Clinics in Surgery

Research Article
Published: 24 Jul, 2020

Modified Pancreatojejunostomy in Robotic Pancreaticoduodenectomy for Patients with High Risk of Postoperative Pancreatic Fistula

Aimin Li[1,2], Junzhou Chen[1#], Jin Lv[1#], Xiang Liu[1] and Quanda Liu[1]**

[1]Department of Hepatobiliary Surgery, PLA Rocket Force Characteristic Medical Center, Beijing, China

[2]Department of General Surgery, Beijing Luhe Hospital, Capital Medical University, China

[#]These authors contributed equally to this work

Abstract

Introduction: Robotic Pancreaticoduodenectomy (RPD) is extremely challenging owing to its technical difficulties and high risks of complications, especially postoperative pancreatic fistula. The Pancreaticojejunostomy (PJs) is the crucial procedure in PD. Given this, we sought to develop a new and safe PJs named as se-drained pancreaticojejunostomy to reduce postoperative pancreatic fistula. We report a mini review on the potentiality of reducing postoperative pancreatic fistula of the se-drained pancreaticojejunostomy in three cases of robotic pancreaticoduodenectomy.

Methods: Patients with periampullary lesions underwent a modified pancreaticojejunostomy in total robotic pancreaticoduodenectomy under the da Vinci S robotic surgical system. A tube was inserted into the pancreatic duct as a stent; pancreatic fluid was drained externally through the jejunal loop by using the stent-like tube with an interval of approximately 0.5 cm maintained to separate the jejunal loop and the pancreatic stump. We called this separately drained pancreaticojejunostomy as se-drained pancreaticojejunostomy. The external drainage tube was removed about three months after the operation, and the pancreatic fluid was discharged into the jejunum through the organically formed canal between the pancreatic stump and the jejunal loop. The main observable variables are 90-day morbidity, mortality, readmission and reoperation. The long-term follow-up was performed and the Disease-Free Survival (DFS) and the postoperative Overall Survival time (OS) was calculated.

Results: All the three patients recovered uneventfully without reoperation or any serious complication. The patient in case 1 was diagnosed lung metastasis 5 months and dead 11 months after surgery due to lung metastasis and pneumonia. The patient in case 2 was diagnosed liver metastasis 10 months after surgery and loss of follow-up after then. The patient in case 3 is still alive and followed up for more than 82 months, who was diagnosed liver metastasis 68 months after surgery.

Conclusion: The se-drained pancreaticojejunostomy can greatly simplify the procedure of pancreaticojejunostomy and reduce the risk of postoperative pancreatic fistula and reoperation.

Keywords: Pancreaticoduodenectomy; Pancreaticojejunostomy; Robotic surgery; Postoperative pancreatic Fistula; Minimally invasive surgery

OPEN ACCESS

Correspondence:
Aimin Li, Department of General Surgery, Beijing Luhe Hospital, Capital Medical University, 82 Xinhua South Road, Tongzhou District, Beijing 100149, China, Tel: 86-10-69543901; E-mail: liaimin53@163.com
Quanda Liu, Department of Hepatobiliary Surgery, PLA Rocket Force Characteristic Medical Center, 16 Xinjiekouwai Street, Xicheng District, Beijing 100088, China, Tel: 86-10-66343020; E-mail: liuquanda@sina.com

Received Date: *01 Jun 2020*
Accepted Date: *03 Jul 2020*
Published Date: *24 Jul 2020*

Citation:
Li A, Chen J, Lv J, Liu X, Liu Q. Modified Pancreatojejunostomy in Robotic Pancreaticoduodenectomy for Patients with High Risk of Postoperative Pancreatic Fistula. Clin Surg. 2020; 5: 2876.

Introduction

As we all know, pancreaticoduodenectomy (Whipple procedure) has a high risk of complications with a morbidity rate of 30% to 40% and a mortality rate of about 2% to 3%, [1,2] even though there have been remarkable advancements in surgical techniques and equipment. The most serious complication of pancreaticoduodenectomy is Postoperative Pancreatic Fistula (POPF), which is associated with formation of intra-abdominal abscesses, hemorrhage, sepsis and even death, and consequently an increased length of hospital stays and costs, which is the major contributor to reoperation and mortality [3-6]. Although robotic pancreaticoduodenectomy has been developed substantially in recent years, it is still restricted by the complexity of operation and postoperative complications [7-10]. Therefore, we attempted to make a mini review on a novel surgical procedure named "se-drained pancreaticojejunostomy" in robotic pancreaticoduodenectomy to simplify

the PJs and decrease the risk of complications. The principle of the procedure was to avoid contact between pancreatic fluid and other digestive juices before anastomotic wound healing in conventional PJs and to reduce the risk of pancreatic fistula.

