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Standardization and streamlining of a pancreas surgery practice improves outcomes and resource utilization: A single institution's 20-year experience

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ABSTRACT

Background: In the past two decades, pancreas surgery (PS) has undergone significant advances in operative techniques and with a focus on multidisciplinary high-volume practices.
Methods: A review of patients undergoing PS from 3/1995-2/2015 was conducted; dividing patients into group A (1995–2005) and group B (2005–2015) for a detailed comparison. Effect of surgeon volume in group B was determined.
Results: A total of 1001 patients underwent PS (group A: 259; group B: 742). The mean age was 62.7 years and 52.8% were female. Group B patients were associated with a higher rate of pylorus preservation and minimally invasive resection and a lower rate of morbidity, pancreas fistula (PF), and delayed gastric emptying (DGE) than group A. High-volume surgeons (HVS) had lower operative blood loss (300 mL vs 600 mL), transfusion requirements, PF (14% vs 20%), DGE, surgical site infections, reoperations, and major morbidity rate (15.5 vs 39%) than low-volume surgeons.
Conclusions: This study demonstrates improved patient outcomes and hospital resource utilization over the past 20 years. Concentration of PS to HVS results in superior results.

1. Introduction

Over the past 2 decades, advances in pancreatic surgery have resulted in major improvements in patient outcomes after pancreatic resection. These changes include increasing emphasis of multidisciplinary pancreatic disease care, advances in pancreatic operative techniques including minimally invasive surgery, and improved postoperative care including intensive care and interventional radiology care for postpancreatectomy complications.[1] Moreover, increasing evidence demonstrates a clear association between high-volume specialized surgical centers and improved outcomes after surgery.[2–4] Studies performed in the last decade have revealed a decrease in in-hospital mortality and improved quality of care.[5–12] Regionalization of pancreatic surgery to high-volume centers and high-volume specialized surgeons has been suggested as a way to significantly improve patient outcomes and is already happening across Europe and some states in the USA.[13,14] This has changed the landscape of pancreatic disease. We sought to assess the impact of our institution's streamlining and standardization of the pancreatic surgical practice over a 20-year time period by evaluating perioperative results and patient outcomes.

2. Material and methods

We retrospectively reviewed a prospectively maintained pancreas surgery database spanning the time period from March 1995 to February 2015. With institutional IRB approval, data for all patients who underwent pancreas surgery at Mayo Clinic, Jacksonville, Florida (USA) was extracted and analyzed. All of the patients whose medical records were reviewed had provided consent to participate in research. The patients in the study were divided

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into two groups (group A and group B) by equal study time periods. Group A consisted of patients who underwent pancreas surgery during the first half of the study period (March 1995 to March 2005). Group B consisted of those who underwent pancreas surgery during the latter half of the study period (April 2005 to February 2015). Operative and patient outcome variables of these two groups were comparatively analyzed. To assess the effect of a surgeon's operative volume on patient outcomes and hospital resource utilization, we evaluated patients in group B who had undergone only pancreatoduodenectomy (PD) and subdivided these into two subgroups (Low-volume surgeons group and high-volume surgeons group) based on the number of PDs performed by each of the participating surgeons during that time period. Definitions of low and high-volume surgeons was as reported in literature.[15] A low-volume surgeon was defined was a surgeon performing fewer than 12 PDs per year, while a high-volume surgeon was defined as one performing 12 or more PDs per year. The intraoperative data and patient outcomes of these two subgroups were also comparatively analyzed. A total of 20 surgeons performed PD over the study time period, 10 surgeons in both groups with an overlap of 5 surgeons. Overall, 26 PD operations per year were performed by surgeons in group A and 74 PD operations per year by surgeons in group B. The 2 top volume surgeons in group A performed 14 and 10 PD operations per year while the remaining 8 performed fewer than 10 per year. Therefore, only 1 surgeon in group A was considered a high-volume surgeon. In the second half of the study period, pancreas surgery practice was streamlined and concentrated to those surgeons with hepatopancreatobiliary expertise. As a result, out of the 10 surgeons involved in group B, 3 surgeons performed the majority of the PD resections in this group, performing 41, 50, and 51 PD operations per year. The pancreas practice has been further streamlined and now consists of only the latter 2 high-volume surgeons. Additionally, further standardization of the pancreas surgery practice was also carried out starting in August 2008. Preoperatively, all patients were reviewed by a multidisciplinary pancreas tumor board comprising of surgeons, medical oncologists, radiologists, interventional radiologists, and gastroenterologists. High-quality pancreas protocol magnetic resonance imaging and endoscopy with ultrasound were obtained and reviewed by the multispecialty pancreas team, and a consensus plan of management followed. The surgical technique was standardized among the 2 surgeons. The resection and reconstruction techniques were replicated for both open and minimally invasive approaches. Postoperatively, patients were managed by a standardized enhanced recovery protocol with modifications made as necessary for each individual patient. Data collected included patient demographics, operative variables, postoperative outcomes, pathologic findings, and postoperative follow-up details. Demographic data collected included age, sex, comorbidities, body mass index, American Society of Anesthesiologists (ASA) score, and Eastern Cooperative Oncology Group performance status. Operative details included operative time (incision to close of the wound), estimated blood loss (EBL), packed red blood cell (pRBC) transfusion obtained from the anesthesia record, type of operative resection performed, operative approach (open versus hand-assisted versus laparoscopic), conversion from one approach to another and reason for conversion, type of pancreatic anastomosis, any vascular resection performed, and drain use. Pathologic specimen details collected included final pathologic diagnosis, number of tumors, size of largest tumor, TNM tumor staging details for malignant tumors, margin status, and distance of closest margin. Postoperative outcomes were tracked for 3 months (90 days) after surgery and were graded according to the Clavien-Dindo system. Minor complications were defined as grades I and II, while major complications were defined as grade III-V. Final overall complication grade assigned was the highest grade complication experienced by each patient. Need for readmission or reoperation and length of stay were also recorded.

