

Original paper

Step-wised Education for Pancreaticoduodenectomy for Young Surgeons at a Single Japanese Institute

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ABSTRACT.

Background: Expert technique and special anatomical or physiological knowledge are needed in the field of pancreatic surgery. The establishment of basic policies and operative techniques for pancreaticoduodenectomy (PD) and stepwise training for young pancreatic surgeons are necessary.

Methods: We scheduled PD for ampullar, biliary and pancreas carcinoma, and evaluated types of pancreatic anastomosis or results by each operator such as a chief, fellowship and resident doctors (>5 years after graduate).

Results: Based on a questionnaire distributed to young residents (n=30), only half of them have experienced PD or PPPD, which was related to operating volume at the hospital.

Postoperative complications at the teaching hospital were observed in 50 of 88 patients (56%).

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). Based on the stepwise education protocol of technique, patient demographics,

the surgical records and 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 resident surgeons (p=0.22).

Conclusion: Competent operative techniques for inexperienced surgeons and the achievement of safe resection at each stage are our educational goals for PD.

INTRODUCTION

Expert technique and special anatomical and physiological knowledge are needed in the field of pancreatic surgery, which is different from other abdominal surgeries. Pancreatic resection techniques have recently been improved (1) and outcomes of pancreaticoduodenectomy (PD) have been improved worldwide (2). However, this technique is still technically complicated and only experienced gastrointestinal surgeons can perform these procedures because of the higher morbidity and mortality compared to operations of gastric and colorectal diseases (3, 4). Systematic PD can also be performed in patients with ampullar, bile duct and pancreas carcinomas, and its postoperative management is important (4). At present, many surgeons can perform pancreatic resections, including PD, with appropriate training from experienced pancreas surgeons. Therefore, the establishment of basic policies and operative techniques for PD at each institute, and stepwise training for young digestive surgeons, is necessary. In this report, we present our protocol of education for young surgeons with respect to PD and operative techniques between 1994 and 2007.

METHODOLOGY

First of all, we investigated the experiences of PD or pylorus preserving PD (PPPD) in resident surgeons based on interviews, and distributed questionnaires to determine the skill of PD. The subjects were 88 consecutive patients with pancreatic malignancies who underwent PD or PPPD in the Division of Surgical Oncology, Department of Translational Medical Sciences, Nagasaki University Graduate School of Biomedical Sciences between January 1994 and 2007. They included 55 men and 33 women with a mean age of 66 ± 10 years (\pm SD, range, 30-87 years). The pancreatic diseases warranting PD or PPPD included ampullar carcinomas in 16 patients, duodenal malignancy in 3, bile duct carcinomas in 28, intraductal papillary mucinous neoplasm in 8, and pancreatic ductal carcinomas in 33. The background pancreas included normal pancreas in 56 patients and chronic pancreatitis in 32. In this cohort, we performed PD in 36 patients and PPPD in 52. These operations included combined hepatectomy in 7 patients and resection of portal or superior mesenteric vein in 10.

We observed uncontrolled ascites (defined by massive ascites unresponsive to diuretics) in 5 patients; pancreatic fistula (=leakage of pancreatic juice; defined by a drain output of any measurable volume of fluid on or after postoperative day 3 with an amylase content greater than 3 times the serum amylase activity (5)) in 14 patients, gastric stasis at 2 weeks after operation in 12, and intra-abdominal postoperative massive bleeding in 2. Ten patients (2%) died of hepatic failure within 30 days. The study design was approved by the Ethics Review Board of our University. Informed consent applying laboratory and surgical records for clinical study was obtained by each patient before operation.

The median incision for laparotomy was basically performed for PD or PPPD. Transection of pancreatic parenchyma was performed by electrocautery or an ultrasonic coagulation and cutting machine (Sono Surg, Olympus Co., Tokyo, Japan). Surgical knife was used for cutting the main pancreatic duct. With respect to pancreatic anastomosis, we have applied 3 types of

anastomosis, which were pancreatico-jejunostomy with pancreatic duct-to-jejunal mucosa anastomosis (PJM group) or with a completely external tube drainage of pancreas juice (PJ group), and pancreatico-gastrostomy (PG group). Between 1994 and 1999, PG was routinely performed. PJ has been mainly applied between 2000 and 2007 and, in case of dilated pancreatic duct more than 5mm, PJM was applied.

