POSTOPERATIVE OUTCOMES OF ELECTIVE PANCREATIC SURGERY IN A LOW-VOLUME ACADEMIC SURGICAL CLINIC

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Summary

According to the volume-outcome concept the postoperative outcome after major pancreatic surgery in high-volume institutions compares favorably to low-volume centers. However, it is not clear whether this is applicable to all low-volume institutions nowadays. The aim of the study was to evaluate the postoperative outcome after major elective pancreatic surgery in a low-volume academic surgical clinic. All consecutive elective major pancreatic cases operated within a 10-year period till October 2013 have been retrospectively reviewed. During the studied period, 36 patients (15 females, 21 males, mean age 54 years, age range 37-76) were scheduled for elective pancreatic surgery and underwent pancreatic resection (n=31, 18 proximal and 13 distal pancreatic resections) or complete pancreatic duct drainage procedure (n=5). Eleven patients had chronic pancreatitis and 25 patients had malignant or benign tumors. Vascular or adjacent organ resection was performed in 9 patients (29% of resections). The overall postoperative morbidity was 36% (n=13), and complications requiring re-operation occurred in 5 patients (14%). The median postoperative hospital stay was 11 days for patients without complications vs. 25 days for patients with any complication. There was no 60-day postoperative mortality or hospital readmission. Major elective pancreatic surgery can be safely performed today in a low-volume academic general surgical clinic, with postoperative outcomes similar to those reported by high-volume centers.

Key words: pancreatic resection, volume, complications, distal pancreatectomy, pancreaticoduodenectomy

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Introduction

According to both risk-assessment protocols and complexity of surgery grading systems, elective pancreatic surgery is considered a high-risk surgical intervention due to its technical complexity and associated postoperative morbidity and mortality rates [1, 2]. Historically, the volume of some surgical procedures performed per year by surgeon/hospital has proven to be closely related to the postoperative outcome. This correlation has led to the concept of regionalization of patients to high-volume centers, especially for major high-risk surgical procedures. However, it is not clear whether the volume-

outcome concept is always valid nowadays, especially for specific interventions rarely performed at academic surgical units, which are usually high volume centers in regard to the total number of major operations performed per year.

The aim of this study was to investigate the postoperative outcomes after elective major pancreatic surgery performed in a low-volume (1-5 resections per year) academic surgical unit, non-sub-specialized in pancreatic surgery.

Patients and Methods

All patients that underwent elective major pancreatic surgery over a ten-years period till October 2013 were included in the study. The studied key interventions were pancreatic resections and complete pancreatic duct drainage procedures (i.e. Partington's, Frey's). The patients that underwent palliative procedures for cancer or incomplete drainage procedures (as pseudocyst drainage interventions) were not included in the study. Surgical techniques used for the main studied interventions were as follows:

• Pancreaticoduodenectomy: the pancreatic head was mobilized using wide Kocher maneuver and sharply transected, whenever possible after blunt separation of portal vein/superior mesenteric vein (PV/SMV) from the pancreas. In cases of vascular infiltration, the adjacent vessel was resected *en bloc* with the specimen. Then the common bile duct, duodenum/stomach and jejunum were transected. With proximal GI-tract transection the pylorus or gastric antrum were preserved or not preserved, depending on the required type of operation (pylorus-preserving-, pylorus-resecting- or Whipple's pancreati-coduodenectomy). Reconstruction was performed on a retrocolic Roux-en-Y jejunal limb with consecutively created pancreati-cojejunostomy (duct to mucosa, two-layered, externally drained), hepaticojejunostomy (single-layered, not drained) and duodeno- or gastrojejunostomy. Before reconstruction, PV/SMV and retroperitoneal arterial stumps were wrapped with omentum in order to protect them from pancreatic juice in cases of pancreaticojejunostomy leak.

• Distal pancreatosplenectomy: after transection of splenic artery at its origin, the pancreas had been mobilized from the retroperitoneum and sharply transected just at the right edge of superior mesenteric artery. Splenic vein was controlled separately. The stump of the pancreas was secured with running mattress sutures after separately securing the main pancreatic duct. Dissection proceeded laterally and included adjacent organs when it was necessary to achieve R0 resection.

• Complete pancreatic duct drainage procedures: after opening the lesser sac, the pancreas was explored with intraoperative ultrasound, the entire pancreatic duct opened, coring-out of the head of the pancreas performed if necessary, longitudinal pancreati-cojejunostomy (two-layered, running suture) performed on a retrocolic Roux-en-Y jejunal limb.

The patient's demographics, operative intervention, morbidity, mortality and hospital readmission were also investigated.

