

Role of External Pancreatic Drainage in Pancreaticogastrostomy in Whipples Procedure

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Abstract

Introduction: Since the introduction of pancreaticoduodenectomy the major morbidity and cause of mortality has been pancreatic leak from the pancreatic anastomosis (pancreatojejunostomy or pancreaticogastrostomy). **Materials and Methods:** This is a prospective non-randomized study, aimed at short term analysis of outcome of pancreaticogastrostomy with external stenting in Whipple's procedure conducted in those patients found to be suffering from periampullary carcinoma.

Results: A prospective series of 12 patients, with pancreatic and preambulatory cancers outlined previously underwent exploratory laparotomy and Whipple's procedure as required. Pancreatic anastomosis was done by pancreaticogastrostomy with external stenting. Whipple's procedure in our hands had a mortality of 8.3% and a morbidity of 40- 50%. The procedure is technically feasible with an operating time of four hours and a blood loss of 1000ml. Preoperative biliary stenting did not influence the leak rate. The one mortality in our study was not related to the pancreatic leak. The one patient with pancreatic leak and had only a minimal leak (Grade A) which was easily managed conservatively. All the other complications were managed conservatively with success in all patients. **Conclusion:** Pancreaticogastrostomy with external stenting is a safe and reliable procedure which can be routinely performed in Whipple's procedure.

Keywords: Pancreaticogastrostomy; Whipples Procedure; Anastomosis; Adenocarcinoma.

Introduction

The first successful resection of periampullary tumors was done by Halstead in 1899. The tumor was resected locally, and the pancreatic and biliary ducts were implanted into the duodenum. The first successful pancreaticoduodenectomy was performed by Kausch in 1912. This procedure was popularised by Whipple in 1935 [1].

Surgery was done in two stages- cholecystogastrostomy and gastrojejunostomy were done in the first stage and after several weeks, when jaundice decreased and nutritional status improved, pancreaticoduodenectomy was done [1].

Periampullary cancers include a group of malignant tumors at or near the ampulla of Vater [2]. The primary symptom is obstructive jaundice. They are usually managed by Pancreaticoduodenectomy. These tumors include adenocarcinoma arising from the head of pancreas, the ampulla of Vater, the distal CBD or duodenum [2].

Pancreaticogastrostomy has been the preferred procedure for drainage of the pancreatic stump. Proponents of pancreaticogastrostomy have noted the following advantages for the procedure

1. The anatomically close apposition between stomach and pancreas makes for a tension free anastomosis. It also avoids a long jejunal loop with its retained secretions that may exert traction on the anastomosis
2. Excellent blood supply to the anastomosis
3. Pancreatic enzymes are incompletely activated because of gastric acid and absence of enterokinase

activity which may cause less autolysis locally and decrease leak rates.

In the past the pancreatic remnant was handled by ligation of the pancreatic duct with oversewing of the transected pancreas, which was the most significant factor predisposing the patient to the development of postoperative pancreatic fistula³. Occlusion of the pancreatic stump with synthetic or biological substances to suppress exocrine pancreatic secretion also has been proposed as a safe alternative to pancreaticojejunal anastomosis. Di Carlo et al. [3] reported a 4% pancreatic leak after Neoprene injection in the Duct of Wirsung. Low rate of postoperative pancreatic fistula in this study appears to be offset by the total loss of pancreatic exocrine function [3]. End to side pancreaticojejunostomy was done by different methods such as Cattle Warren method, Blumgart method and Dunking method [3]. End to end pancreaticojejunostomy was done by two layered method and by dunking [3]. However the role of stenting of the pancreatic anastomosis, both internal and external is not clear. We conducted a study to evaluate external stenting in pancreaticogastrostomy after Whipples procedure.

