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Which risk factors are related to failure to rescue in left pancreatectomy? Mixed cohort study (ERPANDIS and SPANDISPAN projects)

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Introduction

The morbidity and mortality rates associated with pancreatic surgery (PS) have improved in recent years. However, despite advancements in surgical techniques and perioperative care, these

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rates remain high.[1-3] Morbidity and mortality can result from specific surgical complications related to PS or from severe medical events.[4,5]

The resolution of severe postoperative complications is a more accurate indicator of high-quality inpatient care than the overall complication rate.[5] In 1992, Silber et al.[6] established a hospital quality metric, failure to rescue (FTR), to assess this aspect. FTR is defined as the number of patients who die after experiencing a major complication (MC) divided by the total number of patients who present with an MC.[1-3,7-10] Key factors influencing FTR include patient characteristics, hospital volume, surgeon experience, and annual surgical caseload.[1,4,8-10]

Research on FTR in pancreatic surgery is limited and often focuses on pancreaticoduodenectomies (PD) or PS without specifying the type of intervention.[1,4,5,10] Only 1 dedicated study on FTR related to left pancreatectomy (LP) utilized an administrative database, reporting an FTR of 11.2% and noting that this rate was lower in high-volume hospitals.[3]

Given the scarcity of available data, we aimed to determine the FTR in 2 Spanish multicenter databases concerning LP: 1 retrospective (ERPANDIS project) and 1 prospective (SPANDISPAN project). Additionally, we sought to explore the preoperative and perioperative factors that correlate with FTR and the impact of hospital volume on these outcomes.

Methods

We included patients from 2 projects focused on short-term postoperative outcomes LP: the ERPANDIS (retrospective) and SPANDISPAN (prospective) studies. Both studies were conducted in accordance with the Declaration of Helsinki (2013). Each participating center appointed a local manager to collect data and liaise with the overall study coordinator. The inclusion criteria for both studies were any scheduled LP performed during the study period for any diagnosis in patients aged over 18 years. Exclusion criteria included patients who had undergone celiac trunk resection, completion of pancreatoduodenectomy, or those requiring urgent pancreatectomy. Suspected preoperative diagnoses were based on CT, MRI, and endoscopic ultrasound (EUS). The surgical approach employed was either open, laparoscopic, or robotic (only in the SPANDISPAN study), with or without spleen preservation.

ERPANDIS project

The ERPANDIS project was a retrospective multicenter observational study utilizing prospectively recorded data regarding LP, conducted across 8 hepatopancreatobiliary (HPB) surgical units from January 1, 2008, to December 31, 2018. Five of these units are high-volume HPB centers (performing more than 10 DPs per year) located in Spain and 1 in Puerto Rico, while the remaining 2 are mid-volume centers in Spain. The study received approval from the institutional Ethics Committee at Hospital Universitario de Guadalajara (CEIm: 2018.17.EO) on November 27, 2018. The need for informed consent from patients was waived since the study was retrospective, observational, and posed no risk.

SPANDISPAN (SPAnish DIStal PANcreatectomy) project

The SPANDISPAN project was a prospective multicenter observational study conducted over 1 year, from February 1, 2022, to February 28, 2023. It involved Spanish HPB surgical units and was communicated to the 70 centers previously participating in the AEC/IHPBA Pancreatic Surgery Survey.[11] HPB units were classified as high-volume if they performed more than 10 DPs per year.[12] The study received approval from the institutional ethics committee at Hospital General Universitario Dr. Balmis in Alicante, Spain (CEIm: April 28, 2021). Patients provided informed consent to participate, and the study is reported in accordance with the STROCSS guidelines.[13]

