

Duct-to-Mucosa Pancreaticojejunostomy with Less Serosal Stitches: A Different Approach to Well-known Problem

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ABSTRACT

Objective: To describe a new approach (duct-to-mucosa pancreaticojejunostomy with less serosal stitches) for postoperative pancreatic fistula (POPF) in pancreaticoduodenectomy.

Study Design: An observational study.

Place and Duration of Study: Tepecik Training and Research Hospital, Izmir, Turkey, between January 2019 and May 2020.

Methodology: Medical records of 45 patients, who underwent pancreaticoduodenectomy by the same general surgeon between January 2019 and May 2020, were reviewed retrospectively. Pylorus-preserved pancreaticoduodenectomy was performed for all patients. Duct-to-mucosa PJ with less serosal suture technique was used for all patients in reconstruction after pancreaticoduodenectomy. Definition of the ISGPS was used for the POPF and only grade B and C fistulas were accepted as clinically relevant POPF. Here, the descriptive measures were reported.

Results: Seventeen (17) of the forty-five (45) patients were females and median age was sixty-six (66) years. The majority of the underlying disease was pancreatic adenocarcinoma. Hyperbilirunemia was seen in 15 patients. Median operation time was 360 minutes. Number of patients with pancreatic duct size <3 mm was five. Rate of soft pancreas texture was 33.3%. Lastly, the number of patients that underwent vascular resection or additional organ resection were 6 (13.3%) and 8 (17.8%), respectively. Clinically relevant POPF according to ISGPS was seen in 6 patients (grade B:4 and grade C:2). The most prevalent postoperative complication was surgical site infection at a rate of 40%. There was no POPF related mortality.

Conclusion: Two-layer duct-to-mucosa pancreaticojejunostomy with less serosal stitches technique has acceptable pancreatic fistula rates. This technique could be used by surgeons who are faced with challenges with the duct-to-mucosa anastomosis due to aforementioned causes. Large multi-centre randomised future studies are required to confirm these findings.

Key Words: Postoperative pancreatic fistula, Surgical technique, Duct-to-mucosa pancreaticojejunostomy, Less serosal stitches.

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INTRODUCTION

Pancreaticoduodenectomy is widely used as a standard treatment for many benign or malignant lesions located in the periampullary or pancreas head region. Advances in the surgical technique and perioperative management helped reduce mortality rates by about 5%; however, clinically relevant postoperative pancreatic fistula (POPF) and its complications are still the most troublesome.¹ Depending on the definition used, POPF rates range between 5-40% in the literature.^{2,3} POPF potentially contributes to intra-abdominal abscesses, hemorrhage, sepsis and mortality. Many refinements of procedures have been introduced to prevent the POPF.^{1,4}

Technical and surgical risk factors, defined for development of POPF, may be summarised as small main pancreatic duct (≤ 3 mm), soft pancreas, posterior location of the main duct, underlying disease pathology, (non dilated pancreatic duct), decreased pancreatic blood supply of the pancreatic cut surface and surgical experience.⁵ Among them, surgical technique, blood supply of the pancreas cut surface, and surgical experience can be isolated as modifiable risk factors.

In literature, 61 different pancreas anastomosis techniques are defined until now.¹ According to the position statement by the International Study Group of Pancreatic Surgery (ISGPS) recently, the most frequently used reconstruction technique after pancreaticoduodenectomy is pancreaticojejunostomy (PJ) with utilisation rate of 88.7%.⁶ Anastomosis between the pancreatic stump and the jejunum can be performed by using various techniques ranging duct-to-mucosa or invagination either end-to-end or end to side. Duct-to-mucosa technique is extensively used for PJ anastomosis.^{6,7} Variety and heterogeneity of the anastomosis techniques make it challenging to compare them against each other in terms of superiority (or inferiority) on outcomes of different reconstruction techniques.

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In situations like thin and soft pancreatic tissue, posterior location of the pancreatic main duct and edema of the jejunal segment due to prolonged operation time, after posterior serosal suture, performing the duct-to-mucosa PJ anastomosis becomes very difficult, or even impossible. Furthermore, a well-known, important factor for the duct-to-mucosa PJ is impaired blood supply of the pancreas cut surface. It adversely affects the outcomes of the duct-to-mucosa PJ. The technique described in this study (the duct-to-mucosa PJ with less serosal stitches) is a novel approach to overcome above-mentioned, unresolved problems and challenging situations suggested by a transplant surgeon in his early career of hepatopancreaticobiliary surgery.