Methods

Patients included

All patients were informed about the possible advantages and disadvantages of RPD and the novel pancreaticojejunostomy method and gave written informed consent for the operation. Three patients with periampullary lesions were included and underwent robotic pancreaticoduodenectomy under the da Vinci surgical system (Intuitive Surgical Inc. Sunnyvale, California). Case 1 and case 2 experienced severe obstructive jaundice before operation, whereas case 3 did not accompanied with jaundice.

Surgical procedure

The docking, mobilization and dissection were performed using a coagulation hook or an ultrasonic scalpel as described previously [7]. Case 1 and 2 did not have pylorus preserved in digestive tract reconstruction, while case 3 had the pylorus preserved as per Child's procedure. Instead of direct pancreaticojejunostomy, we used an external draining tube in the Main Pancreatic Duct (MPD) at a small distance about 0.5 cm to the jejunum, and then guided the tube through the proximal jejunum, and drained the pancreatic fluid externally (Figure 1).

The PJs were performed using a modified method named se-drained pancreaticojejunostomy. Briefly, the pancreatic remnant was mobilized by 1.0 cm to 1.5 cm from the cut surface of the pancreas. Homeostasis of the pancreatic stump was achieved using bipolar electrocoagulation or suturing. The MPD was dissected using cold scissors. A support 6Fr to 8Fr silicon tube with a few side holes was inserted in the MPD to act as the external stent and was fixed by purse-string sutures with 4-0 Vicryl (Ethicon, Sommerville, NJ, USA). The size of the support tube depended on the diameter of the MPD. A small opening was cut with a coagulation hook in the jejunum at the opposite side of the MPD. The jejunal loop was drawn close to the pancreatic stump: An interval (approximately 0.5 cm) was set between the jejunal wall and the pancreatic stump, which was connected with the drainage tube placed in the main pancreatic duct and the jejunal lumen.

The tube was then pulled out of the jejunum through another hole; the length of the tube inserted in the jejunal lumen was approximately 5 cm. Both holes of the jejunum were closed and fixed by purse-string suturing using 4-0 Vicryl. The hole of the jejunum adjacent to the pancreatic stump was stitched by purse-string sutures in order to prevent intestinal leakage and fix the tube. Subsequently, the superior part of pancreatic stump and the seromuscular layer of the adjacent jejunum were sewed together by one or two transpancreatic U-suture technique devised by Blumgart et al. [11]. Using 4-0 polypropylene (Prolene; Ethicon, Inc., NJ) and the same went for the inferior part of the pancreatic stump and the adjacent jejunum (Figure 2 and 3).

After PJ, a hepaticojejunostomy and gastrojejunostomy were subsequently performed approximately 10 cm and 50 cm downstream from the PJ respectively as described previously [7]. Two drainage tubes were placed at the posterior of the hepaticojejunostomy and anterior of the pancreaticojejunostomy, respectively. Amylase of the abdominal drainage fluid was measured for diagnosis of POPF.

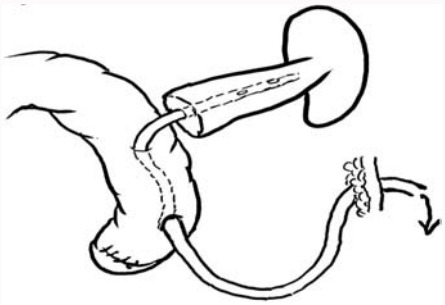

Figure 1: A diagram of stent-drained and separated pancreaticojejunostomy (se-drained pancreaticojejunostomy) in RPD.

