



Nullify leakage of pancreaticojejunostomy after pancreaticoduodenectomy

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Abstract

Background: Pancreatic anastomosis is the corner stone of pancreaticoduodenectomy. Postoperative pancreatic fistula is a major cause of morbidity and mortality. The optimal method of pancreatic remnant reconstruction is controversial and no single technique has shown to be superior. The aim of this work was to present the results of a novel technique for pancreaticojejunostomy in 36 patients after pancreaticoduodenectomy

Method: Our anastomosis is a two layers anastomosis. First layer was done with interrupted transverse mattress sutures with 4/0 PDS including the whole thickness of the pancreas and whole thickness of the jejunum (not duct to mucosa only). Sutures are taken over a 14 G stent inserted in the pancreatic duct and jejunum. A second interrupted mattress sutures were taken between the seromuscular coat of the jejunal stump and the outer half thickness of the pancreas.

Keywords: pancreaticoduodenectomy, pancreaticojejunostomy, postoperative pancreatic fistula, pancreatic surgery.

Introduction:

Pancreaticoduodenectomy, also known as Whipple operation, was first described by Whipple et al. in 1935 [1]. However, during the 1960s and 1970s, the operation became forsaken due to high operative mortality and poor survival [2, 3, 4].

Nowadays, Pancreaticoduodenectomy is considered the ideal treatment for not only pancreatic and periampullary cancer, but also extended to treatment of variety of benign diseases [5, 6-9]. This is due to improvement in surgical care and postoperative management which decreased mortality rate in high volume centers between 0 and 5%. However, the morbidity rate is still high and varies between 32% and 52% [10,11-13].

Postoperative pancreatic fistula is the most common cause of morbidity and accounts for 45% of complications [12, 14, 15]. The International Study Group on Pancreatic Fistulas defines the Postoperative pancreatic fistula as output via the drain of any volume of drain fluid on or after postoperative day 3, with an amylase content more than 3 times the upper normal serum level. The International Study Group on Pancreatic Fistulas recommended a grading system for fistula by severity (A, B, and C), in which grade A is the least severe and grade C is the most severe depending on the clinical condition, the used treatment, results of imaging, infection, persistent drainage, readmission, reoperation and death [16, 17].

So, pancreatic anastomosis is considered the corner stone of Pancreaticoduodenectomy, and postoperative pancreatic fistula can cause many complications such as internal hemorrhage, intra-abdominal abscess, long standing hospital stay or even death. In an attempt to prevent or decrease postoperative pancreatic fistula, many modifications of the technique of surgery was suggested such as closure of the main pancreatic duct with fibrin glue, pancreaticoenterostomy with the stomach or jejunum (with one- or two-layers sutures, duct-to-mucosa anastomosis or invagination, end to side or end to end with or without external/internal pancreatic duct drainage) and even removal of the whole pancreas [2, 18]. However, there is no widely accepted ideal technique for reconstruction of the pancreas after pancreaticoduodenectomy and postoperative pancreatic fistula is still high at 5–25% [2, 19].

There are two main variants of reconstruction of the pancreas after pancreaticoduodenectomy: pancreaticojejunostomy and pancreaticogastrostomy [2]. pancreaticojejunostomy is the commonest method. It is of two main types: invagination anastomosis and duct-to-mucosa anastomosis [2, 20].

Invagination type is done by pancreatic stump invagination into the intestine in either an end-to-side or an end-to-end method. No need to identify the main pancreatic duct. According to the gastrointestinal tract physiological structure, invagination pancreaticojejunostomy may be considered the classic

and commonest type of anastomosis after pancreaticoduodenectomy. The incidence of complications has also regarded as standard to evaluate different techniques [21, 22].

The duct-to-mucosa pancreaticojejunostomy is considered a two-layer anastomosis with suturing of the main pancreatic duct to jejunal mucosa as inner layer. Duct-to-mucosa pancreaticojejunostomy causes firm adhesion between the wall of the intestine and the stump of the pancreas and rapid patent anastomosis and maintenance of the exocrine function [21, 23]. In addition, duct-to-mucosa pancreaticojejunostomy does not consider the size of the pancreatic stump, excluding the problem of very tight or very loose invagination [21, 24].

