

Distal pancreatectomy outcomes: Perspectives from a community-based teaching institution

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Backgrounds/Aims: Distal pancreatic resections are intricate operations with potential for significant morbidity; there is controversy surrounding the appropriate setting regarding surgeon/hospital volume. We report our distal pancreatectomy experience from a community-based teaching hospital. **Methods:** This study includes all patients who underwent laparoscopic distal pancreatectomy (LDP) and open distal pancreatectomy (ODP) for benign and malignant lesions between June 2004 and October 2017. Both groups were compared for perioperative characteristics, parenchymal resection technique, and outcomes. **Results:** 138 patients underwent distal pancreatectomy during this time. The distribution of LDP and ODP was 68 and 70 respectively. Operative time (146 vs. 174 min), blood loss (139 vs. 395 ml) and mean length of stay (4.8 vs. 8.0 days) were significantly lower in the laparoscopic group. The 30-day Clavien Grade 2/3 morbidity rate was 13.7% (19/138) and the incidence of Grade B/C pancreatic fistula was 6.5% (9/138), with no difference between ODP and LDP. 30-day mortality was 0.7% (1/138). 61/138 resections had a malignancy on final pathology. ODP mean tumor diameter was greater (6.4 cm vs. 2.9 cm), but there was no significant difference in the mean number of harvested nodes (8.6 vs. 7.4). The cost of hospitalization, including readmissions and surgery was significantly lower for LDP (\$7558 vs. \$11610). **Conclusions:** This series of distal pancreatectomies indicates a shorter hospital stay, less operative blood loss and reduced cost in the LDP group, and comparable morbidity and oncologic outcomes between LDP and ODP. It highlights the feasibility and safety of these complex surgeries in a community setting. (*Ann Hepatobiliary Pancreat Surg 2020;24:156-161*)

Key Words: Distal pancreatectomy; Laparoscopic pancreatectomy; Open pancreatectomy; Community hospital

INTRODUCTION

Pancreatic resections are intricate operations with the potential for significant morbidity.¹ Open distal pancreatectomy (ODP) was traditionally considered the standard operation for pancreatic body and tail pathology. Advances in surgical technology have made minimally invasive pancreatic surgery, such as laparoscopic distal pancreatectomy (LDP), a safe and feasible alternative to open surgery. Several reports have highlighted the role of laparoscopic distal pancreatectomy in reducing operative morbidity and enhanced recovery.¹⁻⁴ Also, as complex pancreatic surgery continues to undergo centralization to high volume centers, the role of the community-based hepatobiliary and

pancreatic programs needs to be elucidated. The objective of this study was to report our experience with both ODP and LDP in a community-based, academic affiliated, teaching hospital.

MATERIALS AND METHODS

A retrospective comparative study was performed on all patients who underwent LDP and ODP for both benign and malignant pancreatic pathology between June 2004 and October 2017. The study was approved by the Ascension Providence Hospital Institution Review Board (IRB# 1352673-1). Patients were selected from the institution database and were included if they had a distal pancreatec-

Received: October 15, 2019; **Revised:** March 19, 2020; **Accepted:** March 19, 2020

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Annals of Hepato-Biliary-Pancreatic Surgery • pISSN: 2508-5778 • eISSN: 2508-5859

tomy. Procedures with incomplete information or missing data were excluded. All pancreatic resections were performed within the same hospital system, which is comprised of two campuses with a total of 654 beds. The surgical program is a community-based, academic affiliated, teaching hospital with a residency program that includes a Hepatobiliary and Pancreas (HPB) Fellowship Program since 2013, a critical care unit with 24-hour coverage, and a Level II trauma designation. There is a dedicated hepatobiliary service comprising two HPB trained surgeons.

A total of 138 patients were included in the final analysis. Electronic medical records were individually queried to collect patient demographics, operative variables, and information pertaining to postoperative outcomes that included costs. Pathologic information was obtained for all the distal pancreatectomy patients. Intraoperative variables included: Operative approach (laparoscopic/robotic vs. open); Operative time (min); EBL; Additional organs resection; Type of device used for pancreatic parenchymal resection (stapler, electrocautery, scalpel); Technique of distal pancreas resection for cases with splenectomy (en bloc with splenic vessels vs. separate ligation); and type of resection line reinforcement (sutures, glue, tissue patches). Outcomes included: 30- and 90-day postoperative morbidity; Mortality; Clavien-Dindo classification.⁵ Hospital records were queried to obtain a detailed cost analysis.

