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Technical Approaches to Digestive Tract Reconstruction in Laparoscopic Pancreaticoduodenectomy - A Technical Note

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Abbreviations:
CBD: common bile duct;
DGE: delayed gastric emptying;
FRS: fistula risk score;
LPD: laparoscopic pancreatoduodenectomy;
PD: pancreatoduodenectomy;
PG: pancreatogastrostomy;
P-JS: pancreatojejunostomy;
POPF: postoperative pancreatic fistula;
RPLS: reduced port laparoscopic surgery.

Rezumat

Metode tehnice de reconstrucție a tractului digestiv în duodenopancreatectomia cefalică laparoscopică - notă tehnică

Duodenopancreatectomia cefalică rămâne una dintre cele mai complexe operații din sfera digestivă. Din punct de vedere istoric, laparoscopia în chirurgia pancreatică s-a limitat la stadializarea patologiei şi la efectuarea intervențiilor în scop paliativ. De la efectuarea primei duodenopancreatectomii cefalice laparoscopice în anul 1994, s-au realizat progrese semnificative ce au îmbunătățit siguranța perioperatorie şi timpul operator, scăzând totodată morbiditatea postoperatorie. Cu toate acestea, complexitatea chirurgiei pancreatice împreună cu dificultatea tehnică a abordului minimal invaziv pancreatic au limitat până în prezent duodenopancreatectomia laparoscopică la centre cu volum mare de cazuri. Acestă notă tehnică îşi propune să descrie inovațiile aduse tehnicilor chirurgicale laparoscopice de realizare a celor trei anastomoze – anastomoza pancreatico-gastrică, respectiv pancreaticojejunală, cea hepatico-jejunală şi cea gastro-enterală – într-o manieră intracorporeală, menite să faciliteze procesul reconstructiv. În acest articol vor fi detaliate, de asemenea, noi modele standardizate de pregătire şi instruire a chirurgilor, concepute cu scopul de a reduce complicațiile postoperatorii, cum sunt fistulele pancreatice sau cele biliare, de a reduce timpii operatori şi, în cele din urmă, de a promova duodenopancreatectomia laparoscopică, până recent rezervată doar centrelor cu volum mare de cazuri, ca metodă sigură şi eficientă de tratament.

Cuvinte cheie: chirurgie laparoscopică, duodenopancreatectomie, reconstrucție

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Abstract

Pancreaticoduodenectomy is one of the most technically demanding procedures in digestive surgery. Historically, laparoscopy in pancreatic surgery was limited to staging and palliative interventions. Since the first laparoscopic pancreaticoduodenectomy was completed in 1994, significant advances have improved perioperative safety, operative time, and lowered postoperative morbidity. Nevertheless, the complexity of pancreatic surgery paired with the technical challenges of pancreatic minimally invasive approach have restricted laparoscopic pancreatoduodenectomy to high-volume centers until recent times. The aim of this technical note presentation is to describe novel laparoscopic techniques of performing the three anastomoses - pancreaticojejunostomy and pancreaticogastrectomy, hepaticojejunostomy, and gastrojejunostomy- in an intracorporeal fashion, highlighting methods of facilitating the reconstructive process. This technical note's purpose is to also present new training models for surgeons, meant to reduce post-operative complications, such as pancreatic fistula or biliary leakage, to shorten operating times, and, ultimately, to increase the availability of laparoscopic pancreatico-duodenectomy as a safe and efficient treatment option.

Keywords: laparoscopic surgery, pancreaticoduodenectomy, reconstruction

Introduction

Pancreaticoduodenectomy (PD) remains one of the most technically challenging digestive surgeries to be performed, given the retroperitoneal location and the pancreas's proximity to major blood vessels. Until fairly recently, laparoscopy played a minimal role in pancreatic surgery, used primarily for staging pancreatic malignancy or for minimally invasive palliative procedures in unresectable cases (1,2). Since the first laparoscopic pancreatico- duodenectomy (LPD) performed by Gagner et al. in 1994, major progress has been made regarding patient safety, reducing operating time, and the rate of post-operative complications (3,4).