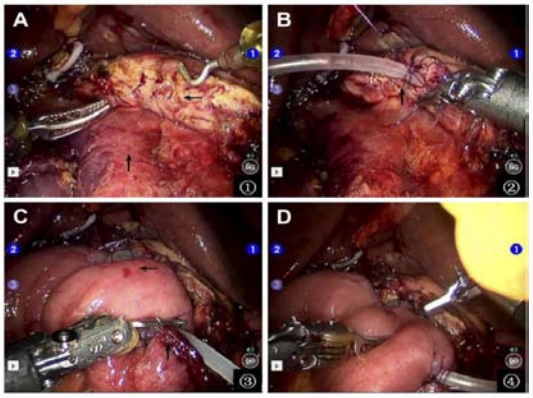

Figure 2: Photographs during the operation in Case 3. A) The pancreatic stump (←) and superior mesenteric vein (↑); B) indwelling of the external tube into the main pancreatic duct, purse-string suture of the orifice, and fixture of the tube (↑); C) insertion of the external tube into the jejunal loop 5 cm away from the blind end (←) and withdrawing the end after moving through the jejunum (↑); D) the interval suture of the back wall of the pancreas and the jejunal wall and purse-string suture of the two ends of the jejunum combined with fixture of the tube.

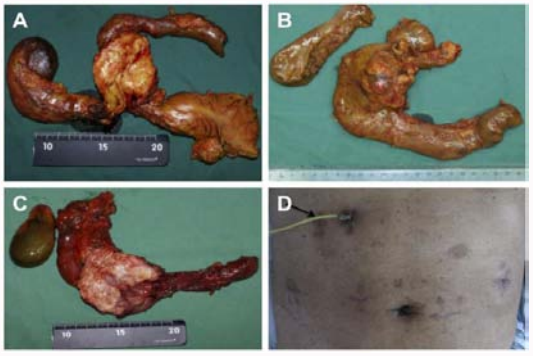

Figure 3: Samples from each of the 3 cases. A) Case 1; B) Case 2; C) Case 3; D) the abdominal scar and pancreatic external tube (arrow) 4 weeks after RPD in Case 3.

The term pancreaticojejunostomy might not be accurate for our surgical procedures, because we did not perform a conventional anastomosis of the pancreatic stump with the jejunum; instead, we adopted a stenting tube and maintained a small interval (about 0.5 cm) between the pancreatic stump and the jejunum to separate the jejunum and the pancreatic stump, avoiding the mixture of pancreatic fluids and intestinal fluids. Nonetheless, we have used the term pancreaticojejunostomy, so that this new surgical technique can be easily understood.

Table 1: Three Patients' Demographics and Intraoperative Characteristics.

Characteristics	Case 1	Case 2	Case 3
Date of surgery	09-Feb-13	31-May-13	01-Jul-13
Gender	F	M	M
Age (y)	61	60	63
Preoperative TBil (μmol/L)	260.8	286.3	5
Preoperative DBil (μmol/L)	199.4	212.7	1.2
Preoperative albumin level (g/L)	48.8	39.5	40.7
Operation time (min)	340	310	390
EBL (mL)	100	100	500
Blood transfusion (mL)	0	0	0
Conversion to OPD	No	No	No

TBil: Total Bilirubin; DBil: Direct Bilirubin; EBL: Estimated Blood Loss; OPD: Open Pancreatico duodenectomy

Follow-up and complications

All the patients were followed up closely after surgery.

The overall complications were defined according to the Clavien-Dindo classification, whereby the major complications were classified as Grade ≥ III [12]. Pancreatic fistula was defined by the International Study Group on Pancreatic Fistula (ISGPF) in 2005 [5] and was revised in 2016 [6]. POPF grade B and C are considered to be Clinically Relevant-POPF (CR-POPF). The biliary fistula was defined as bile components existing in the abdominal drainage for which the high level of total bilirubin continued at day 3 postoperatively. The Chylous fistula was defined as a milky bodily leakage or triglyceride contents exceeding 110 mg/dl of the peritoneal drainage fluid. The delayed gastric emptying was defined as a gastric tube given for 7 or more days after the operation or was confirmed by the digestive tract angiography. 90-day mortality was defined as the death of the patient during hospitalization or within 90 days postoperatively.

The main observable variables are 90-day morbidity, mortality, readmission and reoperation. The postoperative survival was calculated.

Results

The demographic and pathological characteristics of the 3 patients are summarized in Table 1. The patients included 2 men and 1 woman with a mean age of 61 years. All the three patients were treated with antibiotics, rehydration, and intravenous nutrition in the early period after surgery, encouraged to move and get out of the bed as early as possible. The blood glucose levels were normal during the follow-up period. The volumes of externally drained pancreatic fluid increased gradually and became stable at 400 mL to 600 mL one week after pancreaticoduodenectomy (Figure 4), and then decreased after the formation of the canal.

