



# FACTORS ASSOCIATED WITH POSTOPERATIVE COMPLICATIONS AFTER PANCREATODUODENECTOMY (WHIPPLE PROCEDURE) IN A SPECIALIZED CENTER

FACTORES ASOCIADOS A COMPLICACIONES DESPUÉS DE DUODENOPANCREATECTOMÍA CEFÁLICA (CIRUGÍA DE WHIPPLE) EN UN CENTRO ESPECIALIZADO

Jorge Cornejo , Lucy E. Correa-Lopez , José Cornejo , Mariela Vargas , Belkys Figueroa-Depablos , Cesar Rodriguez 

## ABSTRACT

**Introduction:** Whipple procedure, also known as pancreatoduodenectomy (PD), is a widely used procedure for several types of peri-ampullary cancer. **Objectives:** To establish the factors associated with postoperative complications after PD in the Pancreas Surgery Service of the Edgardo Rebagliati Martins National Hospital in Lima, Peru. **Methods:** An observational, quantitative, analytical, cross-sectional, and retrospective study was carried out on 81 patients during the period from January 2017 to December 2019, who underwent PD. The dependent variable was postoperative complications and the independent variables were preoperative, perioperative, and postoperative variables. The medical records were reviewed. Logistic regression was performed to find the crude and adjusted ORs. **Results:** The mean age was  $65.97 \pm 10.14$  and the majority of patients were male. The most common postoperative complication was pancreatic fistula (34.6%). Factors associated with postoperative complications after PD were male sex (aOR: 4.46, 95% CI: 1.35-14.77), ampullary cancer (aOR: 6.92, 95% CI: 1.75-27.48), and soft consistency of the pancreas (aOR: 4.52, 95% CI: 0.07-0.58). **Conclusions:** The factors associated with postoperative complications after PD were male sex, ampullary cancer, and soft consistency of the pancreas.

**Keywords:** Peru; Associated factors; Evolution with complications; Pancreatoduodenectomy. (Source: MESH-NLM)

## RESUMEN

**Introducción:** La cirugía de Whipple, también conocida como duodenopancreatectomía cefálica (DPC), es un procedimiento muy usado para varios tipos de cáncer peri ampular. **Objetivos:** Establecer los factores asociados a la evolución con complicaciones post DPC en el Servicio de Cirugía de Páncreas del Hospital Nacional Edgardo Rebagliati Martins en Lima, Perú. **Métodos:** Se realizó un estudio observacional, cuantitativo, analítico, transversal y retrospectivo en 81 pacientes durante el período comprendido entre enero de 2017 hasta diciembre de 2019, quienes fueron sometidos a una DPC. La variable dependiente fueron las complicaciones postquirúrgicas y las independientes fueron indicadores preoperatorios, perioperatorios y post operatorios. Se revisaron las historias clínicas. Se realizó regresión logística para hallar los OR crudos y ajustados. **Resultados:** La media de la edad fue  $65,97 \pm 10,14$  y el sexo más frecuente fue el masculino. La complicación más frecuente fue la fístula pancreática (34,6%). Los factores asociados a complicaciones post DPC fueron el sexo masculino (ORa: 4,46, IC95%: 1,35-14,77), ampuloma (ORa: 6,92, IC95%: 1,75-27,48) y la consistencia blanda del páncreas (ORa: 4,52, IC95%: 0,07-0,58). **Conclusiones:** Los factores asociados a complicaciones en la evolución post DPC fueron el sexo masculino, el ampuloma, y la consistencia blanda del páncreas.

**Palabras clave:** Perú; Factores asociados; Evolución con complicaciones; Duodenopancreatectomía cefálica. (Fuente: DeCS- BIREME)

<sup>1</sup> Instituto de Investigaciones en Ciencias Biomédicas, Universidad Ricardo Palma, Lima, Perú.

<sup>2</sup> Servicio Cirugía de Páncreas, Hospital Edgardo Rebagliati Martins. Lima, Perú.