Regardless, the difficulty in performing pancreatic surgery combined with the gradual learning curve of laparoscopy in this field have made LPD available only in high-volume centers up until recent times. As is the case with any laparoscopic surgery, the advantages regarding faster recovery time, which translates into earlier initiation of adjuvant treatment, are well established. However, given the complexity of this operation, the laparoscopic approach raises concerns due to technical challenges with both the peripancreatic vascular structures and the intricate digestive reconstructions (5). To overcome the challenge of laparoscopic intracorporeal anastomoses during the reconstructive phase of PD, innovative techniques have been envisioned, and training models developed, both of which have proven effective in reducing postoperative complications and facilitating the reconstructive process.

General Set-up and Trocar Placement

Keeping in mind the conventional principles of port placement in laparoscopic surgery, such as the manipulation angle between multiple ports, avoiding intersecting the instruments, and the elevation angle between the surgeon's instrument and the horizontal plane, port placement for LPD is a crucial step. Given the multiple work planes and varying angles of pancreatic surgery in general, the surgeon must calculate a precise port placement that follows the above-mentioned principles (6).

Starting with the patient in a supine position with the legs abducted, pneumoperitoneum is achieved using a Veress needle placed in the periumbilical region, either 2-3 cm below or above the umbilicus, depending on the distance between that and the xiphoid process, and a 10 or 12 mm optical trocar is then inserted through the insufflation site(7,8). Under direct visualization, 4 to 5 more ports are added, forming either an inverted U-shape or straight line across the abdomen, including a 10 or 12 mm port in the right upper abdomen along the midclavicular line, a 10 or 12mm port in the left upper abdomen along the midclavicular line, two 5 mm ports - one placed in the right, the other in the left subcostal regions, approximately 1 to 2 cm lateral to the midclavicular line (*Fig. 1*).

In recent years, progress has been made to reduce the number of ports needed, as each trocar is associated with a potential risk of bleeding, hematoma, incision hernia, or abscess. In order to achieve this purpose, reduced-port laparoscopic surgery (RPLS) has been introduced (9). This concept has been applied to LPD, but given the difficulty of the procedure itself and therefore the need for 5-6 trocars, patients who are candidates for RPLS have to be carefully selected. Criteria such as locally advanced disease or involvement of major blood vessels make this approach not ideal, as well as a high patient BMI or previous

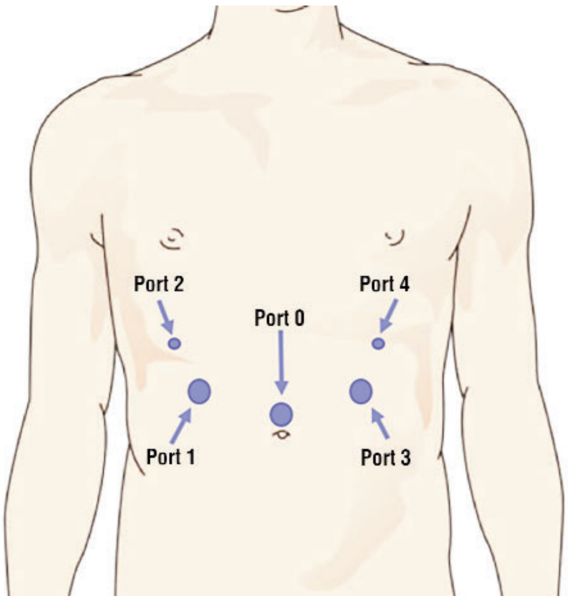

Figure 1. Trocar placement: port 0- optical trocar; ports 1 and 3- for 10 or 12 mm trocars, placed along the midclavicular line; ports 2 and 4- for 5 mm trocars, placed in the subcostal regions. Adapted from Mistry JH, Haribhakti S. Standard port placement for laparoscopic pancreatic surgery: How we do it. General Surgery. 2016;1(1):23 (6)

abdominal surgeries. A case report published in 2020 by Dapri et al. described a three-port LDP with intracorporeal handsewn anastomoses (10). They reported using a 12 mm periumbilical optical trocar and two 5 mm trocars in the right and left abdominal flanks. The reconstruction was performed by hand-sewn anastomoses: an end-to-side pancreatico-jejunostomy using an absorbable running suture (PDS 2/0), an end-to-side hepatico-jejunostomy, in the same manner, using PDS 4/0, and the end-to-side gastro-jejunostomy using PDS 1. Only two abdominal drains were positioned, each near the anastomoses. The patient was discharged on the 9th post-operative day. However, despite the advantages RPLS brings, it remains a scarcely used method, given the already challenging task of performing LDP.