Materials and Methods

This is a prospective non-randomized study, aimed at short term analysis of outcome of pancreaticogastrostomy with external stenting in Whipple's procedure conducted at a tertiary care oncology centre in Hyderabad. All patients who presented to the outpatient department in MNJ Regional Cancer Centre, Osmania Medical College with surgical obstructive jaundice from June 2006 to April 2009 were thoroughly investigated according to the standard protocols of the Institute including complete liver function tests and a contrast enhanced spiral CT scan (64 slice). Those patients found to be suffering from periampullary carcinoma were further evaluated clinically and by endoscopy/ERCP if required for tissue diagnosis and surgical planning.

Inclusion Criteria

- All patients who underwent Whipple's procedure.

Exclusion Criteria

- All patients in whom we were unable to visualize the main pancreatic duct.

After a diagnosis was established and the patient planned for Whipples procedure, the patient was

admitted in the hospital, an evaluation by the anesthesiologist regarding fitness for surgery was done and an informed written consent was taken after explaining in detail the prognosis and complications of the surgical procedure.

Preoperative preparation was according to our standard protocol including maintenance of an adequate urine output by supplementation with IV fluids, oral glucose loading, perioperative antibiotics, bowel preparation, vitamin K injections and incentive spirometry. A detailed proforma was filled out recording the information required for each patient and the written consent of the patient indicating that he was willing to take part in the trial was taken.

At surgery the abdomen was opened by a bilateral subcostal incision and the abdomen was thoroughly explored to rule out inoperability. If found to be operable we proceeded with a standard Whipples procedure. After pancreatoduodenectomy was done, mobilisation of 2 - 3 cm of cut end of pancreas was performed by slow dissection and ligation of vessels draining into the portal and splenic veins. The pancreatic stent (in our case a 5F or 6F infant feeding tube) was first brought through both walls of the stomach. The posterior layer of sutures between stomach wall and pancreas were placed. Then duct to mucosa posterior row sutures were placed. The stent was negotiated into the main pancreatic duct. The anterior sutures of duct to mucosa anastomosis were placed. Lastly the anterior layer of stomach seromuscular to pancreas sutures were placed. The stent was secured to the posterior wall mucosa of the stomach, anterior serosal wall and parietal abdominal wall after being brought out of the anterior abdominal wall like a drain. The size of the stent should be kept smaller than the duct. In case the main pancreatic duct was not visible in the pancreatic remnant the patient was excluded from the trial and we went on to perform an end to end pancreaticojejunostomy. After the pancreatic anastomosis we went on to perform the choledochojejunostomy (end to side), the GJ and the feeding jejunostomy. The abdomen was drained and closed as usual.

In the immediate postoperative period the patients vitals were carefully monitored, input and output charted, adequate fluids and blood replaced and the data carefully noted. Adequate analgesia was ensured and incentive spirometry and chest physiotherapy started on POD 1. Low molecular weight heparin was started from POD 1 and early ambulation encouraged. Drain outputs including the pancreatic stent output were noted daily. Other problems were managed as and when required. Feeding was started on POD 2 or 3 as jejunostomy tube feeds and gradually increased