Results

During the studied period, 108 patients diagnosed with cancer/pancreatic mass/chronic pancreatitis on imaging studies were scheduled for elective pancreatic surgery. Thirty-six of them underwent major pancreatic surgery (15 females, 21 males, mean age 54 years, age range 37-76). Thirty-one of the patients underwent major surgery with various types of resection procedures (Table 1) and 5 patients underwent complete pancreatic duct drainage procedures (2 Frey's, 3 Partington's). Vascular resection was performed in three cases (10%) – in two cases, tangential resection of portal vein and inferior vena cava respectively required along with pancreati-coduodenectomy, and in one case *en block* hepatopancreatoduodenectomy with resection of portal bifurcation and main-to-left portal vein reconstruction was made (Figure 1, B). Resection of adjacent organ was required in 6 cases (19%, Table 1), one patient underwent laparoscopic spleen-preserving distal pancreatectomy (Figure 1, A) and another patient with *situs viscerum inversus totalis* underwent pylorus-preserving pancreaticoduodenectomy. In the remainder, standard procedures were performed as described above.

The overall postoperative morbidity was 36% (13 patients). All complications occurred after resection procedures. Five patients developed only minor complications (Dindo-Clavien grade I) – a superficial wound infection managed at the bedside [2]. Three patients developed Dindo-

Table 1. Patients and operative interventions data

n	gender/age	pathology	Operation, resected adjacent organ/structure
1	M/42	CP	Distal pancreatosplenectomy
2	M/63	CP	PPPD
3	F/67	Ca	Distal pancreatosplenectomy, gastrectomy, transverse colectomy
4	M/37	Ca	Distal pancreatosplenectomy, nephrectomy, suprarenalectomy
5	F/62	CP	PPPD
6	F/44	Ca	Hepatopancreatoduodenectomy, portal bifurcation
7	F/42	cystadenoma	Laparoscopic distal pancreatectomy
8	M/68	Ca	PPPD
9	F/59	cystadenoma	DPPHR, left hepatic lobectomy
10	M/62	CP	PPPD
11	M/48	Ca	PPPD
12	F/62	Ca	PPPD
13	M/61	Ca	Whipples' pancreaticoduodenectomy
14	F/76	Ca	PPPD
15	F/61	Ca	Whipples' pancreaticoduodenectomy, portal vein
16	M/42	Ca	PRPD
17	M/66	Ca	Distal pancreatosplenectomy
18	M/46	Ca	Distal pancreatosplenectomy, nephrectomy, suprarenalectomy
19	M/43	insulinoma	Enucleation (uncinate process), pancreatic tail resection
20	M/63	Ca	Distal pancreatosplenectomy, gastrectomy
21	M/38	AIP	PRPD
22	M/60	Ca	PRPD
23	F/60	Ca	PRPD
24	_	AIP	PRPD
25	M/75	Ca	Distal pancreatosplenectomy, gastrectomy
26	F/45	Ca	PRPD, inferior vena cava resection
27	F/39	Ca	PRPD
28	F/66	Ca	Distal pancreatosplenectomy, solitary hepatic metastasectomy
29	M/31	cystadenoma	Distal pancreatosplenectomy
30	F/66	Ca	Distal pancreatosplenectomy
31	F/42	Ca	Distal pancreatosplenectomy, gastrectomy, suprarenalectomy

CP – chronic pancreatitis, Ca – cancer, AIP – autoimmune pancreatitis, PPPD – pylorus-preserving pancreaticoduodenectomy, DPPHR – duodenum-preserving pancreatic head resection, PRPD – pylorus-resecting pancreaticoduodenectomy