Variables and definitions in both studies

The primary variables analyzed included demographic data such as age, gender, body mass index (BMI), previous abdominal surgeries, medications, and ASA classification[14]; symptoms, biological, radiological, and surgical details, such as type of approach: open, laparoscopic, robotic; conversion defined as starting as minimally invasive but requiring laparotomy, and spleen preservation if Warshaw or Kimura techniques were employed. Associated organ resection was defined as removing at least 1 additional organ, excluding the spleen. We also recorded intraoperative blood loss and the need for transfusions. Postoperative data included morbidity and mortality complications assessed at 90 days based on the Clavien-Dindo classification, with MC classified as Clavien-Dindo grade III or higher.[15] These were documented using electronic medical records and nursing notes. For complications specific to pancreatic surgery, we employed definitions from the International Study Group on Pancreatic Surgery (ISGPS) for delayed gastric emptying,[16] postpancreatic hemorrhage,[17] and postoperative pancreatic fistula (POPF).[18] Resection margins of the specimens were categorized according to Royal College of Pathologists definitions: R0 (margin to the tumor $\geq$1 mm), R1 (margin to the tumor $<$1 mm), and R2 (macroscopically positive margin).[19] Invasive tumors were staged according to the TNM classification (8th edition).[20] Reoperation was defined as any unscheduled surgical intervention related to pancreatic resection, while hospital stay, and readmissions were measured at 90 days. The histological data recorded included tumor size, R status, and size of the resected pancreas. FTR is defined as the number of patients who die after experiencing an MC divided by the total number of patients who present with an MC.[6]

Statistical analysis

Categorical variables are presented as frequencies or percentages. Descriptive statistics for continuous data that follow a normal distribution are reported as mean $\pm$ standard deviation (SD). In contrast, non-normally distributed continuous data are reported as median (lower quartile, upper quartile). The Shapiro-Wilk test and visual inspection were used to evaluate the normality of the distributions of continuous variables. For comparing categorical variables, the Chi-square test or Fisher's exact test was used as appropriate. Differences between groups for normally and non-normally distributed quantitative data were analyzed using the independent samples t-test or the Mann-Whitney U test. All reported *P*-values are 2-sided, with values less than 0.05 considered statistically significant. All calculations were performed using Microsoft® Excel for Mac (version 16.49) and SPSS® for Mac (version 26.0, SPSS Inc., Chicago, Illinois, USA).

Results

ERPANDIS (Tables 1 and 4): A study was conducted with 450 patients. Among them, 142 patients (31.6%) had no complications, 207 patients (46%) experienced minor complications, and 101 patients (22.4%) faced MC. We compared patients without complications to those with minor and MC. The results showed statistical significance for a minimally invasive approach, no intraoperative blood transfusion, fewer pancreatic-related complications, reduced readmissions, and shorter hospital stays among patients without complications or with minor complications. In the group with MC, 7 patients died (FTR: 6.9%). Significant differences between FTR and non-FTR patients were observed only for age (average 63 years vs 71 years, $P = 0.041$) and the need for intraoperative blood transfusion (12.8% vs 57.1%, $P = 0.011$).

SPANDISPAN (Tables 2 and 5): This study involved 313 patients. Of these, 132 patients (42.2%) had no complications, 114 patients (36.4%) had minor complications, and 67 patients (21.4%) had MC. Like the ERPANDIS study, we compared patients without complications to those with minor and MC. The findings indicated statistical significance for a minimally invasive approach, no

Table 1
ERPANDIS retrospective series data comparing noncomplicated patients, patient with minor and major complications.