We examined the experiences of resident surgeons (less than 5 years as a gastrointestinal surgeons) at university-associated hospitals (n= 8, in which gastrointestinal surgeries were performed over 200 per year) and distributed questionnaires with questions about what is necessary to obtain skills of PD for these young surgeons. The stepwise education and its plan for young gastrointestinal surgeons at our institute are shown in **Figure 1**. Clinical data, surgical data and postoperative complications were compared in a chief experienced surgeon, fellowship surgeons (gastrointestinal surgeons for 10-15 years) and senior resident surgeons (gastrointestinal surgeons for 5-10 years).

Continuous data are expressed as the mean \pm SD. Data from different groups were compared using one-way analysis of variance (ANOVA) and examined by the Mann-Whitney U-test. Categorical data were compared by the Chi-square test. Differences between groups were analyzed by Fisher's exact test or Scheffé's multiple comparison test. A two-tailed *P* value < 0.05 was considered significant. Statistical analyses were performed using STATISTICA™ software (StatSoft, Tulsa, OK).

RESULTS

Experience of residents at associated hospitals: Figure 2 shows the experiences of PD or PPPD in young residents as an assistant (n=30). Half of them have experienced PD or PPPD (**Figure 2A**). At the hospitals in which PD or PPPD was performed in over 10 cases per year, residents tended to experience this procedure (**Figure 2B**). From the questionnaire in these 30 residents, the points they want to understand for PD or PPPD were 1) anatomy surrounding pancreas head and main vessels, 2) importance of experience as a first assistant operator in more than 10 cases, 3) to obtain stepwise education of techniques, and 4) understanding the stream of whole techniques using surgical videos. On the other hand, based on instructor's policy, we have built up the stepwise education of PD, as shown in **Figure 1**, at the university hospital since 1994, and residents or fellowship surgeons at our institute could experience some PD or PPPD as a main operator as below.

Comparison of anastomotic procedures: We examined the postoperative complications of each anastomotic procedure; however, significant differences between groups were not observed, although the incidence of pancreatic fistula and hospital stay tended to be lower in the PJM group than those in the PG or PJ group (**Table 1**).

Comparisons of demographics, surgical records, and postoperative complications between surgeons: To understand the present status and problems in PD or PPPD in senior residents and fellowship surgeons, operative records were compared among the 3 groups of surgeons. As a main operator, the chief surgeons experienced 61 operations, fellows experienced 25, and residents experienced 4. The chief surgeon tended to perform PD or PPPD in pancreatic ductal carcinomas, vascular anastomosis and PG procedure compared to other surgeons, but this difference was not significant (**Table 2**). Figure 3 shows the surgical records. Operating time, time of anastomosis and blood loss were not significantly different between surgeons although operating time tended to be longer in residents compared to other surgeons (p=0.22). **Table 3**

shows the postoperative complications between surgeons. Postoperative complications were observed in 50 of 88 patients (56%). Wound infection was significantly greater in the chief surgeon compared to those in other surgeons; however, there were no significant differences of other complications between surgeons.

DISCUSSION

PD and PPPD are relatively complex procedures in the abdominal surgery. At present, pancreatic surgery has become safe due to improved surgical techniques, surgical devices and perioperative management (6); however, 2-9% mortality and 30-52% morbidity still remains (3, 5, 7, 8). Post-PD complications are sometimes life-threatening. Previous investigators have reported various risk factors associated with post-PD complications such as a pancreatic fistula, which were high age (3), blood loss (9, 10), soft architecture of pancreas (5, 9, 10), size of main pancreatic duct (9, 11), hospital volume of pancreatic resections (4, 12-16), and the experiences of the PD (10, 17, 18). Our results showed that hospital death by pancreatic resection has not been observed between 1994 and 2007; however, 14% of 88 patients undergoing PD or PPPD showed pancreatic fistula including two patients with grade B (3, 5). The total complication rate was 38%. These complication rates were not changed between 1994-2000 and 2001-2007 (data not shown in results), which indicated no improvement of postoperative complications in our series.

