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Predictive Parameters of Intraoperative Blood Loss in Patients who Underwent Pancreatectomy

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ABSTRACT

Background/Aims: Despite recent advances in surgical techniques, blood loss is an important factor associated with postoperative outcomes in pancreatectomy. It is useful to identify risk factors of increased blood loss.

Methodology: The clinical records of 161 patients who underwent an elective pancreatectomy for peripancreatic diseases between 1994 and March 2011 were retrospectively examined. Univariate and multivariate analysis of clinicopathological and surgical parameters influencing intraoperative blood loss were performed. We determined the cut-off value of the amount of blood loss based on the analyzed results.

Results: The mean and median blood loss was 1346±901 and 1070mL, respectively. Red cell blood transfusion was performed in 72 patients (45%). Based on ROC analysis, the predictive value of blood loss in patients who received red cell blood transfusion was 880 mL ($p<0.001$); however, blood loss was not significantly associated with postoperative complications ($p=0.40$). The cut-off level of estimated amount of blood loss in the present study was set at 880mL. Male patients, fatty pancreas, higher serum alkaline phosphatase level, longer operating time, performance of pancreaticoduodenectomy (PD) and combined resections of adjacent major vessels were associated with significantly more increased blood loss ($p<0.05$). Based on multivariate

analysis, longer operation time over 480 minutes and performance of PD were significantly associated with increased blood loss ($p<0.05$).

Conclusions: Attempting to reduce operating time in cases of PD is necessary to reduce intraoperative blood loss.

KEY WORDS: intraoperative blood loss; pancreatectomy; predictive parameters; postoperative outcomes

ABBREVIATIONS: pancreatic carcinoma (PC); bile duct carcinoma (BC); intraductal papillary neoplasm (IPMN); pancreaticoduodenectomy (PD); hepato-pancreaticoduodenectomy (HPD); distal pancreatectomy (DP); receiver operating characteristics (ROC)

INTRODUCTION

Perioperative management and recent advances in surgical techniques in pancreatectomy have provided improved patient outcomes [1, 2]. However, the possibility of increased blood loss, which may lead to negative postoperative outcomes, still remains even in the present time [3, 4]. Tumor factors, surgeon experience, existence of chronic pancreatitis, and type of pancreatectomy or combined procedures are recognized as risk factors of intraoperative massive bleeding [3-7]. Intraoperative bleeding requiring blood transfusion or associated poor outcomes has not been predicted preoperatively by full use of surgical procedures to reduce blood loss [4]. Increased blood loss might be related to poor outcomes [3]. However, accurate prediction might not be fully possible and, therefore, it is important to identify the predictive factors associated with bleeding tendency requiring blood transfusion in order to take prompt measures, such as use of preoperative autologous blood transfusion [8] or selection of operative training for young surgical trainees [7].

The aim of the present study was to determine the preoperative factors that influence intraoperative blood loss requiring blood transfusion or poor patient outcome in 161 consecutively selected patients undergoing elective pancreatectomy between 1994 and 2011.

METHODOLOGY

Patients and methods

The clinical records of 161 consecutively selected patients that underwent various hepatectomy surgeries without combined resection of other organs for liver diseases at the Division of Surgical Oncology at Nagasaki University Hospital (NUH) for 17 years between April 1994 and March 2011 were retrospectively examined by the retrieved NUH database. Combined resection of adjacent major vessel was also excluded in this study. Mean age for patients at the time of surgery was 65.3 ± 12.4 years (range, 18-87 years). Gender was 106 males and 55 females. Accompanied chronic pancreatitis was present in 56 patients, fatty pancreas in 3 and normal pancreas in 102 patients. Diseases included pancreatic carcinoma (PC) in 51 patients, bile duct carcinoma (BC) in 34, ampullar carcinoma in 19, gallbladder carcinoma in 5, duodenal tumor in 4, intraductal papillary neoplasm (IPMN) in 22 including carcinoma in 11, mucinous cystic neoplasm in 1, pancreatic endocrine tumor in 4 including malignancy in 2, and others in 21. The procedures performed included pancreaticoduodenectomy (PD) (*n*=113), hepato-pancreaticoduodenectomy (HPD) in 10, distal pancreatectomy (DP) (*n*=32), and central pancreatectomy in 6. Laparoscopic resection was performed in 4 patients. Combined resection of adjacent major vessels was performed in 14 patients. Radical

hepatectomy was performed to remove hepatic tumor without leaving any residual tumor. All peri-pancreatic tumors were completely resected without macroscopic exposure of the amputated section to the remaining liver. All study protocols were approved by the Human Ethics Review Board of our institution. Informed consent for data collection was obtained from each patient during this period. Anesthetic and patient data were retrieved from the NUH database. There is no financial support or conflict of interest regarding the present study.

