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# Surgical Outcomes After Pancreaticoduodenectomy in Elderly Patients

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**Abstract:** Background: Pancreaticoduodenectomy (PD) is an aggressive surgery with considerable operative risks. Objective: The purpose of this study was to evaluate the safety of PD in patients of  $\geq 75$  years of age and to show the influence of advanced age on the mortality and morbidity associated with PD. Methods: Between July 2009 and December 2013, 131 patients underwent PD at Hyogo College of Medicine. We analyzed the perioperative data and outcomes after PD in patients of  $\geq 75$  years of age (elderly group) in comparison to those of patients of  $< 75$  years of age (younger group). Results: There were no differences between the elderly group (n=28) and younger group (n=103) in terms of gender, body mass index (BMI), biochemistry test results, operative time or intraoperative blood loss. There were significant differences in the incidence of preoperative complications in the elderly and younger groups. There were no differences in the rates of mortality (0% vs. 1%;  $p=0.601$ ) or morbidity (64% vs. 49%;  $p=0.139$ ). Morbidities included pancreatic fistula, delayed gastric emptying, intra-abdominal bleeding, intra-abdominal abscess, ascites and pneumonia. Conclusion: The preoperative complication rate in the elderly group was significantly higher than that in the younger group. However, PD can be performed safely in elderly patients and advanced age alone should not be a contraindication to PD.

**Keywords:** Pancreaticoduodenectomy, Elderly Patients, Outcome

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## 1. Introduction

The elderly population has been increasing in many developed countries. The aging population worldwide has resulted in more elderly patients undergoing major surgery, such as pancreaticoduodenectomy (PD). PD has long been associated with high rates of mortality and morbidity [1-5]. With advances in surgical management for PD, the mortality rate has been reported to have decreased to less than 5% [6-7]. However, the morbidity rate of PD has still been reported to be 30-60%, with morbidities including pancreatic fistula, delayed gastric emptying, intra-abdominal bleeding and intra-abdominal abscess [8-9]. Thus, surgeons should carefully consider whether PD will be beneficial for their elderly patients. Some studies have reported the increased surgical risk of elderly patients who undergo PD [10-12], while others have reported the safety and feasibility of the PD for elderly patients [13-17].

The purpose of this study was to evaluate the safety of PD in patients of  $\geq 75$  years of age and to show the influence of advanced age on the mortality and morbidity associated with PD.

## 2. Patients and Methods

### 2.1. Patients

Between July 2009 and December 2013, 131 patients underwent PD at Hyogo College of Medicine. These patients were divided, according to their age into an elderly group ( $\geq 75$  years of age; n=28) and a younger group ( $< 75$  years of age; n=103). The following preoperative data were collected: gender, age, body mass index (BMI), biochemistry tests, and preoperative complications. The following operative data were collected: operative procedure, operative time, intraoperative blood loss and postoperative complications. Pancreatic fistula was defined according to the International

Study Group on Pancreatic Fistula (ISGPF) criteria [18]. Delayed gastric emptying and postpancreatectomy hemorrhage were also defined according to the definitions proposed by the International Study Group of Pancreatic Surgery (ISGPS) [19-20]. Perioperative mortality was defined as death in the hospital or death within 30 days of surgery.

## 2.2. Surgical Procedure

Standard PD, pylorus-preserving PD (PPPD), and subtotal stomach-preserving PD (SSPPD) were performed at the discretion of the individual surgeons. Anastomosis between the pancreas and jejunum was performed using end-to-side two-layer anastomosis with external stent drainage for the pancreatic duct. Anastomosis of the outer layer was performed between the pancreatic parenchyma and jejunal seromuscular tissue using 4-0 absorbable interrupted sutures. Anastomosis between the pancreatic duct and jejunal mucosa was performed using 5-0 or 6-0 absorbable interrupted sutures. Then, end-to-side hepaticojejunostomy was performed 15 cm distal from the site of pancreaticojejunostomy by one-layer

anastomosis. Duodenojejunostomy in PPPD or gastrojejunostomy in PD or SSPPD was performed 50 cm distal from the hepaticojejunostomy site by two-layer anastomosis. All patients underwent reconstruction using modified Child's methods.

