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ORIGINAL ARTICLE

Factors associated with recidivism following pancreaticoduodenectomy

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Abstract

Objectives: Factors related to readmission after pancreaticoduodenectomy (PD) may include postoperative morbidity and the functional status of the patient. This study aimed to retrospectively review our institution's experience of readmission of patients who had undergone Whipple procedure PD.

Methods: Recidivism was defined as readmission to the primary or a secondary hospital within, respectively, 30 days, 30–90 days or 90 days postoperatively. Associations between recidivism, perioperative factors and patient characteristics were evaluated.

Results: During the past 5 years, 30-day, 30–90-day and 90-day recidivism rates were 14.5%, 18.5% and 27.4%, respectively. The most common reasons for readmission included dehydration and/or malnutrition (37.5% of readmissions) and pain (12.5%). Patients who underwent PD for chronic pancreatitis were more likely to be readmitted within 90 days of surgery than patients who underwent PD for malignancy ($P < 0.01$). Intraoperative transfusion was also associated with 30–90-day and 90-day recidivism ($P < 0.01$). Preoperative comorbidities, including Charlson Comorbidity Index score, number of pre-discharge complications, type of Whipple reconstruction, preoperative biliary stenting, need for vascular reconstruction and patient body mass index were not associated with recidivism.

Conclusions: Our data confirm previous reports indicating high rates of readmission after PD. To our knowledge, this report is the first to demonstrate chronic pancreatitis as an independent risk factor for readmission.

Keywords

pancreatic neoplasia, outcomes < pancreatic neoplasia, chronic pancreatitis, complications < chronic pancreatitis

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Introduction

Traditionally, pancreaticoduodenectomy (PD) has been the most common operation performed for head-predominant disease secondary to chronic pancreatitis. It is also the most common operation performed for pancreatic cancer. Advances in surgical technique, anaesthesia and perioperative care during the last two decades have significantly improved outcomes in patients undergoing this surgery.[1–3] The recent implementation of clinical pathways for PD and regionalization of care to specialized centres for the treatment of pancreatic cancer have led to decreases in postoperative length of stay (LoS), mortality and the overall cost of care.[1,2,4]

Although critical pathways have been successful in decreasing LoS and hospital costs, as well as improving outcomes after surgery, considerably high morbidity remains associated with PD. Many centres have reported high rates of complications after

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Whipple procedure PD in the range of 30–60%.[3,5] In addition to the high rate of complications, PD is also associated with a significant need for readmission after discharge. Previous studies have reported rates of recidivism after PD in the range of 26–59%.[6,7]

This study attempts to determine recidivism rates subsequent to PD at a high-volume centre, investigate risk factors and outcomes associated with recidivism, and analyse the literature to determine strong predictors for readmission after the Whipple procedure.

Materials and methods

A retrospective review of patients undergoing PD at the University of Cincinnati Medical Center between January 2005 and January 2010 was performed. Institutional review board (IRB) approval was obtained prior to the initiation of this study and patients were identified for inclusion using a University of Cincinnati pancreatic surgery database. Our patient population includes all patients who underwent PD performed by surgeons in the Division of Surgical Oncology. Thus, surgeries performed by other surgeons at our centre were excluded. These represent a small number of cases that were not subject to the same, methodical pre- and perioperative data collection.

Patient charts were reviewed to obtain data on a number of factors, including: patient descriptors; patient past medical history; perioperative factors, such as the placement of a stent; Charlson Comorbidity Index (CCI) score; age-adjusted CCI score; type of PD performed; transfusion requirements, and operative time. Data on hospital LoS, morbidity and mortality were collected for analysis. However, because an intent-to-treat analysis was performed, patients who died were included in the study. Recidivism was classified into three different categories to examine the possibility that certain factors have a distinct effect on the time course of recidivism. These categories were defined as readmission to the primary or a secondary hospital within 30 days, within the 30–90-day period or within 90 days after surgery. Groups are mutually exclusive within individual time periods because a patient who was readmitted multiple times within a time period was considered as one patient; however, if a patient was readmitted more than once in different time periods, each readmission was considered independently.