Reconstruction Phase

After sectioning the specimen, the reconstruction phase can be performed either intracorporeally or, depending on the level of training of the surgeon, all three of them - pancreaticojejunostomy, hepatico-jejunostomy, and gastrojejunostomy - can be carried out through the mini-laparotomy created for the specimen extraction. For the purpose of this technical note, the focus will be on intracorporeal reconstruction techniques, emphasizing the importance of pancreatic stump management as a central factor in preventing post-operative complications (7).

During the early phase of the learning curve, pancreaticojejunal or pancreaticogastric anastomoses may be conducted through a small midline incision (5–6 centimeters), which allows for specimen extraction without compromising the minimally invasive surgical technique. We recommend that hepatico-jejunostomy be performed intracorporeally from the outset.

Pancreaticojejunostomy and Ancreticogastrostomy

The anastomosis between the pancreatic stump and jejunum is the first one performed, being the most technically complex one out of the three of them and taking advantage of the free jejunal loop for better mobilization and movement of the laparoscopic instruments (11). The classical way to perform it is with two layers of sutures in an end-to-side duct-to-mucosa fashion, ensuring the jejunum's mesentery is in the correct position to avoid torsion of the blood vessels. The posterior continuous layer of sutures is placed in a trans-pancreatic-sero-muscular row, using a synthetic monofilament absorbable suture. The following step is creating a small opening in the jejunum, using either the electrocautery or a harmonic scalpel, which corresponds to the pancreatic duct, at which point the duct-to-mucosa sutures are placed in an interrupted manner. The anterior row suture is to be performed in the same fashion as the posterior one, parallel to it. In order to prevent the formation of a postoperative pancreatic fistula (POPF), the standard is to insert a stent through the pancreatic duct. In 2013, Callery et al. proposed a fistula risk score (FRS), naming as risk factors for developing POPF a reduced diameter of the pancreatic duct, a soft pancreatic tissue texture, high-risk patient comorbidities, and excessive blood loss during surgery (12). Since then, as the LPD became more frequently performed, a new alternative risk score for developing POPF was created, targeting patients undergoing LPD (13). In 2021, Mungroop et al. proposed a new fistula risk score based on a pan-European cohort, which included the male sex and single-row anastomoses as risk factors. In cases where more FRS criteria are met, such as a fragile pancreatic stump or a poorly visualized pancreatic duct, the proposed solution is to perform a purse-string telescoped pancreaticogastrostomy (PG) or a modified binding pancreaticogastrostomy. This is performed by making an anterior gastrotomy of approximately 4 to 5 cm, followed by a posterior one, through which the pancreatic stump is to be invaginated. Either a double or a single full-thickness purse-string suture is to be performed, starting from the superior portion of the posterior gastrotomy and finally followed by an anterior hand-sewn gastrotomy (14-16). As PG has been suggested to reduce overall complications in cases with FRS, novel laparoscopic techniques have been developed to improve the end result, lower the complication rate, and facilitate the procedure from a technical standpoint. In 2019, Puntambekar et al. published a new method of intracorporeal PG, which does not require duct-to-mucosa anastomosis, is favorable in patients with a small pancreatic duct, and does not interrupt the integrity of the pancreatic capsule outside of the stomach, reducing in turn the risk of pancreatic leakage (17-20). The difference in the technique employed by Puntambekar et al consists of using two layers of sutures: an outer layer of interrupted silk sutures binding the pancreatic capsule and the seromuscular gastric layers, and an inner layer of interrupted silk sutures that solidified the invagination of the pancreas into the stomach (*Fig. 2*).