Operative indications, evaluated parameters, surgical procedures

The indications for pancreatectomy and types of surgical procedures were determined according to tumor locations. We examined preoperative clinical parameters, operative procedures, surgical records, and postoperative morbidity. Operative incisions were subcostal transverse incision in 37 patients and upper median incision in 124. We performed resections using electrocautery, and vessel sealing devices were used for transection in 14 patients (9%) using ultrasonic coagulation devices such as Harmonic ultrasonic surgical devices (Ehicon Endo-Surgery Inc., Cincinnati, OH) or Sonosurg (Olympus, Tokyo, Japan) [9]. Pancreatectomy was performed by two attending surgeons for 108 operations and resident training surgeons for 53. In case of trainees,

quality control of the operation was provided by attending surgeons. Autologous blood transfusion was not used in all patients in the present study. Intraoperative blood transfusion (= red blood cell) was performed when unstable vital signs or hemoglobin value of less than 9.0 mg/dl were observed. Fresh frozen plasma was transfused in the patients who underwent HPD. Patients were divided into two groups according to blood loss. In the first step, the cut-off level of blood loss was set at the predictive value for red cell transfusion by the receiver operating characteristics (ROC) analysis. In the second step, the predictive value of blood loss was set by existence of postoperative pancreatic complications such as fistula, uncontrolled ascites, intraabdominal infection and hemorrhage.

Statistical analysis

Chi-square test was used for comparison of categorical variables. Differences between groups were analyzed by Fisher's exact test and Scheffe's multiple comparison test. All continuous data were expressed as mean ± SD. Data for different groups were compared using one-way analysis of variance and examined by Student's *t*-test. Logistic regression analysis was performed to determine the predictive value of risk factors. Potentially predictive variables were identified using a significance level of $p<0.10$ by

univariate analysis and the identified factors were then entered into logistic regression multivariate analysis. A two-tailed *P* value < 0.05 was considered significant. PASW Statistics 18.0.0 for Windows (SPSS Inc., an IBM Company, Chicago, IL) was used for all statistical analyses.

RESULTS

Surgical record

The mean and median blood loss were 1346±901 mL (range: 80-4890 mL) and 1070mL, respectively. The mean red cell blood transfusion was 440±672 mL (maximum range: 41500 mL), and transfusion was performed in 72 patients (45%). Postoperative complications were was observed in 55 patients (34%), which included pancreatic fistula in 35 patients, intraabdominal infection in 37, hemorrhage in 7, and uncontrolled ascites in 17. Postoperative hospital death was observed in 2 patients. By the ROC analysis, the predictive value of blood loss in patients who received red cell blood transfusion was 880 mL ($p<0.001$) **(Figure 1a);** however, those in patients who had postoperative complications was 1200mL but was not significantly associated with postoperative complications ($p=0.398$) **(Figure 1b)**. We therefore set the cut-off level of estimated amount of blood loss in the present study at 880mL.

Associated parameters with the estimated blood loss

Predictive value of continuous parameters for blood loss is shown in **Table 1**. By using these data, the predictive value for the estimated blood loss was examined as

noted in **Table 1**. **Table 2** shows the univariate analysis between associated parameters and blood loss over 880mL. Male patients showed significantly more blood loss in comparison with female patients ($p<0.05$). Age was not significantly associated with blood loss. Blood loss over 880mL in patients with fatty pancreas (100%) was significantly more than those in others ($p<0.05$); however, difference of disease was not associated with increased blood loss. Existence of co-morbidity such as diabetes, smoking and alcohol abuse was not associated with blood loss over 880mL.