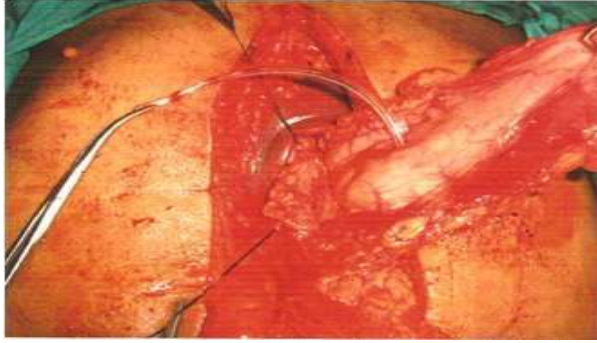


Fig. 1: Stent through posterior wall of stomach

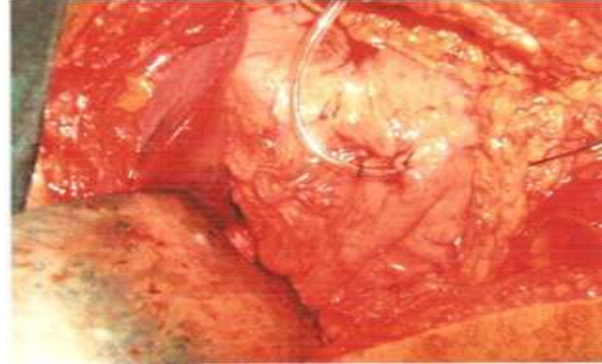


Fig. 4: Anchoring of stent to anterior wall of stomach



Fig. 2: Anterior layer of duct to mucosal anastomosis to be done



Fig. 3: Completion of duct to mucosa anastomosis

as per the patients tolerance. Other investigations (blood, X rays and abdominal scans) were used as necessary till the patients recovered and got discharged. The data from the proformas was collated and analysed for the purpose of the thesis.

Results

A prospective series of 12 patients, with pancreatic and periampullary cancers following selection criteria as outlined previously underwent exploratory laparotomy and Whipple's procedure as required. Pancreatic anastomosis was done by pancreatico-gastrostomy with external stenting. Special consent was taken after explaining in detail the procedure, risks and benefits and complications of the procedure. Postoperative care was standard as per Institute protocols. The major emphasis was kept on documenting pancreatic leak and its related morbidity and mortality. Different variables were analysed thoroughly for proper study and comparison with other series in the literature.

Table 1: Demographic distribution

Age(years in intervals)	No of patients
11-20	1
21-30	0
31-40	1
41-50	6
51-60	3
61-70	1
Symptom	
Jaundice	7
Pruritis	6
Pain	5
Palpable gall bladder	4
Hepatomegaly	3
Clay coloured stools	2
Melena	1
Cholangitis	1
Site of Lesion	
Ampulla	3
Pancreas	6
Duodenum	2
Distal common bile Duct	1

Majority of patients are in the 41-50 year age group and almost all in 41-60 year group. This is expected as the disease mainly occurs in the middle aged and elderly. The male to female ratio is 1:1 (Males = 6, females = 6).

The most common presenting symptom is jaundice and then pruritis. Pain is the third most common symptom in our study. In carcinoma head of pancreas pain is the commonest symptom but in our study this is not so as a significant number are patients with periampullary carcinoma.

Pancreas is the most common primary site followed by ampullary carcinoma. Together they account for 75% of patients (9/12). Only five out of twelve patients were stented preoperatively in our study. (Table 1).

The mean operating time for Whipples procedure in our hospital was four hours. The mean intra operative blood loss was one litre.

Majority of the pancreas handled in our study (8/12) were firm in texture and therefore it was technically easier to perform the pancreaticogastric anastomosis. Only one pancreas was friable and it was significantly more difficult to handle and insert sutures.

Pancreatic leaks were graded according to the ISGPF definition. There was only one pancreatic leak which was grade A. No other patient had either a biliary or pancreatic leak. (Table 2).

The most common complication in our study was wound infection followed by delayed gastric emptying. We had one case of bilious vomiting which

Table 2: Variables in study

Operative time and bloodloss	
Mean operative time	240 min
Mean blood loss	1000 ml
Mean no of blood transfusions	2 units
Texture	
Firm	8
Soft	3
Friable	1
Pancreatic Leak - ISGPF Grading	
A	1
B	0
C	0

Table 3: Postoperative complications

Postoperative Complication	Number of cases
Delayed gastric emptying	2
Pancreatic leak	1
Wound infection	3
Intra-abdominal abscess/ Collections	0
Bilious vomiting	1
Sub-acute intestinal Obstruction	1

was treated conservatively and recovered. One patient developed subacute intestinal obstruction which resolved in a few days with conservative management. One Patient died in this study, due to unexplained persistent hypotension on the first postoperative day. This was not considered related to pancreatic leak. It is possible that it was due to undetected postoperative hemorrhage. (Table 2).

Hospital Stay

The mean duration of hospital stay was 13 days (excluding 1 case of mortality in the early postoperative period).