In cases where the pancreatic duct is easily visualized and the texture of the pancreas is hard enough, pancreaticojejunostomy (P-JS) is the standard procedure. To ensure a safe anastomosis and render the technique less time-consuming, as it requires both precise needle handling and coordination in a confined space, novel methods of P-JS have been envisioned. Honda et al. describe using a modified Kakita method with the help of a new device, called Haenawa (21,22). This consists of an 18-Fr catheter previously cut to measure 10cm long, through which four 18-cm pieces of suture are inserted, with the needle end at one point and the free end at the other, using metal clips as stoppers for the free end. This device, along with a urethane sponge, is inserted in the abdominal cavity through a mini-laparotomy incision, used for specimen extraction. The Haenawa device is left on the right side of the abdominal cavity, while the sponge is left on the pancreatic stump. The modified Kakita method consists of a two-layer end-to-side anastomosis: the outer layer goes through the seromuscular layer of the jejunum and the full thickness of the pancreas, while the inner layer is the duct-to-mucosa anastomosis. In the laparoscopic version, the outer layer is created using the 4 interrupted sutures already mounted on the Haenawa, and are then placed through the urethane sponge situated on the pancreatic stump and secured with clips. This method arranges the sutures like „guitar strings", making it easier to visualize each one before ligating and avoiding tangles between sutures (*Fig. 3*). The inner layer is performed as usual, either using a stent if the pancreatic duct is of normal size, which is sutured to the pancreatic parenchyma with a purse-string suture and then inserted into the small openning created in the jejunum, or directly performing a duct-to-mucosa anastomosis if the pancreatic duct is sufficiently dilated. The Haenawa sutures are ligated in a cranial-to-caudal sequence. Using this technique, Honda et al reported an incidence of post-operative complications in 8 out of the 17 cases in which the Haenawa method was used for P-JS, out of which POPF was reported in 3 patients: Grade A fistula in one patient, and Grade B in 2 patients (23). In all three cases, the complication was resolved conservatively.

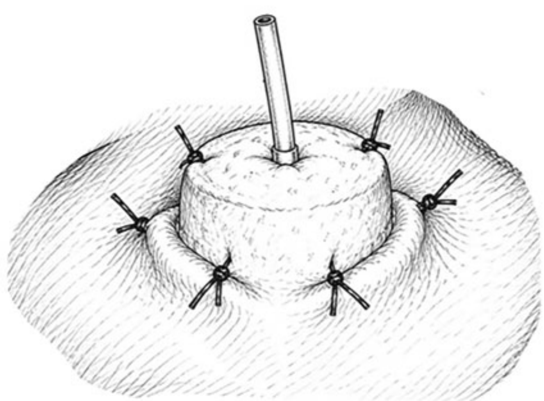

Figure 2. Intracorporeal PG- invagination of the pancreas into the stomach and fixation using interrupted silk sutures, without disrupting the integrity of the pancreatic capsule outside the stomach. Adapted from Puntambekar SP, Mehta MJ, Manchekar MM, Chitale M, Panse M, Jathar A, et al. Laparoscopic Intracorporeal Pancreaticogastrostomy in Total Laparoscopic Pancreaticoduodenectomy - A Novel Anastomotic Technique. Indian Journal of Surgical Oncology [Internet]. 2019;10(2):274–9 (17)

To further prevent the occurrence of POPF, Junhan et al. proposed a new method to avoid the two surgical mistakes that increase the risk of POPF. On one hand, if the sutures of the anastomosis are tightened too tightly or the needle's spacing between two consecutive sutures is too close in between, the pancreas's blood supply is disrupted. Excessive suturing can also damage the pancreatic tissue, causing edema and possible necrosis. On the other hand, loose or sparse sutures are also risk factors that increase the probability of POPF. A new technique called „shunt-block combined" was proposed (24,25). This approach consists of burying the jejunum wall to the anterior and posterior portions of the pancreatic stump as the first and last step of the anastomosis, in a caudal to cranial direction. Out of 93 cases performed between 2017 and 2023, 0 cases of grade C POPF were reported, and only 10 cases of grade B POPF. The main advantage of this method consists of anastomotic blockage: as the anastomosis is sealed and blocked by the jejunum, it limits the leakage from the small para-

