

Clinical Science

# High-volume surgeons vs high-volume hospitals: are best outcomes more due to who or where?



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## Abstract

**BACKGROUND:** High-volume hospitals are purported to provide “best” outcomes. We undertook this study to evaluate the outcomes after pancreaticoduodenectomy when high-volume surgeons relocate to a low-volume hospital (ie, no pancreaticoduodenectomies in >5 years).

**METHODS:** Outcomes after the last 50 pancreaticoduodenectomies undertaken at a high-volume hospital in 2012 (ie, before relocation) were compared with the outcomes after the first 50 pancreaticoduodenectomies undertaken at a low-volume hospital (ie, after relocation) in 2012 to 2013.

**RESULTS:** Patients undergoing pancreaticoduodenectomies at a high-volume vs a low-volume hospital were not different by age or sex. Patients who underwent pancreaticoduodenectomy at the low-volume hospital had shorter operations with less blood loss, spent less time in the intensive care unit, and had shorter length of stay ( $P < .05$  for each); 30-day mortality and 30-day readmission rates were not different.

**CONCLUSIONS:** The salutary benefits of undertaking pancreaticoduodenectomy at a high-volume hospital are transferred to a low-volume hospital when high-volume surgeons relocate. The “best” results follow high-volume surgeons.

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The impact of surgeon and/or hospital volume and experience is of great interest when comparing outcomes after pancreaticoduodenectomy. Surgeon volume and experience is an important determinant of outcomes after high-risk procedures, for example, pancreaticoduodenectomy.<sup>1,2</sup> Surgeon experience and frequency in which pancreaticoduodenectomy is undertaken has proven to have an effect on postoperative outcomes.<sup>3-6</sup> Similarly, improved

outcomes for high-risk procedures are more likely to be achieved at high-volume hospitals, presumably because of sufficient resources and experience.<sup>7-11</sup> Although high-risk procedures (ie, pancreatic resection) have been undertaken at high-volume, and to a lesser extent, low-volume hospitals for a number of years, most agree that high-volume hospitals offer advantages, which may be intangible.<sup>12-14</sup> Notably, high-volume hospitals and high-volume surgeons are generally inextricably related.

Hospital-volume standards as set by the Leapfrog criteria have proven to improve patient safety.<sup>15</sup> Leapfrog has identified that 12 or more pancreaticoduodenectomies per year must be undertaken at a hospital for it to be identified as a high-volume hospital. A hospital would certainly be denoted as a low-volume hospital if no pancreaticoduodenectomies

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have been undertaken there in more than 5 years.<sup>16,17</sup> The preponderance of data supports that high-volume hospitals are purported to provide “best” outcomes and patients treated there are denoted to receiving the “best” care. Notably, the arrival of high-volume surgeons can quickly transform a low-volume hospital into a high-volume hospital. It is not clear if postoperative outcomes are more dependent on surgeon volume or hospital volume, as their relationship is generally inextricable. The postoperative outcomes of patients do not demonstrate if surgeon volume vs hospital volume will portend better outcomes.

Outcomes after pancreaticoduodenectomy for 2 high-volume surgeons are detailed herein, first while at a high-volume hospital and then at what had been a low-volume hospital to better understand the interplay between surgeon volume and hospital volume in predicting outcomes after pancreaticoduodenectomy. We undertook this study to evaluate the outcomes after pancreaticoduodenectomy when high-volume surgeons relocate to a low-volume hospital. In undertaking this study, we hypothesized that “best” results are surgeon dependent and relatively independent of hospital volume and that the “best” results transfer with the surgeons when they relocate to a low-volume hospital.

## Methods

Patients were entered into a database with institutional review board approval after patient informed consent. Outcomes after the last 50 pancreaticoduodenectomies undertaken by 2 surgeons at a high-volume hospital (using the Leapfrog definition) in 2012 (ie, before relocation) were compared with the outcomes after the first 50 pancreaticoduodenectomies undertaken by the same 2 surgeons at a low-volume hospital (no pancreaticoduodenectomy in over 5 years) in 2012 to 2013 (ie, after relocation). Operative time is defined as the time from when an incision is made to the application of dressing. After discharge, patients were prospectively followed.