ERPANDIS	Total	Non complicated	Minor complications	Major complication	*P*-value
Patients, n (%)	450	142 (31.6)	207 (46)	101 (22.4)	
Age (years), median (IQR)	64 (52-72)	60 (51-70)	65 (53-73)	64 (52-71)	0.168
Gender, n (%)					0.226
Male	217 (48.2)	60 (42.3)	106 (51.2)	51 (50.5)	
Female	233 (51.8)	82 (57.7)	101 (48.8)	50 (49.5)	
ASA, n (%)					0.083
I	30 (7)	16 (12)	11 (5.4)	3 (3.3)	
II	229 (53.5)	75 (56.4)	108 (52.9)	46 (50.5)	
III	163 (38.1)	41 (30.8)	82 (40.2)	40 (44)	
IV	6 (1.4)	1 (0.8)	3 (1.5)	2 (2.2)	
Previous surgical abdominal procedures n (%)	200 (44.5)	65 (45.8)	82 (39.8)	53 (52.5)	0.104
Minimally invasive Approach n (%)	188 (41.8)	39 (27.8)	107 (51.7)	42 (41.6)	< 0.001
Multivisceral resection n (%)	82 (18.2)	29 (20.4)	29 (14)	24 (23.8)	0.082
Intraoperative blood transfusion n (%)	49 (10.9)	7 (4.9)	26 (12.6)	16 (15.8)	0.015
Pancreatic fistula n (%)	94 (20.9)	0	43 (20.8)	51 (50.5)	< 0.001
Delayed gastric emptying n (%)	13 (2.9)	0	8 (3.9)	5 (5)	0.006
Post pancreatectomy hemorrhage n (%)	14 (3.1)	0	4 (1.9)	10 (9.9)	< 0.001
Histology, n (%)					0.137
Neuroendocrine tumor	126 (28)	37 (26.1)	59 (28.5)	30 (29.7)	
Adenocarcinoma	114 (25.3)	36 (25.4)	46 (22.2)	32 (31.7)	
IPMN+MCN	99 (22)	25 (17.6)	52 (25.1)	22 (21.8)	
Others	111 (24.7)	44 (31)	50 (24.2)	17 (16.8)	
Malignant etiologies	114 (25.3)	36 (25.4)	46 (22.2)	32 (31.7)	0.201
Hospital stay (days), median (IQR)	7 (4-10)	6 (5-8)	6 (4-10)	9 (5-21)	< 0.001
R Readmission n (%)	74 (16.4)	8 (5.6)	28 (13.5)	38 (37.6)	< 0.001

IPMN, intraductal papillary mucinous neoplasm; MCN, mucinous cystic neoplasm.

intraoperative blood transfusion, fewer pancreatic-related complications, no readmissions, and shorter hospital stays among noncomplicated or minor-complication patients. There was no difference related to hospital volume. In the MC group, 3 patients died (FTR: 4.5%). Significant differences between FTR and non-FTR patients were observed only for age (average 63 years vs 80 years, $P = 0.021$) and readmission rates (43% vs 0%, $P = 0.042$).

ERPANDIS + SPANDISPAN (Tables 3 and 6): A total of 763 patients were analyzed across both studies. Among them, 274 patients (35.9%) had no complications, 321 patients (42.1%) had minor complications, and 168 patients (22%) had MC. Once again, we compared patients without complications to those with minor and MC. The analysis demonstrated statistical significance for a minimally invasive approach, no intraoperative blood transfusion, fewer pancreatic-related complications, reduced readmissions, and shorter hospital stays among noncomplicated or minor-complication patients. In the group with MC, ten patients died (FTR: 6%). Significant differences between FTR and non-FTR patients included age (average 63 years vs 72 years, $P = 0.003$), the necessity for intraoperative blood transfusion (12.7% vs 40%, $P = 0.038$), and the diagnosis of adenocarcinoma (26% vs 70%, $P = 0.027$).

Discussion

After evaluating the complications, the results from a retrospective series involving 450 laparoscopic pancreatectomies (LP) showed that 101 patients experienced major complications (MC), and 7 of these patients died, resulting in an FTR of 6.9%. In a prospective series of 313 LPs, 66 patients presented with MC, and there were 3 deaths, yielding an FTR of 4.5%. When combining both series, there were ten deaths, leading to an overall FTR of 6%. This figure is lower than the previously published LP-specific FTR of 11.2%.[3] Factors associated with FTR included age

Table 2
SPANDISPAN prospective series data comparing noncomplicated patients, patient with minor and major complications.