## 2.3. Statistical Analysis

Comparisons between groups were made using the chi-squared test, and averages were compared using Student's *t* test. *P* values of <0.05 were considered to indicate statistical significance. Numerical data are expressed as the mean±SD.

## 3. Results

### 3.1. Comparisons of Patient Characteristics and Preoperative Factors

The clinicopathological characteristics of the two groups of patients are shown in Table 1.

Table 1. Patient characteristics and preoperative factors.

	≥75 years (n=28)	<75 years (n=103)	<i>p</i> value
Background			
Age (years)	77.6±2.0	62.7±10.1	<0.05
Gender (male/female)	19/9	69/34	0.931
BMI	21.4±2.8	22.5±3.2	0.105
Biochemistry test			
Total bilirubin (mg/dl)	1.7±1.9	2.3±2.7	0.057
Albumin (g/dl)	3.6±0.5	4.0±3.2	0.496
Hemoglobin (g/dl)	11.8±1.5	12.2±1.7	0.309
Preoperative complication			
Overall	23 (82%)	64 (62%)	<0.05
Brain infarction	2 (7%)	5 (5%)	0.633
Pulmonary dysfunction	9 (32%)	24 (23%)	0.339
Hypertension	15 (54%)	41 (40%)	0.192
Ischemic heart disease	5 (18%)	10 (10%)	0.23
Diabetes mellitus	10 (36%)	26 (25%)	0.271
Hyperlipidemia	5 (18%)	15 (15%)	0.667

BMI: body mass index.

Twenty-eight (21%) of the 131 patients were ≥75 years of age. The mean age of the elderly group was 77.6±2.0 years, whereas that of the younger group was 62.7±10.1 years. There were no significant differences between the groups with regard to sex, BMI, total bilirubin, albumin or hemoglobin. The preoperative complication rate in the elderly group (82%)

was significantly higher than that in the younger group (62%).

### 3.2. Comparisons of Surgical Factors

Comparisons of the surgical factors are shown in Table 2.

Table 2. Surgical factors.

	≥75 years (n=28)	<75 years (n=103)	<i>p</i> value
Diseases			
Pancreatic cancer	10 (36%)	39 (38%)	0.835
Bile duct cancer	8 (29%)	29 (28%)	
Cancer of the ampulla of Vater	4 (14%)	8 (8%)	
Intraductal papillary mucinous neoplasm	2 (7%)	8 (8%)	
Duodenal cancer	0 (0%)	5 (5%)	
Others	4 (14%)	14 (13%)	
Operative procedures			
PPPD	23 (82%)	88 (85%)	0.667
SSPPD	2 (7%)	9 (9%)	
PD	3 (11%)	6 (6%)	
Operative factor			

	≥75 years (n=28)	<75 years (n=103)	p value
Operative time, mean (min)	634±79	650±126	0.552
Intraoperative blood loss, mean (ml)	1210±1093	1377±1254	0.523

PPPD: pylorus-preserving pancreaticoduodenectomy, SSPPD: subtotal stomach-preserving pancreaticoduodenectomy, PD: pancreaticoduodenectomy.

The most common disease in the elderly group was pancreatic cancer, followed by bile duct cancer, cancer of the ampulla of Vater, and duodenal cancer. On the other hand, the most common disease in the younger group was pancreatic cancer, followed by bile duct cancer, cancer of the ampulla of Vater, and duodenal cancer. PD was performed in 28 patients in the elderly group (PPPD, n=23 [82%]; SSPPD, n=2 [7%]; and standard PD, n=3 [11%]) and 103 patients in the younger group (PPPD, n=88 [85%], SSPPD, n=9 [9%] and standard

PD, n=6 [6%]). The operative time and intraoperative blood loss of the two groups did not differ to a statistically significant extent.

### 3.3. Postoperative Complications and Clinical Outcomes

Comparisons of the postoperative complications and clinical outcomes are shown in Table 3.