Pancreaticogastrostomy was developed to substitute pancreaticojejunostomy. In this anastomosis, the proximal 3-4 cm of the residual pancreas is freed from the retroperitoneum and splenic vein and anastomosed to the posterior wall of the stomach [2].

The aim of this work is to present the results of a novel technique for pancreaticojejunostomy in 36 patients after pancreaticoduodenectomy which resulted in zero percentage leakage. It is two layers anastomosis with the smallest aperture in jejunum performed by a 14-gauge canula to decrease the chance of digestion of the anastomosis by the activated pancreatic juice from intestinal secretion.

Patients and Methods:

During the period of this study from 2000 to 2018, a total of 36 patients underwent pancreaticoduodenectomy for malignant or benign diseases. All patients were performed in National Cancer Institute, Cairo University and Cairo private hospitals. 34 patients were done by one surgeon and two were done by another surgeon. All patients underwent pancreaticojejunostomy for reconstruction of the pancreas. The age of patients ranged from 17 to 72 years with a median of 58 years. The tumour size ranged from 1 to 6 cm. All patients with malignant or benign lesions in the head of pancreas, distal common bile duct or duodenum who required pancreaticoduodenectomy were included in this study. All patients were subjected to pancreaticojejunostomy after pancreaticoduodenectomy. All data concerning the postoperative pancreatic fistula, early complications, postoperative pathology, postoperative mortality and postoperative sequelae were recorded and interpreted.

Technique

Our anastomosis was a two layers anastomosis. First layer was done with interrupted transverse mattress sutures with 4/0 PDS. The sutures include the whole thickness of the pancreas and whole thickness of the jejunum and all are inserted into the lumen of the pancreatic duct (Figure 1). Sutures were taken over a 14 G stent inserted in the pancreatic duct and jejunum (Figure 2). The 14 G catheter was removed before tying the last suture of the first layer. This technique will nullify the problem of soft texture of pancreas in some patients because inclusion of the whole thickness of

pancreas overlying pancreatic duct will boost the healing of the anastomosis in contrast to duct to mucosa anastomosis. A second interrupted mattress sutures were taken between the seromuscular layer of the jejunal stump and the outer half thickness of the pancreas (Figure 3).

Results:

During the period of this study from 2000 to 2018, a total of 36 patients underwent pancreaticoduodenectomy for malignant or benign diseases. All patients underwent pancreaticojejunostomy for reconstruction of the pancreas. The tumour size ranged from 1 to 6 cm.

As shown in Table 1, 24 were male (66.67 %) and 12 were female (33.33 %). The preoperative pathological diagnosis included carcinoma of head of pancreas in 24 patients (66.67 %), carcinoma of the ampulla in 6 patients (16.67 %), carcinoma of the duodenum in 4 patients (11.11 %), carcinoma of the common bile duct in one patient (2.78 %) and chronic pancreatitis also in one patient (2.78 %). Preoperative stent for drainage of CBD was inserted in 21 patients (58.33 %) and 2 patients underwent bypass before surgery (5.56%).

The postoperative morbidity rate (Table 2) was 25 % (9 / 36) with major complications occurred only in one patient (2.68 %) in the form of pulmonary embolism. Postoperative wound infection occurred only in 2 patients (5.56 %) while stress ulcer and hematemesis occurred in 3 patients (8.33 %). Also delayed gastric emptying occurred in 3 patients (8.33 %).

As shown in Table 2, there was no postoperative pancreatic leakage. We found no difference between soft or firm pancreas because the first layer includes the whole thickness of pancreas and duct wall. And so, it is a sound anastomosis with a large chunk of pancreas for anastomosis.

Concerning the postoperative pathology (Table 3), adenocarcinoma grade II was the most common postoperative pathology and occurred in 28 patients (77.78 %) followed by high grade adenocarcinoma which occurred in 4 patients (11.11 %). Solid pseudopapillary neoplasm occurred in 2 patients (5.56 %). The least pathology was MALT lymphoma and chronic pancreatitis, each of which occurred in one patient (2.78 %).