SPSS version 23 (IBM Corporation) was used for statistical analysis of the data.

The two groups were compared with Chi-Square and Fisher’s Exact tests for discrete variables and the Student’s t-test for continuous variables. A *p*-value of less than 0.05

Table 1. Patients’ characteristics

Patients’ characteristics	Surgical approach		<i>p</i> -value
	LDP (n=68)	ODP (n=70)	
Mean age (y)	61.3	61.7	0.87
Gender (female/male)	46/22	46/24	0.86
Comorbidities			
Diabetes	23	21	0.71
COPD	6	6	1
CAD	8	13	0.35
Cigarette smoking	15	23	0.18
Chronic pancreatitis	13	14	0.83

LDP, laparoscopic distal pancreatectomy; ODP, open distal pancreatectomy

was considered statistically significant.

RESULTS

Demographics

A total of 138 patients underwent distal pancreatectomy between June 2004 and October 2017. Patient characteristics and demographics are presented in Table 1. Comorbidity assessment included diabetes, a history of coronary artery disease (CAD) and/or chronic obstructive pulmonary disease (COPD), smoking status, and a preoperative diagnosis of chronic pancreatitis. Mean age and gender distribution were comparable between the LDP and ODP groups.

Operative/Technical characteristics

Operative data is presented in Table 2. The distribution of LDP and ODP was 68 and 70, respectively. The mean operative time, EBL, and average length of stay was significantly lower in the LDP group (Table 2). Multivisceral resections other than a splenectomy were performed in 34/138 patients (24.6%) to enable an en bloc resection for a tumor. The ODP group had a higher proportion of mul-

Table 2. Perioperative characteristics

Perioperative characteristics	Surgical approach		<i>p</i> -value
	LDP (n=68)	ODP (n=70)	
Operative time (min)	146	174	0.004
Estimated blood loss (ml)	139	395	0.001
Average length of stay (days)	4.8	8	0.001
Spleen preservation	8	5	0.4
Multi visceral resection	9	25	0.003
Splenic vessel ligation			
En bloc	34	18	
Separately	34	52	0.005
Device for transection			
Stapler	66	58	
Electrocautery/scalpel	2	9	0.03
Transection line reinforcement			
Yes	47	55	
No	21	15	0.25
Cost (including readmission costs)	\$7,558.00	\$11,610.0	0.001

LDP, laparoscopic distal pancreatectomy; ODP, open distal pancreatectomy

tivisceral resections (n=25 (35%); $p < 0.01$). Overall, the spleen was preserved in 13 patients (9.4%), with no significant difference in the splenic preservation rate between the two groups.

Our program has previously reported the technique of stapled en bloc ligation of the splenic vessels along with the distal pancreas for non-spleen preserving distal pancreatectomies.⁶ In this study, the splenic vessels were stapled along with the distal pancreas in 52/138 patients (37%), while the vessels were dissected and separately ligated in 86/138 (67%) of patients, with a higher proportion of such dissections in the open group (n=52; $p < 0.01$). Further, subgroup analysis revealed a significantly lower blood loss with en bloc ligation/resection technique (195 ml vs 314 ml, $p < 0.05$).

The EndoGIA (Medtronic) stapler was the device used for parenchymal resection in the majority of the cases (n=124). The resection line was routinely reinforced (n=102, 74%). Non-absorbable monofilament suture with over sewing of the pancreatic duct and staple line was the most common method of reinforcement. Tissue flaps, such as omental or falciform flaps were performed when feasible and fibrin glue was used in select cases. Electrosurgical energy devices were not used to divide the pancreatic parenchyma.

Morbidity

Postoperative complications are shown in Table 3. The Clavien 2 and 3 morbidity rate (based on 30-day outcomes) was 13.7%; the overall incidence of clinically fistula (Grade B/C)⁷ was 6.5% (9/138), with no significant difference between the LDP and ODP groups. The 30-day and 90-day mortality was nil and no patients required

Table 3. Postoperative complications

Postoperative complications	Surgical approach		<i>p</i> -value
	LDP	ODP	
Clavien Grade 1 complications	1	2	
Clavien Grade 2&3 complications	10	9	0.45
Pancreatic fistula (Grade B/C)	6	3	0.32

LDP, laparoscopic distal pancreatectomy; ODP, open distal pancreatectomy

reoperation.