Discussion

Pancreaticogastrostomy has been gaining favor in recent years. The clinical introduction of this procedure seems to have originated with the Waugh and Clagett. The lack of a uniform technique of performing a pancreaticogastric anastomosis has led to the same debate as that with the pancreaticojejunal anastomosis. Delcore et al. [3] reported a method of pancreaticogastrostomy in which 3 cm of pancreatic remnant was telescoped into the gastric lumen (small gastrotomy made in the posterior gastric wall) without any stenting of the main pancreatic duct. Pancreaticogastrostomy

is performed either through the gastric stump or through an anterior-wall gastrotomy (in the case of a pylorus-preserving procedure). Aranha describes a 1-layer invaginating pancreaticogastrostomy after a Whipple procedure [4]. The pancreatic remnant is mobilized for a distance of 4 cm, and sutures are placed from the posterior superior wall of the stomach to the anterior wall of the pancreas. A 3-cm gastrotomy is made, and then sutures are placed from the posterior inferior wall of the stomach to the posterior pancreas. When the sutures are tied, 1 cm of the pancreas is invaginated into the stomach. Among other alternatives, Teldorf et al. [5] have reported that direct anastomosis of the pancreatic duct to the gastric mucosa provides better patency of the pancreatic duct than does a simple implantation procedure. Takao et al. [6] have described a modified pancreaticogastrostomy. The proximal 2 cm of the pancreatic remnant is freed from the retroperitoneum and anastomosed end-to-side to the posterior wall of stomach. The seromuscular layer of the stomach in this region is excised in a 2-cm area. A stent in the pancreatic duct is then passed into the stomach through the exposed mucosa/sub mucosa of the posterior gastric wall. A suture anchoring the pancreatic duct is passed through the gastric mucosa/ submucosa and circumferentially around the pancreatic tube. The anastomosis is completed by applying sutures between the anterior pancreatic edge and the stomach. Recently, a new technique of pylorus-preserving pancreaticodu-

denectomy with gastric partition has been reported. Gastric partition is performed using 2 or 3 Endo-GIA staplers along the greater curvature of the stomach, 3 cm from the border. This gastric segment, 10-15 cm in length, is placed in close proximity to the cut edge of the pancreatic stump. An end-to-side duct-to-mucosa anastomosis or invagination anastomosis is constructed [4].

Indications for Surgery

In study by Aranha GV [4] which included 235 consecutive patients of pancreatoduodenectomy, the three most common initial symptoms were jaundice (73.2%), weight loss (23.8%) and abdominal pain (17.0%) and the four most common indications for surgery were pancreatic adenocarcinoma (41.3%), ampullary carcinoma (17.0%), duodenal carcinoma (7.2%) and chronic pancreatitis ((7.2%). The median operating time was 6.5 hours and median blood loss was 900ml. Postoperative mortality was 0.9% and the most common complication was pancreatic fistula (13.6%).

In a study by Delcore [3] out of 45 patients who underwent pancreaticogastrostomy, carcinoma pancreas was the indication in 24 patients, ampullary carcinoma in 8 patients, duodenal carcinoma in 4 patients, CBD carcinoma in 4 patients, pancreatic islet cell carcinoma (1 patient), trauma (1 patient), carcinoma colon (1 patient), chronic pancreatitis (1 patient) and gastroduodenal

Table 4: Indications for Surgery in comparison of other studies

	Delcore ³ (n=45)	Aranha ⁴ (n=235)	Our study (n=12)
Pancreatic Carcinoma	24 (53.3%)	97 (41.3%)	6 (50%)
Ampullary Carcinoma	8 (17.7%)	40 (17%)	3 (25%)
Duodenal Carcinoma	4 (8.9%)	17 (7.2%)	2 (16.7%)
CBD Carcinoma	4 (8.9%)	-	1 (8.4%)
Pancreatic Islet Cell Carcinoma	1	-	-
Trauma	1	-	-
Carcinoma Colon	1	-	-
Chronic Pancreatitis	1	17 (7.2%)	-
Gastroduodenal Artery Aneurysm	1	-	-

artery aneurysm (1 patient). There was 1 death (mortality 2%) and 7 patients had major postoperative complications (mortality 15%). No pancreatic leaks occurred. As shown in the above table the 4 most common indications are pancreatic carcinoma, ampullary carcinoma, duodenal carcinoma, CBD carcinoma and Chronic Pancreatitis.