Postoperative pathological examination of the dissected lymph nodes (Table 3) was negative in 27 patients (75 %) and positive for tumour metastasis in 9 patients (25 %).

The postoperative mortality occurred in 2 patients (5.56 %), one patient died from acute myocardial infarction and the other one died from a cerebrovascular stroke (Table 4).

Concerning the postoperative sequelae (Table 5), 31 patients (86.11 %) resumed oral intake within 10 days from the operation and 3 patients (8.33 %) after 10 days. The fat contents of the stool were less than 3gm/24 hours in 22 patients (61.11 %). 24 patients (66.67 %) gained weight 3 months after operation. Only

3 patients (8.33 %) received postoperative adjuvant chemotherapy.

Table 1: Preoperative clinicopathological features and characteristics of patients.

Parameter		Number of patients	Percentage
Total number of patients		36	
Gender	Male	24	66.67 %
	Female	12	33.33 %
Diagnosis	Carcinoma of head of pancreas	24	66.67 %
	Carcinoma of the ampulla	6	16.67 %
	Carcinoma of the duodenum	4	11.11 %
	Carcinoma of common bile duct	1	2.78 %
	Chronic pancreatitis	1	2.78 %
	Preoperative stenting	21	58.33 %
	No	13	36.11 %
	Bypass before surgery	2	5.56 %

Table 2: Postoperative complications (morbidity).

Parameter	Number of patient	percentage
Postoperative leakage from pancreaticojejunostomy	0	0 %
Wound infection	2	5.56 %
Stress gastric ulcer and hematemesis	3	8.33 %
Delayed gastric emptying	3	8.33 %
Pulmonary embolism	1	2.78 %

Table 3: Postoperative pathology.

Parameter	Number of patients	percentage
Adenocarcinoma grade II	28	77.78 %
High grade adenocarcinoma	4	11.11 %
Solid pseudopapillary neoplasm	2	5.56 %
MALT lymphoma of the duodenum	1	2.78 %
Chronic pancreatitis	1	2.78 %
Regional lymph node status		
Negative	27	75 %
Positive	9	25 %

Table 4: Postoperative mortality.

Parameter		Number of patients	percentage
Total deaths		2	5.56 %
Cause of death	Acute myocardial infarction	1	2.78 %
	Cerebrovascular stroke	1	2.78 %

Table 5: Data related to postoperative sequelae.

Parameter	Number of patients	Percentage
Resumed oral intake within 10 days	31	86.11 %
Resumed oral intake after 10 days	3	8.33 %
Adjuvant chemotherapy	3	8.33 %
Stool fat one month after operation less than 3gm/24 hours	22	61.11 %
Weight gain 3 months after operation	24	66.67 %

Discussion:

Pancreaticoduodenectomy is the most complicated procedure for diseases of head of pancreas and periampullary region [10, 11]. Postoperative pancreatic fistula is the most serious complication after PD and the incidence of leakage ranged from 0 to 25 % [10, 25]. The technique of anastomosis is one of the most important factors in occurrence of Postoperative pancreatic fistula. So, various techniques of pancreatic stump management have been studied to reduce the rate of leakage [10, 26].

The main advantages of our technique is that we perform a small aperture (14 G) in the jejunal stump which was found to be crucial in preventing leakage. Also, this technique is suitable for all pancreatic stumps and not influenced by the consistency of the pancreas as the sutures of first layer include the whole thickness of the pancreatic stump which will nullify the problem of soft texture of pancreas in some patients. This will boost the healing of the anastomosis in contrast to duct to mucosa anastomosis. Also, the pancreatic transection surface is not exposed to the intestinal lumen which will decrease the incidence of scar or stricture formation at the pancreatic duct opening. Finally, the technique is simple, easy to do and easy to learn.