Clavien grade II complications after pancreatico-duodenectomy - grade B pancreatic fistula (according to International Study Group on Pancreatic Fistula, ISGPF), requiring prolonged drainage, treatment with antibiotics and somatostatin or analogues. Five patients (14%) had Dindo-Clavien grade IIIb complications requiring reoperation – in all of these, an abdominal collection as a consequence of ISGPF grade C pancreatic fistula was drained (4 after pancreaticoduodenectomy, 1 after distal pancreatosplenectomy). Delayed gastric emptying was observed in seven patients with pancreatic fistula after pancreaticoduodenectomy. The median postoperative hospital stay was 11 days for patients without complications vs. 25 days for patients with any complication. There was no 60-day postoperative mortality or hospital readmission.
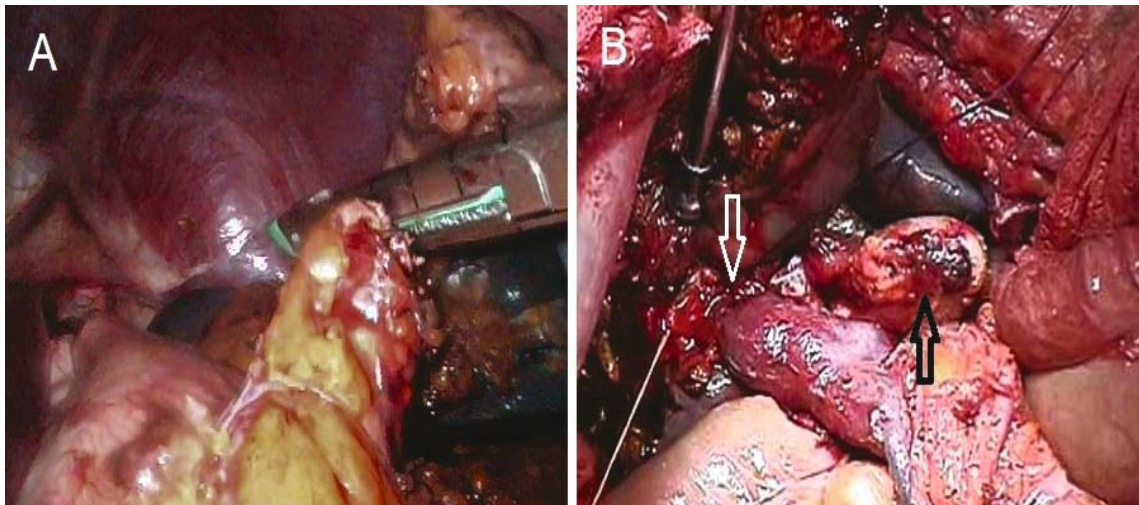
Figure 1. Intraoperative photographs. **A** – Laparoscopic spleen-preserving distal pancreatectomy - transection of the pancreas with EndoGIA stapler. **B** – *En bloc* hepatopancreatoduodenectomy with resection of portal bifurcation – completed main portal-to-left portal vein anastomosis (white arrow) and stump of the pancreas (black arrow) are marked

Discussion

Historically, evidence showing better outcomes after complex surgical procedures (such as pancreatic surgery) in high-volume hospitals have led to the concept that these operations should be regionalized to high-volume institutions [3-5]. However, considering pancreatic surgery in particular, as well as some other complex procedures, this hypothesis is being questioned today by several recent studies [6-10].

The complexity and difficulties in drawing definitive conclusions related to volume-outcome concept in major abdominal surgery were clearly demonstrated by Tol et al. in a recent review of the published meta-analyses and systematic reviews on the subject [11]. The authors identified 8 reviews investigating the effect of volume on mortality after pancreatic resection. In this analysis report, the reviews with nonadjusted mortality rates included significant decrease of postoperative mortality in high volume hospitals/surgeons. Three systematic reviews, reporting adjusted mortality rates, have also found significant difference in mortality (14.1% vs. 3.5%, p<0.001) between low volume (1-5 resections per year) and high volume (>50 resections per year) hospitals. However, other adjusted studies included in this analysis do not find significant association between hospital or surgeon volume and mortality, and one meta-analysis has reported an association between the hospitals' but not surgeons' volume and postoperative mortality. Analyzing all those conflicting evidence, the authors have concluded that the forms of hospital structure and process of care may play a more important role than the surgeon's expertise and skills alone. The presence of high-intensity intensive care unit, interventional radiology and effective prevention and managing complications, along with the careful patient selection seems to be a major predictor of postoperative mortality, rather than the hospital/surgeon volume. A similar conclusion has been drawn by LaPar et al. [8] after an exhaustive analysis of discharge data of 261 412 patients after four major surgical procedures, including pancreatic resection. The adjusted mortality for pancreatic resection reported in this study was 4.7%, with no significant differences regarding the volume of the hospital. The authors have concluded that the hospital procedure volume is not a significant predictor of mortality for the performance of pancreatic resection and should not be used as a proxy measure for surgical quality. In the above study, mortality risk is generally attributed to patient-level characteristics such as age and comorbidities. Recently, a "pancreatectomy risk calculator" has been developed based on the American College of Surgeons-National Surgical

Quality Improvement Program (ACS-NSQIP) dataset of 7571 pancreatic resections performed in 193 hospitals from 2005 to 2008 [12]. The mortality in this cohort was 2.5%, serious morbidity was 21.2%, and overall morbidity amounted to 31.8%. The authors identified 10 pre-operative variables for prediction of post-operative mortality, serious or overall morbidity, all of them representing patient-level characteristics. A similar risk-model was published by Kimura et al., based on the analysis of 8575 pancreatic resections (40% morbidity, 2.8% in-hospital mortality) included in a Japanese National Clinical Database [13]. However, it is clear that differences in outcome cannot be explained by patient-dependent variables alone, and that hospital/surgeon characteristics also play a considerable role. It is important to note that even after an administrative plea for centralization of pancreatic resections, the results of nationwide analyses failed to demonstrate improvement in postoperative outcomes at population-based level [14, 15]. In a population-based study of 103 222 major pancreatic resections performed in USA from 1988 to 2003, Teh et al. [15] surprisingly did not find significant improvement in postoperative mortality during the 16-year period they studied. Similarly, data from the Dutch nationwide registry, including 19 688 pancreatic resections from 1994 to 2004 failed to show a reduction in mortality [14]. Both studies have noted a major disparity between results of different hospitals which are not always related to volume, and this

