

Total Laparoscopic Pancreaticoduodenectomy: A Single-center Experience of 33 Cases in Patients with Periapillary Tumor—Lessons Learnt

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ABSTRACT

Introduction: The introduction of minimally invasive procedures has revolutionized surgical practice worldwide. However, its application to total pancreaticoduodenectomy since its inception in 1994 by Gagner and Pomp has elicited reluctance and skepticism due to the need for expertise, advanced laparoscopy skills, long operative time, difficulty in adhering to oncological principles of resection, and high rates of conversion to open surgery.

Materials and methods: A retrospective review of 33 patients who underwent total laparoscopic pancreaticoduodenectomy at a tertiary care center in Mumbai from May 2015 to December 2019 was performed. All cases were operated by the principal investigator. Patients with malignancy on final histopathology report were included in the study. Patients with involvement of major vessels on preoperative contrast-enhanced computed tomography scan, distant metastasis, and contraindication to general anesthesia were excluded from the study. Perioperative data were collected and analyzed.

Results: Thirty-three patients were operated for total laparoscopic pancreaticoduodenectomy. The average operative time was 330 minutes. Only one patient required conversion to open surgery and postoperative blood transfusion. The resection margins were negative in all the patients with an average lymph node retrieval rate of 12 nodes. There was no postoperative mortality.

Conclusion and clinical significance: Total laparoscopic pancreaticoduodenectomy is a safe and feasible procedure with standard laparoscopic setup in patients with malignant periapillary disease.

Keywords: Laparoscopic pancreaticoduodenectomy, Minimally invasive pancreaticoduodenectomy, Minimal invasive surgery.

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INTRODUCTION

The introduction of minimally invasive procedures has revolutionized surgical practice worldwide. However, its application to total pancreaticoduodenectomy since its inception in 1994 by Gagner and Pomp¹ has elicited reluctance and skepticism due to the need for expertise, advanced laparoscopy skills, long operative time, difficulty in adhering to oncological principles of resection, and high rates of conversion to open surgery. Initially, case series were limited to high-volume centers with the availability of advanced laparoscopic setup. We report a series of total laparoscopic pancreaticoduodenectomy for periapillary tumors at a tertiary care institute in Mumbai.

MATERIALS AND METHODS

A retrospective review of 33 patients who underwent total laparoscopic pancreaticoduodenectomy for periapillary malignancy from May 2015 to December 2019 was performed. All cases were operated by the principal investigator after confirmation of periapillary tumor. Patients with malignancy on final histopathology report were included in the study. Patients with involvement of major vessels on preoperative contrast-enhanced computed tomography scan, distant metastasis, and contraindication to general anesthesia were excluded from the study. Preoperative ERCP-guided biliary stenting was performed in patients with cholangitis and those who required optimization for surgery ($n = 16$). Perioperative data were collected and analyzed. Preoperative variables included age, gender, American Society

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of Anaesthesiologists (ASA) classification of anesthetic risk,² and indication for surgery. Intraoperative variables included operative time, blood loss, and transfusion requirements. Postoperative complications were assessed during the duration of stay till discharge. Pancreas-specific complications were assessed and graded according to the recommendations of the International Study Group on Pancreatic Surgery.³ Pathological staging and margin status were determined from final histopathology reports.

OPERATIVE PROCEDURE

Patients were operated in the split-leg supine (French) position under general and epidural anesthesia with the operating surgeon standing between the legs of the patient.