The gastric feeding tubes were removed at day 5 to 7 after surgery. All the patients had no indwelling jejunal feeding tubes and resumed normal diets when the gastrointestinal function recovered. No obvious infections, abdominal discomfort, or significant increase of amylase in the abdominal drainage fluids was noted in all three patients. Bile leakage was observed in case 1. Postoperative computed tomography scan also revealed a small volume of fluids and encapsulated effusion in case 1, which was self-absorbed in 6 weeks (Figure 5). Case 2 recovered smoothly without any abnormal computed tomography findings (Figure 6). After pull out of gastric tube and gradually added diet, chylous fistula was observed in case 3, which was recovered

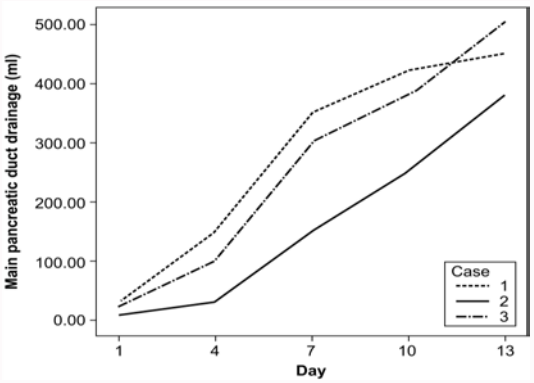

Figure 4: Changes in the volume of postoperative drainage from the main pancreatic duct in the 3 cases.

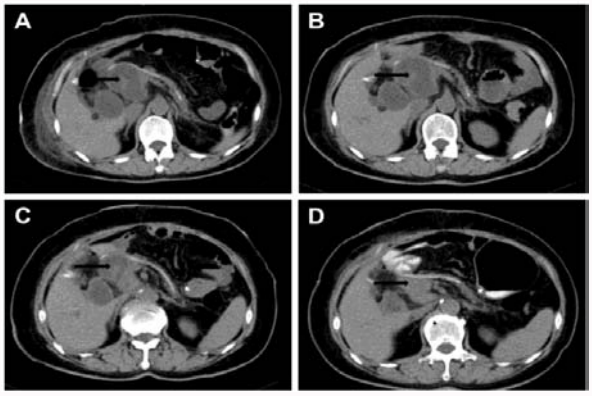

Figure 5: A small amount of bile leakage and formation of encapsulated effusions (arrow) is visible on computed tomography in Case 1, which were self-absorbed after 6 weeks. A) 1 week after RPD; B) 2 weeks after RPD; C) 4 weeks after RPD; D) 6 weeks after RPD.

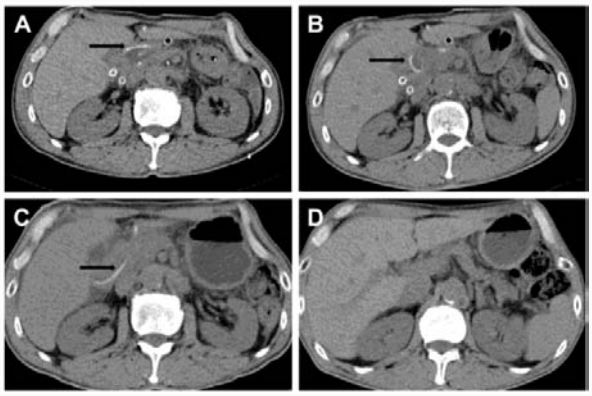

Figure 6: The external tube (arrow) as seen on computed tomography in Case 2. A) 1 week after RPD; B) 2 weeks after RPD; C) 4 weeks after RPD; D) 4 months after RPD.

slowly without any intervention therapy. Case 3 also had accidental extubating of the external stent and then small intestinal fistula and local peritonitis 86 days (about 3 months) after the operation, which was controlled by conservative treatment one week (Figure 7). The pancreatic duct drainage tube was intermittently clipped 2 or 3 weeks after surgery, and pulled out two or three months later.

The Length of hospital Stays (LOS) of the three patients was 18,

Table 2: Postoperative outcomes.

