Editorial

Spleen-preserving distal pancreatectomy with splenic vessel preservation: challenges in measuring the learning curve

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Laparoscopy developed in the late 20th century with the aim of decreasing procedural invasiveness and improving patient outcomes. Multiple studies have demonstrated the utility of minimally invasive approaches in decreasing blood loss, shortening length of hospital stay, improving postoperative pain and lowering rates of surgical site infections (1,2). These encouraging studies, coupled with advances in instrument technology and surgeon experience, have led to broad adoption of laparoscopy across multiple surgical disciplines, including pancreatic surgery (3-6). Laparoscopic distal pancreatectomy (LDP) has evolved into a safe and effective operation when compared to open distal pancreatectomy with significantly lower blood loss, shorter length of stay, and fewer surgical site infections without significant differences in operative time, margin positivity, or mortality (7).

A spleen-preserving distal pancreatectomy technique is considered for benign/borderline pancreatic disease which does not mandate oncologic *en bloc* resection and when conservation of the spleen and its immunologic/hematologic functions is desired. Two surgical methods have been described for spleen conservation: the Warshaw and Kimura techniques. The Warshaw technique sacrifices the splenic vessels but preserves the spleen, relying on perfusion from the short gastric and the left gastroepiploic vessels (8,9). Alternatively, the Kimura technique preserves the native splenic vessels [spleen preserving vessel preserving distal pancreatectomy (SPVP-DP)] (10), adding considerable technical challenges to the procedure. In order to perform the procedure laparoscopically (SPVP-LDP), most surgeons will experience a significant learning curve with the Kimura approach. Previous studies analyzing the learning curve for LDP, with primary outcomes of blood loss and operative times, suggest a range of 10 to 20 cases prior to proficiency (11-14). However, these studies all included distal pancreatectomy with splenectomy and thus there is a lack of data specifically surrounding SPVP-LDP. In their article "*True learning curve of laparoscopic spleen-preserving distal pancreatectomy with splenic vessel preservation*", Kim *et al.* present a single institution's 10-year retrospective experience of LDP in an attempt to define the learning curve for SPVP-LDP (15).

To answer this question, Kim et al performed a retrospective review of 83 consecutive patients who underwent attempted SPVP-LDP. Following exclusions for open conversion and robotic approaches, 65 patients were identified during this 10-year period (15). Multiple prior studies addressing learning curve utilize outcomes such as conversion to open, operative time and blood loss as their primary endpoint. This particular study however, focused on successful completion of splenic preservation, with either reversion to splenectomy or the Warshaw technique then considered "failure". To expound upon these trends, the authors utilized the cumulative sum control chart (CUSUM) analysis method. They reported that the frequency of successful spleen and vessel preserving LDP increased over time and was significantly more likely in smaller tumors with a more proximal location (body *vs.* tail). When successful, overall blood loss was lower and rates of complications were equivalent. CUSUM analysis suggested that 16 cases represented the time point after which successful SPVP-LDP was more likely than "failure" necessitating spleen or splenic vessel resection. Interestingly, the authors also report that following this

learning curve period length of hospital stay and rates of major complications declined (15).

This is a well performed study addressing an interesting clinical issue; however, the methodology begs several key questions. First, the study design presupposes the preference of SPVP-LDP over the Warshaw approach. To our knowledge, limited prospective data and no randomized controlled trials have compared the two techniques, and thus superiority of one technique over another is not readily apparent. Matched comparative studies have had conflicting outcomes regarding blood loss and operating time when comparing the two techniques (16,17). Due to alteration of splenic perfusion patterns, the Warshaw technique has been suggested to lead to splenic infarction or perigastric varices with potential increased long-term risk for gastric hemorrhage. While long-term risks of gastric bleeding have proven to be low, the impact of perigastric varices and potential left sided portal hypertension have not been studied (18). Nevertheless, while awaiting more robust data, SPVP-LDP is still an important procedure and appropriate approach for many patients.

