

ORIGINAL ARTICLE

The “Nouvelle Vague” of surgeons in pancreatic surgery: can they rise to the legacy of current surgeons?

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Summary

Purpose: Pancreatic surgery is still thought as a challenging field even for experienced hepatobiliary (HPB) surgeons and high volume tertiary centers. The purpose of this study was to present the results (mortality and morbidity) of pancreatic surgery in a high volume center, in operations performed solely by inexperienced surgeons (two 6th year residents and a HPB fellow) under the supervision of expert surgeons on the field.

Methods: Forty-one consecutive patients who underwent curative-intent pancreatic resection with a modified pancreaticojejunostomy between January 2010 and December 2014 at Asklepios Hospital Barmbek, Germany, were identified from our institutional computer-based database. Two 6th year residents and an HPB-fellow performed all pancreatic anastomoses under the instructions of an experienced surgeon. Perioperative outcomes were recorded and analyzed.

Results: Median postoperative length of stay for all pa-

tients was 15 days (IQR: 7-31). In the first 90 postoperative days, the postoperative mortality rate was 0% and morbidity rate reached 39%. Reoperation was required in 1 patient (2.44%). However, no reoperation was performed for pancreatic anastomotic failure. No postoperative hemorrhage requiring interventional procedure or reoperation occurred in any patient.

Conclusions: The outcomes of pancreatic surgery performed by less experienced surgeons are satisfactory. The instructions of an expert surgeon in a high volume hospital definitely secures a favorable outcome after pancreatic surgery with lower mortality and morbidity rates compared with current literature trends.

Key words: high volume center, pancreatic anastomosis, pancreaticojejunostomy, pancreatic surgery, surgical experience

Introduction

Pancreatic surgery is technically complex and has evolved significantly in the modern era. This - beyond the traditional limits - progress could be attributed to further insights on surgical anatomy, innovative technological advances and the seminal work of pioneering surgeons.

While postoperative mortality has declined significantly from higher than 29% reported by Whipple et al. in 1941 [1] to less than 5% [2-7] nowadays in tertiary academic centers, postopera-

tive morbidity remains a common clinical problem ranging from 20-40% [1,6], thus pancreatic surgery is still thought as a challenging field even for experienced HPB surgeons and high volume tertiary centers. Despite these results, surgical resection is the mainstay of any curative therapeutic approach, however, up to 40% of patients with potentially resectable pancreatic cancer are not offered surgery, mainly due to a high rate of systemic recurrence and local invasion or distant spread [8].

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Multiple publications have suggested that outcomes after complex operations such as those in pancreatic surgery are better at high volume centers [9-11]. Additionally, surgical experience seems to play a crucial role on the outcomes of pancreatic surgery and since it stands for one of the most complex abdominal operations, a certain number of surgical procedures are essential to reach expertise [12-14].

The aim of our study was to present the results (mortality and morbidity) of pancreatic surgery in a high volume center, in operations performed solely by inexperienced surgeons (two 6th year residents and a HPB fellow) with the same operative technique, under the supervision of expert surgeons on the field. Can they rise to the legacy of their mentors?

Methods

Study design

Forty-one consecutive patients who underwent curative intent pancreatic resection with modified pancreaticojejunostomy (PJ) between January 2010 and December 2014 at Asklepios Hospital Barmbek, Germany, were identified from our institutional computer-based database. Two 6th year residents and an HPB fellow performed all resections and pancreatic anastomoses under the instructions of an experienced surgeon. In these cases, the senior surgeon assisted from the beginning until the end of the operation.

Standard demographic and clinicopathological data were collected, including gender and age. The indication for pancreatic resection was recorded for each patient. Intraoperative data included type of operation, indication and operative time. Operative notes provided information on treatment-related variables, such as indication for resection and specific type of resection. Clavien-Dindo classification system [3] was used to record the perioperative complications with a major complication classified as \geq grade 3. In case a patient had two or more complications, the most severe one was taken into account. The length of hospital stay for each patient was recorded. From the date of pancreas resection perioperative 90-day mortality was calculated.