Preoperative Stenting

Similarly, in our study preoperative stenting was not associated with any increased postoperative

complications. The benefit of an internal or external stent across the pancreaticoenteric anastomosis remains controversial. Theoretically, a stent may help divert pancreatic secretions away from the anastomosis, and it also allows more precise placement of sutures for duct-to-mucosa anastomosis. Two recent prospective randomized trials have reached different conclusions on the benefit of stenting in reducing the pancreatic fistula rate. Winter et al.⁷ found that the use of a short internal stent did not reduce the frequency or the severity of pancreatic fistula after pancreaticoje-

junostomy. The major criticism of this study is that the technique of pancreaticojejunal anastomosis was not standardized, as the use of a duct-to-mucosa or an invagination technique was at the discretion of the surgeons. There could be a possible bias in that the invagination technique was chosen for a pancreatic stump with a small pancreatic duct, which is more difficult for a duct-to-mucosa anastomosis; hence, the benefit of a stent could have been missed in such patients. On the other hand, Poon et al. [8] using an end-to-side duct-to-mucosa anastomosis, randomized patients to have either an external stent inserted across the anastomosis to drain the pancreatic duct or no stent. This randomized trial showed a reduction of the pancreatic fistula rate from 20% in the non-stented group to 6.7% in the stented group.

In our study we had 12 consecutive patients, all of whom had a Classical Whipples procedure performed with pancreatic drainage by pancreaticogastrostomy and external stenting. This technique was chosen by us in view of the latest studies in the literature. As evinced by the analysis of the data, this technique was presumably successful and we had only one leak, that too a minor one in the 11 surviving patients. The single patient who succumbed to postoperative hypotension did not have any evident leak (mortality 8.3%). We found that our 2 main indications for surgery were pancreatic cancer and periampullary cancer while in the literature it was mainly pancreatic cancer. Perhaps this is a geographical variation. As stated in the literature preoperative stenting did not seem to influence the incidence of pancreatic leak. We had roughly equal numbers of stented and unstented patients.

Texture of Pancreas

We found the texture of the pancreas to be of technical importance. We found it easier to handle and insert sutures in a firm pancreas as opposed to a soft pancreas. This is also echoed in the literature where patients with chronic pancreatitis and hard glands were found to have low leak rates. In our study all the subjects had either a firm or soft pancreas. There were no patients with a friable pancreas. The most common complications in the literature are delayed gastric emptying, pancreatic leak and wound infection. This is reflected in our data with delayed gastric emptying in 2/12 patients, pancreatic leak in 1/12 patients and wound infection in 3/13 patients.

In the studies shown above the mortality rates for Whipples ranged from 0-11% in large series, a

remarkable result. In our series the mortality was 8.3% which is comparable but requires a much larger number of patients to accurately measure the mortality rate.

A study by Fabre JM [9] analysed 160 consecutive patients of pancreaticogastrostomy for factors that could influence immediate outcome. Age, sex, indications and texture of pancreatic remnant did not influence occurrence of pancreatic fistula or delayed gastric emptying.

In a study of 149 randomized patients by Duffas JP [10], 81 patients underwent pancreaticogastrostomy and 68 patients underwent pancreaticojejunostomy; univariate analysis found the following risk factors (1) Age \geq 70yrs (2) Extrapancreatic disease (3) Normal consistency of pancreas (4) Diameter of MPD $<$ 3mm (5) Duration of Operation $>$ 6 hrs and (6) A centre effect. However in multivariate analysis the independent risk factors were (1) Operation time $>$ 6 hrs for intraabdominal complications and pancreatic fistula, extrapancreatic disease for pancreatic fistula and age \geq 70 yrs for mortality. We found Firm and Soft pancreas' to be technically easy to handle, but had considerable difficulty handling the one pancreas that was friable. However the pancreatic leak we had did not occur in that patient.