The aim of this study was to determine the results of patients with POPF, who underwent duct-to-mucosa PJ with less suture.

METHODOLOGY

Medical records of consecutive 45 patients, who underwent pancreaticoduodenectomy at Tepecik Training and Research Hospital, Izmir, Turkey, by the same general surgeon between Jan 2019 and May 2020, were reviewed retrospectively. Pylorus preserved pancreaticoduodenectomy was performed for all patients. Additional organ or vascular resections were performed for eight patients (17.8%) and six patients (13.3%), respectively. Duct-to-mucosa PJ with less serosal suture technique was used for all patients in reconstruction after pancreaticoduodenectomy.

Demographic data of the patients (age, gender, comorbidities and alike) and perioperative data (texture of the pancreas, size of pancreatic duct, duration of the operation, use of pancreatic stent and alike) and postoperative follow-up (POPF, delayed gastric emptying morbidities, amylase level of drain liquid, hospital stay, mortality within PO 30 days and alike) were documented in detail. Drain amylase levels were checked at PO 0 and 3 day in all patients.

Octreotide was not used for prophylaxis of POPF. Additionally, topical application of the fibrin glue or omental wrapping technique was not used.

Definition of the ISGPS was used for the POPF and only grade B and C fistulas were accepted as clinically relevant POPF.^{8,9} Pancreatic main duct size was categorised into three parts: less than 3mm, between 3 and 8 mm, and larger than 8 mm. Pancreatic gland texture was also defined as soft/normal or hard/fibrotic. The degree of pancreatic margin mobilisation was measured intraoperatively with a sterile ruler from the tip of the divided pancreas to the limit of the fully mobilised pancreatic parenchyma on its posterior aspect.

All the operations were performed by the same transplant surgeon in his early career of hepatopancreaticobiliary surgery. In all cases, anastomosis were performed by using a 2.5 times magnified surgical loop. All the procedures were performed on the same manner and the surgical procedure was not modified during the study period. Standard and generally accepted pancreaticoduodenectomy was performed in all

cases. Although the authors usually performed pylorus preserved pancreaticoduodenectomy depending on the preoperative observations; but for advanced cases, the authors performed classic pancreaticoduodenectomy.

This study was approved by the local Ethics Committee of Tepecik Training and Research Hospital, Izmir, Turkey.

The data were assessed by using the SPSS version 22.0 (SPSS, Chicago, IL). Only descriptive measures (numbers, percentages, median, minimum and maximum) were reported due to lack of control group in this study, as the main purpose of this study is to describe a surgical technique.

A scalpel was used to sharply transect the pancreas at the left site of the portal vein. In some cases, WATSA procedure was performed to ensure R0 surgical resection margin. Pancreatic resection margin was sent for frozen section evaluation only for selected cases.

Two-stay hemostatic sutures were never used. After the pancreaticoduodenectomy specimen was removed, hemostasis of the pancreatic stump was achieved by 5/0 non-absorbable sutures or bipolar cautery. Moreover, pancreas remnant was not dissected free extensively (2-3 cm) from the retroperitoneum and splenic vein, but it is mobilised only approximately just 1 cm to ensure the outer layer stitches.

Transected jejunum is prepared in an antecolic manner for tension-free pancreaticojejunostomy and hepaticojejunostomy.

Double needles 5/0 absorbable monofilament suture needle was inserted from the pancreatic duct margin and pancreatic duct wall was observed to go as deep as possible. Additionally, this process should be performed with in-out needle movement and each suture should be held separately with a hemostat. Seven sutures were used with a clockwise pattern at 5,7,3,9,11,12,1 locations, respectively (Figure 1). Then a small, full thickness enterotomy was performed along antimesenteric site, 4-5 cm distal to the jejunal stump. Firstly, clamped sutures at 5,7,3,9 o'clock were respectively placed in an in-out direction through the enterotomy by the full thickness of the jejunum. Note that exit of these sutures should follow their o'clock pattern, if possible. And these sutures were gently tightened after approximation of the pancreatic and jejunal stump. All of the knots were tied on the outside. In all cases, a 15 cm stent was inserted to the pancreatic duct for 1-2 cm deep and remaining length was inserted into enterotomy. The stent should fit loosely because the size of the stent depends on the pancreatic duct size. Then, other remaining sutures at 11,12 and 1 o'clock were placed in-out direction through the enterotomy. To fix the stent, 12 o'clock suture was used. All knots were tied gently. Duct-to-mucosa anastomosis was then completed.