In this study, we found that the incidence of leakage from pancreaticojejunostomy with our technique is 0 %. In a study by Weiping Ji et al [10], they found that the incidence of pancreatic leakage in patients with double layer continuous sutures is 17.14 % (6/35). It was lower than those with double layer interrupted sutures which was 39.24 % (31/79). They concluded that the two layers continuous sutures are better than the two layers interrupted sutures and provides better surgical outcomes. Chen et al [27]

developed a new technique for anastomosis using end-to-side penetrating-suture pancreaticojejunostomy. The Postoperative pancreatic fistula in their study occurred in 26/106 patients (24%). Mario Testini et al [5] developed a new technique for pancreaticojejunostomy in which duct evagination, posterior double-layer suture and anterior single layer suture are done in eight patients (4 females, 4 males; average age 66, range 57-74). No cases of pancreatic fistula were observed. Fujii et al [20] found in their study that Postoperative pancreatic fistula occurred in 2.5% of 120 patients. They used Blumgart technique for pancreaticojejunostomy in all 120 patients. 187 patients underwent Blumgart pancreaticojejunostomy after pancreaticoduodenectomy by Grobmyer et al [18] of whom 13 patients (6.9 %) developed Postoperative pancreatic fistula. Also 90 patients underwent Blumgart PJ by Kleespies et al [19] of whom 4% developed Postoperative pancreatic fistula in contrast to 92 patients who underwent conventional PJ of which 13% developed Postoperative pancreatic fistula.

In our study, the postoperative complications occurred in 9/36 patients (25%) and were not fatal and management of these complication was easy and helpful. The complications were as follows: 2 patients (5.56%) developed wound infection, 3 patients (8.33%) developed stress gastric ulcer and hematemesis, 3 patients (8.33%) developed delayed gastric emptying and one patient (2.78%) developed pulmonary embolism. There were no cases with bile leak or postoperative bleeding and no patients required reoperation. Chen et al [27] in their study found that 2/106 patients (0.94%) developed bile leakage, 6/106 patients (5.66%) developed delayed gastric emptying and no patients required reoperation. In a study by Mohammed Abu Helal et al [28], 6/50 patients (12%) developed wound infection, 4/50 patients (8%) developed postoperative hemorrhage, one patient (2%) developed bile leakage and 6/50 patients (12%) developed chest infection. 5 patients required reoperation; 4 due to postoperative hemorrhage and one with intestinal obstruction due to internal herniation.

In this study, concerning the postoperative pathology, adenocarcinoma grade II was the most common postoperative pathology and occurred in 28 patients (77.78 %) followed by high grade adenocarcinoma which occurred in 4 patients (11.11 %). Solid pseudopapillary neoplasm occurred in 2 patients (5.56 %). The least pathology was MALT lymphoma and chronic pancreatitis, each of which occurred in one patient (2.78 %). The postoperative pathological examination of the dissected lymph nodes was negative in 27 patients (75 %) and positive for tumour metastasis in 9 patients (25 %). In the study by Chen et al [28], the postoperative pathology were as follow: 41 patients (38.7%) had adenocarcinoma of pancreatic head, 16 patients (15.1%) had adenocarcinoma of the ampulla, 21 patients (19.8%) had distal bile duct adenocarcinoma, 19 patients (17.9%) had duodenal adenocarcinoma, one patient (0.9%) had duodenal lipoma, 5 patients (4.7%) had pancreatic head cystic adenoma and 3 patients (2.8%) had chronic pancreatitis.

In this study, the postoperative in-hospital mortality occurred in 2 patients (5.56 %) with one patient died from acute myocardial infarction and the other one died from a cerebrovascular stroke. This is slightly higher than average universal mortality rate (less than 5%) after pancreaticoduodenectomy [27]. Mohammed Abu Hilal et al [28] reported no in-hospital mortality in their series of 50 patients who underwent modified Cattell's pancreaticojejunostomy. Azhar Perwaiz et al [29] developed a study comparing the isolated roux loop pancreaticojejunostomy and conventional reconstruction in pancreaticoduodenectomy, 4 patients (3.2%) died, 2 in each group. In the first group, one patient died from internal bleeding from pancreaticojejunostomy site secondary to pancreatic fistula and the other one died from cardiac arrhythmia. In the other group one patient also died from internal bleeding from pancreaticojejunostomy site secondary to pancreatic fistula and the other patient died from chest infection.