Comparisons were undertaken using Mann-Whitney *U*-test or chi-square test, where appropriate. For contingency testing, where appropriate, Fisher exact test was used for summing small *P* values. Significance was accepted with 95% probability. Data were maintained on a spreadsheet (Excel; Microsoft, Redmond, WA) and analyzed using GraphPad InStat, version 3.06 (GraphPad InStat; GraphPad Software, Inc., San Diego, CA). Where appropriate, data are presented as median or median (mean  $\pm$  standard deviation).

## Results

One hundred patients (56 men) were included in this analysis. Their median age was 70 years with an American Society of Anesthesiologists (ASA) class of 3. The median operative time was 252 minutes with an estimated blood loss (EBL) of 300 mL. The median intensive care unit (ICU) stay was 2 days and hospital length of stay (LOS)

was 9 days. The 30-day readmission rate for all patients was 20% with a 30-day mortality of 5% (Table 1). Overall, 80 patients had a malignancy (Table 2).

For patients undergoing pancreaticoduodenectomy at the high-volume hospital, 30 patients were men, and the median age was 70 years with an ASA class of 3. ASA classes were as follows: 1 (0%), 2 (6%), 3 (82%), and 4 (12%; Table 3). The median operative time was 305 minutes with an EBL of 350 mL. The median ICU stay was 3 days, and hospital LOS was 8 days. The 30-day readmission rate for patients was 19% with 6% of 30-day mortality (Table 1). Forty-five patients (90%) had a malignancy (Table 2).

For the low-volume hospital, 26 patients were men, and the median age was 69 years with an ASA class of 3. ASA classes were as follows: 1 (0%), 2 (36%), 3 (54%), and 4 (10%; Table 3). The median operative time was 205 minutes with an EBL of 260 mL. The median ICU stay was 1 day, and hospital LOS was 7 days. The 30-day readmission rate for patients was 20% with 4% of 30-day mortality (Table 1). Thirty-five patients (70%) had a malignancy (Table 2).

Patients undergoing pancreaticoduodenectomies at the high-volume vs the low-volume hospital were not different by sex or age (Table 1). More patients at the high-volume hospital underwent pancreaticoduodenectomy for malignancy than at the low-volume hospital ( $P < .05$ ) (Table 1). Patients who underwent pancreaticoduodenectomy at the low-volume hospital had shorter operations with less blood loss, spent less time in the ICU, and had shorter hospital LOS ( $P < .05$  for each; Table 1); 30-day mortality and 30-day readmission rates were not different (Table 1).

There was a significant difference in ASA class between the high-volume and low-volume hospital ( $P = .001$ ; Table 3). There was no significant difference in margin status between high-volume and low-volume hospitals. At the high-volume hospital, 40 patients had an R0 resection and 7 patients had an R1 resection compared with 33 R0 resections and 13 R1 resections at the low-volume hospital (Table 4). There was no significant difference in T and N categories, but there was a significant difference in the American Joint Committee on Cancer stage between the high-volume and low-volume hospital ( $P = .017$ ; Table 4).

## Comments

It has been well established that patients undergoing pancreaticoduodenectomy at a high-volume hospital have lower in-hospital morbidity and mortality than patients undergoing pancreaticoduodenectomy at a low-volume hospital.<sup>4,7,18–20</sup> The portability of these outcomes was here-to-date unknown. Herein, we document the salutary benefits associated with high-volume surgeons who relocate to a low-volume hospital. For pancreaticoduodenectomy, the benefits of a high-volume hospital can accompany high-volume surgeons when they relocate to a low-volume hospital; it seems that optimal outcomes

**Table 1** Patients undergoing pancreaticoduodenectomy at the high-volume hospital with the high-volume surgeons compared with patients undergoing pancreaticoduodenectomy at the low-volume hospital with the high-volume surgeons

Patient data	High-volume hospital (n = 50)	Low-volume hospital (n = 50)	P value
Sex, Men	60%	52%	NS
Age (y)	70 (70 ± 10.0)	69 (68 ± 11.8)	NS
ASA class	3 (3 ± .63)	3 (3 ± .44)	.001
Operative time (min)	305 (304 ± 67.9)	205 (216 ± 56.0)	.0001
Estimated blood loss (mL)	350 (479 ± 394.6)	260 (348 ± 251.0)	.05
Diagnoses, malignant	90%	70%	.02
ICU days	3 (7 ± 10.1)	1 (4 ± 11.1)	.01
Length of stay (d)	8 (12 ± 13.2)	7 (11 ± 13.1)	.01
30-d readmission	19%	20%	NS
30-d mortality	6%	4%	NS

ASA = American Society of Anesthesiologists; ICU = intensive care unit; NS = nonsignificant.

after pancreaticoduodenectomy are more a result of “who” not “where.”