Postpancreatectomy complications were defined according to International Study Group of Pancreas Surgery consensus definitions. Postpancreatectomy pancreas fistula was defined as drain output of any measurable volume of drain fluid on or after postoperative day 3, with an amylase content >3 times the upper normal serum value.[16] Postpancreatectomy hemorrhage was defined according to the time of onset, location, and severity of hemorrhage as early onset (≤24 h after end of the index operation) or late onset (>24 h); intraluminal or extraluminal; and mild or severe depending on degree of hemoglobin drop, success of conservative management, and need for invasive intervention (reoperation or interventional angiography). Delayed gastric emptying (DGE) was defined as an inability to tolerated oral intake, emesis, and a need for prokinetics or nasogastric tube decompression with grading into A, B, and C based on the presence and duration of each of these factors.[17]

Comparative statistical analysis of group A and group B was performed. Categorical data are reported as number with percentage of the whole. Continuous data are reported as a mean with range. Significance for categorical data was tested using a two-tailed Fischer's exact test or Chi square test where appropriate using a 2×2 contingency table. Significance for continuous data was tested using the *t*-test to compare two means. A *P* value of <0.05 was used to determine significance.

3. Results

From March 1995 to February 2015, 1001 patients underwent pancreatic resection. Overall, the mean age of the group was 62.7 years (range 32–82 years) and 52.8% were female. Group A was comprised of 259 patients and group B 742. A comparison of patient demographics is shown in Table 1. Group B had significantly more patients with hypertension, diabetes mellitus, and ASA class III and IV.

A comparison of operative details between the two groups is shown in Table 2. With time, a shift towards pylorus preserving PD and minimally invasive pancreatic resection was noted. Ninety-eight percent of the pancreas operations in group A were performed open (laparotomy) while the remaining 2% were performed through a hand-assisted laparoscopic approach. No procedures were performed by a totally laparoscopic approach in group A. In contrast, 48% of patients in group B underwent laparoscopic pancreas surgery, 50% underwent open pancreas surgery, and the remaining 2% underwent hand-assisted surgery. EBL and pRBC transfusions were reduced in the latter time period.

Table 1
Patient demographics.

Variable	Group A (n = 259)	Group B (n = 742)	P value
Male	121 (46.7%)	356 (47.9%)	0.773
Hypertension	136 (52.5%)	451 (60.8%)	**0.023**
Diabetes	51 (19.7%)	213 (28.7%)	**0.004**
Cardiac disease	78 (30.1%)	206 (27.8%)	0.472
Pulmonary disease	21 (8.1%)	61 (8.2%)	1.000
ASA			**0.0001**
I/II	92 (35.5%)	155 (20.9%)	
III/IV	162 (62.5%)	585 (78.8%)	
Mean age *years*[a]	63.1 (21–85)	64.1 (17–90)	0.276
Body mass index[a]	26.8 (14.9–46.1)	27.5 (15–62.5)	0.086

Bold values are statistically significant.
[a] Values are mean (range). ASA, American Society of Anesthesiologists score.