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## INTRODUCTION

Whipple's surgery, also known as pancreaticoduodenectomy (PD), is a procedure performed in various specialized centers around the world and is carried out by highly experienced surgeons<sup>(1)</sup>. This treatment is considered the preferred option for benign and malignant tumors of the pancreas, as well as for neoplasms affecting the periampullary region, including ductal cholangiocarcinoma, ampullary cancer, duodenal adenocarcinoma, and pancreatic adenocarcinoma<sup>(2)</sup>. However, surgical treatment carries a high rate of post-surgical complications, resulting in a discouraging prognosis<sup>(3)</sup>.

Perioperative mortality associated with pancreatic surgery has significantly decreased in recent decades, currently standing at less than 5% in high-volume medical centers. Despite this improvement, the complication rate remains high, exceeding 30%<sup>(4)</sup>. This notable improvement in patient survival is due to the refinement of surgical techniques, leading to better perioperative management and a reduction in complications<sup>(5)</sup>. Despite this, morbidity and mortality are still closely linked to preoperative, intraoperative, and postoperative factors<sup>(6)</sup>.

Postoperative complications of Whipple's surgery include biliary fistula, delayed gastric emptying, post-PD hemorrhage, and pancreatic fistula, the latter being the most common according to most studies<sup>(7)</sup>. It has been reported that elevated levels of the CA 19.9 marker, tumor size, and tumor grade are significant risk factors for reduced survival following Whipple's surgery. Therefore, these should be considered in the selection of patient candidates for the surgical procedure to improve their outcomes<sup>(8)</sup>.

Given the complexity of the procedure and its potential complications, healthcare professionals need to maintain a deep and up-to-date understanding of the subject. This knowledge is important, as the procedure involves significant costs to the healthcare system due to the use of specialized surgical instruments and the need for intensive postoperative care. This includes a stay in the Intensive Care Unit (ICU) and an extended hospitalization time for a series of examinations, thus ensuring that the patient is discharged in good health<sup>(9)</sup>.

For all these reasons, the study aimed to determine the factors associated with the evolution of complications post-PD in the Pancreas Surgery Service of the Edgardo Rebagliati Martins National Hospital in Lima, Peru.

## METHODS

### Design and study area

An observational, quantitative, analytical, cross-sectional, and retrospective study was conducted in the Pancreas Surgery Service of the Edgardo Rebagliati Martins National Hospital.

### Population and sample

During the period from January 2017 to December 2019, there were 81 patients diagnosed with pancreatic adenocarcinoma, ampullary cancer, distal cholangiocarcinoma, duodenal carcinoma, and cystic pancreatic tumor who underwent a PD. All patients who underwent surgery were included. Exclusion criteria were considered for patients who died during the surgery or who had undergone additional surgical procedures not related to the PD during the same hospitalization period; however, there was no need to exclude any patients. The entire population included in the study period was used, so no sampling was conducted. The statistical power calculation, with an expected frequency of ampullary cancer as a cause of surgery at 36.4%<sup>(10)</sup>, and a 95%

### Variables and Instruments

The variables were classified into three categories: preoperative, perioperative, and postoperative. The preoperative variables include age, gender, cause of surgery, medical history (alcohol consumption, tobacco use, previous surgeries, and acute pancreatitis), comorbidities (hypertension and diabetes mellitus), and laboratory values (CA 19-9 and albumin). The perioperative variables encompass operative time, blood loss, type of pancreatic anastomosis, blood transfusions, and pancreatic consistency. Finally, the postoperative variables include postoperative complications, reoperations, days of hospitalization, and days spent in the Intensive Care Unit. The data collection instrument was a data collection form created ad hoc for the study, and the technique of documentation from clinical histories was used.



## Procedures

The data were extracted from the clinical records obtained from the surgical programming book of the Pancreas Surgery Service of the Edgardo Rebagliati Martins National Hospital. All postoperative patients were included because they met the previously described criteria.

## Statistical Analysis

In the descriptive statistical analysis, different methods were used for data treatment according to their nature. For qualitative variables, frequencies and percentages were calculated to describe the distribution of these variables in the studied sample. For quantitative variables, measures of central tendency and dispersion were used to provide a more detailed view of these characteristics in the dataset. Furthermore, an inferential analysis was conducted using logistic regression testing, both bivariate and multivariate. This allowed for the estimation of crude and adjusted odds Ratios (ORs), along with their respective 95% confidence intervals. A p-value of less than 0.05 was considered statistically significant. The analysis was performed using SPSS Statistical version 25.0 (IBM Corp.).