The CCI has been validated to predict the 1-year and 10-year risk for death from comorbid disease in hospitalized patients. The index takes into account a range of comorbid conditions such as heart disease, AIDS and cancer (a total of 22 conditions), which are assigned risk scores of 1, 2, 3 or 6. The scores are then summed to a total score, which is used to predict mortality.[8]

Our definition of postoperative pancreatic fistula is based on the International Study Group for Pancreatic Fistula (ISGPF) definition.[9] A pancreatic fistula was defined as a drain output of any measurable volume of fluid on or after postoperative day (PoD) 3 with an amylase content greater than three times the serum amylase activity.[9] Delayed gastric emptying was defined by the ISGPF as the inability to return to a standard diet by the end of the first postoperative week and included prolonged nasogastric intubation of the patient.[10]

We followed a standard post-PD pathway for all patients. In general, all patients received routine postoperative jejunostomies. On PoD 3, the patient's caloric goal was determined by a nutritionist and the patient was started on an oral diet as well as tube feeds. If a patient was able to meet his caloric goal through the oral diet, he was weaned off tube feeds. However, if a patient was unable to meet his goal through the oral diet, tube feeds were cycled overnight until the patient achieved his caloric goals.

Pain management was initiated in all patients with an anaesthesia consultation on PoD 0. Pain was managed using an epidural catheter until PoD 5, when patients were started on both long- and short-acting oral narcotics. Most patients with chronic pancreatitis arrived in hospital already on narcotics. These patients were also discharged on a titrated dose of both long- and short-acting oral narcotics, from which they were weaned over several months.

SAS Version 8.1 (SAS Institute, Inc., Cary, NC, USA) was used to perform the statistical analyses. Student's *t*-test analysis was used to determine significant differences among recidivism groups for the following variables: patient age; body mass index (BMI); CCI score; age-adjusted CCI score; length of procedure, and hospital LoS. Chi-squared analyses were performed to determine significant differences among recidivism groups for the remaining variables. A multiple logistic regression was used to further validate variables that were statistically significant in the previous univariate analyses. Results are expressed as mean ± standard error of the mean.

Results

Patient demographics

Between January 2005 and January 2010, 124 patients underwent PD. Their mean age was 61.7 ± 1.3 years, mean BMI was 25.7 ± 0.4 and 52.4% of the group were men. Mean CCI score was 2.0 ± 0.1. When this score was adjusted for age, it became 3.6 ± 0.2. A total of 16.9% of patients underwent PD for chronic pancreatitis and 83.1% underwent PD for malignancy. A comparison of patient demographics and presenting symptoms revealed that the only statistically significant difference between patients who were and were not readmitted was the diagnosis of chronic pancreatitis (Table 1).

Perioperative characteristics

A total of 12.5% of patients with malignancy received preoperative neoadjuvant therapy. The median duration of surgery was 406 min (range: 146–721 min). Median estimated blood loss was 500 ml (range: 100–5000 ml). Mean LoS was 10 days (range: 2–52 days). The minimum hospital LoS of 2 days reflected data for a patient who died 2 days after the procedure. A total of 31 patients required a blood transfusion during the operation (mean trans-

Table 1 Demographic data for the patients in this series (n = 124)

	Readmitted (n = 17)	Not readmitted (n = 107)
Gender, *n* (%)		
Male	8 (47.1%)	58 (54.2%)
Female	9 (52.9%)	49 (45.8%)
Race, *n* (%)		
African American	1 (5.9%)	8 (7.5%)
White	16 (94.1%)	89 (83.2%)
Asian American	0 (0%)	2 (1.9%)
Other	0 (0%)	8 (7.5%)
Smoking status, *n* (%)		
Current	3 (17.6%)	26 (24.3%)
Prior	7 (41.2%)	26 (24.3%)
Never	7 (41.2%)	55 (51.4%)
COPD, *n* (%)	0 (0%)	10 (9.4%)
Diabetes, *n* (%)	4 (23.5%)	27 (25.2%)
Hypertension, *n* (%)	10 (58.8%)	43 (40.2%)
Heart disease, *n* (%)	2 (11.8%)	21 (19.6%)
Steroid use, *n* (%)	0 (0%)	4 (3.7%)
Chronic pancreatitis, *n* (%)	9 (52.9%)[a]	12 (11.2%)
Stent, *n* (%)	6 (35.3%)	45 (42.1%)
Transfusion, *n* (%)	4 (23.5%)	26 (24.3%)
Whipple type, *n* (%)		
Pylorus-preserving PD	0 (0%)	2 (1.9%)
Standard PD	17 (100%)	105 (98.1%)

[a]$P < 0.05$.
COPD, chronic obstructive pulmonary disease; PD, pancreaticoduodenectomy.

fusion: 2.5 units; range: 1–25 units). Seventy-two (58.1%) patients developed at least one complication within 30 days of PD. Common complications included wound infection (19.9%), intra-abdominal abscess (11.8%), delayed gastric emptying (10.3%), pancreatic fistula (9.6%) and urinary tract infection (8.8%).