Cost

Cost analysis between the LDP and ODP groups revealed a similar mean procedural cost: \$3442 vs. \$3384, $p=0.78$. The procedural cost included surgery and anesthesia-related expenses. However, the overall cost of hospitalization (including readmissions) was significantly higher for the ODP group (\$11,610 vs. \$7,558; $p < 0.01$).

Pathology

The final pathology was comparable between the two groups (Table 4). The mean tumor diameter was significantly greater for ODP (6.4 cm vs. 2.9 cm; $p < 0.01$), but there was no significant difference in the mean number of harvested nodes between the two groups.

DISCUSSION

Pancreatic resection has evolved to incorporate an increasing number of minimally invasive approaches. Cuschieri⁸ first described minimally invasive pancreatectomy in 1994, and the first laparoscopic distal pancreatectomy was performed by Gagner et al.⁹ in 1996. Contemporary studies have highlighted a reduction in intraoperative blood loss, blood transfusions, wound complications and a decrease in the overall length of stay with minimally invasive distal pancreatectomies.^{1,2,10,11} DiNorcia et al.¹⁰ reported their audit of 360 patients who underwent a distal

Table 4. Surgical pathology

Surgical pathology	Surgical approach		<i>p</i> -value
	LDP	ODP	
Pancreatic adenocarcinoma	16	24	0.27
Neuroendocrine	14	7	0.06
Intraductal papillary mucinous neoplasm (IPMN)	13	9	0.17
Mucinous cystic neoplasm (MCN)	8	3	0.13
Serous cystic neoplasm (SCN)	6	4	0.53
Chronic pancreatitis	10	12	0.82
Other	3	9	0.13
Mean tumor dimension (cm)	2.9	6.4	0.001
Mean number of nodes harvested	7.4	8.6	0.38

LDP, laparoscopic distal pancreatectomy; ODP, open distal pancreatectomy

pancreatectomy for both benign and malignant pancreatic disease: the LDP patients had fewer overall complications than ODP patients, with a quicker recovery and shorter stay. Adam et al.¹² evaluated 1733 cases of distal pancreatectomy and reported a reduced hospital stay with comparable short-term oncological outcomes between the open and minimally invasive group, which included both robotic and laparoscopic pancreatectomies. Finally, a review of pancreatic surgery by Postlewit and Kooby¹³ affirmed that minimally invasive distal pancreatectomy is safe and effective for appropriately selected patients with pancreatic ductal adenocarcinoma. The LEOPARD trial has validated these findings in a prospective randomized setting.^{11,14} However, most minimally invasive pancreatic surgical outcomes data is from high volume expert centers,¹⁵ despite a significant number of pancreatectomies being performed in the community setting.^{16,17} Our retrospective study from a community setting reports a statistically significant decrease in the operative time, blood loss, and length of stay in the laparoscopic group compared to the open cohort.

Several techniques for pancreatic parenchymal resection and splenic vessel ligation have been reported in the literature.^{18,19} We perform a stapled en bloc resection of the distal pancreas simultaneously with the splenic vessels with an EndoGIA stapler (Medtronic). We have previously reported that this technique does not increase the risk of pancreatic leak or hemorrhage.⁶ Our current analyses indicate that en bloc resection of the distal pancreas along with the splenic vessels is associated with a reduced blood loss in both open and laparoscopic distal pancreatectomy, although the technique was most commonly used in the laparoscopic group in this cohort of patients. The overall splenic preservation rate in our study was 9.4%; the splenic preservation rate in LDP group was 11.7% while it was 7.1% in the open group. When compared to the literature, splenic preservation rates range from 15.5-44.2% in the laparoscopic group compared to 5.7-15.6% in open pancreatectomy groups.²⁰ Most meta-analyses have shown a higher splenic preservation rate with minimally invasive pancreatectomy, likely as result of a magnified view of the splenic hilum during video assisted surgery.^{20,21}

Minimally invasive pancreatectomy is considered to be at least non-inferior to conventional open pancreatectomy

in terms of oncologic margins and lymph node retrieval for distal pancreatic tumors.^{4,22-24} The results reported in literature are likely confounded by size and type of the distal pancreatic tumor, whereby larger tumors were more likely to undergo an open resection. Our results indicate the same finding, i.e.: the tumor size was significantly smaller in the laparoscopic group and there was higher percentage (albeit not significant) of adenocarcinoma in the open cohort. Surgeon judgment, experience, patient factors, and tumor size may all play a role in the decision to perform one technique over the other. Again, we found no significant difference in the number of harvested nodes and negative resection margins. Overall, there was no significant difference in the pathological characteristics between the LDP and ODP groups. Therefore, when technically feasible we propose that LDP should be offered as the primary therapy for distal pancreatic neoplasia.