In the preoperative laboratory data, serum alkaline phosphatase level was significantly associated with increased blood loss over 880mL, otherwise there was no different. In the surgical records, longer operating time was significantly associated with increased blood loss over 880mL ($p<0.01$). Difference in surgeon experience was not significantly associated with increased blood loss. Performance of pancreaticoduodenectomy (PD) and combined resections of adjacent major vessels led to significantly more blood loss over 880mL ($p<0.05$).

Based on these data by univariate analysis, we selected candidate parameters with p values less than 0.05 for the multivariate analysis in the present study, as shown in **Table 3**. With respect to blood loss over 880mL, long operation time over 480 minutes (8 hours) and performance of PD were significantly associated with increased blood

loss ($p<0.05$). Males tended to have increased blood loss ($p=0.066$).

DISCUSSION

To minimize intraoperative blood loss, we attempted to modify surgical techniques in our recent series using advanced hemostatic devices (9) although we have mainly used electrocautery. Unexpected bleeding could not be completely controlled in some cases. Since 2008, additional procedures of use of vessel sealers as ultrasonic coagulation devices were applied to improve surgical records in our series (9, 10). Under these various methods for intraoperative blood loss control at our institute, we examined associated parameters with respect to increased blood loss affecting blood transfusion or poor patient outcomes in the present study. In the pancreatic resections, blood vessels in the pancreatic parenchyma and surrounding operative field were the main bleeding sites during operation. After operation, pancreatic fistula or infection causes lethal postoperative bleeding (11). Thus, pancreatectomy always has a risk of massive hemorrhage. Nagai et al. reported that excessive blood loss over 2000mL was a significantly risk factor of postoperative morbidity or poor patient survival in the early postoperative period (3). Control or prediction of intraoperative blood loss, therefore, is an important issue to improve patient outcomes.

To determine the clinical significance of the cut-off level of blood loss, we set a cut-off level of intraoperative blood loss for necessity of intraoperative allogeneic blood

transfusion and association with postoperative severe complications, because blood transfusion or increased blood loss might affect postoperative outcomes (3, 12, 13). Fresh frozen plasma (FFP) has been used for patients with intraoperative excessive ascites; however, FFP is not always necessary. In the present study, only red cell transfusion was evaluated. Our present result showed that patients might require blood transfusion in case of 880mL of blood loss by the ROC analysis. Below 880mL, a few cases received blood transfusion. In other reports, blood loss requiring transfusion was higher than in our present study (3, 4). As a tendency of anesthetists at our institute, blood transfusion might be decided at a hemoglobin level of 9mg/dl. The timing and decision for transfusion may be influenced by anemia, underlying cardiovascular status, or the anesthesiologist's inappropriate orders for transfusion. This must be improved to limit blood transfusion, based on the present result. A larger blood loss regarding postoperative complications could be calculated by the ROC analysis; however, this association was not statistically significant. Eventually, 880mL of blood loss was applied in the subsequent analysis of the present study.

In the parameters of patient demographics, male gender and fatty pancreas were significantly associated with increased blood loss. A previous report also indicated that male gender was strongly associated with postoperative morbidity in pancreatic surgery

(14). Although definite mechanisms or reasons for this parameter could not be explained, male patients might have several co-morbidities reflecting bleeding tendency or lower tolerance of blood circulation by blood loss, in comparison with female patients (15). Usually, a soft pancreas demonstrates pancreatic fistula tendencies (2, 16). Regarding the intraoperative bleeding, in the present study, fatty pancreas showed bleeding tendency because of its fragile architecture. Although diabetes or other co-morbidities are proposed risk factors of blood loss or morbidity in pancreatectomy, this co-morbidity was not related to intraoperative bleeding, which is similar to other recent reports (17, 18). Regarding preoperative laboratory parameters, only increased level of alkaline phosphatase was associated with increased blood loss. Coagulation parameters such as platelet count or prothrombin activity were not associated with increased blood loss in the present results.