Recidivism

Patients are described as those who were readmitted to hospital within 30 days, within the 30–90-day period post-surgery, and within 90 days of surgery. Of the 124 patients who underwent PD, eight died or were lost from follow-up within 30 days of surgery and an additional 14 died or were lost from follow-up by 90 days; a total of eight patients died and 14 were lost from follow-up. The 30-day, 30–90-day and 90-day recidivism rates were 14.5%, 18.5% and 27.4%, respectively. Dehydration and/or malnutrition represented a major cause of 30-day (33.3%), 30–90-day (39.1%) and 90-day (37.5%) recidivism. Pain was a causative factor in 16.7% of readmissions within 30 days, 8.7% of readmissions within 30–90 days and 11.8% of readmissions within 90 days. Wound infection was also a significant contributor to readmission, accounting for 11.1% of 30-day readmissions and 8.8% of all readmissions within a 90-day period. Delayed gastric emptying accounted for 8.8% of all readmissions within 90 days. No patients were readmitted for pancreatic fistula.

Factors associated with recidivism

A univariate analysis was undertaken to assess for factors associated with recidivism. No associations were found between patient demographics (gender, age, BMI, CCI score, age-adjusted CCI score) and readmission. There were also no associations between readmission within 90 days and common comorbidities (history of smoking, steroid use, chronic obstructive pulmonary disease, heart disease, hypertension). Differences in perioperative factors [preoperative biliary stenting, operation duration, Whipple type (pylorus-preserving PD vs. standard PD)] were also not associated with rates of readmission (Tables 2 and 3). By univariate analysis, patients who underwent PD for chronic pancreatitis were more likely to be readmitted within 30 days and 90 days of surgery than patients who underwent surgery for malignancy. The need for intraoperative transfusion was also associated with 30–90-day and 90-day recidivism (Tables 2 and 3). Patients who required transfusion had a longer hospital LoS (15.7 ± 1.6 days vs. 12.0 ± 0.7 days; $P = 0.02$) and more complications ($P = 0.04$) than those who did not require intraoperative transfusion. However, there was no significant increase in hospital LoS (15.0 ± 2.2 days vs. 12.7 ± 0.7 days; $P = 0.29$) and postoperative complications ($P = 0.18$) in patients requiring vein resection compared with those who did not. Postoperative LoS was also significantly associated with increased rates of readmission. The analysis showed that patients who were readmitted within 30–90 days of discharge had a significantly increased LoS (17.9 ± 2.2 days vs. 11.8 ± 0.6 days; $P = 0.01$) compared with patients who did not require readmission within 30–90 days (Table 3). All of these factors continued to be associated with recidivism after multivariate analysis (Table 4).

Chronic pancreatitis vs. malignancy

Patients who underwent PD for chronic pancreatitis were younger than those who underwent PD for cancer (51.1 ± 2.5 years vs. 63.9 ± 1.2 years; $P < 0.0001$). The chronic pancreatitis group also demonstrated fewer comorbidities than patients with malignancy, as indicated by CCI scores (0.8 ± 0.2 vs. 2.2 ± 0.1; $P < 0.0001$) and age-adjusted CCI scores (1.4 ± 0.4 vs. 4.0 ± 0.2; $P < 0.0001$). Patients with chronic pancreatitis also had shorter operative time (362 ± 21 min vs. 421 ± 10 min; $P = 0.0156$) and significantly decreased estimated blood loss (391 ± 44 ml vs. 705 ± 78 ml; $P = 0.0006$) (Table 5). Overall, patients with malignancy were most likely to be readmitted for malnutrition or dehydration (50.0%), whereas the most common reason for readmission in patients with chronic pancreatitis was inadequate pain control (35.7%) (Table 6).