In the present study, we examined the experiences of young resident surgeons at university-associated hospitals. In this period, they had mainly trained in general surgery such as gastrectomy, colectomy or cholecystectomy. Few were experienced as assistant operators in PD. Parsa et al. described that PD is not an operation in which a resident surgeon can serve as a main operator (19). In our series, a few of the 30 young residents experienced PD, but this was rare. The number of experiences of PD was almost correlated with the number of PD operations at each hospital. For young residents, balanced rotations between hospitals would be necessary to experience such a complex operation.

In the present study, we showed post-PD complications in each type of anastomosis at the university hospital between 1994 and 2007. Historically, the rates of anastomosis decreased in 2000, and this was considered to be a result of the skill of surgeons. Eventually, however, the

complication rates were not significantly different between types of anastomosis. Recent reports have shown that pancreatic fistula was decreased in the anastomosis between the pancreatic duct and intestinal mucosa (10, 20). Therefore, we attempted to perform this anastomosis. In the present study, pancreatic fistula was not observed in 12 patients.

Education and specialist training in pancreatic surgery are current topics that were discussed at the Japanese Congress of the Japanese Association of Hepato-biliary Pancreas Surgery in 2007 (not published). Therefore, a comprehensive training system should be developed in the near future. At our institute program, the resident surgeons return to our institute (Nagasaki University Hospital) for training in order to select specialists in each field of surgery. In the course of abdominal surgery, some senior residents have training in hepatobiliary pancreas surgery according to the stepwise issues shown in Figure 1. Based on this training system, we compared the surgical records of PD in surgeons with different experience to consider young surgeon's education as the results. Recent reports indicated the necessity that complex surgeries such as PD should be performed at high-volume centers or at teaching hospitals to avoid post-PD complications and the associated mortality (1, 21, 22). For senior residents or fellowship surgeons, training at high-volume centers is important to obtain adequate skills for this operation. Our present results showed that the most experienced teaching surgeon performed PD with the combined resection of the portal vein; however, there were no significant differences of other background parameters. In the surgical records, senior resident surgeons had the longest time of total operation and anastomosis, but this difference was not statistically significant, which might be due to the inexperience of resident surgeons. Because the surgical records between chief and fellowship surgeons were not different, we believe that our training protocol is effective.

Results of post-PD complications were important to evaluate this program. As shown in the present results, these complications, including pancreatic fistula, did not occur more frequently

in young trainees compared to teaching surgeons. Some reports described that performing over 50 PDs was necessary to stabilize the procedure (10, 17, 18); however, it takes many years to achieve this level at our institute.

In conclusion, in order for young residents to experience PD, they should train at hospitals with a larger volume of PD. While acquiring the basic skills of gastro-intestinal surgery, stepwise education is necessary to obtain a strong knowledge of basic anatomy and techniques in training of PD. Under instruction from experienced pancreatic surgeons and their training programs, surgical records and postoperative complication rates were not different. The ability to perform procedures competently and to master safe pancreatectomy procedures are important to develop hepatobiliary pancreas surgeons.