Concerning the postoperative sequelae, 31 patients (86.11%) resumed oral intake within 10 days from the operation and 3 patients (8.33 %) after 10 days. The fat contents of the stool was less than 3gm/24 hours (i.e no steatorrhea) in 22 patients (61.11 %). 24 patients (66.67 %) gained weight 3 months after operation. In a study by Ayman El Nakeeb et al [30], they also compared isolated roux loop pancreaticojejunostomy versus pancreaticogastrostomy after pancreaticoduodenectomy. In their study, the median days to resume oral intake in both groups were 6 (range from 4 to 30 days). Also, in that study, the postoperative steatorrhea occurred in a total of 27 patients in both groups (32.53%). After publishing this study, we hope that other surgeons use this technique and do more studies to further evaluate it.

Conclusion:

Performing small aperture in the jejunal stump is crucial in preventing leakage after pancreaticojejunostomy and was performed in this study with a 14 G trocar.

Abbreviations: Not applicable

No conflict of interest

References:

1. Whipple AO, Parsons WB, Mullins CR. Treatment of carcinoma of the ampulla of vater. *Ann Surg.* 1935;102(4):763–79.
2. Shyr YM, Wang SE. Type of reconstruction after pancreaticoduodenectomy. In: *Pancreatic cancer.* Edited by Kim SW., Yamaue H. Springer, Berlin, Heidelberg, 2017: 239-246.
3. Crile Jr G. The advantages of bypass operations over radical pancreatoduodenectomy in the treatment of pancreatic carcinoma. *Surg Gynecol Obstet* 1970;130(6):1049–53.
4. Shapiro TM. Adenocarcinoma of the pancreas: a statistical analysis of biliary bypass vs Whipple