## Ethical Aspects

The research was conducted following the ethical principles of the Declaration of Helsinki, protecting the privacy and confidentiality of the participant's data. The project was registered with the Institute for Research in Biomedical Sciences at Ricardo Palma University<sup>(11)</sup> and received approval from the Ethics Committee of the Edgardo Rebagliati Martins National Hospital, as reflected in Letter No. 111-GRPR-ESSALUD-2020.

## RESULTS

During the study period, 81 pancreaticoduodenectomies were performed, which met the described selection criteria. Table 1 summarizes the preoperative and intraoperative characteristics of patients undergoing PD at the Edgardo Rebagliati Martins National Hospital. Notable findings include an average age of 65.97 years, with the most common age range being 45-65 years (48.1%). In terms of gender, males represented 53.1%. The most frequent cause of surgery

was ampullary cancer (40.7%), followed by pancreatic adenocarcinoma (25.9%). Intraoperatively, the majority had a soft pancreatic consistency (55.6%), and the Blumgart pancreatic anastomosis technique was primarily used (96.3%). The average operative time was 382.09 minutes, and the average blood loss was 596.29 ml, with 39.5% of patients receiving transfusions.

Table 2 shows that 54.3% of the patients did not present postoperative complications, while pancreatic fistula was the most common (34.6%). Reoperation was necessary in only 4.9% of cases. The average hospital stay was 15.02 days, with 27.2% of patients hospitalized for more than 16 days. In the ICU, the average stay was 3.79 days, with 38.3% of patients staying more than 4 days.

In Figure 1, the presence of complications in patients undergoing PD is compared, and stratified according to the cause of the surgical intervention. The cause with the highest percentage of complications was ampullary cancer (63.6%), followed by cystic tumors of the pancreas (50%) and pancreatic adenocarcinoma. On the other hand, cholangiocarcinoma and duodenal carcinoma showed the lowest percentages of complications.

Table 3 shows that, in the bivariate analysis, the factors associated with complications in the evolution of patients undergoing PD were mainly the cause of Whipple and the consistency of the pancreas. Specifically, ampullary cancer was significantly associated with an increase in complications compared to pancreatic adenocarcinoma (OR: 7.44, 95% CI: 2.03-27.28,  $p=0.002$ ). In addition, a soft consistency of the pancreas was related to a higher risk of postoperative complications (OR: 4.94, 95% CI: 0.08-0.53,  $p=0.001$ ). Moreover, reoperation was significantly associated with complications, with a notably higher number of cases in the group with complications (10.8%) compared to those without complications (0%,  $p=0.025$ ). Furthermore, a hospital stay of 16 days or more showed a strong association with postoperative complications (OR: 14.43, 95% CI: 0.02-0.26,  $p<0.001$ ) (Table 4).

In Table 5, it can be observed that the male gender showed a significant association with an increased risk of complications (adjusted OR: 4.46, 95% CI: 1.35-14.77,  $p=0.014$ ). Additionally, patients with ampullary cancer had a significantly higher frequency of complications

compared to those with pancreatic adenocarcinoma (OR: 6.92, 95% CI: 1.75-27.48,  $p=0.006$ ). A soft consistency of the pancreas was also significantly associated with greater complications (OR: 4.52, 95% CI: 0.07-0.58,  $p=0.003$ ).

**Table 1.** Characteristics of preoperative and intraoperative variables in patients who underwent pancreaticoduodenectomy at the Pancreas Surgery Service of the Edgardo Rebagliati Martins National Hospital.