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Figure legends

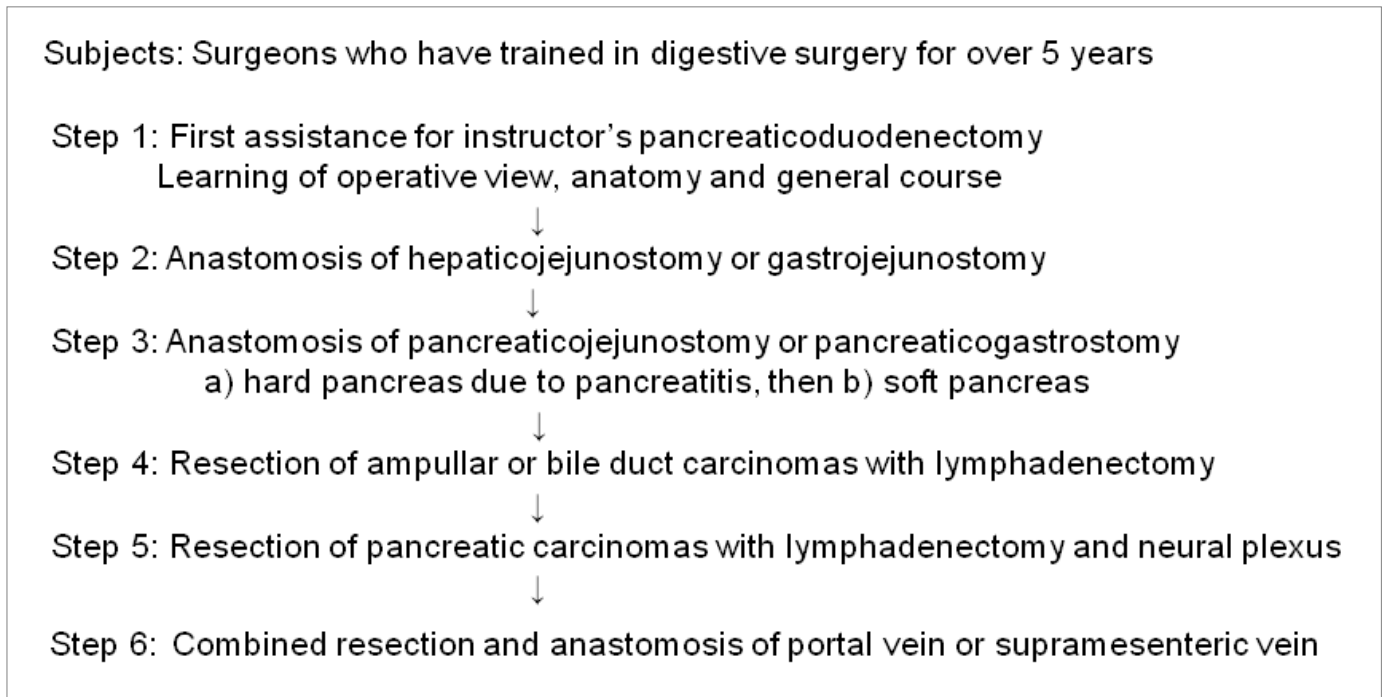
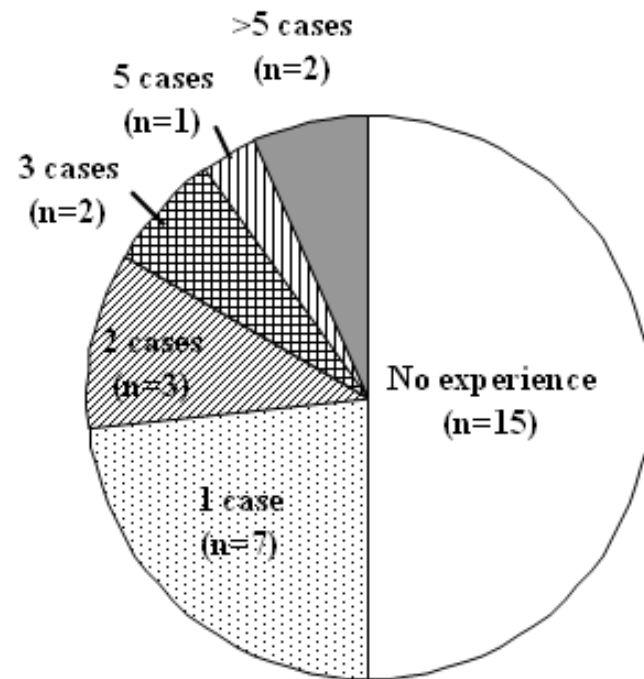