Table 2 Univariate analysis of patients subject to recidivism

	30-day recidivism	30–90-day recidivism	90-day recidivism
Gender, *n* (%)			
Male	8/60 (13.3%)	14/53 (26.4%)	18/66 (27.3%)
Female	10/56 (17.9%)	9/49 (18.4%)	16/59 (27.1%)
Race, *n* (%)			
African American	1/8 (12.5%)	2/7 (28.6%)	2/9 (22.2%)
White	17/100 (17.0%)	19/88 (21.6%)	30/106 (28.3%)
Asian American	0/2 (0%)	1/2 (50.0%)	1/2 (50.0%)
Other	0/6 (0%)	1/5 (20.0%)	1/8 (12.5%)
Smoking status, *n* (%)			
Current	3/25 (12%)	5/23 (21.7%)	6/29 (20.7%)
Prior	6/29 (20.7%)	6/26 (23.1%)	9/32 (38.1%)
Never	9/59 (15.3%)	12/53 (22.6%)	19/64 (29.7%)
COPD, *n* (%)	0/9 (0%)	1/7 (14.3%)	1/10 (10.0%)
Diabetes, *n* (%)	4/28 (14.3%)	5/22 (21.6%)	8/31 (25.8%)
Hypertension, *n* (%)	10/48 (20.8%)	12/43 (27.9%)	19/53 (35.9%)
Heart disease, *n* (%)	2/20 (10.0%)	5/18 (27.8%)	6/23 (26.1%)
Steroid use, *n* (%)	0/4 (0%)	2/4 (50.0%)	2/4 (50.0%)
Chronic pancreatitis, *n* (%)	9/21 (42.9%)[a]	5/17 (29.4%)	10/21 (47.6%)[a]
Stent, *n* (%)	7/52 (13.5%)	10/44 (22.7%)	15/56 (26.8%)
Transfusion, *n* (%)	4/24 (16.7%)	13/23 (56.5%)[a]	14/30 (46.7%)[a]
Whipple type, *n* (%)			
Pylorus-preserving PD	0/2 (0%)	0/2 (0%)	0/2 (0%)
Standard PD	18/114 (15.6%)	23/100 (23.0%)	34/122 (27.6%)

[a]$P < 0.05$.
Denominators differ in the three columns because each readmission was treated independently.
COPD, chronic obstructive pulmonary disease; PD, pancreaticoduodenectomy.

Table 3 Univariate analysis of data for patients subject to recidivism. Data are given as mean ± standard error of the mean

	30-day recidivism		30–90-day recidivism		Any recidivism	
	Yes (*n* = 18)	No (*n* = 98)	Yes (*n* = 23)	No (*n* = 79)	Yes (*n* = 34)	No (*n* = 90)
Age, years	61.9 ± 4.0	61.2 ± 1.2	62.1 ± 3.0	60.5 ± 1.4	61.8 ± 2.6	61.7 ± 1.2
BMI, kg/m^2	25.7 ± 1.1	25.6 ± 0.5	25.2 ± 1.0	25.8 ± 0.6	25.8 ± 0.9	25.6 ± 0.5
CCI score	1.6 ± 0.3	2.0 ± 0.1	1.9 ± 0.3	1.8 ± 0.1	1.8 ± 0.2	2.0 ± 0.1
Age-adjusted CCI score	3.1 ± 0.6	3.5 ± 0.2	3.3 ± 0.5	3.3 ± 0.3	3.4 ± 0.4	3.6 ± 0.2
OR time, min	392.0 ± 26.0	414.0 ± 10.3	454.0 ± 25.7	397.0 ± 10.7	433.0 ± 21.4	403.0 ± 9.7
Initial LoS, days	11.0 ± 1.0	13.5 ± 0.8	17.9 ± 2.2	11.8 ± 0.6[a]	15.4 ± 1.7	12.0 ± 0.6

[a]$P = 0.01$.
BMI, body mass index; CCI, Charlson Comorbidity Index; OR, operating room; LoS, length of stay.

Discussion

Pancreaticoduodenectomy is a complicated procedure that has previously been associated with exceptionally high rates of morbidity and mortality. Advances in patient care and the implementation of clinical pathways have decreased the mortality rate associated with PD significantly and high-volume centres now report rates of <5%.[11–13] Although mortality rates have decreased significantly, morbidity remains very high as a result of

Table 4 Multivariate analysis

	30-day recidivism	30–90-day recidivism	Any recidivism
Chronic pancreatitis	$P = 0.0005$	N/A	$P = 0.002$
Length of stay	N/A	$P = 0.02$	N/A
Transfusion	N/A	$P = 0.0006$	$P = 0.001$

N/A, not applicable.

Table 5 Characteristics of patients operated for chronic pancreatitis or malignancy

	Chronic pancreatitis (n = 21)	Malignancy (n = 103)	P-value
Age, years	51.1 ± 2.5	63.9 ± 1.2	<0.0001
Body mass index	26.4 ± 1.4	25.5 ± 0.5	NS
CCI score	0.8 ± 0.2	2.2 ± 0.1	<0.0001
Age-adjusted CCI score	1.4 ± 0.4	4.0 ± 0.2	<0.0001
EBL, ml	391.0 ± 43.5	705.0 ± 77.6	0.0006
OR time, min	362.0 ± 21.0	421.0 ± 10.0	0.0156
Length of stay, days	13.8 ± 2.4	12.7 ± 0.6	NS

CCI, Charlson Comorbidity Index; EBL, estimated blood loss; OR, operating room; NS, not significant.