The authors favored use of the CUSUM analysis method to identify the learning curve over previously used outcomes such as operative time or blood loss. This analysis approach is uniquely suited to learning-curve analysis recognizing the importance of time and experience in clinical practice as well as allowing identification of improved or suboptimal performances before recognition by standard statistical methods (19). Interestingly in this study, cases that were converted to open were excluded. This was observed in approximately 10% of these consecutive patients. While a multitude of factors influence rates of open conversion (14), the attempt of splenic vessel preservation is often a primary factor and therefore should be included in the CUSUM analysis. The omitted cases necessitating conversion to open would likely influence the slope of the CUSUM graph and thereby calculation of the learning curve. Furthermore, while the CUSUM analysis approach is unique and well fit for learning curve studies such as this, the X_0 or "acceptable initial clinical failure rate" was set at 50% without additional justification (15). A change in this value would potentially drastically alter the author's conclusions.

Patient demographics, particularly BMI, raise concern regarding the generalizability of these results to Western patient populations. Obesity has been shown to be an independent prognostic risk factor for postoperative complications in laparoscopic surgery (20-22). In fact, in a retrospective series at our institution, excessive intraabdominal fat was the most common (32.3%) factor in conversion to open for LDP (14). The median BMI for all patients in the study by Kim *et al.* was just 23 kg/m^2 (15). Unfortunately, greater than two-thirds of Americans are obese (BMI >30 kg/m^2) or overweight (BMI 25–29.9 kg/m^2) (23). Obesity increases technical difficulty with greater challenges in visualization and adequate exposure and a different patient population could theoretically increase technical challenges, thus affecting the learning curve. Nevertheless, the laparoscopic approach is important for these patients as many of the proposed advantages such as shorter length of stay and decreased postoperative infections, have an amplified importance in this at-risk population.

While the authors present an analysis from an experienced group of pancreatic surgeons, individual surgeon data are not available for this series. The total number and laparoscopic experience of the pancreatic surgeons included in this series is unclear. The authors show that this 16-case learning curve served as a cut-off with an increase of successful completion of SPVP-LDP as well as a decrease in hospital stay and complications (15). However, caution should be exercised when generalizing this 16-case cutoff to all individuals, as learning curve can be influenced by multiple factors, such as the surgeon's experience in performing open DP, institutional experience with SPVP-LDP, level of training of the assisting surgeons, and overall surgeon experience with laparoscopy.

The learning curve for complex, uncommon cases such as SPVP-LDP is difficult to measure. The authors have shown that SPVP-LDP proficiency may require 16 cases even for established surgeons. The volume of laparoscopic pancreatic resections, particularly those appropriate for SPVP-LDP, is limited as indicated by the 10-year period required to accrue 65 cases in this study. Ultimately in practice, proficiency is likely closely associated with other factors such as the completion of specialized post-residency training and practicing at high volume centers. Beyond the specific number of cases required to "learn" a particular procedure, progressive improvement occurs throughout a surgeon's career. Dr. John L. Cameron, Alfred Blalock Distinguished Service Professor of Surgery at Johns Hopkins Hospital has performed over 2,400 pancreaticoduodenectomies and when asked "*How many (pancreatectomies) do you have to do to be really good at it?*" famously replies "*I'll let you know when I get to that point. You never stop getting better at any operative procedure, no matter how many you have done.*" (24).

In conclusion, Kim *et al.* utilize the CUSUM analysis

method to estimate the learning curve of LDP with the spleen and splenic vessel preservation over a 10-year period. A greater likelihood of successful case completion was achieved following 16-cases. Additionally, after this period, hospital stay became significantly shorter and rates of major complications lower. This technique is appropriate for patients with benign or borderline pancreatic disease, thus a better understanding of the learning curve is important for both trainees and established surgeons adapting to new techniques.

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Footnote

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