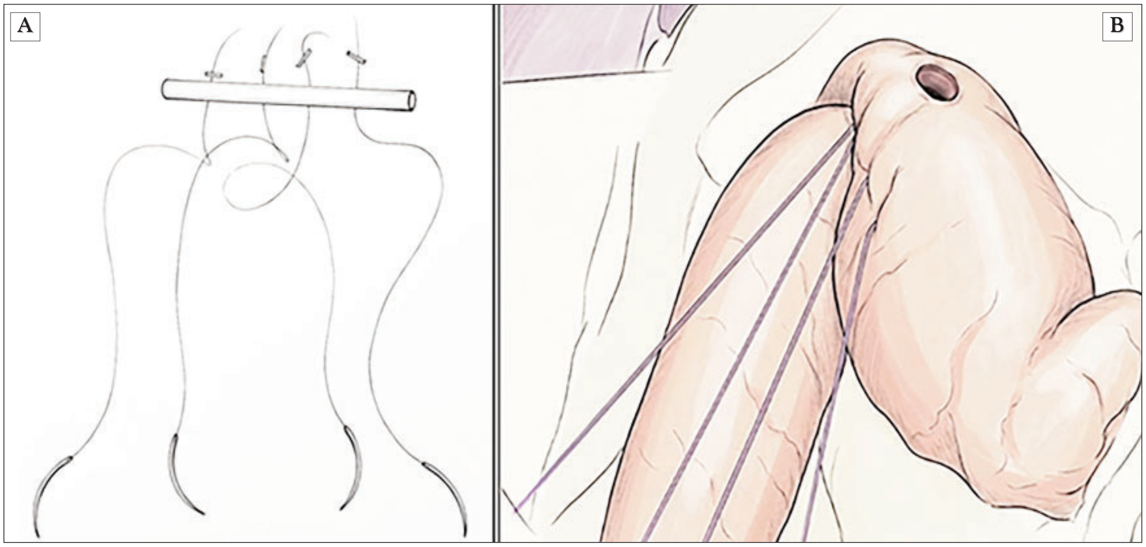

Figure 3. **(A)** - Haenawa device, consisting of a 10-cm long catheter with 4 pieces of sutures inserted. **(B)** - The sutures from the Haenawa device are arranged like guitar strings. Adapted from Honda G, Kurata M, Okuda Y, Kobayashi S, Yamaguchi T, Matsumoto H, et al. Novel Device for Pancreaticojejunostomy via a Pure Laparoscopic Approach. Journal of the American College of Surgeons [Internet]. 2013;216(6):e73–6 (22)

pancreatic or lobular ducts and redirects this secretion to the interior of the small intestine.

Hepaticojejunostomy

After completing the pancreaticojejunostomy, the second anastomosis is between the common bile duct (CBD) and the jejunum. Following placement of a bulldog clamp on the proximal common bile duct (CBD), transection is performed using cold scissors. This technique minimizes tissue trauma and enables effective assessment of the bile duct's vascular supply. The transection plane is located just above the insertion of the cystic duct, starting with the anterior wall to provide a better visualization of the posterior wall in order to avoid vascular injuries (26). In patients with previously manipulated CBDs, such as those with a history of bile duct stent placement procedures, a thick and rigid CBD can be dissected using diathermy (27). In most cases, the posterior layer is created first, using a running absorbable suture. For better visualization, the jejunum is pushed downwards after placing the first knot. The anterior layer is fashioned using interrupted stitches or, in selected cases where the bile duct diameter is larger, the anterior layer can be done in the same manner as the posterior one, using a continuous suture. Both methods are prone to complications, with some authors claiming that interrupted sutures can lead to a higher risk of anastomotic leak, while stenosis of the bile duct can be favored by continuous sutures (28). Different techniques can be used in cases where the bile duct is smaller in size to avoid anastomotic biliary strictures (29). The duct can be enlarged by performing a diagonal cut along the left side of the duct, followed by placing stay sutures on the same side to improve exposure. For stable visualization, the middle part of the anterior wall can also be suspended using a stay suture. Currently, there is no widespread agreement on the optimal type of suture wire for this anastomosis—options include absorbable versus nonabsorbable wires, monofilament or polyfilament varieties, self-locking sutures, or traditional suturing methods.

Furthermore, in such cases with small-caliber ducts, patency of the anastomosis and prevention of stricture formation can be achieved by placing an intra-anastomotic stent. Moris et al. describe their technique of placing either an 8-10 Fr. Nelaton catheter or the end of a 6 Fr. Pigtail catheter inside the anastomosis, after completing the posterior wall and before completing the anterior one. To temporarily fixate the stent to the jejunal stump, a 5-0 Vicryl suture can be used (30). Laukkarinen et al. described a novel technique of narrow-duct hepaticojejunostomy, tested in experimental models. They reported using a 4-mm caliber intra-anastomotic biodegradable biliary stent combined with a purse-string technique in animal models with bile ducts measuring 3.5-4.0 mm in caliber and compared the results to a conventional group in which no stent was used. The results showed a low rate of stricture in stented models and the increase in caliber of the anastomosis at 6 months in this group, with the biodegradable stent disappearing by the 3-month threshold (31).