The relocation of the 2 high-volume surgeons from a high-volume hospital to a (before their arrival) low-volume hospital provided a unique opportunity to study the interplay and relative impact between hospital volume and high-volume surgeons. The transition from a high-volume hospital to a low-volume hospital might be daunting for surgeons (and patients) in many ways, although this study suggests that the transition does not have to be associated with suboptimal outcomes.

All the patients in this study were cared for in the recent past. They are a consecutive number of patients. They are usual by metrics of age, sex, ASA class, and disease process. Their operations were, by conventional standards, not unusual in duration and EBL. ICU stay and in-hospital LOS are not out of line compared to most centers. In-hospital mortality was a little higher than hoped for, but with the small number of patients, it was not outside the usual for “centers of

excellence.”<sup>19</sup> Readmissions were in line with national “standards” as reported in several recent multicenter studies, although higher than we would like.<sup>5,21,22</sup> With collaborative efforts among all personnel, we are continually working to decrease hospital readmissions.

For patients receiving care at the previously low-volume hospital, sex and age were not different than for patients receiving care at the high-volume hospital; as well, they had similar in-hospital mortality and similar rates of readmission to the hospital within 30 days of discharge. Patients who underwent pancreaticoduodenectomy at the previously low-volume hospital by the high-volume surgeons had shorter operations with less blood loss, spent less days in the ICU, and had shorter LOSs than patients who underwent pancreaticoduodenectomy by the same surgeons at the high-volume hospital. Notably, patients undergoing pancreaticoduodenectomy at the low-volume hospital had better ASA class, were less likely to harbor a malignancy, and had earlier stage cancers. Although we cannot fully explain differences in EBL, operative duration, ICU stay, and hospital LOS, they are real.

As stated, patients undergoing pancreaticoduodenectomy at the high-volume hospital were more likely to have had malignant disease, and for those who did, their cancers were generally of a more advanced stage. Furthermore, patients at the high-volume hospital were more likely to have a more advanced ASA class. These differences were not because of conscious decisions in patient selection, but rather, “the luck of the draw.” Could these differences lead to greater blood loss and longer operations and ICU stays? Possibly, but the statistical differences in pathology, tumor stage, and ASA class do not seem sufficiently substantial or meaningful to translate into such notable differences and broad measures of quality (eg, operative duration of 100 or more minutes and ICU stays of 2 or more days in the high-volume hospital).

Maybe we focused more on the small details at the low-volume hospital and micromanaged more without realizing it on a daily basis. This is not an issue of more infrastructure or

**Table 2** Final pathology for patients undergoing pancreaticoduodenectomy at the low-volume hospital or the high-volume hospital

Low-volume hospital (n = 50)	Total
Pancreatic adenocarcinoma	31
Neuroendocrine tumor	7
Intraductal papillary mucinous neoplasia	3
Chronic pancreatitis	2
Other*	7
High-volume hospital (n = 50)	Total
Pancreatic adenocarcinoma	45
Chronic pancreatitis	2
Intraductal papillary mucinous neoplasia	1
Acute on chronic pancreatitis with abscess	1
Pancreatic serous cystadenoma	1

\*“Other” included 1 patient for each: ampullary adenocarcinoma, adenosquamous carcinoma, cholangiocarcinoma, duodenal adenocarcinoma, chronic peptic duodenitis, pancreatic intraepithelial neoplasia, and sclerosing cholangitis.