Only two simple interrupted sutures (3/0 absorbable monofilament) were used for the posterior outer layer. Jejunal part was lifted gently from the anterior position and a simple suture was placed between posterior superior and posterior inferior border of the parenchyma of the pancreatic stump and its counterpart of the jejunal seromuscular layer (Figures 2-3).

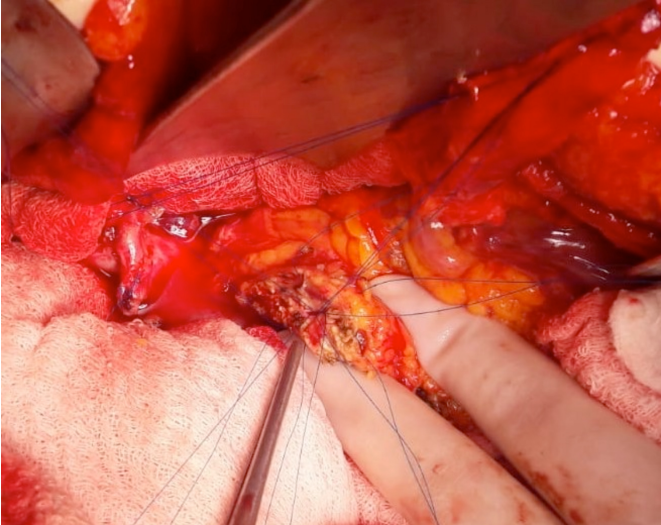


Figure 1: Duct-to-mucosa anastomosis inner layer 3-9-5-7-11-12-1 o'clock sutures.

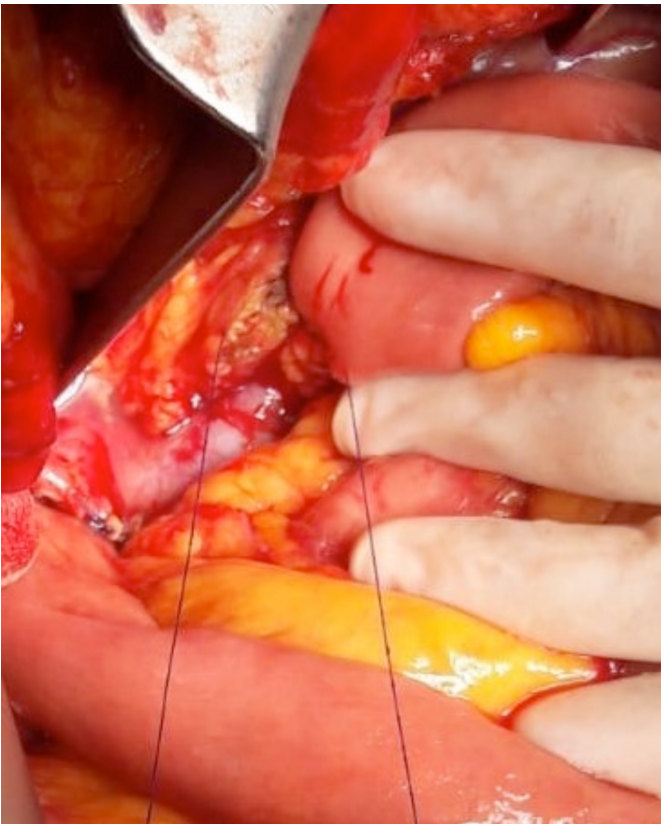


Figure 2: Outerserosal layer posterior superior sutures.

Only three simple interrupted sutures (3/0 absorbable monofilament sutures) were placed for the anterior outer layer. These sutures were placed between anterior superior, middle and anterior inferior part of the parenchyma of the pancreatic stump and its counterparts of the jejunal seromuscular layer (Figure 4). When tying, the knot should be pushed gently not to tear the pancreatic parenchyma.