**Table 3.** Postoperative complications and the clinical outcomes.

	≥75 years (n=28)	<75 years (n=103)	p value
Morbidity	18 (64%)	50 (49%)	0.139
Postoperative complications			
Pancreatic fistula	16 (57%)	41 (40%)	0.101
Grade A	2 (7%)	8 (8%)	
Grade B	14 (50%)	32 (31%)	
Grade C	0 (0%)	1 (1%)	
Delayed gastric emptying	1 (4%)	6 (6%)	0.638
Intra-abdominal bleeding	1 (4%)	5 (5%)	0.773
Intra-abdominal abscess	1 (4%)	9 (9%)	0.361
Wound infection	4 (14%)	15 (15%)	0.971
Ascites	0 (0%)	4 (4%)	0.289
Pneumonia	0 (0%)	1 (1%)	0.601
Mortality	0 (0%)	1 (1%)	0.601

There were no significant differences between the older and younger groups in the rates of mortality (0% vs. 1%) or morbidity (64% vs. 49%). The most common complication was pancreatic fistula (44%). The incidence of pancreatic fistula in the elderly and younger groups was similar (57% vs. 40%). There was also no significant differences in the incidence of other complications, including delayed gastric emptying, intra-abdominal bleeding, intra-abdominal abscess, wound infection, ascites and pneumonia.

## 4. Discussion

It is important to study the surgical outcomes of PD in elderly patients because of the aging of populations in developed countries. In patients with periampullary tumors, PD has been performed for curative resection during each generation. However, PD is an aggressive surgical modality with reported complication rates of 30-60% [8-9]. PD may cause considerable complications, including pancreatic fistula, intra-abdominal bleeding and intra-abdominal abscess, and requires high-quality techniques and management in the perioperative period. Recently, the rates of morbidity and mortality associated with PD have decreased, especially in high volume centers [21-23]. Several reports have emphasized the elevated operative risks of PD in elderly patients. Finlayson *et al.* found a high perioperative mortality rate of up to 15.5% for patients of ≥80 years of age [24]. Makary *et al.* examined the outcomes of PD in 207 patients of ≥80 years of age and found significant increases in mortality (4.1% vs.

1.7%;  $p<0.05$ ) and morbidity (52.8% vs. 41.6%;  $p<0.05$ ) among older patients [25]. Brozzetti *et al.* reported that the surgical complications after PD that led to reoperation were responsible for a high rate of mortality in patients of >70 years of age [10]. Recent studies of high volume centers for PD reported that with the application of improved surgical techniques, instruments, and perioperative management, PD could be performed safely for elderly patients with no adverse effects after the operation [12, 14-17]. In our study, although the rate of preoperative complications was significantly higher in patients of ≥75 years of age (82% vs. 62%;  $p<0.05$ ), there was no significant differences in the rates of mortality (0% vs. 1%;  $p=0.601$ ) or overall morbidity (64% vs. 49%;  $p=0.139$ ). Although not statistically significant, surgical stressors, such as operative time (634±79 min vs. 650±126 min;  $p=0.552$ ) and intraoperative blood loss (1210±1093 ml vs. 1377±1254 ml;  $p=0.523$ ) were lower in patients of ≥75 years of age who underwent surgery at the discretion of the individual surgeons.

Pancreatic fistula is the most threatening complication of PD. In the literature, the reported rate of pancreatic fistula ranges from 5% to 40% [26-29]. In our study, the incidence of pancreatic fistula in the elderly and younger groups was similar (57% vs. 40%;  $p=0.101$ ). Several reports have compared external drainage and no-stent procedures and found that the incidence of pancreatic fistula was significantly lower when external drainage was performed [27, 30]. As anastomosis is made with the narrow main pancreatic duct was made, postoperative swelling may develop temporarily, which can result in stenosis [16]. Thus, stent placement is

considered essential at our institution. Regarding DGE, our study showed no differences between the elderly and younger groups. However the incidence of DGE in elderly patients has been reported to be higher than that in younger patients [31]. In our study, anastomosis between the jejunum and the duodenum or stomach with antecolic reconstruction was made as straight as possible, in order to improve the physical flow until peristalsis improved. Thus, the incidence of DGE in our study was decreased in all generations in comparison to the incidence in previous reports [31].

## 5. Conclusion

The preoperative complication rate in the elderly group was significantly higher than that in the younger group. However, our study demonstrated that the surgical outcomes of PD can be similar in elderly and younger patients. We suggest that PD can be performed safely in elderly patients and that advanced age alone should not be a contraindication to PD.

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