In surgical records, total operating time, performance of PD and combined vascular resection were closely associated with increased blood loss, which was reasonable because of the increased complexity of operative procedures in comparison with DP or pancreatectomy without vascular reconstruction (19). Longer operating time might be associated with increased blood loss. Therefore, it is important to reduce operating time by applying various surgical procedures. Furthermore, unexpected bleeding might have

been principally caused by an injury to the surrounding vessels of the pancreas. PD and combined vascular resections were associated with increased blood loss (19). PD showed some hazards of intraoperative bleeding such as a congestive portal venous bleeding in the pancreatic head. Ligation of arterial inflow at the earlier stage of operation was recommended to reduce congestive bleeding (20). Combined resection and anastomosis of the portal vein may increase bleeding (19). Nowadays, the advanced vessel sealing devices could decrease blood loss (9, 10) although we did not examine the association of such a device in the present series. Surgeon experience was not associated with increased blood loss in the present study (21). We have had an education system regarding PD for young surgeons, as reported previously (7) and, therefore, fellows or residents could overcome blood loss with advanced skills. Except for these parameters, patient obesity calculated by body mass index can be associated with operative difficulty (22) but this factor was not examined in our series. Multivariate analysis showed operating time and performance of PD were independently associated parameters with blood loss over 880mL in the present study. By this result, reducing operating time in case of PD is important.

In conclusion, we examined the associated parameters with increased intraoperative blood loss during pancreatectomy in a retrospective analysis using the

clinical records of 161 patients who underwent elective pancreatectomy for peripancreatic diseases. Based on ROC analysis, predictive blood loss in patients who received red cell blood transfusion was set as the estimated value at 880mL. Male patients, fatty pancreas, higher ALP level, longer operating time, performance of PD and combined vascular resection were significantly associated with increased blood loss based on univariate analysis. Performance of PD and operating time were predicted as risk factors of increased blood loss for pancreatectomy by multivariate analysis. Attempting to reduce transection and operating time by applying the latest hemostatic devices may reduce blood loss in these patients.

REFERENCES

1. **Donahue TR, Reber HA:** Pancreatic surgery. Curr Opin Gastroenterol 2010;26:499-505.

2. **Niedergethmann M, Farag Soliman M, Post S:** Postoperative complications of pancreatic cancer surgery. Minerva Chir 2004;59:175-83.

3. **Nagai S, Fujii T, Kodera Y, Kanda M, Sahin TT, Kanzaki A, Yamada S, Sugimoto H, Nomoto S, Takeda S, Morita S, Nakao A:** Impact of operative blood loss on survival in invasive ductal adenocarcinoma of the pancreas. Pancreas 2011;40:3-9.

4. **Rumstadt B, Schwab M, Korth P, Samman M, Trede M:** Hemorrhage after pancreatoduodenectomy. Ann Surg. 1998;227:236-241.

5. **Simons JP, Shah SA, Ng SC, Whalen GF, Tseng JF:** National complication rates after pancreatectomy: beyond mere mortality. J Gastrointest Surg. 2009;13:1798-1805.

6. **Nanashima A, Yamaguchi H, Sumida Y, Abo T, Tobinaga S, Tanaka K, Takeshita H, Hidaka S, Sawai T, Yasutake T, Nagayasu T:** Hepatectomy and pancreatectomy with combined vascular resection in patients with hepato-biliary and pancreas diseases at a single cancer institute. Hepatogastroenterology. 2008;55:873-878.

7. **Sumida Y, Nanashima A, Abo T, Tobinaga S, Araki M, Kunizaki M, Nonaka T, Takeshita H, Hidaka S, Sawai T, Yasutake T, Nagayasu T:** Stepwise education for pancreaticoduodenectomy for young surgeons at a single Japanese institute. Hepatogastroenterology. 2010;57:1046-1051.

8. **Martin RC, Wellhausen SR, Moehle DA, Martin AW, McMasters KM:** Evaluation of intraoperative autotransfusion filtration for hepatectomy and

pancreatectomy. Ann Surg Oncol. 2005;12:1017-1024.

9. **Okabayashi T, Hanazaki K, Nishimori I, Sugimoto T, Yoshioka R, Dabanaka K, Kobayashi M, Onishi S:** Pancreatic transection using a sharp hook-shaped ultrasonically activated scalpel.Langenbecks Arch Surg. 2008;393:1005-1008.

10. **Hartwig W, Duckheim M, Strobel O, Dovzhanskiy D, Bergmann F, Hackert T, Büchler MW, Werner J:** LigaSure for pancreatic sealing during distal pancreatectomy. World J Surg. 2010;34:1066-1070.