SPANDISPAN	Total	Noncomplicated	Minor complications	Major complication	*P*-value
Patients, n (%)	313	132 (42.2)	114 (36.4)	67 (21.4)	
Age (years), median (IQR)	65 (55-74)	66 (53-76)	66 (57-74)	63 (56-71)	0.244
Gender, n (%)	146 (46.6)	57 (43.2)	56(49.1)	33 (49.3)	0.577
Male	167 (53.4)	75 (56.8)	58 (50.9)	34 (51.5)	
Female					
ASA, %	17 (5.4)	8 (6.1)	5 (4.4)	4 (6)	0.974
I	149 (47.6)	65 (49.2)	52 (45.6)	32 (47.8)	
II	141 (45)	57 (43.2)	54 (47.4)	30 (44.8)	
III	6 (1.9)	2 (1.5)	3 (2.6)	1 (1.5)	
IV					
Previous surgical abdominal procedures	138 (44.2)	57 (43.2)	51 (44.7)	31 (46.3)	0.914
Minimally invasive approach	217 (69.3)	94 (71.2)	81 (71.1)	42 (62.7)	0.413
Multivisceral resection	42 (13.4)	16 (12.1)	15 (13)	11 (16.7)	0.669
Intraoperative blood transfusion	20 (6.4)	3 (2.3)	9 (7.9)	8 (11.9)	0.022
Pancreatic fistula	120 (38.3)	2 (1.5)	69 (60.5)	49 (73.1)	< 0.001
Delayed Gastric Emptying	9 (2.9)	0	2 (1.8)	7 (10.4)	< 0.001
Postpancreatectomy hemorrhage	17 (5.4)	0	5 (4.4)	12 (17.9)	< 0.001
Histology, %	98 (31.3)	39 (29.5)	39 (34.2)	20 (29.9)	0.730
Neuroendocrine tumor	84 (26.8)	42 (31.8)	25 (21.9)	17 (25.4)	
Adenocarcinoma	61 (19.5)	25 (18.9)	23 (20.2)	13 (19.4)	
IPMN+MCN	70 (22.4)	26 (19.7)	27 (23.7)	17 (25.4)	
Others					
Malignant etiologies	107 (34.2)	49 (37.1)	36 (31.6)	22 (32.8)	0.636
Hospital stay	7 (5-10)	6 (4-7)	7 (5-13)	9 (7-25)	< 0.001
High-volume centers (≥10 patients)	146 (46,6)	62 (47)	60 (52,6)	24 (35,8)	0.091
Readmission	69 (22)	9 (6.8)	17 (14.9)	43 (64.2)	< 0.001

IPMN, intraductal papillary mucinous neoplasm; MCN, mucinous cystic neoplasm.

(in both retrospective and prospective databases), intraoperative blood transfusion (in the retrospective and combined databases), readmission (in the prospective series), and adenocarcinoma (in both databases).

The FTR provides insights that other assessment tools, such as benchmarking and textbook outcomes, do not specifically evaluate. It measures a center's ability to prevent the death of seriously ill patients, reflecting a multidisciplinary approach (including radiology, anesthesia, and surgery) that is typical of high-volume centers beyond just the technical skills of the surgical staff. Improvements in postoperative outcomes in surgery have been linked to enhancements in FTR rather than a reduction in overall morbidity.[7] Accurate measurement of FTR requires a precise evaluation, definition, and assessment of complications[1,9,21] Brunner et al.[5] developed a questionnaire to investigate in-hospital mortality following pancreatic surgery, which may help identify areas for improvement aimed at reducing FTR.

The multicenter study by Lequeu et al. is the only 1 exclusively focused on FTR in LP. The mortality rate in their series was 3.9%, which is higher than the 1.6% reported in the current series.[3] Lequeu et al.[3] found that mortality decreased in patients who underwent laparoscopic procedures at high-volume centers (3.4% vs 4.4%) and in more recent years, likely due to the regionalization of procedures. They also noted a linear increase in mortality related to age and comorbidities. In their study, the FTR rose among patients with preoperative comorbidities, malignant tumors, and those who underwent open approaches, especially in older patients and those treated at low-volume centers (10.2% vs 12.5%)[3] In our series, the factors associated with FTR included age, blood transfusion, adenocarcinoma, and absence of readmission.

We can outline a theoretical profile of a patient at risk for FTR following LP: an older patient with pancreatic adenocarcinoma undergoing a technically challenging resection that necessitates a transfusion and whose medical condition may delay their discharge from the hospital.

Table 3
SPANDISPAN + ERPANDIS: Combined prospective + retrospective series data comparing noncomplicated patients, patient with minor and major complications.