Variables	n (%) or Mean $\pm$ SD
<b>Age (mean)</b>	65.97 $\pm$ 10.14
<b>Age (years)</b>	
45-65 years	39 (48.1%)
66-75 years	26 (32.1%)
76-85 years	16 (19.8%)
<b>Gender</b>	
Male	43 (53.1%)
Female	38 (46.9%)
<b>Cause of surgery</b>	
Pancreatic adenocarcinoma	21 (25.9%)
Ampullary cancer	33 (40.8%)
Cholangiocarcinoma	7 (8.6%)
Cystic tumor of the pancreas	16 (19.8%)
Duodenal carcinoma	4 (4.9%)
<b>Alcohol Consumption</b>	
Yes	19 (23.5%)
No	62 (76.5%)
<b>Tobacco Consumption</b>	
Yes	12 (14.8%)
No	69 (85.2%)
<b>Previous Surgeries</b>	
Yes	40 (49.4%)
No	41 (50.6%)
<b>Acute Pancreatitis</b>	
Yes	9 (11.1%)
No	72 (88.9%)
<b>Hypertension</b>	
Yes	31 (38.3%)
No	50 (61.7%)



<b>Diabetes Mellitus</b>	
Yes	20 (24.7%)
No	61 (75.3%)
<b>CA 19.9</b>	
≥400 U/ml	16 (19.8%)
< 400 U/ml	65 (80.2%)
<b>Serum Albumin</b>	
≥3.5 mg/ml	53 (65.4%)
< 3.5 mg/ml	28 (34.6%)
<b>Pancreatic Consistency</b>	
Soft	45 (55.6%)
Firm	36 (44.4%)
<b>Type of Pancreatic Anastomosis</b>	
Gastric	3 (3.7%)
Blumgart	78 (96.3%)
<b>Operative Time (mean)</b>	382.09 ± 93.61
<b>Operative Time</b>	
≥ 4 hours	78 (96.3%)
< 4 hours	3 (3.7%)
<b>Blood Loss (mean)</b>	596.29 ± 500.11
<b>Blood Loss</b>	
≥ 1000 cc	11 (13.6%)
< 1000 cc	70 (86.4%)
<b>Blood Transfusions</b>	
No transfusions	41 (50.6%)
≥ 2 units packed red blood cells	32 (39.5%)
< 2 units packed red blood cells	8 (9.9%)