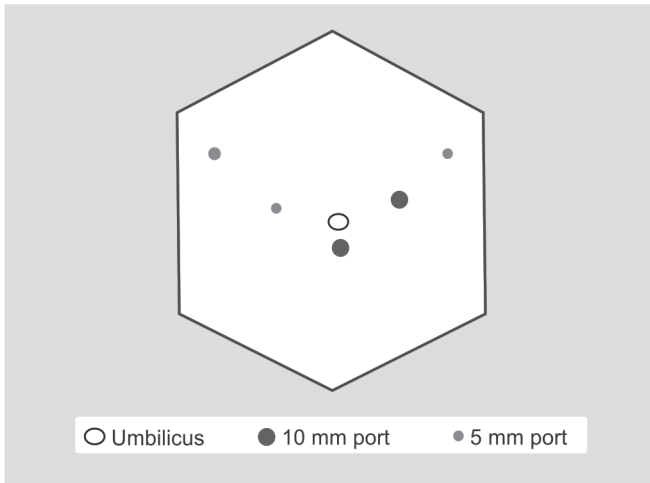


Fig. 1: Port placement

Procedure

A 10 mm port is inserted via an infraumbilical vertical incision for 30° laparoscope by open method (Fig. 1). After creation of pneumoperitoneum, the remaining ports (with little variation depending upon the height of the patient, contour of abdomen, and subcostal angle for ergonomic intracorporeal suturing) were inserted under vision and a thorough examination of the abdomen for metastasis on all visible peritoneal and visceral surfaces was performed. Gallbladder was held retracted superolaterally. The lesser sac was entered by making a window in the gastrocolic ligament and the pancreas examined. The hepatic flexure of colon was then mobilized. The duodenum was Kocherized to identify the inferior vena cava and the aorta. Superior mesenteric vein (SMV) was traced and a plane created between the neck of pancreas and the SMV. Lymphoareolar tissue in the lesser omentum and the porta hepatis was dissected to identify the common hepatic artery and common bile duct and bared. The Calot's triangle was dissected to identify the cystic artery and the duct, both clipped and cut. After dissecting the vessels of the lesser curvature of the stomach, distal one-third of the stomach was transected using Endo-GIA stapler. Gastrooduodenal artery was identified and ligated after ruling out aberrant vascular anatomy. Pancreas was transected at the junction of neck and body with ultrasonic shear. The duodenojejunal flexure was mobilized and the jejunum was divided 10–20 cm distal to it. The cut distal end of the proximal loop was brought to the right below the mesenteric vessels. The head of pancreas and the uncinate process were separated from the SMV with the help of ultrasonic and bipolar diathermy from caudal to cranial with confirmation of hemostasis at every step. The dissection cranially included the baring of the portal vein and of the common bile duct up to the level of cystic duct clearing all lymphovascular tissues. Common hepatic duct was transected above the level of the insertion of cystic duct. In preoperatively stented patients, the stent was removed and sent for culture. The gallbladder was not disconnected from the hepatic bed as it is used as the retractor to visualize the hepatic duct. The specimen was bagged and parked on side. The distal pancreas was dissected posteriorly from the SMV and the splenic vein for about 3 cm to facilitate anastomosis. The loop of the jejunum was brought retrocolic and hepaticoduodenojejunal anastomosis was performed with PDS 4.0 continuous sutures first placed posteriorly from medial to lateral followed by anterior layer in a similar manner, which avoids purse string effect on the

Table 1: Frequency of pancreaticoenteric and pancreaticogastric anastomosis

Anastomosis	Frequency
Pancreaticojejunal (dunking)	8
Pancreaticojejunal (duct-to-mucosa)	14
Pancreaticogastric (dunking)	11

anastomosis. The site for pancreaticogastrostomy was marked higher on the body of the stomach and anterior gastrotomy was performed opposite to it. The pancreatic stump was brought inside a smaller posterior gastrotomy so as to have a snug placement of pancreas inside stomach which was sutured with continuous sutures with 2.0 silk leaving at least 1 cm of pancreatic stump inside the stomach. The anterior gastrotomy was closed with 2.0 silk in two layers (Table 1). Gastrojejunal anastomosis was performed with 3.0 mersilk in two layers. The nasojejunal tube for feeding was placed across the gastrojejunal anastomosis. Hemostasis was confirmed and drains placed in Morrisons pouch and in pelvis. The port of optical port was widened and the specimen extracted. Closure of all ports and the infraumbilical incision was performed with non-absorbable sutures. Patients were extubated postoperatively and shifted to ICU for observation.

PERIOPERATIVE CARE

All patients received epidural analgesia infusion for three days postoperatively. Nasogastric tube was removed on postoperative day 1 and nasojejunal tube test feed was administered. A clear liquid diet was begun on postoperative day 3 and oral diet advanced as tolerated. Abdominal drain was removed on postoperative day 5 if the output continued to be low volume and serous nature. Patients received routine antibiotic cover and prophylactic anticoagulation for deep venous thrombosis. Subcutaneous octreotide was continued until patients were started on orals.

RESULTS

Thirty-three patients were operated for total laparoscopic pancreaticoduodenectomy with age of patients varying from 45 to 67 years. There were 13 males and the average BMI of the study group was 28.3. Nine patients were diabetic and eight patients were smokers who had ceased when getting prepared for the surgery. Eighteen patients had presented with cholangitis and were stented preoperatively. Eleven patients were preoperatively nutritionally resuscitated with nasojejunal feeds. All patients were provided with preoperative chest physiotherapy.

Three patients with higher BMI required additional ports for retraction which aided completion of the procedure laparoscopically. The final histopathological diagnosis was periampullary adenocarcinoma in 22 patients, distal cholangiocarcinoma in 11 patients. The resection margins were negative in all the patients with an average lymph node retrieval rate of 12 nodes. There was no postoperative mortality (Table 2).