- resection in good risk patients. *Ann Surg* 1975;182(6):715–21.
5. Testini M, Piccinni G, Greco L, et al. A modification technique of pancreaticojejunostomy after pancreatoduodenectomy: a preliminary experience. *Updates Surg* 2011;36:287-291.
 6. Schmidt CM, Powell ES, Yiannoutsos CT, et al. Pancreaticoduodenectomy: a 20-year experience in 516 patients. *Arch Surg* 2004; 139:718–727.
 7. Yeo CJ, Cameron JL, Sohn TA, et al. Six hundred fifty consecutive pancreaticoduodenectomies in the 1990s: pathology, complications, and outcomes. *Ann Surg* 1997;226:248–257.
 8. Kleespies A, Albertsmeier M, Obeidat F, Seeliger H, Jauch KW, Bruns CJ. The challenge of pancreatic anastomosis. *Langenbecks Arch Surg* 2008;393(4):459–471.
 9. Kim JH, Yoo BM, Kim JH, Kim WH. Which method should we select for pancreatic anastomosis after pancreaticoduodenectomy? *World J Surg* 2009; 33(2):326–332.
 10. Ji W, Shao Z, Zheng K, et al. Pancreaticojejunostomy with double-layer continuous suturing is associated with a lower risk of pancreatic fistula after pancreaticoduodenectomy: A comparative study. *Internat J Surg* 2015;13:84-89.
 11. Suzuki Y, Fujino Y, Ajiki T, et al. No mortality among 100 consecutive pancreaticoduodenectomies in a middle-volume center. *World J Surg* 2005;29:1409-1414.
 12. Bassi C, Butturini G, Molinari E, et al. Pancreatic fistula rate after pancreatic resection, The importance of definitions. *Dig Surg* 2004; 21 (1):54-59.
 13. Benzoni E, Zompicchiatti A, Saccomano E, et al. Postoperative complications linked to pancreaticoduodenectomy: An analysis of pancreatic stump management. *J Gastrointest Liver Dis* 2008; 17 (1): 43-47.
 14. Barreto SG, Shukla PJ. Different types of pancreatico-enteric anastomosis. *Transl Gastroenterol Hepatol* 2017;2:89.
 15. Bassi C, Marchegiani G, Dervenis C, et al. The 2016 update of the International Study Group (ISGPS) definition and grading of postoperative pancreatic fistula: 11 Years After. *Surgery* 2017;161:584-91.
 16. Kennedy EP, Yeo CJ. Dunking pancreaticojejunostomy versus duct-to-mucosa anastomosis. *J Hepatobiliary Pancreat Sci* 2011;18:769-774.
 17. Bassi C, Dervenis C, Butturini G, et al. Postoperative pancreatic fistula: an international study group (ISGPF) definition. *Surgery* 2005;138(1):8–13.
 18. Grobmyer SR, Kooby D, Blumgart LH, Hochwald SN. Novel pancreaticojejunostomy with a low rate of anastomotic failure-related complications. *J Am Coll Surg* 2010;210(1):54–59.
 19. Kleespies A, Rentsch M, Seeliger H, Albertsmeier M, Jauch KW, Bruns CJ. Blumgart anastomosis for pancreaticojejunostomy minimizes severe complications after pancreatic head resection. *Br J Surg* 2009;96(7):741–750.
 20. Fujii T, Sugimoto H, Yamada S, et al. Modified Blumgart anastomosis for pancreaticojejunostomy: technical improvement in matched historical control study. *J Gastrointest Surg* 2014;18(6):1108–1115.
 21. Chen YJ, Lai ECH, Lau WY, Chen XP. Enteric reconstruction of pancreatic stump following pancreaticoduodenectomy: A review of the literature. *Internat J Surg* 2014;12:706-711.
 22. Choi SH, Moon HJ, Heo JS, Joh JW, Kim YI. Delayed hemorrhage after pancreaticoduodenectomy. *J Am Coll Surg* 2004;199 (2): 186-191.
 23. Bassi C, Falconi M, Molinari E, Mantovani W, Butturini G, Gumbs AA, Salvia R, Pederzoli P. Duct-to-mucosa versus end-to-side pancreaticojejunostomy reconstruction after pancreaticoduodenectomy: results of a prospective randomized trial. *Surgery* 2003;134 (5):766-771.
 24. Fragulidis GP, Arkadopoulos N, Vassiliou I, et al. Pancreatic leakage after pancreaticoduodenectomy: the impact of the isolated jejunal loop length and anastomotic technique of the pancreatic stump. *Pancreas* 2009;38 (7):e177-e182.
 25. Howard JM. Pancreaticojejunostomy: leakage is a preventable complication of the Whipple resection. *J Am Coll Surg* 1997;184:454.
 26. Yeo CJ, Cameron JL, Maher MM, et al. A prospective randomized trial of pancreaticogastrostomy versus pancreaticojejunostomy after pancreaticoduodenectomy. *Ann Surg* 1995;222: 580-592.
 27. Chen Y, Zhu X, Huang J, Zhu Y. end-to-side penetrating-suture pancreaticojejunostomy: A novel anastomosis technique. *J Am Coll Surg* 2015;221(5):e81-e86.
 28. Abu Helal M, Malik HZ, Burke WH, Verbeke C, Menon KV. Modified Cattell's pancreaticojejunostomy, buttressing for soft pancreases and an isolated biliopancreatic loop are safety measurements that improve outcome after pancreaticoduodenectomy: a pilot study. *HPB* 2009;11:154-160.
 29. Perwaiz A, Singhal D, Singh A, Chaudhary A. Is isolated roux loop pancreaticojejunostomy superior to conventional reconstruction in pancreaticoduodenectomy ?. *HPB* 2009;11:326-331.
 30. Nakeeb A, Hamdy E, Sultan AM, et al. isolated roux loop pancreaticojejunostomy versus pancreaticogastrostomy after pancreaticoduodenectomy: a prospective randomized study. *HPB* 2014;16:713-722.