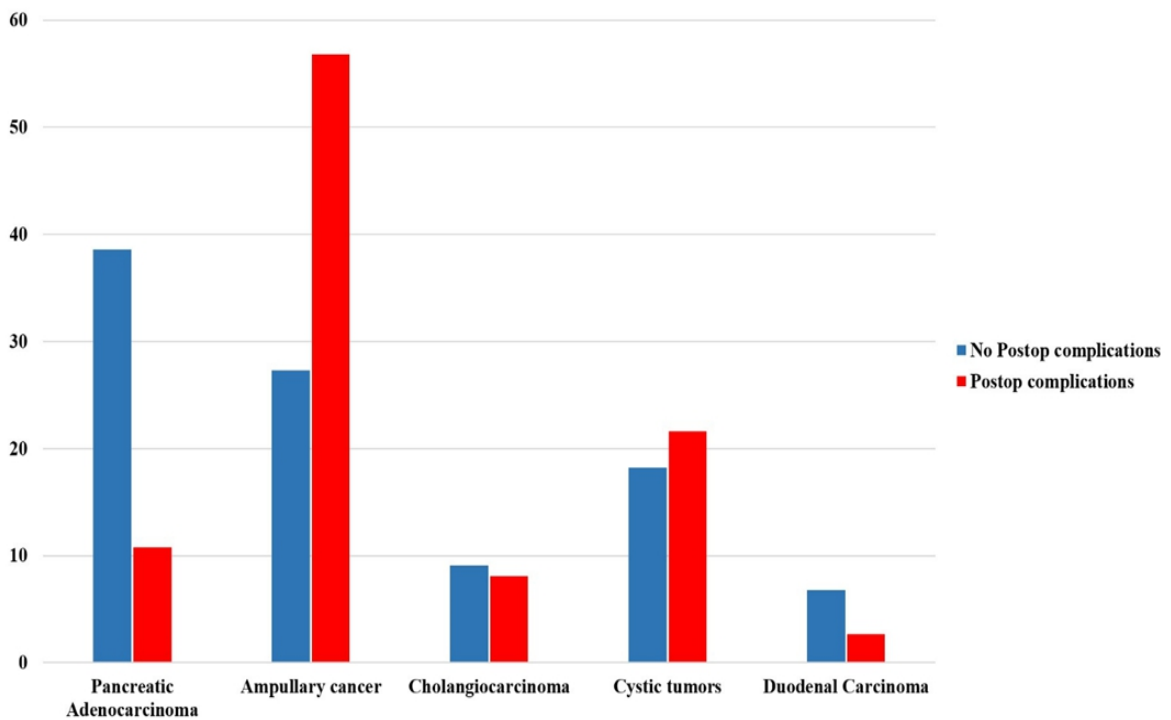
SD: Standard Deviation

**Table 2.** Characteristics of postoperative variables in patients who underwent pancreaticoduodenectomy at the Pancreas Surgery Service of the Edgardo Rebagliati Martins National Hospital.

Variables	n(%) or Mean ± SD
<b>Post PD Complications</b>	
None	44 (54.3%)
Pancreatic Fistula	28 (34.6%)
Delayed Gastric Emptying	3 (3.7%)
Post PD Hemorrhage	4 (4.9%)
Biliary Fistula	2 (2.5%)
<b>Reoperation</b>	
Yes	4 (4.9%)
No	77 (95.1%)

<b>Days of Hospitalization (mean)</b>	15.02 ± 9.04
<b>Days of Hospitalization</b>	
≥ 16 days	22 (27.2%)
< 16 days	59 (72.8%)
<b>Days in ICU (mean)</b>	3.79 ± 2.98
<b>Days in ICU</b>	
≥ 4 days	31 (38.3%)
< 4 days	50 (61.7%)

PD: Pancreaticoduodenectomy. ICU: Intensive Care Unit.



**Figure 1.** Comparative bar graph between the cause of pancreaticoduodenectomy and the presence of complications in its progression in patients from the Pancreas Surgery Service of the Edgardo Rebagliati Martins National Hospital from 2017 to 2019.

**Table 3.** Bivariate analysis of preoperative and intraoperative variables and the progression of patients who underwent pancreaticoduodenectomy in the Pancreas Surgery Service of the Edgardo Rebagliati Martins National Hospital.

VARIABLES		Post Pancreaticoduodenectomy Outcome				p*	OR	IC 95%
		With complications		Without complications				
		n	%	n	%			
Age	45-65	20	54,1%	19	43,2%	<b>Reference category</b>	0,70	0,26 - 1,89
	66-75	11	29,7%	15	34,1%			
	76-85	6	16,2%	10	22,7%			