11. **Frymerman AS, Schuld J, Ziehen P, Kollmar O, Justinger C, Merai M, Richter S, Schilling MK, Moussavian MR:** Impact of postoperative pancreatic fistula on surgical outcome--the need for a classification-driven risk management.J Gastrointest Surg. 2010;14:711-718.

12. **Kazanjian KK, Hines OJ, Duffy JP, Yoon DY, Cortina G, Reber HA:** Improved survival following pancreaticoduodenectomy to treat adenocarcinoma of the pancreas: the influence of operative blood loss. Arch Surg. 2008;143:1166-1171.

13. **Yao HS, Wang Q, Wang WJ, Hu ZQ:** Intraoperative allogeneic red blood cell transfusion in ampullary cancer outcome after curative pancreatoduodenectomy: a clinical study and meta-analysis. World J Surg. 2008;32:2038-2046..

14. **Kelly KJ, Greenblatt DY, Wan Y, Rettammel RJ, Winslow E, Cho CS, Weber SM:** Risk stratification for distal pancreatectomy utilizing ACS-NSQIP: preoperative factors predict morbidity and mortality. J Gastrointest Surg. 2011;15:250-259

15. **Yokoyama Y, Schwacha MG, Samy TS, Bland KI, Chaudry IH:** Gender dimorphism in immune responses following trauma and hemorrhage. Immunol Res. 2002;26:63-76.

16. **Kawai M, Kondo S, Yamaue H, Wada K, Sano K, Motoi F, Unno M, Satoi S, Kwon AH, Hatori T, Yamamoto M, Matsumoto J, Murakami Y, Doi R, Ito M, Miyakawa S, Shinchi H, Natsugoe S, Nakagawara H, Ohta T, Takada T:** Predictive risk factors for clinically relevant pancreatic fistula analyzed in 1,239 patients with pancreaticoduodenectomy: multicenter data collection as a project study of pancreatic surgery by the Japanese Society of Hepato-Biliary-Pancreatic Surgery.J Hepatobiliary Pancreat Sci. 2011 E-Pub.

17. **Seeliger H, Christians S, Angele MK, Kleespies A, Eichhorn ME, Ischenko I, Boeck S, Heinemann V, Jauch KW, Bruns CJ:** Risk factors for surgical complications in distal pancreatectomy. Am J Surg. 2010;200:311-317.

18. **Chu CK, Mazo AE, Sarmiento JM, Staley CA, Adsay NV, Umpierrez GE, Kooby DA:** Impact of diabetes mellitus on perioperative outcomes after resection for pancreatic adenocarcinoma. J Am Coll Surg. 2010;210:463-473.

19. Siriwardana HP, Siriwardena AK: Systematic review of outcome of synchronous portal-superior mesenteric vein resection during pancreatectomy for cancer. Br J Surg. 2006;93:662-673.

20. **Ishizaki Y, Sugo H, Yoshimoto J, Imamura H, Kawasaki S:** Pancreatoduodenectomy with or without early ligation of the inferior pancreatoduodenal artery: comparison of intraoperative blood loss and short-term outcome. World J Surg. 2010;34:2939-2944.

21. **Schmidt CM, Turrini O, Parikh P, House MG, Zyromski NJ, Nakeeb A, Howard TJ, Pitt HA, Lillemoe KD:** Effect of hospital volume, surgeon experience, and surgeon volume on patient outcomes after pancreaticoduodenectomy: a single-institution experience. Arch Surg. 2010;145:634-640.