In an effort to standardize definitions a consensus [2] defined postoperative pancreatic fistula (POPF) as the drain output of any measurable amount of fluid (around 10 ml) occurring on or after postoperative day 3 with amylase content at least three times that of serum amylase levels. A fluid collection was identified through CT scan or US as the presence of fluid greater than 5 cm in diameter, with or without clinical relevance; acute pancreatitis was defined as a threefold increase of normal plasma amylase or lipase values from the 4th postoperative day, confirmed by CT scan find-

ings and clinical course; early postoperative hemorrhage was defined according to the International Study Group of Pancreatic Surgery (ISGPS). Postpancreatectomy hemorrhage (PPH) was defined as intra-abdominal or intestinal bleeding according to the criteria of the ISGPS [15]. The definition of PPH is based on three parameters: onset (early \leq 24hrs, late $>$ 24hrs), location (intraluminal or extraluminal) and severity (mild or severe).

Operative technique

As we have already described, we imagine the pancreatic duct hole as a clock, where the anterior border of the duct constitutes the 12 o'clock and the posterior the 6 o'clock [9,10]. The "duct-to-mucosa" anastomosis begins by placing the 5-0 or 6-0 Polydioxanone (PDS) sutures in a clockwise fashion through the pancreatic duct; the first stitch is placed in 12 "o'clock", then a stitch is placed in 2 and a last one in 3 "o'clock". The stitches from 9 "o'clock" to 11 "o'clock" follow in the same fashion. All these sutures are not tied at this time, but instead are secured in rubber coated clamps.

Once these sutures have been placed and secured, a small enterotomy, of almost equal diameter to the main pancreatic duct, is performed just opposite the location of the pancreatic duct utilizing electrocautery. A series of duct-to-mucosal sutures from 4 to 8 "o'clock" are then placed. The first one is placed in 6 "o'clock" and is followed by the remainder of these sutures in a series of one stitch for each hour in a direction of 4 to 8 "o'clock".

Sutures are all placed such that knots are on the inside. Subsequently, the edge of a matching pigtail (6 Fr) catheter is inserted in the main pancreatic duct over the anastomosis and gets tied at this place with a rapid resorbable 4-0. Finally, the "secured" seven stitches from 9 to 3 "o'clock" are placed through the jejunum hole and tied carefully. Once all duct-to-mucosal sutures have been placed and tied, the anterior surface of pancreas and the jejunum are approximated by using again the double armed 4-0 PDS suture in the same fashion as the posterior layer. These sutures are then tied almost into the center of the anastomotic line, leading to a "sandwich" overlapping of the jejunum over the anterior aspect of the pancreatic duct.

In the case of the junior surgeons, both clinical fellows and chief residents performed the anastomoses and mainly clinical fellows performed the tissue dissection. Each case was supervised by a senior surgeon that was actively involved in the operation as the first assistant. The philosophy of the program was that each surgeon should be independent and the aim was to train young surgeons to operate with confidence and independence on the field of pancreatic surgery in the setting of their choice (private or public hospitals). All fellows graduating from the program are doing these operations well in practice, with the majority of them not seeking for any further fellowship training.

Statistics

Continuous variables were described as medians. Categorical variables were described as totals and frequencies. Statistical analyses were carried out using R language and environment for statistical computing (<http://www.R-project.org>) applying x2 test and Fisher's exact test to compare results between groups when appropriate. P values <0.05 were considered statistically significant.

Results

Between January 2010 and December 2014 a total of 41 patients who underwent pancreatic resection and novel PJ anastomosis for benign or malignant disease at our institution by junior surgeons (two 6th year residents and a HPB fellow) who performed all pancreatic anastomoses were identified.