Hepaticojejunostomy was performed 10-20 cm proximal to the PJ to ensure tension-free anastomosis. Suture technique was resumed with 4/0 absorbable monofilament suture for hepaticoje-

junostomy. Two close simple sutures were placed at the far corner. After tightening these two sutures, they should be tied together. Posterior suture was used on the posterior wall of the anastomosis; and anterior suture was used on the anterior wall of the hepaticojejunostomy. Then they were tied to each other on anterior wall. Additionally, two corner stay sutures were placed between hepatic duct and jejunum to reinforce the anastomosis.

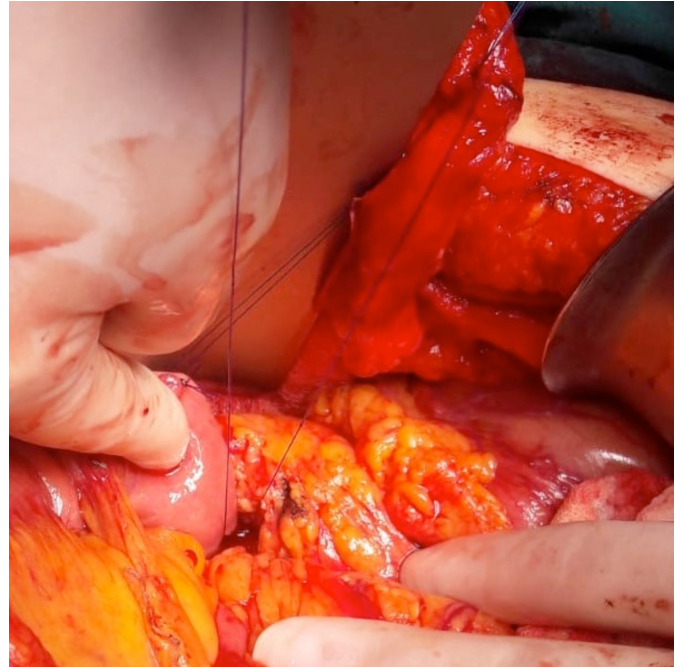


Figure 3: Outerserosal layer posterior inferior sutures.

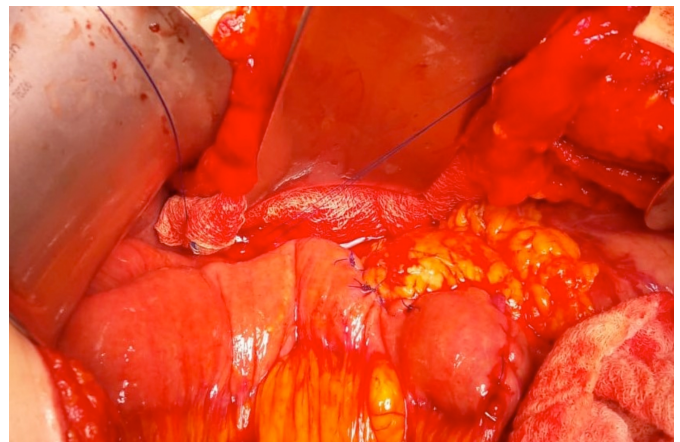


Figure 4: Outerserosal layer anterior sutures.

After checking the viability of the duodenal part, duodenojejunostomy anastomosis was performed approximately 40 cm proximal to the HJ by two layer manner, using 3/0 absorbable monofilament suture.

After the anastomosis were completed, two nelathon drains were routinely placed to facilitate postoperative observation and drainage fluid monitoring. One drain was placed on the right upper abdominal wall by passing posteriorly the HJ to inferior posterior side of the pancreaticojejunostomy anastomosis. The other drain was placed on the left upper abdominal wall to anterior side of the pancreaticojejunostomy anastomosis.

RESULTS

The duct-to-mucosa PJ with less suture technique was performed on 45 consecutive patients, who underwent PD by the same surgeon. Seventeen of the patients were females; and median age was 66 years. The majority of the underlying disease was pancreatic adenocarcinoma. Number of patients with ASA score 3 and 4 were 24 (53.3%) and 2 (4.4%), respectively. Hyperbilirubinemia was seen in 15 patients. Patient characteristics were summarised in Table I.