Characteristics	Case 1	Case 2	Case 3
Postoperative Pathological Diagnoses	Poorly differentiated adenocarcinoma of pancreas	Moderately differentiated adenocarcinoma of pancreas	Duodenal carcinoid tumor
R0 resection	Yes	Yes	Yes
Morbidity			
Clavien 1–2	Yes	No	Yes
Clavien ≥ 3	No	No	No
Bile leakage	Yes	No	No
Chylous fistula	No	No	Yes
Delayed gastric emptying	No	No	No
POPF	No	No	No
LOS (d)	18	19	47
90-day readmission	No	No	No
90-day mortality	No	No	No
Reoperation	No	No	No
Follow-up			
DFS (months)	5	10	68
Metastasis Site	Lung	Liver	Liver
OS (months)	11	lost fellow-up	82

POPF: Postoperative Pancreatic Fistula; LOS: Length of Hospital Stay; DFS: Disease Free Survival; OS: Overall Survival

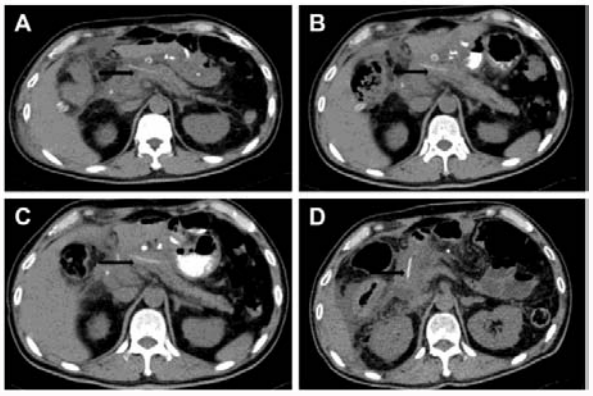

Figure 7: The external tube (arrow) as seen on computed tomography in Case 3. A) 1 week after RPD; B) 2 weeks after RPD; C) 4 weeks after RPD; D) a small amount of leakage and local peritonitis caused by accidental extubating 86 days (about 3 months) after RPD, which was treated with conservative treatment for 1 week.

19, and 47 days respectively. And no grade ≥ III complications and 90-day mortality were observed. Postoperative pathology showed that all the patients received R0 resection. Data were summarized in Table 2.

In all the cases, the pancreatic supporting tube was removed two to three months after pancreaticoduodenectomy. Thereafter, a natural anastomotic canal formed organically for the pancreatic fluid entering the jejunum. All the patients regained their normal diet and bowel movements without any discomfort in the follow-up period.

All the three patients were followed up closely. The patient of case 3 is still alive, followed up for more than 82 months, who was diagnosed liver metastasis 68 months after surgery. The patient of case 1 was diagnosed lung metastasis 5 months and dead 11 months after surgery due to pneumonia and lung metastasis. The patient of case 2 was diagnosed liver metastasis 10 months after surgery and lost to follow up after then.

Discussion

Pancreaticoduodenectomy is still the first-line treatment for pancreatic head carcinoma, primary malignant duodenal tumors, and periampullary carcinoma [13]. In earlier years, pancreaticoduodenectomy was normally performed in two stages: (1) the first was to establish an anastomosis between the gallbladder and the stomach or the jejunum to eliminate jaundice and (2) then it was followed by the resection of the pancreaticoduodenal complex. Some pioneers preferred non-simultaneous pancreaticoenterostomy and simply maintained the pancreatic stump in place by pancreatic duct ligation, which not only prevented the development of the pancreatic fistula but also protected the endocrine functions of the pancreas [14-17]. Previously, Sauve et al. accomplished a one-stage radical pancreaticoduodenectomy combined with resection of the pancreatic head and placed the pancreatic stump near the wounds of the abdominal wall, which was conducive to the external pancreatic fistula [18]. Since then, a fact has been generally acknowledged that the mixture of pancreatic fluid and bile or gastrointestinal fluids is more likely to trigger uncontrolled anastomotic fistula, autolysis, bleeding and infections. Thus, that was why the easiest methods to prevent POPF lies in the closure, isolation, and maintenance of the pancreatic stump or a simple external drainage placement [14].