The median patient age was 68.3 years (range 28-86) and the majority was male (N=27;65.8%). The median operating time was 374 min and the median estimated blood loss 474 ml per case. Indications for pancreaticoduodenectomy for patients in this series were pancreatic adenocarcinoma (N=19;46.3%), ampullary adenocarcinoma (N=5;12.2%), distal cholangiocarcinoma (N=1;2.43%), neuroendocrine tumor (N=2;4.86%), intraductal papillary mucinous neoplasm (N=5; 12.2%), chronic pancreatitis (N=6;14.6%) and other (N=3;7.31%). Table 1 summarizes the indications for pancreatic surgery in the present series.

Pancreatic resection involved mostly pylorus-preserving pancreatectomy (N=36;88%), central pancreatectomy (N=2;4.8%) and Beger pancreatectomy (N=3;7.32%). Concurrent major vascular

Table 1. Characteristics of the patients and indications for surgery (N=41)

<i>Characteristics</i>	
Age, years	68.3
Median	28-86
Range	
Gender, N (%)	
Male	27 (65.8)
Female	14 (34.2)
<i>Indications for surgery</i>	
	<i>N (%)</i>
Adenocarcinoma	19 (46.3)
Ampullary adenocarcinoma	5 (12.2)
Distal cholangiocarcinoma	1 (2.43)
Neuroendocrine tumor	2 (4.86)
Intraductal papillary mucinous neoplasm	5 (12.2)
Chronic pancreatitis	6 (14.6)
Other	3 (7.31)
Total	41

Table 2. Procedures

<i>Procedures</i>	<i>N (%)</i>
Pylorus preserving pancreatectomy	36 (88)
Central pancreatectomy	2 (4.8)
Beger pancreatectomy	3 (7.32)

Table 3. Morbidity and mortality, length of hospital stay and rate of pancreatic fistula

Length of stay, days	15 (7-31)
Median (range)	
Morbidity	
DGE	N= 3
PF	N= 1
Other	N=12
Mortality, 90-day N (%)	0
Pancreatic fistula	
Grade A	N=1
Grade B	None
Grade C	None

For abbreviations see text

reconstruction (PV) was performed in 2 patients. Table 2 summarizes the types of operations in the present series.

Median postoperative length of stay for all patients was 15 days (range: 7-31). In the first 90 postoperative days, no patient died, accounting for a postoperative mortality of 0%. Among the 16 (39%) patients who experienced a complication, 3 presented with delayed gastric emptying (DGE) (7.32%), 1 with POPF grade A (2.44%) (according to the International Study Group of Pancreatic Surgery-ISGPF), 1 with deep venous thrombosis (2.44%), 2 with wound infection (4.88%), 2 with cardiac arrhythmias (4.88%), 1 with pulmonary embolism (2.44%), 2 with pneumonia (4.88%), 1 with colitis (2.44%), 1 with anastomotic insufficiency (2.44%), 1 with chronic obstructive pulmonary disease (2.44%) and 1 with postoperative pancreatitis (2.44%). Reoperation was required in 1 patient (2.44%) due to bile leak. However, none of the reoperations was performed for pancreatic anastomotic failure. No postoperative hemorrhage requiring interventional procedure or reoperation occurred. Table 3 summarizes the complications in this series.

When comparing these outcomes with the outcomes of experienced surgeons, it is obvious that junior surgeons, under the supervision of experienced ones, can reach satisfactory or even competitive operative outcomes (Table 4). Despite the fact that operative and anastomosis times were increased in the junior group, the morbidity and reoperation rates were satisfactory or even favor-

Table 4. Comparison of the operative outcomes between junior and experienced surgeons

Factors	Junior (N=41)	Experienced (N=207)	p value
Operative time (min)	374	235	0.0002
Postoperative length of stay (days)	16	14	0.538
Blood loss (ml)	474	520	0.8
Morbidity, N (%)	16 (39)	45 (21.7)	0.028
Reoperation, N (%)	1 (2.4)	3 (1.4)	0.5170
POPF, N (%)	1 (2.4)	9 (4.3)	1
Postoperative hemorrhage (%)	0 (0)	0 (0)	1
Duration of anastomosis (min)	28	20	0.0024
Body mass index (kg/m ²)	23.2	25.7	0.0291

able. We must though underline the fact that the number of cases in the junior group were much less than these in the experienced group and the patients in the junior group were less obese and “hostile” that could affect the outcomes.