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<b>Cause of Whipple</b>	<i>Pancreatic Adenocarcinoma</i>	4	10,8%	17	38,6%	<b>Reference category</b>		
	<i>Ampullary cancer</i>	21	56,8%	12	27,3%	0,002	7,44	2,03-27,28
	<i>Cholangiocarcinoma</i>	3	8,1%	4	9,1%	0,220	3,19	0,50-20,30
	<i>Cystic Tumors</i>	8	21,6%	8	18,2%	0,053	4,25	0,98-18,39
	<i>Duodenal Carcinoma</i>	1	2,7%	3	6,8%	0,786	1,42	0,12-17,46
<b>Gender</b>	<i>Male</i>	24	64,9%	19	43,2%	0,051	2,43	0,99-5,98
	<i>Female</i>	13	35,1%	25	56,8%	<b>Reference category</b>		
<b>Alcohol Consumption</b>	<i>Yes</i>	9	24,3%	10	22,7%	0,866	1,09	0,39-3,06
	<i>No</i>	28	75,7%	34	77,3%	<b>Reference category</b>		
<b>Tobacco Consumption</b>	<i>Yes</i>	4	10,8%	8	18,2%	0,352	0,55	0,15-1,98
	<i>No</i>	33	89,2%	36	81,8%	<b>Reference category</b>		
<b>Previous Surgeries</b>	<i>Yes</i>	18	48,6%	22	50,0%	0,904	0,95	0,4-2,27
	<i>No</i>	19	51,4%	22	50,0%	<b>Reference category</b>		
<b>Acute Pancreatitis</b>	<i>Yes</i>	4	10,8%	5	11,4%	0,937	0,95	0,23-3,81
	<i>No</i>	33	89,2%	39	88,6%	<b>Reference category</b>		
<b>Hypertension</b>	<i>Yes</i>	12	32,4%	19	43,2%	0,321	0,63	0,25-1,57
	<i>No</i>	25	67,6%	25	56,8%	<b>Reference category</b>		
<b>Diabetes Mellitus</b>	<i>Yes</i>	7	18,9%	13	29,5%	0,269	0,56	0,2-1,58
	<i>No</i>	30	81,1%	31	70,5%	<b>Reference category</b>		
<b>CA19.9</b>		8	21,6%	8	18,2%	0,699	1,24	0,27-2,41
	<i>&lt; 400 U/ml</i>	29	78,4%	36	81,8%	<b>Reference category</b>		
<b>Albumin</b>		26	70,3%	27	61,4%	0,401	1,49	0,27-1,70
	<i>&lt; 3.5 mg/ml</i>	11	29,7%	17	38,6%	<b>Reference category</b>		
<b>Pancreatic Consistency</b>	<i>Soft</i>	28	75,7%	17	38,6%	0,001	4,94	0,08-0,53
	<i>Firm</i>	9	24,3%	27	61,4%	<b>Reference category</b>		
<b>Type of Pancreatic Anastomosis</b>	<i>Gastric</i>	1	2,7%	2	4,5%	0,662	0,58	0,15-19,70
	<i>Blumgart</i>	36	97,3%	42	95,5%	<b>Reference category</b>		
<b>Operative Time</b>	<i>≥4 hours</i>	36	97,3%	42	95,5%	0,662	1,71	0,05-6,70
	<i>&lt; 4 hours</i>	1	2,7%	2	4,5%	<b>Reference category</b>		
<b>Blood Loss</b>	<i>≥1000 cc</i>	7	18,9%	4	9,1%	0,198	2,33	0,12-1,60
	<i>&lt;1000 cc</i>	30	81,1%	40	90,9%	<b>Reference category</b>		

**Table 4.** Bivariate analysis of postoperative variables and the progression of patients who underwent pancreaticoduodenectomy (PD) in the Pancreas Surgery Service of the Edgardo Rebagliati Martins National Hospital.

VARIABLES		Post Pancreaticoduodenectomy Outcome				p*	OR	IC 95%
		With complications		Without complications				
		n	%	n	%			
Reoperation	<i>Yes</i>	4	10,8%	0	0,0%	0,025	---	---
	<i>No</i>	33	89,2%	44	100,0%	<b>Reference category</b>		
Days of Hospitalization	<i>≥16 days</i>	19	51,4%	3	6,8%	<0,001	14,43	0,02-0,26
	<i>&lt;16 days</i>	18	48,6%	41	93,2%	<b>Reference category</b>		
Days in ICU	<i>≥4 days</i>	16	43,2%	15	34,1%	0,399	1,47	0,28-1,67
	<i>&lt;4 days</i>	21	56,8%	29	65,9%	<b>Reference category</b>		



**Table 5.** Multivariate analysis of preoperative and intraoperative variables of patients who underwent pancreaticoduodenectomy (PD) in the Pancreas Surgery Service of the Edgardo Rebagliati Martins National Hospital.

VARIABLES		p*	OR	IC 95%
Gender	Male	0,014	4,46	1,35-14,77
	Female	Reference category		
Cause of Whipple	Pancreatic Adenocarcinoma	0,072	Reference category	
	Ampullary cancer	0,006	6,92	1,75-27,48
	Cholangiocarcinoma	0,529	1,86	0,27-12,86
	Cystic Tumors	0,056	4,61	0,96-22,15
	Duodenal Carcinoma	0,596	2,06	0,14-30,01
Pancreatic Consistency	Soft	0,003	4,52	0,07-0,58
	Firm	Reference category		