Through centralization, refinements in techniques and advances in perioperative management, mortality has dropped below 5%. Nevertheless, morbidity remains 30% to 40%, with failure of the pancreatic anastomosis as the most feared complication [1,2]. The pancreatic anastomosis is therefore considered to be the 'Achilles heel' of pancreatoduodenectomy. The technique in dealing with the Pancreaticoenterostomy (PE) technique is a vital factor in the management of PD procedures. Several pancreatic anastomosis techniques have been brought forward and practiced as an alternative for this concern, such as end-to-end invaginated PE, duct-to-mucosa PE, conventional end-to-side inserting PE, and

pancreaticogastrostomy [19]. Despite all this, there is no widespread agreement on the pancreatic anastomotic technique which can prominently minimize the high risks of CR-POPF and its latent complications [20-21]. Whereupon a simplified anastomotic technique would be desired, which can be easily grasped and performed in any surgical context with different pancreatic duct sizes and textures.

In our performance, we did not repeat pancreaticojejunostomy but externally drained the pancreatic duct through the jejunal loop when our patients needed reoperation for pancreatic fistula and abdominal infections after the traditional open pancreaticoduodenectomy. We also successfully treated pure external pancreatic fistula resulting from long-term pancreatic injuries by end-to-side fistulojejunostomy. Thus, our experience reminded that the pancreatic leakage or pancreatic fistula is not harmful, provided the pancreatic fluid is not mixed with other digestive liquids and the digestive enzymes are not stimulated to destruct tissues. An isolated leakage of pancreatic fluid could form pseudocysts and be self-absorbed or treated by simple percutaneous drainage; and the pseudocysts are not fatal or difficult to manage, as shown in our experience in case 1.

Gagner et al. [22] attempted the first laparoscopic Whipple procedure in 1994, but the value of Minimally Invasive Pancreatic Surgery (MIPS) is still debated due to the complicated surgical procedures, high open conversion rate, long operation time, and high incidence of complications. Minimally Invasive Pancreaticoduodenectomy (MIPD) is a demanding surgical procedure, thus limiting its wide application and clinical proficiency amongst Hepato-Pancreatico-Biliary (HPB) surgeons. However, the robotic pancreaticoduodenectomy can make compensation for the shortcomings from three highlighted features including improved dexterity, 3D visualization and minimizing surgeon fatigue. In 2003, Giulianotti et al. [23] first reported RPD in the treatment of benign and malignant pancreatic diseases. In view of unsatisfactory results in early time, they used gel embolization of the pancreatic duct in RPD for 8 patients who were unavailable to undergo pancreaticojejunostomy, in order to terminate the exocrine function of the pancreas, which is similar to the principle of remaining of the stump in place after pancreatic duct ligation [23-25]. Zeh et al. practiced gel embolization as well and obtained a good prognosis on survival and long-term efficacy [26]. However, the conventional pancreaticojejunostomy is still adopted in robotic surgery in some medical centers and institutions [27].

From February 2009 to October 2013, we performed 459 robotic surgeries in all types including 73% of HPB complex among 326 robotic abdominal cases. Through our experience of 24 robotic Whipple procedures including 2 patients who had POPF and needed reoperation. Pancreaticojejunostomy is the biggest obstacle restricting the rapid development of RPD in practice. Thus, an easier and secure procedure to perform pancreaticojejunostomy is required. An ideal anastomosis technique for PE should be easy to perform in any pancreatic duct size and pancreatic texture and induce a low rate of CR-POPF [21]. As so far, most frequently used methods are duct-to-mucosa and end-to-side PJs. Recently a single-layer continuous anastomosis was proposed for RPD and received beneficial outcomes [28].

We obtained satisfactory outcomes after using se-drained pancreaticojejunostomy in robotic pancreaticoduodenectomy. None of the patients experienced postoperative pancreatic fistula and its related hemorrhage and infections. Case 3 developed local peritonitis after operation due to an accidental extubating of the pancreatic draining tube and consequently a slight leakage of intestinal fluids from the jejunal loop. However, the patient recovered soon with conservative treatment. Therefore, we were more confident about the minimal complications during the early and late postoperative periods and found that se-drained pancreaticojejunostomy could make pancreaticojejunostomy easier and safer and could develop into a more applicable surgical procedure for robotic anastomosis. And further improvement of specialized tubes and standardized procedures is certainly demanded.