Operative Time and Blood Loss

Our operating time of 240 mts (mean) and mean blood loss of 1000ml compares favourably to the literature. Aranha GV [4] had a median operating time of 6.5 hrs and median blood loss of 900ml. Kang CM [11] had a mean operating time of 327 +/- 67.4mts. It is possible that very prolonged operative times could increase the morbidity and mortality rates in a complex and major surgery like Whipples procedure.

Pancreatic Leak

In our study, we had 1 leak out of 12 patients (8%). This was a grade A leak, which was managed successfully conservatively by us. It is known that leak rates for Whipples procedure decreases with increased surgeon experience. The average is 6.42%. As seen table 5 the leak rates have varied from 0% to 20.7%.

Mortality and morbidity

Many major centres today are on the verge of approaching zero mortality rate for Whipples. We had 1 early postoperative death out of 12 patients

Table 5: Pancreatic leak in various studies

Study	Pancreatic leak
Delcore R ³ (n=45)	0
Mason GR, ⁵ (n=733)	4%
Mason GR, Freeark RT ¹² (n=34)	0
Fabre JM ⁹ (n=160)	2.5%
Barnett SA ¹³	4%
Schlitt ¹⁴ (n=250)	2.8%
Kang CM ¹¹ (n=51)	12.3%
Aranha GV ⁴ (n=235)	13.6%
Nakao A ¹⁵ (n=58)	20.7%
Wellner U ² (n=114)	11.4%
Duffas JP ¹⁰ (n=81)	16%
Kim C W ¹⁶ (n=48)	2.1%

due to unexplained hypotension giving us a mortality rate of roughly 8%. We expect this rate to decrease further with more procedures being performed by us in the future.

Morbidity is in contrast still very high. The rates range from 15-45%. We had complications in 7/12 patients although almost all were minor. Morbidity (including leak) therefore still remains the most major challenge faced by surgeons performing pancreatoduodenectomy.

A Study by Barnett SA [13] examined the effect of pancreaticobiliary drainage (PBD), patient age and method of pancreatic reconstruction on postoperative morbidity and mortality on 104 consecutive patients undergoing pancreatoduodenectomy.

The postoperative mortality was <1% the group undergoing PBD did not have higher rates of infectious complications (12 vs 19% , p=0.34) or

Table 6: Morbidity and Mortality in various studies

Morbidity	Percentage %
Delcore R ³ (n=45)	15%
Fabre JM ⁹ (n=160)	30% (Reoperation 12 %) (Delayed emptying 22.5%)
Barnett SA ¹³	43%
Wellner U ² (n=114)	(Hemorrhage-10.5%, Delayed Gastric emptying-18.3%)
Duffas JP ¹⁰ (n=81)	23%
Kim CW ¹⁶ (n=48)	18.8%
Mortality	
Delcore R ³ (n=45)	2%
Arnaud JP ⁴ (n=32)	6.2%
Mason GR, Freeark RT ¹² (n=34)	0
Fabre JM ⁹ (n=160)	3%
Barnett SA ¹³	<1%
Schlitt ¹⁴ (n=250)	1.6%
Kang CM ¹¹ (n=51)	0%
Aranha GV ⁴ (n=235)	0.9%
Nakao A ¹⁵ (n=58)	0%
Duffas JP ¹⁰ (n=81)	11%
Kim CW ¹⁶ (n=48)	4.2%

overall complications (41 vs 42%, p=0.88). The rate of anastomotic leak (18 vs 4%, p=0.045) was significantly higher in the pancreaticojejunostomy group.

Conclusions

Whipples procedure in our hands had a mortality of 8.3% and a morbidity of 40- 50% . The one patient

with pancreatic leak in our study had only a minimal leak (Grade A) which was easily managed conservatively.

All the other complications in our study were managed conservatively with success in all patients. Our series has shown the feasibility of standardization of the anastomosis in our setup. Pancreaticogastrostomy with external stenting is a safe and reliable procedure which can be routinely performed in Whipples procedure.

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