Postoperative complications noted in this study were hematemesis due to stress gastritis in two cases diagnosed with gastroscopy, superficial surgical site infection in two cases, and grade A pancreatic fistula in three cases. All cases were managed conservatively. The range of hospital stay for these patients was 8–19 days (longer stay for pancreatic fistula).

Table 2: Operative outcome

Parameter	Operative outcome
Conversion to open surgery	1
Operative time (range in minutes)	200–390
Estimated blood loss (range in mL)	110–350
Transfusion requirement	1
Margin negative	33
Number of lymph nodes retrieved (range)	12–16
Reintervention	2 patients OGD scopy

OGD, oesophagogastroduodenoscopy

DISCUSSION

The enthusiasm for minimally invasive hepatopancreaticobiliary surgeries has been encouraging. The laparoscopic approach for pancreaticoduodenectomy, however, has received much criticism in view of long duration of surgery, need for laparoscopic expertise, long learning curve, and the frequent need for conversion to open. Experience in this field of surgery is limited due to complexity of the procedure leading to several reports of laparoscopic-open hybrid surgeries. Also, the need for an advanced laparoscopic setup, robotic assistance, and hemostatic instruments discourages its widespread applicability.

In this case series, we have operated on 33 patients with routinely available laparoscopic instruments, ultrasonic shear and electrocautery for dissection and hemostasis at a civic run hospital. In our experience, the need for laparoscopic expertise is a must. With a good clarity and knowledge of anatomical details, the procedure can be performed in basic well-equipped surgical setup. We have noted a decline in duration of surgery with increasing experience in the procedure while adhering to oncological principles of resection. An improvement in operative time was similarly reported in case series by Kendrick and Cusati (7.7 hours for the first 10 patients to 5.3 hours for the last 10 patients)⁴ and Kim et al. (9.8–6.6 hours).⁵ Although robotic surgery does offer an advantage of more precise surgery with better maneuverability of instruments, it is time-consuming, expensive, and often unavailable to surgical setups in developing nations.

As we progressed from one case to another, we noticed some technical difficulties in performing pancreaticoenteric anastomosis that we tried to overcome by altering the methods of anastomosis. In the initial eight cases, we used a pancreaticojejunal dunking anastomosis. However, it was difficult to do the same with soft pancreas, where duct to mucosa pancreaticojejunal anastomosis was performed in 14 patients with a dilated pancreatic duct. The pancreatic duct was cannulated with a 6-Fr feeding tube in eight patients, however in six patients, the feeding tube could not be passed, hence was cannulated with outer sheath of intravenous catheter which is shorter in length and stiffer. In seven patients, the pancreatic duct could not be identified, possibly due to temporary sealing effect of ultrasonic shears and hence pancreaticogastric dunking anastomosis was performed. The pancreaticogastric anastomosis is technically easy to perform laparoscopically as compared to other pancreatic anastomosis, hence we followed the same in subsequent three patients too. There are numerous case series comparing the outcome of pancreaticoenteric and pancreaticogastric anastomosis by studying the rates of pancreatic fistulae.^{6–8} We, however, are of the opinion that the most suitable anastomosis should be performed depending upon the consistency of the pancreas, size of the pancreatic duct, and

expertise of the operating surgeon, and have therefore evolved our methods over time.

The magnified view offered by the laparoscopic approach along with better energy sources allows meticulous dissection and hemostasis thus limiting blood loss. Thus, in our operated patients only one patient required blood transfusion postoperatively who required conversion to open surgery due to hypervascularity due to history of cholangitis. A reduced mean blood loss (110 ± 22 mL) by minimally invasive approach has also been mentioned by Senthilnathan et al. in their experience of 130 cases of laparoscopic pancreaticoduodenectomy for malignant indications.⁹

Reoperation in the early postoperative period has been reported for indications of bleeding and obstruction. However, in our case series, no patient required reoperation and all complications were successfully managed conservatively.

The uncertainty of achieving a R0 resection with the laparoscopic approach is often cited as a disadvantage of the procedure. All our operated cases had tumor-free gross and microscopic margins supporting the oncological soundness of this procedure.

LIMITATIONS

Our study has the limitation of a small sample size and lack of comparison between the open and laparoscopic approach. We also emphasize the need of a long-term follow-up for tumor recurrence and disease-free survival.

CONCLUSION

Total laparoscopic pancreaticoduodenectomy is a safe and feasible procedure with standard laparoscopic setup in patients with malignant periampullary disease. Precision of dissection and hemostasis is better achievable with the magnified view of laparoscopy. Adequate resection of tumor is achievable by this approach if case selection is appropriate with thorough review of computed tomography of patients. Surgical expertise is required and key for favorable outcomes.

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