We report a similar general complication rate in both groups, including the frequency of clinically significant pancreatic fistula. The major complication and pancreatic fistula rates have been respectively reported as 8-38% and 11-39% for distal pancreatectomy.²⁵⁻²⁸ In addition to the variable definitions of postoperative pancreatic fistula, there remains conflicting data regarding the impact of technique and type of pancreatic parenchymal resection line reinforcement and stump closure.^{29,30} A meta-analysis failed to draw firm conclusions on the optimal method of stump closure, although there was a trend towards favoring stapled closure.³⁰ Some authors have indicated that specific ligation of the pancreatic duct is an important factor in reducing the incidence of pancreatic fistula. We report an overall pancreatic fistula rate of 6.5% based on the International Study Group for Pancreatic Fistula (ISGPF) definition of clinically significant Grade B/C fistulas.⁷ Our data did not reveal any preoperative risk factors for a postoperative pancreatic fistula (POPF), including comorbidity profile, smoking status, and a pre-procedure diagnosis of chronic pancreatitis in either of the groups. Furthermore, there was no difference in POPF rates based on the technique of parenchymal resection and type of resection line reinforcement; although an overwhelming number involved the use of the tri-staple EndoGIA (Medtronic) for resection. Finally, the low overall POPF of 6.5% likely contributed to the lack of any meaningful differences during ad-hoc analysis between

the subgroups in our cohort of patients. An important factor identified in this regard was the gradual closure of the tri-staple GIA stapler over the course of about a minute during our stapled resections, as previously suggested by Asbun and Stauffer.³¹ Also the stapler cartridge height was routinely adjusted (based on the color coding to indicate various heights) based on the firmness/thickness of the pancreatic tissue. Our study did not retain the data on staple height use per case simply because of variability and the need to exercise judgment per case. Typically, soft pancreas required shorter heights and dense pancreas required larger load heights.

Minimally invasive approaches for distal pancreatectomy are often assumed to be more expensive than open surgery because of the need for expensive surgical equipment and prolonged operations. A few studies have negated the argument of cost^{32,33} and our study reports a similar procedural cost between the two groups. An important point to note is that a significantly lower overall hospitalization cost was identified for the LDP group, even with readmission.

The appropriate setting for pancreatic surgery has been the topic of much controversy.^{16,17,34,35} The surgical care of patients with pancreatic pathology requires dedicated hospital resources and current evidence suggests that hospitals with a higher annual volume of pancreatic operations have improved short- and long-term outcomes.^{36,37} Most would agree that regionalization of pancreatic surgery is well underway, but these trends fail to take into account regional health care disparity, patient and provider preference for local care, insurance dilemmas, and lack of access for minority groups to tertiary centers, to name a few. Also, readmissions may occur at the local level and may not be accounted for in the larger tertiary centers data. Additionally, hospital volume might not correlate with surgeon volume and vice versa. For example, some proficient surgeons may opt to practice in community-based centers, especially since the advent of HPB fellowships has produced more highly trained HPB surgeon graduates that will likely continue to deploy into the community. Nonetheless, we do not intend to debate reports that highlight positive outcomes based on hospital status and volume. We concur with others findings that this specialization can be carried out in the community setting with minimal LOS, morbidity, and mortality.³⁴ We

support that hospital volume and dedicated HPB services translate into superior outcomes, regardless of hospital designation. We acknowledge that this study has inherent limitations from its retrospective nature, even though the data has been collected prospectively in a hospital HPB database.

Our retrospective appraisal indicates that complex distal pancreatic resections, both LDP and ODP, can be safely performed in the community setting within the confines of a dedicated and well-constructed HPB program. Furthermore, low pancreatic fistula rates, morbidity, and mortality can be achieved. We suggest, when feasible, en bloc parenchyma and vessel stapled ligation to reduce the rate of postoperative pancreatic fistula and blood loss. We support the judicious use of LDP to reduce overall hospital cost in the community-based teaching institution.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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AUTHOR CONTRIBUTIONS

Conceptualization: MUB. Data curation: AK. Formal analysis: NMJ. Methodology: AK. Project administration: MJJ. Visualization: JAP. Writing - original draft: MUB. Writing - review & editing MJJ.

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