Single-Surgeon Learning Curve in 111 Laparoscopic Distal Pancreatectomies: Does Operative Time Tell the Whole Story?

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BACKGROUND: Laparoscopic distal pancreatectomy (LDP) is becoming the standard treatment for left-sided pancreatic disease. Learning curve identification is essential to ensure a safe and steady expansion. However, large (n > 30) single-surgeon learning curve series are lacking.

STUDY DESIGN: Data of all patients undergoing LDP between June 2007 and March 2016 by a single surgeon were collected prospectively. For learning curve analysis, the first 10, 20, 30, 40, and 50 LDPs were compared with LDPs performed thereafter.

RESULTS: In total, 111 LDPs were performed, of which 2 (2%) were converted. Median operative time was 200 minutes (interquartile range [IQR] 150 to 245 minutes) and median blood loss was 200 mL (IQR 100 to 300 mL). Learning curve analysis did not show improvements in operative time or blood loss. However, the number of patients with pancreatic ductal adenocarcinoma increased after 30 cases and a significant reduction of Clavien-Dindo grade III or higher complications was seen; from 30% (n = 9) for cases 1 to 30 to 5% (n = 4) for cases 31 to 111 (p < 0.001). Similarly, the International Study Group on Pancreatic Fistula grade B/C fistulas (33% [n = 10] vs 9% [n = 7]; p = 0.001) and percutaneous drainage rate (23% [n = 7] vs 4% [n = 3]; p = 0.001) were lower. Hospital stay was 7 days (IQR 5 to 13 days) for cases 1 to 30 vs 5 days (IQR 4 to 6 days) for cases 31 to 111 (p < 0.001).

CONCLUSIONS: Operative outcomes of LDP remained stable with increasing surgical complexity over time. Postoperative outcomes, such as complications and length of hospital stay, improved after the first 30 cases. When describing learning curves, short- and long-term outcomes should be considered. (J Am Coll Surg 2017;224:826–832. © 2017 by the American College of Surgeons. Published by Elsevier Inc. All rights reserved.)

Laparoscopic distal pancreatectomy (LDP) is gaining popularity and is becoming the standard approach for the management of left-sided pancreatic lesions, at least for the treatment of symptomatic benign and premalignant disease.[1-3] This is supported by excellent results of recent systematic reviews on case-matched studies.[4,5] However, a clear understanding of the required surgical proficiency and the impact of the surgical learning curve on operative and postoperative outcomes is essential for a safe and steady expansion of LDP.

Learning curve identification and the influence of learning on outcomes was first described in 1936.[6] Surgical learning curve is commonly assessed using standard measurements (eg operative time, blood loss, and conversion). Operative time, however, can be influenced by a number of factors, such as the availability of surgical equipment, complexity of the procedure, and presence and experience of surgical assistants. In addition, patient outcomes are not limited to operative results, all clinical outcomes up to 90 days after surgery are included. It is

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Abbreviations and Acronyms
ERP = enhanced recovery program
ISGPF = International Study Group on Pancreatic Fistula
IQR = interquartile range
LDP = laparoscopic distal pancreatectomy

therefore clear that for an accurate understanding of the learning curve, different aspects of short- and long-term outcomes should be assessed, considering large cohorts to reduce the effects of confounding factors.

The LDP learning curve has been assessed previously,[7-10] but only 1 of these studies described the learning curve of a single surgeon, in only 32 patients.[9] In most series, LDP outcomes (ie operative time and conversion) improved significantly after 10 to 20 procedures,[7-10] but in case of a steep learning curve, the curve often follows an exponential rise, and outcomes can hypothetically improve significantly after performing 20 LDPs. Here we analyze a single-surgeon LDP learning curve during a 9-year period, with the aim to outline short- and long-term metrics, including operative and postoperative outcomes.

METHODS

Patients and design

All patients who underwent an elective LDP performed by a single surgeon (MAH) at the University Hospital Southampton National Health Service Foundation Trust from June 2007 to March 2016 were assessed in a prospective study. Routine workup consisted of blood tests and abdominal ultrasound, CT, or MRI. Every case was discussed during a multidisciplinary team meeting to assess the indication for surgery, type of surgery, and feasibility of optional approaches. As of November 2012, an enhanced recovery after surgery program was implemented. All analyses were based on intention-to-treat principles, meaning that patients in whom the laparoscopic procedure was converted to open surgery were included in the analysis. Data from 35 patients have been published previously.[11]

Surgical technique

Details of the surgical procedure used in all cases have been described previously.[11] Laparoscopic distal pancreatectomy was performed using 5 trocars (three 5-mm trocars and two 10/12-mm trocars). The lesser sac was opened by transecting the gastrocolic ligament. If needed, the pancreatic lesion was identified using intraoperative ultrasound. The inferior pancreatic margin was mobilized, which enables access to the posterior pancreatic surface. The superior pancreatic margin was mobilized and 2 umbilical tapes were placed around the pancreas, 1 at the portomesenteric vein (right side of the tumor) and 1 at the left side of the tumor. Major vessels (eg the splenic artery and vein) were slung using vessel loops. The pancreas was preferably transected using an Endostapler (Echelon 60; Ethicon EndoSurgery). Splenectomy was always performed for malignant disease or in case of premalignant disease involving the spleen. Spleen-preserving distal pancreatectomy was attempted in all other cases, preferably using a splenic vessel preserving approach (Kimura),[12] but if not feasible, after resection of splenic vessels (Warshaw).[13] The entire specimen was mobilized from medial to lateral and extracted using a Pfannenstiel incision.

Definitions

Subtotal pancreatectomy was defined as resection of the pancreas at the right side of the portomesenteric vein. Multivisceral resection was defined as any procedure in which additional organs or parts of organs besides the pancreas and spleen were resected (eg adrenal, small bowel, or stomach), as defined by the International Study Group on Pancreatic Surgery (ISGPS).[14] Operative time (minutes) was defined as the time from first incision to final skin closure. Resection margins on histopathologic investigation, including transection and all circumferential margins, were classified into R0 (distance margin to tumor $\geq$1 mm), R1 (distance margin to tumor $<$1 mm), and R2 (macroscopically irradical resection), as described by the Royal College of Pathologists.[15] Morbidity was classified using the internationally accepted Clavien-Dindo classification of surgical complications.[16] Postoperative pancreatic fistulas were scored using the International Study Group on Pancreatic Fistula (ISGPF) definition,[17] but only ISGPF grade B and C pancreatic fistulas were collected. Patients leaving the hospital with a surgical drain in situ, in whom drain stay was not prolonged because of a pancreatic fistula and did not undergo re-intervention due to a pancreatic fistula were classified as ISGPF grade A. This was according to the new pancreatic fistula definition by the International Study Group on Pancreatic Surgery, which will be published soon. Surgical site infection was defined using the Center for Disease Control and Prevention definition.[18]

Data collection

Data were retrospectively assessed from a prospectively collected database. Baseline characteristics collected included age, sex, American Society of Anesthesiologists physical status, histopathologic diagnosis, and tumor size (mm). Outcomes collected were operative time,