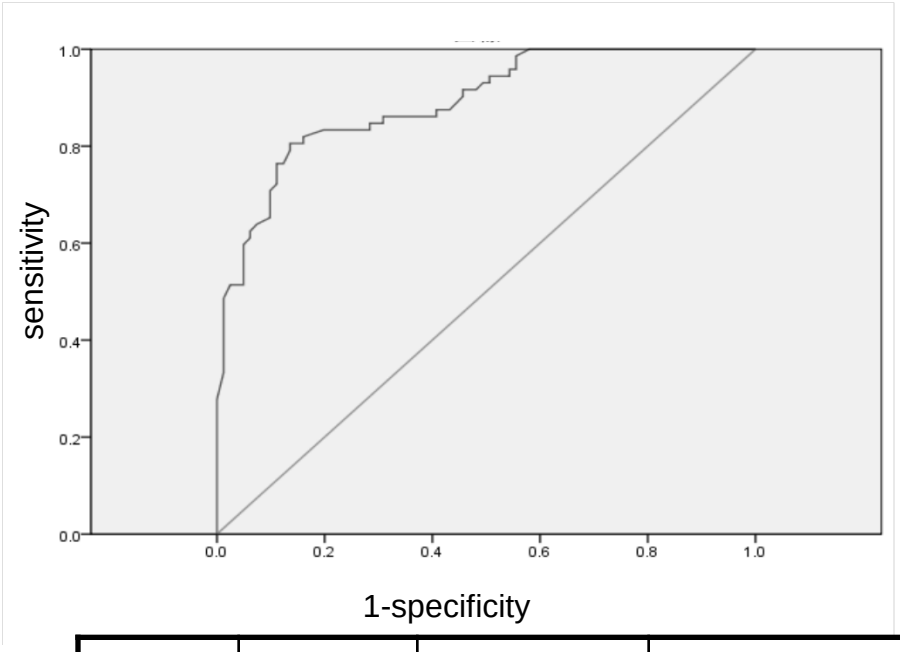
22. **Benns M, Woodall C, Scoggins C, McMasters K, Martin R:** The impact of obesity on outcomes following pancreatectomy for malignancy. Ann Surg Oncol. 2009;16:2565-2569.

Figure legends

Figure 1. ROC analyzed curve for the estimated probability of blood loss calculated. A) predictive value of blood loss in patients who received red cell blood transfusion, B) those in patients who had postoperative morbidity.

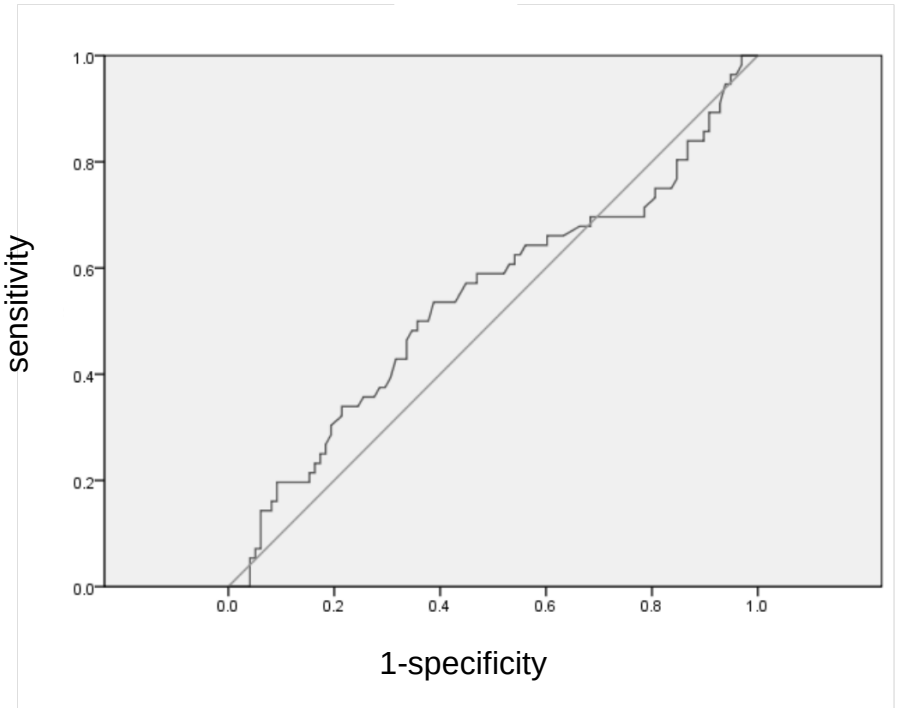
Figure 1

A)



Area	Standard deviation	Significant possibility	95% confidence interval	
			Lower limit	Upper limit
.890	.025	<0.0001	.840	.940

B)



Area	Standard deviation	Significant possibility	95% confidence interval	
			Lower limit	Upper limit
.540	.050	0.398	.442	.640