SPANDISPAN + ERPANDIS	Total	Non complicated	Minor complications	Major complication	*P*-value
Patients, n (%)	763	274 (35.9)	321 (42.1)	168 (22)	
Age (years), median (IQR)	64 (53-72)	63 (52-72)	65 (54-73)	64 (54-71)	0.391
Gender, n (%)	363 (47.6)	117 (42.7)	162 (50.5)	84 (50)	0.130
Male	400 (52.4)	157 (57.3)	159 (49.4)	84 (50)	
Female					
ASA, %	47 (6.3)	24 (9.1)	16 (5)	7 (4.4)	0.281
I	378 (51)	140 (52.8)	160 (50.3)	78 (49.4)	
II	304 (41)	98 (37)	136 (42.8)	70 (44.3)	
III	12 (1.6)	3 (1.1)	6 (1.9)	3 (1.9)	
IV					
Previous surgical abdominal procedures	339 (44.5)	122 (44.5)	133 (41.6)	84 (50)	0.204
Minimally invasive approach	405 (53.1)	133 (48.5)	188 (58.6)	84 (50)	0.033
Multivisceral resection	124 (16.3)	45 (16.4)	44 (13.7)	35 (20.8)	0.127
Intraoperative blood transfusion	69 (9)	10 (3.6)	35 (10.9)	24 (14.3)	< 0.001
Pancreatic fistula	214 (28)	2 (0.7)	112 (34.8)	100 (59.9)	< 0.001
Delayed Gastric Emptying	22 (2.9)	0	10 (3.1)	12 (7.1)	< 0.001
Post pancreatectomy hemorrhage	31 (4.1)	0	9 (2.8)	22 (13.1)	< 0.001
Histology, %	224 (29.4)	76 (27.7)	98 (30.5)	50 (29.8)	0.353
Neuroendocrine tumor	198 (26)	78 (28.5)	71 (22.1)	49 (29.2)	
Adenocarcinoma	160 (21)	50 (18.2)	75 (23.4)	35 (*20.8*)	
IPMN+MCN	181 (23.7)	70 (25.5)	77 (24)	34 (20.2)	
Others					
Malignant etiologies	221 (29)	85 (31)	82 (25.5)	54 (32.1)	0.201
Hospital stay	7 (5-10)	6 (4-7)	7 (5-11)	9 (6-21)	<0.001
Readmission	143 (18.7)	17 (6.2)	45 (14)	81 (48.2)	< 0.001

IPMN, intraductal papillary mucinous neoplasm; MCN, mucinous cystic neoplasm.

Table 4
ERPANDIS: Retrospective series data comparing patients with major complications with and without failure to rescue.

ERPANDIS	Major complications	No FTR	FTR	*P*-value
Patients, n (%)	101 (22.4)	94 (93.1)	7 (6.9)	
Age (years), median (IQR)	64 (52-71)	63 (51-71)	71 (66-74)	0.041
Gender, n (%)	51 (50.5)	48 (51.1)	3 (42.9)	0.715
Male	50 (49.5)	46 (48.9)	4 (57.1)	
Female				
ASA, %	3 (3.3)	3 (3.5)	0	0.686
I	46 (50.5)	44 (51.8)	2 (33.3)	
II	40 (44)	36 (42.4)	4 (66.7)	
III	2 (2.2)	2 (2.4)	0	
IV				
Previous surgical abdominal procedures	53 (52.5)	48 (51.1)	5 (71.4)	0.441
Minimally invasive approach	42 (41.6)	41 (43.6)	1 (14.3)	0.234
Multivisceral resection	24 (23.8)	23 (24.5)	1 (14.3)	0.541
Intraoperative blood transfusion	16 (15.8)	12 (12.8)	4 (57.1)	0.011
Pancreatic fistula	51 (50.5)	48 (51.1)	3 (42.9)	0.715
Delayed gastric emptying	5 (5)	5 (5.3)	0	0.531
Postpancreatectomy hemorrhage	10 (9.9)	9 (9.6)	1 (14.3)	0.529
Histology, %	30 (29.7)	29 (30.9)	1 (14.3)	0.080
Neuroendocrine tumor	32 (31.7)	27 (28.7)	5 (71.4)	
Adenocarcinoma	22 (21.8)	22 (23.4)	0	
IPMN+MCN	17 (16.8)	16 (17)	1 (14.3)	
Others				
Malignant etiologies	32 (31.7)	27 (28.7)	5 (71.4)	0.031
Hospital stay	9 (5-21)	9 (5-21)	15 (4-27)	0.794
Readmission	38 (37.6)	35 (37.2)	3 (42.9)	0.767

IPMN, intraductal papillary mucinous neoplasm; MCN, mucinous cystic neoplasm.