This ingenious method is particularly suitable for the patients with high risk of postoperative pancreatic fistula. The pancreatic drainage tube plays a supporting and fixing role with the aim to reduce the shearing stress of the continuous running sutures on the soft pancreatic tissues in traditional pancreaticojejunostomy. The external drainage of the pancreatic fluid is aimed to eradicate the mixture of the pancreatic juice, bile and intestinal fluid, which effectively avoids the activation of the pancreatic fluid and reduces the risk of POPF and the relevant complications. At the meantime, this method has shortcomings in two concerns: On the one hand, the exudation of the pancreatic fluid at the cutting edge of the pancreas may accumulate and develop into local encapsulated effusion; on the other hand, the supporting pancreatic drainage tube needs long-term care and there is a risk of accidental traction and loosening of the tube. In general, this strategy is simple and effective and not only decreases the occurrence of the postoperative pancreatic fistula but also improve the safety of the robotic pancreatoduodenectomy. Moreover, as our long-term follow-up results illustrated that, the organically formed drainage canal is beneficial and potential.

To our knowledge, this is the first exploration of se-drained pancreaticojejunostomy in RPD. This report highlights the advantages of this simple, safe, effective, and beneficial technique for the modification of pancreaticojejunostomy in Whipple procedures.

Our initial experience in the three cases described here elucidates that pancreatic fistula and consequent infection, hemorrhage, and reoperation could be effectively controlled by avoiding mixture of the pancreatic fluid and other digestive fluids in the early phase of anastomosis or wound healing after pancreaticoduodenectomy. The achievement of this pioneering attempt on the se-drained pancreaticojejunostomy will further encourage researchers to explore a new dimension to perform robotic pancreaticojejunostomy.

Conclusion

We propose a novel technique of PJ named as se-drained pancreaticojejunostomy that simplifies and facilitates the PJ procedure for RPDs, which can greatly simplify the procedure of pancreaticojejunostomy and reduce the risk of postoperative pancreatic fistula. However, further high-quality Randomized Controlled Trials (RCTs) are needed in the future to validate this recommendation.

Acknowledgment

We sincerely thank our robotic surgery group for their hard work. As you see in Figure 1, Prof. Ningxin Zhou illustrated the se-drained pancreaticojejunostomy graphically and performed the operations. This paper is to deeply honor the memory of Prof. Zhou.

Funding

This study was supported by National Key Research and Development Program of China (2017YFC0110405).