**Table 3** Patients stratified by ASA class at the high-volume hospital compared with the low-volume hospital

ASA class	High-volume hospital (n = 50)	Low-volume hospital (n = 50)	P value
2	3	18	.001
3	41	27	
4	6	5	

ASA = American Society of Anesthesiologists.

support at the previously denoted low-volume hospital, as the compliment of middle-level provider support and fellow support was identical. The “take home” message is that salutary outcomes seem more due to the impact of the surgeons than the impact of the hospital, given adequate baseline hospital support.

It might be presumed that patients who are discharged earlier from the hospital have a higher propensity of “bounce back” for readmission. We did not see this, consistent with others, who have made efforts to reduce hospital LOS. This observation endorses the notion that decreased LOSs do not have to translate into higher readmission rates, but does lead to lower medical costs.<sup>22</sup> We need to continue to focus our efforts on identifying patients at high risk for readmission.<sup>21</sup> Across the United States, hospital LOS and readmission rates for many operations, disorders, and diseases are decreasing because of increased attention. We trust ours will follow this trend. Expediting recovery after operations is a “hot” topic in US surgery.

**Table 4** Pathologic characteristics of carcinoma at the high-volume hospital compared with the low-volume hospital

Staging	High-volume hospital	Low-volume hospital	P value
Margin status	n = 47	n = 46	NS
R0	40	33	
R1	7	13	
T category	n = 45	n = 42	NS
T1	1	4	
T2	8	13	
T3	28	22	
T4	8	3	
N category	n = 45	n = 42	NS
N0	11	19	
N1	32	22	
N2	0	1	
NX	2	0	
AJCC stage	n = 45	n = 42	.017
IA	1	4	
IB	1	10	
IIA	9	5	
IIB	27	20	
III	5	3	
IV	2	0	

AJCC = American Joint Committee on Cancer; NS = nonsignificant.

Multidisciplinary care has been proven to reduce in-hospital mortality after pancreatic resections.<sup>23</sup> To facilitate the relocation and ease the transition to the low-volume hospital, the surgeons and their staff organized a few (<5) short programs with nursing staff to orient the hospital professionals and support staff to the care of their patients, including those undergoing pancreaticoduodenectomy. These programs focused on nursing care and expectations covering basic issues in the care of patients undergoing complex operations. Other educational programs were initiated and continue. A weekly multidisciplinary gastroenterology and/or surgery case conference, which also includes interventional radiologists, promotes discussions of complex care. At this conference, complex gastrointestinal disorders are discussed in great detail. Every other week, medical oncologists, gastroenterologists, interventional radiologists, diagnostic radiologists, and surgeons from the previously low-volume hospital meet for a “tumor board,” discussing the “total care” for patients with cancer. Weekly, we undertake a preoperative case conference at which we discuss all our upcoming operations for the week. This conference includes surgeons and support staff (ie, operating room personnel) along with members of the department of anesthesia. We also host a biweekly surgical “grand rounds” for advanced education across a broad range of topics involving complex surgical care. Nursing staff, internists, cardiologists, gastroenterologists, interventional radiologists, critical care intensivists, and surgeons, among many, attend and participate in this lecture series. In addition to the educational aspects of these activities, these activities also put the hospital and everyone who works there on notice that a new era in the hospital has begun and that “score” will be kept in the broadest possible terms. Of all the activities, the early short programs focusing on nursing care and expectations were the most helpful. Notably, many health care professionals and colleagues chose not to participate and continue to not participate, possibly feeling threatened by the impending changes at the hospital.

The need for centralization of highly complex operations, such as pancreaticoduodenectomy, should continue to be studied.<sup>12,15–17,20,24</sup> As centralization progress and health care focuses on high-risk high-reward operations, the role and relative importance of high-volume surgeons will be better defined. It seems high-volume surgeons cannot be commoditized; they play an important role in the care of patients with complex problems. As well, with dissemination of health care, high-volume surgeons should not be discouraged to relocate to low-volume hospitals as portability of positive outcomes after complex operations, like pancreaticoduodenectomy is possible. Salutary outcomes can be achieved with a well-planned transition, regular educational sessions for nurses and staff, and promotion of an institutional culture that embraces difficult and complex postoperative management. The “best” results after complex operations, like pancreaticoduodenectomy, seem to be related more to who undertakes the

pancreaticoduodenectomy and the associated care rather than where the pancreaticoduodenectomy is undertaken; salutary outcomes seem more to “who” than “where.”

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