Table 5
SPANDISPAN prospective series data comparing patients with major complications with and without failure to rescue.

SPANDISPAN	Major complications	No FTR	FTR	*P*-value
Patients, n (%)	67 (21.4)	63 (95.5)	3 (4.5)	
Age (years), median (IQR)	63 (56-71)	63 (56-71)	80 (70-80)	0.021
Gender, n (%)	33 (49.3)	30 (46.9)	3 (100)	0.114
Male	34 (51.5)	34 (54)	0	
Female				
ASA, %	4 (6)	4 (6.3)	0	0.824
I	32 (47.8)	31 (48.4)	1 (33.3)	
II	30 (44.8)	28 (43.8)	2 (66.7)	
III	1 (1.5)	1 (1.6)	0	
IV				
Previous surgical abdominal procedures	31 (46.3)	30 (47.6)	1 (33.3)	0.646
Minimally invasive approach	42 (62.7)	41 (64.1)	1 (33.3)	0.551
Multivisceral resection	11 (16.7)	9 (14.1)	2 (66.7)	0.068
Intraoperative blood transfusion	8 (11.9)	8 (12.5)	0	0.514
Pancreatic fistula	49 (73.1)	47 (74.6)	2 (66.7)	0.796
Delayed Gastric Emptying	7 (10.4)	6 (9.4)	1 (33.3)	0.286
Postpancreatectomy hemorrhage	12 (17.9)	12 (17.9)	0	0.408
Histology, %	20 (29.9)	19 (30.2)	1 (33.3)	0.264
Neuroendocrine tumor	17 (25.4)	15 (23.8)	2 (66.7)	
Adenocarcinoma	13 (19.4)	13 (20.6)	0	
IPMN+MCN	17 (25.4)	16 (25.4)	0	
Others				
Malignant Etiologies	22 (32.8)	20 (31.3)	2 (66.7)	0.249
Hospital stay	9 (7-25)	9 (7-25)	27 (19-39)	0.132
High-volume centers (≥10 patients)	24 (35.8)	23 (35.9)	1 (33.3)	0.926
Readmission	43 (64.2)	43 (64.2)	0	0.042

IPMN, intraductal papillary mucinous neoplasm; MCN, mucinous cystic neoplasm.

Table 6
ERPANDIS + SPANDISPAN: Prospective + retrospective series data comparing patients with major complications with and without failure to rescue.

ERPANDIS + SPANDISPAN	Major complications	No FTR	FTR	*P*-value
Patients, n (%)	168 (22)	158 (94)	10 (6)	
Age (years), median (IQR)	64 (54-71)	63 (52-71)	72 (69-79)	0.003
Gender, n (%)	84 (50)	78 (46.4)	6 (60)	0.746
Male	84 (50)	80 (50.6)	4 (40)	
Female				
ASA, %	7 (4.4)	7 (4.7)	0	0.536
I	78 (49.4)	75 (50.3)	3 (33.3)	
II	70 (44.3)	64 (43)	6 (66.7)	
III	3 (1.9)	3 (2)	0	
IV				
Previous surgical abdominal procedures	84 (50)	78 (49.7)	6 (60)	0.514
Minimally invasive Approach	84 (50)	82 (51.9)	2 (20)	0.099
Multivisceral resection	35 (20.8)	32 (20.3)	3 (30)	0.436
Intraoperative blood transfusion	24 (14.3)	20 (12.7)	4 (40)	0.038
Pancreatic fistula	100 (59.9)	95 (60.5)	5 (50)	0.527
Delayed gastric emptying	12 (7.1)	11 (7)	1 (10)	0.534
Postpancreatectomy hemorrhage	22 (13.1)	21 (13.3)	1 (10)	0.765
Histology, %	50 (29.8)	48 (30.4)	2 (20)	0.027
Neuroendocrine tumor	49 (29.2)	42 (26.6)	7 (70)	
Adenocarcinoma	35 (20.8)	35 (22.2)	0	
IPMN + MCN	34 (20.2)	33 (20.9)	1 (10)	
Others				
Malignant etiologies	54 (32.1)	47 (29.7)	7 (70%)	0.013
Hospital stay	9 (6-21)	9 (6-21)	20 (6-27)	0.335
Readmission	81 (48.2)	78 (49.4)	3 (30)	0.332

IPMN, intraductal papillary mucinous neoplasm; MCN, mucinous cystic neoplasm.