Table 1 Predictive value of continuous parameters for estimated blood loss

	Blood loss over 880ml
Age (years)	41
Laboratory data	
BT-PABA test (%)*	64
Hemoglobin (g/dl)	13
Total bilirubin (mg/dl)	0.9
Prothrombin activity (%)	96
Total protein (g/dL)	6.8
Platelet count (/mm^3)	$22x10^4$
Alkaline phosphatase (U/l)	310
Cholinesterase (U/l)	140
Amylase (U/l)	75
Total cholesterol (mg/dl)	178
Hemoglobin A1C (%)	5.5
Surgical record	
Operating time (minutes)	480

* Oral administration of the synthetic peptide N-benzoyl-L-tyrosyl-p-aminobenzoic acid.

Table 2 Univariate analysis between associated parameters and estimated blood loss

		Blood loss ≥880mL (n=105)	Significance
Gender			
Male/ female (n=106/55)		75(71)/30(55)	0.049
Age			
≤40 / ≥41 (n=9/152)		5(56)/100(67)	0.49
Background pancreatic diseases			
Normal (n=102)		59(58)	
Fatty (n=3)		3(100)	0.020
Pancreatitis (n=56)		43(77)	
Diseases			
Pancreatic carcinoma (n=51)		37 (73)	
Biliary carcinoma (n=58)*		39 (67)	0.15
Duodenal tumor (n=4)		2 (50)	
IPMN or MCN (n=23)		15 (65)	
Other diseases (n=25)		12 (48)	
Co-morbidity			
Diabetes no/yes (n=46/115)		33(72)/72(65)	0.56
Smoking no/yes (n=102/59)		63(64)/41(73)	0.30
Alcohol no/yes (n=92/69)		53(60)/51(76)	0.11
Liver functions*			
BT-PABA test (%)*	<64/≥64 (n=63/66)	41(64)/51(77)	0.28
Hemoglobin (g/dl)*	<13/≥13 (n=67/80)	45(67)/54(68)	1.0

Total bilirubin (mg/dl)*	<0.9/≥0.9 (n=130/17)	88(68)/11(65)	0.89
Prothrombin activity (%)*	<96/≥96 (n=75/64)	55(73)/41(64)	0.32
Total protein (g/dL)*	<6.8/≥6.8 (n=37/110)	26(70)/73(66)	0.81
Platelet count ($x10^4/mm^3$)*	<22/≥22 (n=22/125)	15(68)/84(67)	1.0
Alkaline phosphatase (U/l)*	<310/≥310 (n=77/70)	44(57)/55(79)	<0.001
Cholinesterase (U/l)*	<140/≥140 (n=82/60)	56(68)/41(68)	1.0
Amylase (U/l)*	<75/≥75 (n=85/61)	62(73)/36(59)	0.11
Total cholesterol (mg/dl)*	<178/≥178 (n=63/89)	46(73)/56(63)	0.26
Hemoglobin A1C (%)*	<5.5/≥5.5 (n=63/58)	39(62)/43(74)	0.22
Surgical records*			
Operating time (min.)	<480/≥480 (n=65/96)	28(44)/77(83)	<0.001
Operator			
Attending/Fellow or Resident	(n=108/53)	75(69)/30(57)	0.40
Incision*			
Transverse/Median	(n =37/124)	29(78)/76(62)	0.38
Extend of hepatectomy			
PD/HPD/DP/Others	(n=113/10/32/6)	85(75)/9(90)/11(34)/1(17)	<0.001
Combined vascular resection			
None/yes	(n=147/14)	92(63)/13(93)	0.035

*: some data was deficit.

Table 3 Multivariate analysis between associated parameters and estimated blood loss

	Blood loss over 850ml		
	Risk ratio	95% Confidence interval	Significance
Gender			
Male vs. Female	2.2	0.94-5.0	0.066
Background pancreatic diseases			
Fatty/pancreatitis vs. Normal	2.6	0.44-68	0.17
Liver functions*			
Alkaline phosphatase ≥310 vs. <310	1.6	0.65-3.7	0.32
Operating time (min.) ≥480 vs. <480	2.5	1.04-5.7	0.039
Pancreatectomy			
PD/HPD vs. DP/Others	4.6	1.54-12.8	0.006
Combined resection			
Yes vs. no	1.8	0.91-28	0.11