Figure 1. Stepwise education and training plan for pancreaticoduodenectomy

A



B

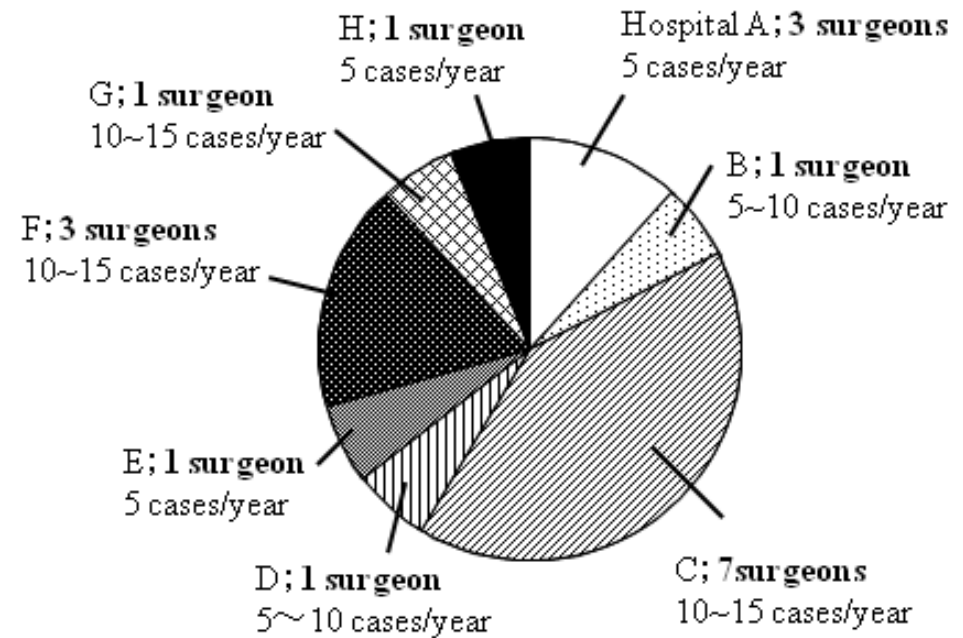


Figure 2. Experiences of pancreaticoduodenectomy in trainees between 5 and 10 years as a gastrointestinal surgeons at university-associated hospitals (n=30). (A) Experiences of PD in residents and (B) relationship between experiences of PD in 15 residents and the number of PD per year at each hospital.