Given the limited existing literature on FTR specific to LP, we have chosen to review the current literature on FTR following pancreaticoduodenectomy (PD) and pancreatic surgery (PS).[1,2,7-9,22] The reported FTR rates in PD/PS show significant variability, ranging from 2% to 15%. Our FTR rate falls within this range.[1-3,6-9] Factors associated with an increased FTR in PD/PS include age over 65 years, ASA greater than 3, high BMI, diabetes, COPD, heart failure, hypertension, hypoalbuminemia, organ failure, such as unplanned intubation, renal failure, and septic shock, life-threatening complications, and the need for reinterventions.[1,9]

The causes of FTR in PS can be categorized into 4 main areas: advanced age, frailty, serious postoperative surgical or medical complications, and care in low- and intermediate-volume hospitals.[1,4,6,9,23] While chronological age is significant, we believe that biological age, which reflects the patient's overall health and fragility, should also be considered. Therefore, it is crucial to assess frailty and implement systematic prehabilitation. Additionally, the volume of the hospital matters; not only should the crude complication rates be similar, but the capacity for effective rescue should also be assessed.[4,6,9]

In exploring these factors, Gleeson et al. developed a scoring system to identify patients at high risk of FTR among PD patients. This includes criteria such as hypoalbuminemia less than 3.5 g/dL, age over 65 years, shock, renal failure, and the need for reintubation.[9] Other findings regarding FTR in PS indicate that percutaneous treatment of pancreatic fistulas may be protective against FTR. While admission to the ICU after PD/PS does not seem to improve FTR rates, specialization in PS is associated with better outcomes.[1,2,21] In a nationwide database study, Ghaferi et al. identified several hospital characteristics linked to lower FTR rates after pancreatectomy. These include being a teaching hospital, operating as a high-volume center, maintaining higher nurse-to-patient ratios, and possessing advanced hospital technology.[24]

Johnston et al.[24] highlighted that the initial step in recognizing and managing a deteriorating patient is often an escalation of care. However, barriers to escalating care include the need for established protocols. Thus, implementing appropriate structures and specific care processes, such as institutional safety protocols and enhanced quality measures, could reduce mortality by preventing hospital deaths following complications more effectively.[22,25]

The limitations of this study include its mixed cohort nature, particularly in the retrospective series, which may introduce author bias. Moreover, both studies were conducted over different periods and in different hospitals, which could introduce selection and confounding bias due to the lack of standardized hospital protocols. To minimize these biases, in each study (ERPANDIS and SPANDISPAN), a principal investigator (JMR) established the guidelines and methodology for participant recruitment and the objectives to be achieved. Conversely, the study's strengths are the large number of cases examined, the comparability of results between retrospective and prospective series, and the fact that it is the first investigation conducted in a real-life database rather than an administrative one.

In conclusion, FTR is a valuable tool for enhancing postoperative care by pinpointing areas that require improvement in patients who experience complications after major surgeries. However, its applicability is limited to high-morbidity and high-mortality surgical procedures. Given the low mortality rate associated with LP, it is challenging to identify factors related to FTR specifically. A detailed examination of FTR cases provides more insightful information than aggregated FTR data.

Author contributions

Conception and design: JM Ramia, C Villodre, C Alcazar. Administrative support: M Serradilla, C Alcazar. Provision of study materials or patients: All authors. Collection and assembly of data: C Villodre, M Serradilla, Alcazar C, JM Ramia. Data analysis and interpretation: C Villodre, C Alcazar, JM Ramia. Manuscript writing: JM Ramia. Final approval of manuscript: All authors.

Appendix A

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