References

1. Donahue TR, Reber HA. Surgical management of pancreatic cancer--pancreaticoduodenectomy. Semin Oncol. 2015;42(1):98-109.
2. Cameron JL, He J. Two thousand consecutive pancreaticoduodenectomies. J Am Coll Surg. 2015;220(4):530-6.
3. Kamarajah SK, Bundred JR, Marc OS, Jiao LR, Hilal MA, Manas DM, et al. A systematic review and network meta-analysis of different surgical approaches for pancreaticoduodenectomy. HPB (Oxford). 2020;22(3):329-39.
4. Reid-Lombardo KM, Farnell MB, Crippa S, Barnett M, Maupin G, Bassi C, et al. Pancreatic Anastomotic Leak Study Group. Pancreatic anastomotic leakage after pancreaticoduodenectomy in 1,507 patients: A report from the Pancreatic Anastomotic Leak Study Group. J Gastrointest Surg. 2007;11(11):1451-8.
5. Bassi C, Dervenis C, Butturini G, Fingerhut A, Yeo C, Izbicki J, et al. Postoperative pancreatic fistula: An International Study Group (ISGPF) definition. Surg. 2005;138(1):8-13.
6. Bassi C, Marchegiani G, Dervenis C, Sarr M, Abu Hilal M, Adham M, et al. The 2016 update of the International Study Group (ISGPS) definition and grading of postoperative pancreatic fistula: 11 Years After. Surgery. 2017;161(3):584-91.
7. Zhou NX, Chen JZ, Liu Q, Zhang X, Wang Z, Ren S, et al. Outcomes of pancreatoduodenectomy with robotic surgery versus open surgery. Int J Med Robot. 2011;7(2):131-7.
8. Shyr BU, Shyr BS, Chen SC, Chang IW, Shyr YM, Wang SE. Operative results and patient satisfaction after robotic pancreaticoduodenectomy. Asian J Surg. 2020;43(4):519-25.
9. Shi Y, Wang W, Qiu W, Zhao S, Wang J, Weng Y, et al. Learning curve from 450 cases of robot-assisted Pancreaticoduodenectomy in a high-volume pancreatic center: Optimization of operative procedure and a retrospective study. Ann Surg. 2019.
10. Yan Q, Xu LB, Ren ZF, Liu C. Robotic versus open pancreaticoduodenectomy: A meta-analysis of short-term outcomes. Surg Endosc. 2020;34(2):501-9.
11. 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):54-9.
12. Clavien PA, Barkun J, De Oliveira ML, Vauthey JN, Dindo D, Schulick RD, et al. The clavien-dindo classification of surgical complications: Five-year experience. Ann Surg. 2009;250(2):187-96.
13. Kim HS, Han Y, Kang JS, Kim H, Kim JR, Koon W, et al. Comparison of surgical outcomes between open and robot-assisted minimally invasive pancreaticoduodenectomy. J Hepatobiliary Pancreat Sci. 2018;25(2):142-9.
14. Schnelldorfer T, Adams DB, Warshaw AL, Lillemoe KD, Sarr MG. Forgotten pioneers of pancreatic surgery: Beyond the favorite few. Ann Surg. 2008;247:191-202.
15. Kausch W. Das carcinom der paplla duodeni und seine radikale entfeinung. Betr Z. Clin Chir. 1912;78:439-86.
16. Whipple AO, Parsons WB, Mullins CR. Treatment of carcinoma of the ampulla of vater. Ann Surg. 1935;102(4):763-79.
17. Whipple AO. Pancreaticoduodenectomy for islet carcinoma: A five-year follow-up. Ann Surg. 1945;121:847-52.
18. Sauve L. Des pancreatectomies ET specialement de lapancreatectomie cephalique. Rev Chir. 1908;37:113-53.
19. Kawaida H, Kono H, Hosomura N, Amemiya H, Itakura J, Fujii H, et al. Surgical techniques and postoperative management to prevent postoperative pancreatic fistula after pancreatic surgery. World J Gastroenterol. 2019;25(28):3722-37.
20. Xu J, Ji SR, Zhang B, Ni QX, Yu XJ. Strategies for pancreatic anastomosis after pancreaticoduodenectomy: What really matters? Hepatobiliary Pancreat Dis Int. 2018;17(1):22-6.
21. Bai X, Zhang Q, Gao S, Lou J, Li G, Zhang Y, et al. Duct-to-mucosa *vs.* invagination for pancreaticojejunostomy after pancreaticoduodenectomy: A prospective, randomized controlled trial from a single surgeon. J Am Coll Surg. 2016;222(1):10-8.
22. Gagner M, Pomp A. Laparoscopic pylorus-preserving pancreatoduodenectomy. Surg Endosc. 1994;8(5):408-10.
23. Giulianotti PC, Coratti A, Angelini M, Sbrana F, Cecconi S, Balestracci T, et al. Robotics in general surgery: Personal experience in a large community hospital. Arch Surg. 2003;138(7):777-84.
24. Giulianotti PC, Sbrana F, Bianco FM, Elli EF, Shah G, Addeo P, et al. Robot-assisted laparoscopic pancreatic surgery: Single-surgeon experience. Surg Endosc. 2010; 24(7):1646-57.
25. Buchs NC, Addeo P, Bianco FM, Gangemi A, Ayloo SM, Giulianotti PC. Outcomes of robot-assisted pancreaticoduodenectomy in patients older than 70 years: A comparative study. World J Surg. 2010;34:2109-14.
26. Zeh HJ, Zureikat AH, Secrest A, Dauoudi M, Bartlett D, Moser AJ. Outcomes after robot-assisted pancreaticoduodenectomy for periampullary lesions. Ann Surg Oncol. 2012;19(3):864-70.
27. Nguyen KT, Zureikat AH, Chalikonda S, Bartlett DL, Moser AJ, Zeh HJ. Technical aspects of Robotic-Assisted Pancreaticoduodenectomy (RAPD). J Gastrointest Surg. 2011;15(5):870-5.
28. Liu Q, Zhao Z, Gao Y, Zhao G, Tan X, Wang C, et al. Novel single-layer continuous suture of pancreaticojejunostomy for robotic pancreaticoduodenectomy. J Hepatobiliary Pancreat Sci. 2020;27(2):56-63.