated loop PJ can be done for well-preserved young patients.

REFERENCES

1. Berberat, 1999b. Berberat PO, et al: Prevention and treatment of complications in pancreatic cancer surgery. Dig Surg 1999; 16: 327-336.
2. Trede, 2001. Trede M, et al: Personal observations, opinions, and approaches to cancer of the pancreas and periampullary area. Surg Clin North Am 2001; 81:595-610.
3. Zenilman, 2000. Zenilman ME: Use of pancreaticogastrostomy for pancreatic reconstruction after pancreaticoduodenectomy. J Clin Gastroenterol 2000; 31:11-18.
4. Yeo, 1995a. Yeo CJ, et al: Pancreaticoduodenectomy for cancer of the head of the pancreas: 201 patients. Ann Surg 1995; 221:721-731.
5. Yeo, 1995b. Yeo CJ, et al: A prospective randomized trial of pancreaticogastrostomy and pancreaticojejunostomy after pancreaticoduodenectomy. Ann Surg 1995; 222:580-588.
6. Wente MN,Shrikande et al ,Pancreaticojejunostomy versus pancreatico gastrostomy: systematic review and meta-analysis
7. Ramesh H, Pancreaticojejunostomy versus pancreaticogastrostomy in reconstruction following pancreaticoduodenectomy
8. Khan AW, Aggarwal AK, Davidson BR. (2002) Isolated Roux loop duct to mucosa pancreaticojejunostomy avoids pancreatic leaks in pancreaticoduodenectomy. Dig Surg 19:199–204.
9. Sutton CD, Garcea G, White SA, O'Leary E, Marshall LJ, Berry DP et al. (2004) Isolated Roux loop pancreaticojejunostomy: a series of 10 patients with zero postoperative pancreaticoenteric leaks. J Gastrointest Surg 8: 701–705.
10. Funovics JM, Zöch G, Wenzl E, Schulz F. (1987) Progress in reconstruction after resection of the head of the pancreas. Surg Gynecol Obstet 164:545–548.
11. Kingsnorth AN. (1994) Safety and function of isolated Roux loop pancreatico jejunostomy after Whipple's pancreaticoduodenectomy. Ann R Coll Surg Engl 76:175–179.
12. Albertson DA. (1994) Pancreaticoduodenectomy with reconstruction by Roux en Y pancreaticojejunostomy: no operative mortality in a series of 25 cases. South Med J 87:197–201.
13. Papadimitriou JD, Fotopoulos CA, Smyrniotis B, Prahalias AA, Kostopanagiotou G, Papadimitriou LJ. (1999) Subtotal pancreatoduodenectomy. Use of a defunctionalized loop for pancreatic stump drainage. Arch Surg 134:135–139.
14. Jover JM, Carabias A, Feurte S, Ríos R, Ortega I, Limones M. (2006) Results of defuntionalized jejunal loop after pancreaticoduodenectomy. Cir Esp 80:373–377.
15. Machado MC, Monterio da Cunha JE, Bachella T, Bove P. (1976) A modified technique for the reconstruction of the alimentary tract after pancreatoduodenectomy. Surg Gynecol Obstet 143:271–273.
16. Funovics JF, Zoch G, Wenzel G, Schulz M. Progress in reconstruction after resection of the head of the pancreas. Surg Gynecol Obstet 1987; 164: 545-8.
17. Isolated Roux loop pancreaticojejunostomy versus pancreatico gastrostomy after pancreaticoduodenectomy: a prospective randomized study. El Nakeeb A, Hamdy E, Sultan AM, Salah T, Askr W, Ezzat H, Said M, Zeied MA, Abdallah T. HPB(Oxford). 2014 Jan 28
18. Randomized clinical trial of isolated Roux-en-Y versus conventional reconstruction after pancreaticoduodenectomy M. Tani, M. Kawai, S. Hirono, K.-I. Okada, M. Miyazawa, A. Shimizu, Y. Kitahata and

H. Yamaue; Second Department of Surgery, School of Medicine,Wakayama Medical University, 811-1 Kimiidera,Wakayama 641-8510, Japan Published online 26 June 2014 in Wiley Online Library (www.bjs.co.uk). **DOI:** 10.1002/bjs.9544

19. Postoperative pancreatic fistula: An international study group (ISGPF) definition Claudio Bassi, MD,a Christos Dervenis, MD,b Giovanni Butturini, MD,a Abe Fingerhut, MD,c Charles Yeo, MD,d Jakob Izbicki, MD,e John Neoptolemos, MD,f Michael Sarr, MD,g William Traverso, MD,h and Marcus Buchler, MD,i for the International Study Group on Pancreatic Fistula Definition,*Verona, Italy; Athens, Greece; Poissy, France; Baltimore, Md; Liverpool, United Kingdom; Hamburg, Germany; Rochester, NY; Seattle, Wash; and Heidelberg, Germany
20. Oneil Machado N. Pancreatic fistula after pancreatectomy: definitions, risk factors, preventive measures, and management-review. Int J Surg Oncol 2012; **2012**: 602478.
21. Shimada K, Yanagisawa J, Nakayama F. Increased lysophosphatidylcholine and pancreatic enzyme content in bile of patients with anomalous pancreaticobiliary ductal junction. Hepatology 1991; **13**: 438–444.