Regardless of the surgical technique used, there are a few key general principles that should be followed: excessive disection of the bile duct should be avoided, adequate blood perfusion of the anastomosed bile duct should be ensured, and the surgical technique should be without tension or excessive manipulation of the tissue (32-34).

Gastrojejunostomy

The last reconstructive step of the LPD to be performed is between the remaining stomach and jejunum, using either a hand-sewn or stapled technique. As is the case in open surgery, one of the most frequent post-operative complications is represented by delayed gastric emptying (DGE), which, although not a lethal complication, has a great impact on the quality of life and postoperative recovery time (35,36). Multiple factors are considered to be at fault, such as injuries to the vagal nerves and vascularisation of the stomach during the resection step of the PD (37). Another possible explanation could be the decrease in motilin secretion brought by removing the duodenum (38). The anastomosis can be performed either by taking the antecolic route or the retrocolic route. Studies have shown a decrease in DGE incidence following antecolic gastrojejuno-stomy, with similar outcomes comparing side-to-side reconstruction versus end-to-end one (39). A study published by Sabry et al. stated the superiority of posterior wall vertical gastrojejuno-stomy when it comes to DGE incidence and, therefore, a better recovery time and an earlier start of chemotherapy treatment (36). This anastomosis is typically created with stapling devices, such as Endo-GIA staplers, and less commonly by employing a hand-sewn technique. There is no established consensus on this maneuver; however, it is recognized that the mechanical technique decreases operating time while increasing the risk of hemorrhage along the margins of the anastomosed sections.

Training Programs

Although LPD has gained momentum in recent years, it remains a technically challenging surgery, as the learning curve required is greater than in other laparoscopic procedures, with an inflection point marked at 80-100 cases (40-42). In order to optimize this learning curve and increase the availability of LPD, training models have been created. Tang et al. proposed a laparoscopic model meant to analyze the outcomes of surgeons who have previously trained using this model, and compared the postoperative complications as well as the learning curve when performing LPD after completing the training session (43).

Using transected portions of bovine liver, in which the diameter of the bile duct was similar to that of the pancreatic duct in humans, they created a model suited for duct-to-mucosa anastomosis. The anastomosis was then evaluated by injecting methylene blue into the silicone tube used as a duct stent.

For the laparoscopic hepaticojejunostomy, the selected training models were cases in which this anastomosis was performed during biliary cyst procedures.

Lastly, the training models for the gastro-jejunostomy were palliative bypass surgeries and subtotal gastrectomy.

The two surgeons who completed this training model in 11 and 14 months, respectively, were compared to a third surgeon without previous LPD training. Both surgeons who completed the training session obtained shorter operative times in real-life cases compared to the third surgeon, with fewer complications such as POPF, biliary-enteric anastomosis leakage, and shorter hospital stay. Another simulation training model was developed at Sir Run Run Shaw Hospital by Yang et al., focusing on laparoscopic pancreaticojejuno-stomy, using a three-dimensional dry lab model. The stepwise training model proposed included three levels of training: a basic suture training, a biliary-enteric anastomosis, and, lastly, a pancreatic-enteric anastomosis training. The surgeons participating in this model were grouped into attending, fellow, and resident surgeons. The results showed that by completing a stepwise model, such as a laparoscopic biliary-enteric training program, surgeons showed better performance when completing the pancreatico-jejunostomy model. Improved surgical performance was shown after repeated training (44).

Multicenter structured training programs in LPD are another key factor in raising the availability of this procedure. Between 2014 and 2016, 8 surgeons from 4 centers completed the Longitudinal Assessment and Realization of Laparoscopic Pancreatic Surgery (LAELAPS-2) program, which included video training, proctoring, and technique description. In total, 114 patients underwent LPD, performed by 2 experienced surgeons in all centers. The conversion rate was 11%, with a grade B/C POPF observed in 34% of patients, and an overall mortality of 3.5% at both 30 and 90 days. The LAELAPS-2 training program showed acceptable outcomes during the learning process, mentioning the need for future studies in determining the applicability of such training programs (45).