Distance of pancreatic margin (PM) mobilisation was <1 cm for all cases (PM1). Median operation time was 360 minutes. Number of patients with pancreatic duct size ≤ 3 mm was five (11.1%). Rate of soft pancreas texture was 33.3%. The number of the patients who underwent vascular resection or additional organ resection were 8 (17.8%) and 6 (13.3%), respectively. Pancreatic internal stent during PJ could not be performed for only two patients due to technical problems. Intraoperative data is summarised in Table II.

Clinically, relevant POPF according to ISGPS was seen in 6 patients (grade B:4 patients and grade C:2 patients). The greatest postoperative complication was observed as surgical site infections (40%). There was no POPF related mortality. Postoperative mortality within 30 days was 8.9% (4 patients). The postoperative course and complications are summarised in Table III.

Table I: Demographic data of the patients.

	Number (%)	Median (min - max)
Age		66 (41-86)
Gender:		
Female	17 (37.8)	
Male	28 (62.2)	
ASA score:		
ASA 3	24 (53.3)	
ASA 4	2 (4.4)	
Charlson comorbidity index		6 (1-11)
BMI		26 (20- 35)
History of smoking	22 (48.9)	
Preoperative biliary drainage	15 (33.3)	
Albumin (g/dl)		3.3 (2.0-4.1)
Hemoglobin (g/ dl)		11.5 (7.8- 13.5)
Trombosit (10 ³ *uL)		280 (90 -320)
Lymphocyte (10 ³ *uL)		2.4 (1.0- 3.2)

Table II: Intraoperative data.

	Number (%)	Median (min-max)
Operation technique:		
Pylorus preserved pancreaticoduodenectomy	45 (100)	
Texture of pancreas:		
Soft	15 (33.3)	
Hard	30 (66.7)	
Pancreatic duct size:		
≤ 3 mm	5 (11.1)	
>3 mm	40 (88.9)	
Vascular resection	6 (13.3)	
Additional Organ resections (colon resection, splenectomy)	8 (17.8)	
Operation time (minutes)		360 (210 - 620)

Table III: Postoperative follow-up data.

	Number (%)	Median (min-max)
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POPF		
Grade B	4 (8.9)	
Grade C	2 (4.4)	
Delayed gastric emptying	8 (17.8)	
Bile leak	2 (4.4)	
Gastrojejunostomy leak	2 (4.4)	
Surgical site infection	18 (40)	
Intraabdominal abscess	1 (2.2)	
Re-operation	3 (6.7)	
Hospital stay (days)		12 (7 - 32)
Mortality in postoperative 30 days	4 (8.9)	

DISCUSSION

Pancreatic fistula is one of the unresolved problems after the pancreaticojejunostomy reconstruction.^{2,3} In this study, the rate of clinically relevant pancreatic fistula rate was 6-13 %. This rate is compatible with the literature and it should be reminded that all the procedures were performed by the same surgeon without previous experience on pancreaticoduodenectomy and reconstruction.

Many factors (patient age, obesity, smoking, biliary stenting, neoadjuvant therapy, nutritional status, tissue exture, duct size, type of resection, surgeon volume, blood loss, pathology type, post-op pancreatitis, etc.) associated with the pancreatic fistula formation were reported.⁷ When the present authors focus on peri-operative factors, herein it is realised that the modifiable risk factors are only an extension of the pancreatic remnant mobilisation, site of enteric drainage, operative time, blood loss, perfusion, fluids, use of stent, prophylactic, use of octreotide, and pancreatic anastomosis technique.^{7,9}

Still many hepatobiliary surgeons focus on the modification of reconstruction techniques or sites, although more than 60 pancreas anastomosis techniques have been reported until now.¹

For a technically successful anastomosis, the conditions of tension-free, supply optimal blood flow and unobstructed pancreatic secretion should be obtained.¹⁰ Surgical technique described in the present study is a modification of the two-layered duct-to-mucosa pancreatojejunostomy, using a pair-watch suturing technique; but it contains many modifications to overcome challenging situations, especially like posterior serosal stitches of the duct-to-mucosa anastomosis.¹¹ Furthermore, present study is important to introduce the feasibility of less stitches for both duct-to-mucosa and outer serosal layer during PJ, when compared to the current technique.