## DISCUSSION

An average age of 65.97 years was found with a male predominance of 53.1%, similar to what was observed by Junrungsee in Thailand<sup>(12)</sup> and Distler in Germany<sup>(13)</sup>. The most common periampullary neoplasm was ampullary cancer (40.7%), followed by pancreatic adenocarcinoma (25.9%), which contrasts with that reported in other international studies<sup>(6,13)</sup>. Regarding harmful habits, 23.5% and 14.8% of the patients consumed alcohol and tobacco, respectively, and the most common comorbidities were hypertension (38.3%) and diabetes mellitus (24.7%), similar to what Distler found<sup>(14)</sup>. Only 11.1% had a history of acute pancreatitis, akin to the reports by Targarona<sup>(4)</sup>. As for laboratory markers, 19.8% showed CA 19.9 levels above 400 U/mL, which is lower than the study by Zakaria in Egypt<sup>(8)</sup>, and 53% had albumin levels  $\geq 3.5$  mg/dl, comparable with Junrungsee<sup>(12)</sup>.

Intraoperatively, 55.6% of patients had a soft pancreatic consistency, which is different from the observations by Zakaria<sup>(8)</sup>. The most common pancreatic anastomosis was different from that reported by Llacta<sup>(15)</sup>. The average operative time was 382.09 minutes, and the average blood loss was 596.29 ml, which is less than that reported by Pugalenthi in New York<sup>(16)</sup>. Blood transfusions were received by 49.4% of patients, in line with Luna in Venezuela<sup>(10)</sup>. The most frequent

complication was pancreatic fistula (34.6%), followed by postoperative hemorrhage (4.9%), similar to findings by Targarona and Dokmark<sup>(3,17)</sup>, but different from Luna and Zakaria<sup>(8,10)</sup>. Only 4.9% required reoperations, mainly for postoperative hemorrhage, which is a smaller percentage than reported by Zakaria<sup>(8)</sup>. Finally, the average stay in the ICU and hospitalization were 3.79 and 15.02 days, respectively, shorter than what was observed by Distler<sup>(14)</sup>.

In this study, we observed that male patients had higher odds of complications compared to females, even in the multivariate analysis. This observation is consistent with the findings of the multicenter study led by Shuichi and colleagues, conducted at the Department of Surgery, School of Medicine, Tohoku University, Japan, in 2011 and 2012. In that study, male gender was identified as a significant risk factor for the development of Grade C postoperative pancreatic fistula and severe postoperative complications, classified as Clavien-Dindo Grade IV and V<sup>(18)</sup>. These findings suggest that men may be more susceptible to postoperative complications in oncological pathologies, possibly due to factors such as a higher body mass index, alcohol consumption, and nicotine use, which are more prevalent in men than in women<sup>(19)</sup>. Additionally, differences in treatments received, such as more frequent neoadjuvant chemoradiotherapy in men,





could influence postoperative outcomes. Understanding these differences is crucial for developing more personalized surgical strategies and postoperative management to improve outcomes in patients of both genders. This information is vital for advancing toward personalized medicine in oncology, enhancing both the quality of care and health outcomes in patients with periampullary cancer or other types.

Furthermore, it was found that 63.6% (n=21) of patients diagnosed with ampullary cancer had a progression with more complications, when compared with pancreatic adenocarcinoma, in the multivariate analysis adjusted for gender and pancreatic consistency. This result is similar to that obtained by Feng and colleagues at the Zhejiang Cancer Hospital in China, where it was observed that patients with a diagnosis of ampullary cancer had a higher percentage of complications, and among these, the most frequent was pancreatic fistula<sup>(20)</sup>. On the other hand, a study by Yifei Yang and colleagues revealed that ampullary carcinoma of Vater significantly increases the risk of clinically relevant postoperative pancreatic fistula after pancreaticoduodenectomy. This research found that ampullary carcinoma of Vater was an independent risk factor for the development of this complication<sup>(21)</sup>. Additionally, another study audited 532 consecutive cases of pancreaticoduodenectomy, identifying postoperative pancreatic fistula as one of the most challenging complications, associated with substantial mortality and morbidity. In this study, factors such as the type of pancreaticojejunostomy, the diameter of the pancreatic duct, and intraoperative blood loss were identified as independent risk factors for the development of postoperative pancreatic fistula<sup>(22)</sup>.