has led to the conclusion that outcome-based rather than volume-based guidelines for referral of patients requiring pancreatic resection should be developed and used in the future. The data derived from the study published by Shell et al. [7] confirms the applicability of this concept, especially to academic institutions. The latter study demonstrates that it is possible to implement both decision making and perioperative care pathways from leading high-volume centers with excellent results to low-volume academic centers, thus enabling the latter to reproduce the favorable outcomes of the former. It seems that even low-volume academic surgical units are capable of keeping standards of care established by high-volume institutions regarding both the resectability and postoperative morbidity/mortality rates. Our results also confirm these observations.

Conclusion

Major elective pancreatic surgery can safely be performed today in a low-volume, non-sub-specialized in pancreatic surgery academic general surgical clinic, with postoperative outcomes similar to those reported by high-volume centers. However, due to small sample sizes of studies coming from low-volume centers, it is still not clear whether they are also able to reproduce oncological long-term outcomes of high-volume institutions.

References

1. Klotz H, Candinas D, Platz A, Horvath A, Dindo D, Schlumpf R, et al. Preoperative risk assessment in elective general surgery. Br J Surg. 1996;83912): 1788-99.
2. Dindo D, Demartines N, Clavien PA. Classification of Surgical Complications. Ann Surg. 2004;240(2):205-13.
3. Birkmeyer JD, Siewers AE, Finlayson EV, Stukel T, Lucas FL, Batista I, et al. Hospital volume and surgical mortality in the United States. N Eng J Med. 2002; 346(15):1128-37.
4. Begg CB, Cramer LD, Hoskins WJ, Brennan MF. Impact of hospital volume on operative mortality for major cancer surgery. JAMA. 1998;280(20): 1747-51.
5. Halm EA, Lee C, Chassin MR. Is volume related to outcome in health care? A systematic review and methodologic critique of the literature. Annals of Internal Medicine. 2002;137(6):511–20.
6. Simunovic M, Urbach D, Major D, Sutradhar R, Baxter N, To T, et al. Assessing the volume-outcome hypothesis and region-level quality improvement interventions: pancreas cancer surgery in two Canadian Provinces. Ann Surg Oncol. 2010;17(10):2537-44.
7. Schell MT, Barcia A, Spitzer AL, Harris HW. Pancreaticoduodenectomy: Volume is not Associated with outcome within an Academic Health Care System. HPB Surgery. 2008; 2008:825940.
8. LaPar DJ, Kron IL, Jones DR, Stukenborg GJ, Kozower BD. Hospital procedure volume should

not be used as a measure of surgical quality. Ann Surg. 2012;256(4):606-15.

9. Fisher WE, Hodges SE, Wu MF, Hilsenbeck SG, Brunicardi FC. Assessment of the learning curve for pancreaticoduodenectomy. Am J Surg. 2012;203(6):684-90.

10. Rosales-Velderrain A, Bowers SP, Goldberg RF, Clarke TM, Buchanan MA, Stauffer JA, et al. National trends in resection of the distal pancreas. World J Gastroenterol. 2012;18(32):4342-9.

11. Tol J, van Gulik T, Busch O, Gouma D. Centralisation of highly complex low-volume procedures in upper gastrointestinal surgery. A summary of systematic reviews and meta-analyses. Dig Surg. 2012;29(5):374-83.

12. Parikh P, Shiloach M, Cohen M, Bilimoria K, Ko C, Hall B, et al. Pancreatectomy risk calculator: an ACS-NSQIP resource. HPB. 2010;12(7):488-97.

13. Kimura W, Miyata H, Gotoh M, Hirai I, Kenjo A, Kitagawa Y, et al. A Pancreaticoduodenectomy Risk Model Derived From 8575 Cases From a National Single-Race Population (Japanese) Using a Web-Based Data Entry System: The 30-Day and In-hospital Mortality Rates for Pancreaticoduodenectomy. Ann Surg. 2013; doi: 10.1097/SLA.0000000000000263. [PubMed PMID 24253151].

14. Van Heek N, Kuhlmann K, Scholten R, De Castro S, Busch O, van Gulik T, et al. Hospital volume and mortality after pancreatic resection. A systematic review and an evaluation of intervention in the Netherlands. Ann Surg. 2005;242(2):781-90.

15. Teh S, Diggs B, Deveney C, Sheppard B. Patient and hospital characteristics on the variance of perioperative outcomes for pancreatic resection in the United States. A plea for outcome-based and not volume-based referral guidelines. Arch Surg. 2009;144(8):713-21.