Multicenter training programs have also been envisioned for robotic PD (RPD). The LAELAPS-3 program included a total of 275 patients who underwent RPD performed by 15 surgeons between March 2016 and October 2019 in 7 different centers. The means of training included a video bank, training models on robot simulators, bio-tissue drills, and proctoring. The conversion rate to open surgery was 6.5%, with a grade B/C POPF of 23.6% and a 90-day mortality related to complications 2.5%. It was observed that, during the period of this study in the Netherlands, the rate of RPD increased from 0% to 25%, while the rate of LPD decreased from 15% to 1%. The results from this training program, along with the increase in robotic procedures when it comes to PD, highlight the rise of RPD as a minimally invasive technique in pancreatic surgery (46).

Searching to compare the two minimally invasive methods of PD, robotic and laparoscopic, when it comes to conversion rates, morbidity and 30-day mortality, operating time, and complications, Emmen et al. conducted a pan-European multi-center study, including data from 50 medical centers in 12 countries, where a total of 2082 patients underwent minimally invasive PD between 2009 and 2020. The main results of this study showed no significant differences in morbidity or 30-day mortality between the two methods. The results favoring RPD consisted of a lower conversion rate (6.7% vs 18.0%) and a higher number of lymph nodes retrieved (16 vs 14). On the other hand, LPD proved superior with regard to shorter operating time (400 minutes vs 446 minutes), higher R0 resection rate (84.4% vs 73.2%), and lower rates of grade B/C POPF (7.4% vs 21.4%) (47).

Discussion

As minimally invasive surgical techniques develop further, LPDs have become safe and feasible treatment options in patients who meet the criteria for resecability. Keeping in mind the challenges brought by the laparoscopic resection and reconstructive aspects of this surgery, novel techniques have been created to ease the difficulty of the intracorporeal anastomoses, while minimizing the post-operative complications and overall morbidity of the patient.

Given the multiple work planes and varying angles of pancreatic surgery, LPD is usually performed with 5 to 6 trocars, including the optical trocar, arranged in a U-shape or in a straight line across the abdomen. Progress has also been made regarding applying the reduced port laparoscopic surgery concept when performing LPDs.

When it comes to performing the anastomosis between the pancreatic stump and the stomach or jejunum, new surgical techniques have been employed in order to ease the process and to lower postoperative complications, such as pancreatic fistulas. The invagination of the pancreatic stump into the stomach using a double layer of interrupted silk sutures, without interrupting the integrity of the pancreatic capsule outside of the stomach, has proven to be effective. When performing a pancreatico-jejunostomy, in order to avoid tangles between sutures in an already reduced space by arranging them like „guitar strings”, a device called Haenawa was proposed, created using only materials already available in any surgical setting.

For hepaticojejunostomy, the challenge lies in cases of small-caliber bile duct, which can be enlarged by performing a diagonal cut to the left side of the duct and by placing stay sutures. In order to avoid anastomotic strictures in such cases, biliary stents can be used.

While performing the last anastomosis in LPD- the gastrojejunostomy- special attention should be paid in order to avoid complications such as delayed gastric emptying, with a great impact on the patient's quality of life. Injuries to the vagal nerves as well as to the gastric vascularisation during resection can both increase the risk of DGE. Antecolic or posterior wall vertical gastrojejuno-stomy are correlated with a lower rate of DGE.

Lastly, given the challenges imposed by the complexity of minimally invasive PD, training programs have proven to be of great importance. Large-scale projects such as LAELAPS-2 and LAELAPS-3 are among the most valuable multicenter training programs in recent years, with the end goal of raising the availability of this procedure.

Conclusions

The reconstruction of the digestive tract during laparoscopic pancreaticoduodenectomy represents a technical challenge, given the complexity of the three anastomoses and the confined space and multiple work planes. For the purpose of facilitating the reconstruction in an intracorporeal fashion, along with reducing post-operative complications, novel techniques have been envisioned, with favorable outcomes. In order to further increase the availability of laparoscopic pancreaticoduodenectomy, training models and multicenter programs are vital.

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Conflicts of Interest

The authors have no conflict of interest to disclose.

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