These findings are of great importance. They underscore the need for more detailed preoperative assessment and tailored surgical approach for patients with ampullary carcinoma of Vater, given its implications in increasing morbidity and mortality. Understanding these risk factors and implementing strategies to mitigate them can significantly improve postoperative outcomes and patient quality of life. Moreover, these findings reinforce the need for ongoing research to develop safer and more effective surgical techniques for this specific patient group.

Regarding pancreatic consistency, it was found that patients with a soft pancreas had more complications compared to patients with a firm pancreas.

This observation coincides with the findings of the study conducted by Rungsakulkij and colleagues at Ramathibodi Hospital in Thailand between January 2001 and December 2016. In this study, a soft pancreatic consistency was determined to be the most significant risk factor for the development of pancreatic fistula<sup>(23)</sup>. Similarly, Patel and Yagnik, in their study at Zydus Hospital in India between November 2012 and May 2014, concluded that patients with a soft pancreas had a tenfold higher incidence of pancreatic fistula compared to those with a firm pancreas<sup>(23)</sup>. The link between the soft consistency of the pancreas and increased postoperative complications, particularly pancreatic fistula, is a critical aspect. Postoperative pancreatic fistula is a severe complication with significant morbidity and mortality. Studies have shown that factors such as age, gender, cancer in the head of the pancreas, and the presence of a soft pancreas are associated with an increased risk of developing postoperative pancreatic fistulas<sup>(19)</sup>.

Specifically, it has been observed that the incidence of pancreatic fistulas is higher after distal pancreatectomy, and the severity of these fistulas is greater after pancreaticoduodenectomy. These findings emphasize the importance of a detailed preoperative assessment, including pancreatic consistency, to predict and possibly mitigate the risk of postoperative complications in patients with ampullary cancer or other related oncological pathologies. Understanding these risk factors can help surgeons better prepare for potential complications and optimize postoperative management strategies. Furthermore, these observations can guide future research toward identifying more effective preventive and therapeutic interventions for patients with these characteristics, improving surgical outcomes and patient quality of life.

In our study, it was found that all of those who were reoperated experienced complications, showing a statistically significant relationship. This trend parallels that identified by Targarona and colleagues at the Edgardo Rebagliati Martins National Hospital during the period from October 2002 to December 2006, who

determined that reoperated patients had an 11 times greater risk of presenting complications compared to those who did not require surgical reintervention<sup>(24)</sup>. Additionally, we observed that 86.4% of patients with more than 16 days of hospitalization had complications, which is also statistically significant. This finding is consistent with the results of Sarmiento and colleagues in 2019, who identified soft pancreatic consistency and prolonged hospitalization as the main risk factors for the development of postoperative complications<sup>(25)</sup>.

This study presents some limitations, such as those inherent to its observational and retrospective design, which could lead to the possibility of selection bias and limitation in causal inference. The inclusion of all patients undergoing PD suggests a homogeneous study population. However, this may also limit the generalization of the results to other contexts or populations with different characteristics. On the other hand, the review of clinical records could introduce a potential information bias due to the quality and accuracy of the records. Moreover, reliance on existing documentation may limit the depth and breadth of data available for analysis, such as carcinoembryonic antigen and C-reactive protein; very important markers

for preoperative evaluation of patients with periampullary neoplasms. Despite these limitations, the study provides valuable information on the factors associated with complications in the PD procedure in a quite particular context such as Metropolitan Lima.

## CONCLUSIONS

It is concluded that male gender, the diagnosis of ampullary cancer (as opposed to pancreatic adenocarcinoma), and a soft pancreatic consistency were factors independently associated with postoperative complications in patients who underwent PD in the Pancreas Surgery Service of the Edgardo Rebagliati Martins National Hospital from 2017 to 2019, with pancreatic fistula being the most frequent.

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**Correspondence:** Jorge A. Cornejo Aguilar.

**Address:** Jr. Galicia 369, Lima, Peru.

**E-mail:** [jcornejo\\_17@ieee.org](mailto:jcornejo_17@ieee.org)



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