Firstly, while applying intraoperative two-layer duct-to-mucosa pancreaticojejunostomy technique, conditions like complicate anastomosis, and make it impossible to coexist. In order to reduce the negative effects of these problems on the application of duct-to-mucosa anastomosis, the authors applied the technique, which was described in detail.

Thin pancreatic tissue, posterior location of the main pancreatic duct, edema of the jejunal segment due to prolonged operation time, soft pancreatic texture, and main pancreatic duct size

<3mm.

There are some important points of this technique and their literature support. Although, some authors suggest that excessive mobilisation (3-4 cm) of the pancreatic remnant is necessary for a tension-free anastomosis during PJ.^{12,13} As previously underlined by Strasberg *et al.*, the authors believe that adequate blood supply to the remnant pancreas is essential and mobilisation of the pancreatic remnant should be kept to a minimum as much as possible. Excessive mobilisation should be avoided. In all cases, the surgeons performed limited mobilisation, a distance <1 cm from tip of the divided pancreas is achieved and stay sutures were never used.

In patients with thin pancreas tissue, posterior location of the pancreatic main duct, soft pancreas texture and edema of the jejunal segment was experienced, making the posterior outer layer sutures in continued or interrupted fashion very challenging and endangered the safe duct-to-mucosa PJ anastomosis. As a result, pancreatic duct sutures were first placed in-out manner, then posterior and lateral jejunal aperture sutures were introduced by in-out manner and finally the sutures were tied. After the introduction of the pancreatic stent, the anterior jejunal secure sutures were completed again by in-out manner and tied. In this way, the identification of the pancreatic duct was ensured. The number of stitches used during the duct-to-mucosa PJ changes, depends on the surgeons.¹³⁻¹⁷ In this technique, only a total of seven stitches were used for duct-to-mucosa anastomosis on 5,7,3,9,11,12,13 o'clock locations.

The outer suture layer is required for protection of detachment of the PJ anastomosis, as previously reported.^{14,18} Running or interrupted suture techniques were generally used for the outer layer of the PJ, prior to inner layer anastomosis. Number of the stitches were commonly more than five.^{16,19-21} Outer layer sutures can be performed after inner layer of the duct-to-mucosa anastomosis was completed.^{14,18} In the present technique, the outer layer anastomosis was completed by using only five stitches for both the side (two stitches for posterior outer layer and three stitches for anterior outer layer) after performing the duct-to-mucosa anastomosis.

Modifiable risk factors for pancreatic fistula are limited and the surgical technique and modifications are one of them. ISGPS position statement suggests that experienced surgeons at high volume centres can decrease the incidence of POPF by using different techniques depending on the intraoperative situations.⁶ The same position statement expresses that: practice and mastery of a standardised technique can be a potential solution to overcome the complication of POPF for surgeons early in their career.⁶ The present study is a nice guide for the surgeons early in their career, and who want to practice in duct-to-mucosa technique.

CONCLUSION

Present study suggests that two-layer duct-to-mucosa pancreaticojejunostomy, with less serosal stitches technique, is feasible and has acceptable pancreatic fistula rates. This technique can be used by surgeons who face difficulties with the duct-to-mucosa anastomosis due to aforementioned causes.

Large multi-centre randomised future studies are required to confirm these findings.

ETHICAL APPROVAL:

This study was approved by the local Ethics Committee of Tepecik Training and Research Hospital, Izmir, Turkey.

PATIENTS' CONSENT:

Informed consent was taken from all patients in the study.

CONFLICT OF INTEREST:

The authors declared no conflict of interest.

AUTHORS' CONTRIBUTION:

IS: Conception or design of the work, or the acquisition, analysis, or interpretation of data for the work, drafting the work or revising it critically for important intellectual content, final approval of the version to be published.

DY: Conception or design of the work; or the acquisition, analysis or interpretation of data for the work.

SCE: Conception or design of the work, or the acquisition, analysis, or interpretation of data for the work, final approval of the version to be published.

CK, ME: Analyses, or interpretation of data for the work.

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