Despite the fact that operative time and anastomosis were increased in the junior group, the morbidity and reoperation rates were satisfactory or even favorable. We must though underline the fact that the number of cases in the junior group were much less than those in the experienced group and the patients in the junior group were less obese and “hostile” that could affect the outcomes.

Discussion

There is an ongoing debate in the literature about the feasibility of performing pancreatic surgery as well as offering adequate surgical education to fellows and residents, without compromising the surgical quality (low mortality and morbidity rates).

Fisher and Hong [4] examined the surgical outcomes following pancreatic surgery performed by surgical resident staff in a university-based general surgery training program. The perioperative outcomes were 2.2% 30-day mortality, 6.1% pancreatic fistula, 2.2% reoperation, 13.5 days average length of hospital stay, 489 min mean operating time, and 1274 ml median estimated blood loss per case [4].

In the same frame, Schmidt et al. [11] evaluated the importance of hospital volume, surgeon experience and surgeon volume in performing PD. Perioperative morbidity and mortality performance between young surgeons and experts were 41 and 3%, respectively [11]. Surgeons with less experience (<50 PDs) performed PD with higher morbidity (53 vs 39%), pancreatic fistula rate (20 vs 10%), estimated blood loss (1918 vs 1101 ml), and

operative time (458 vs 335 min) compared with surgeons with more experience (\geq 50 PDs) [11]. Yet, learning curves projected that less experienced surgeons would achieve morbidity and mortality rates equivalent to those of experienced surgeons when they reached 20 and 60 PDs, respectively [11].

Kakizawa et al. [5] evaluated the outcome after standard PD performed by less experienced surgeons under expert supervision in a high-volume hospital for PD. The overall mortality rate of 99 patients in this series was 1.0% [5] with regard to postoperative major complications, there was no significant difference in the number of patients with all postoperative major complications (Group A 43.9% vs Group B 33.3%) [5].

Sumida et al. [12] evaluated a stepwise surgical education program on pancreatic surgery and especially on the performance of PD. Postoperative complications were observed in 50 of 88 patients (56%) [12]. The postoperative complications were not significantly different between experienced teaching surgeons, fellowship surgeons and senior residents, although the time of operation and anastomosis tended to be longer in the resident surgeons ($p=0.22$) [12]. Postoperative complications were not significantly correlated with the type of anastomosis; however, duct-to-mucosa anastomosis of the pancreas might decrease pancreatic fistula (0 vs 26% in pancreaticogastrostomy and 13% in pancreaticojejunostomy without duct-to-mucosa anastomosis) [12].

In our series an acceptable morbidity rate was noted (39%) which is lower to the rates presented in the current literature as far as the performance of young surgeons is concerned [4,5,11,12]. Of interest, no death was found in our series. Moreover, the fact that the operations in this series were carried out by two 6th year residents and one HPB clinical fellow under the guidance of an experienced surgeon, reflects a relatively short

learning curve and adds to the benefits of the proposed procedure. However, it should be taken into account the relatively long time (28 min) that is required for the construction of the anastomosis, as opposed to other types of PJ.

All in all, our modified PJ seems to have many advantages such as feasibility, short learning curve and low rate of anastomotic leak or failure even when performed by less experienced surgeons.

Conclusions

The outcomes of pancreatic surgery performed by less experienced surgeons are favorable. The instruction of expert surgeon in a high

volume hospital definitely secures a favorable outcome after pancreatic surgery with lower mortality and morbidity rates compared with current literature trends. Within the teaching structure of a general surgery training program, especially at a high-volume, tertiary center, advanced and senior residents as well as fellows should be given the opportunity to perform these operations under the supervision of senior surgeons since the performance compares favorably to best-practice benchmark outcomes.

Conflict of interests

The authors declare no conflict of interests.

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