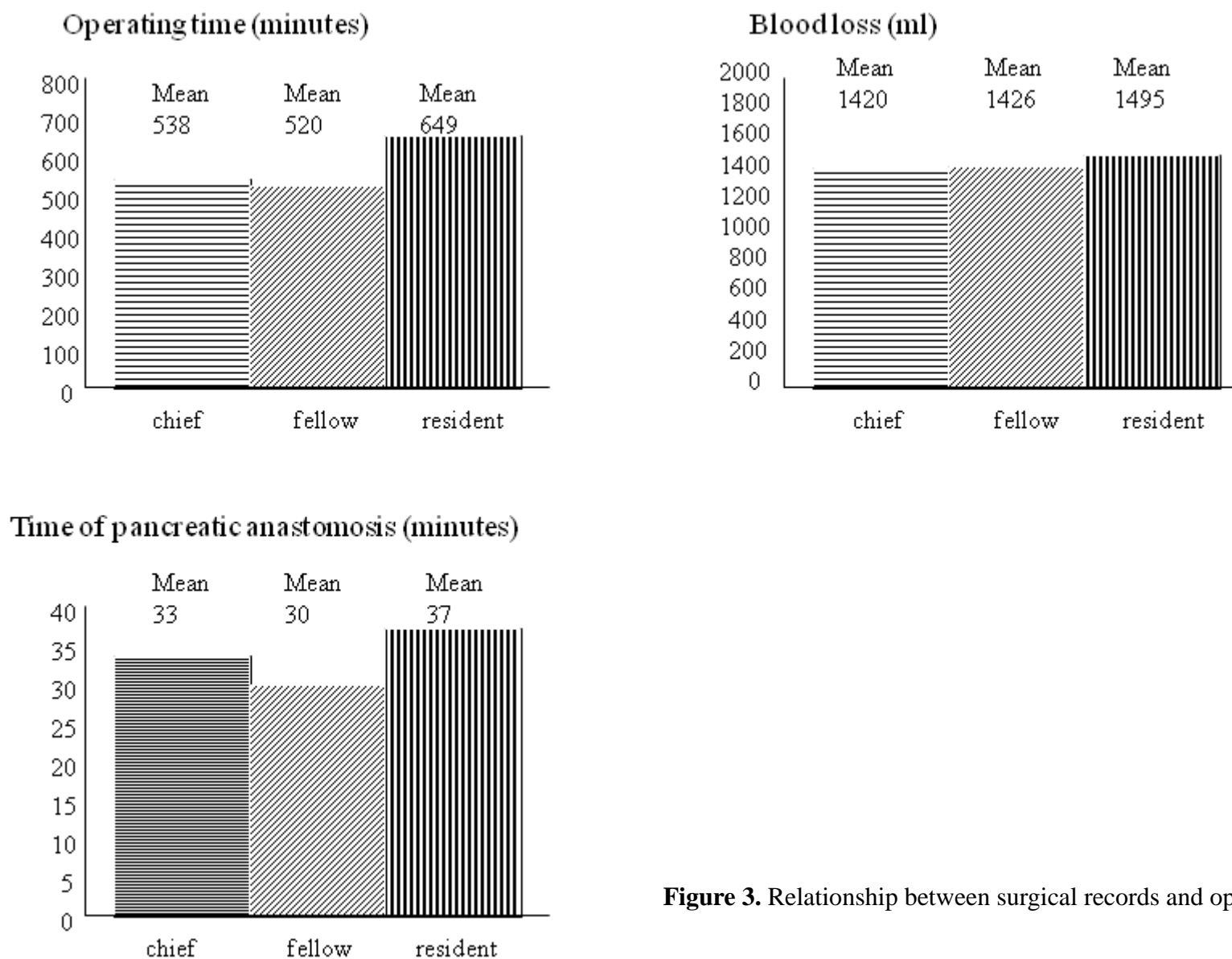


Figure 3. Relationship between surgical records and operator's experiences

TABLE 1. Relationship between Pancreatic Anastomosis and Postoperative Complications

	PG group (n=21)	PJ group (n=55)	PJM group (n=12)	P value
Pancreatic fistula	26.3%	12.8%	0%	0.16
Intraabdominal abscess	21.0%	15.3%	11.1%	0.77
Postoperative bleeding	5.3%	2.6%	0%	0.73
Uncontrolled ascites	5.3%	7.8%	0%	0.67
Biliary fistula	0%	2.5%	11.1%	0.26
Wound infection	21.0%	18.0%	11.1%	0.81
Re-laparotomy	5.3%	2.6%	0%	0.73
Hospital stay (days)	42.0 ± 16.0	47.6 ± 28.7	35.4 ± 8.0	0.39

TABLE 2. Relationship between Demographics and Operator Experiences

	Chief (n=61)	Fellow (n=23)	Resident (n=4)	P value
Diseases				
Ampullar ca.	9	7	0	0.38
Bile duct ca.	22	4	2	
Duodenal tumor	2	1	0	
Intraductal papillary mucinous neoplasm	4	4	0	
Pancreatic carcinoma	24	7	2	
Background of pancreas				
Normal, soft	36	18	2	0.22
Pancreatitis, hard	25	5	2	
Operation				
PD (Resection of portal vein)	28 (7)	6 (1)	2 (0)	0.24
PPPD (Resection of portal vein)	33 (1)	17 (1)	2 (0)	
Anastomosis				
Pancreatogastrostomy	19	2	0	0.13
Pancreatojejunostomy (PJ)	36	16	3	
Duct-to-mucosa anastomosis in PJ	6	5	1	

TABLE 3. Relationship between Surgical Experience and Postoperative Complications

		Instructor	Fellow	Resident	P value
Pancreatic fistula	yes	11	3	0	0.68
	no	60	20	4	
Postoperative bleeding	yes	2	0	0	0.64
	no	59	23	4	
Wound infection	yes	14	0	1	0.03
	no	47	23	3	
Uncontrolled ascites	yes	3	2	0	0.71
	No	58	21	4	
Gastric stasis	yes	8	4	0	0.63
	no	53	19	4	