Table 6 Reasons for recidivism in patients operated for chronic pancreatitis or malignancy

	Chronic pancreatitis (n = 14)	Malignancy (n = 26)
Malnutrition or dehydration	2/14 (14.3%)	13/26 (50.0%)
Pain	5/14 (35.7%)	0/26 (0%)
Wound infection	1/14 (7.1%)	2/26 (7.7%)
Other[a]	6/14 (42.9%)	11/26 (42.3%)

[a]Other reasons for readmission included (chronic pancreatitis, malignancy): intra-abdominal abscess (0%, 7.7%); delayed gastric emptying (14.3%, 0%); small bowel obstruction (0%, 7.7%); gastrointestinal bleed (5.9%, 3.8%), and fever (0%, 7.7%).

postoperative complications such as sepsis, pancreatic fistula and wound infection.[5,14]

In addition to the significant morbidity associated with this procedure, there is also a high rate of readmission following PD. The high rate of recidivism associated with PD is similar to rates associated with other technically complex procedures. Whereas this study found a 30-day readmission rate of 14.5%, research into outcomes in other complicated procedures have identified 30-day recidivism rates of 16.6% after gastrectomy, 16.7% after coronary artery bypass and 18.4% after oesophagectomy.[15] This study aimed to assess the rate of recidivism, as well as factors associated with an increased need for readmission in 124 patients who underwent PD at a single high-volume centre. Even after regionalization and the implementation of centres of excellence, 27.4% of patients who underwent this intricate procedure required readmission within 90 days of discharge from hospital.

A review of the literature shows that many studies have assessed mortality associated with PD. However, only a few have focused on recidivism and only two have specifically addressed factors associated with it (Table 7).[6,7] Emick *et al.* in 2006 focused on the factors associated with recidivism at a single high-volume institution.[7] They found an overall recidivism rate at their institution of 26%. Factors associated with readmission included patient demographics (increased age and male gender), perioperative factors (longer operative time, greater estimated blood loss, intraoperative transfusion, vessel resection) and postoperative complications (pancreatic fistula, wound infection, intra-abdominal abscess, biliary leak, cholangitis, increased hospital LoS) (Table 7).[7]

The other major study to assess factors associated with recidivism following PD was conducted by Yermilov *et al.*[6] They undertook a population-based method of appraisal to account for readmission to the primary institution as well as to secondary hospitals. This study found a recidivism rate of 59%, with 47% of patients readmitted to secondary hospitals. Yermilov *et al.* addressed factors associated with recidivism, as well as the most common reasons for readmission.[6] Patients who were readmitted were more likely to have a high-grade malignancy (stage T4) or a relatively long Los compared with patients who did not require readmission within 1 year of PD (Table 7). The most common reasons for readmission were progression of disease (24.3%), surgery-related complications (14.0%), infections (12.3%) and malnutrition (6.2%).[6]

Finally, a study by van Geenen *et al.* also examined reasons for readmission after PD.[16] It found a recidivism rate of 38.0%, with the most common reasons for readmission consisting of progression of disease (64.0%), including biliary obstruction (14.2%) and pain (19.8%), and surgery-related complications (44.0%), such as abscess (10.4%), fistula (7.5%) and gastrointestinal obstruction (7.5%) (Table 7).[16]

The recidivism rate identified in this study is similar to that reported by Emick *et al.*,[7] but lower than the 59% described by Yermilov *et al.*[6] The obvious explanation for this discrepancy may refer to the inability of studies that focus on a single high-volume institution to account for readmission to secondary institutions. Yermilov *et al.* undertook a population-based study to capture all admissions in primary and secondary hospitals.[6] In our current study, we attempted to capture all secondary hospital admissions by reviewing notes from referring doctors. However, this method probably underestimated the number of secondary hospital readmissions. Therefore, our true recidivism rates may very well be higher than the rates we report here. Another possible explanation for the discrepancy in recidivism rates may refer to the fact that a population-based study incorporates both low- and high-volume institutions. Low-volume institutions are known to have poorer outcomes compared with high-volume centres; thus the inclusion of these centres in the study by Yermilov *et al.*[16] may have contributed to the higher rate of readmission seen in their study.

Unlike Emick *et al.*,[7] we did not find a significant association between recidivism and patient demographics or most postoperative factors such as abscess formation, wound infection and percutaneous stents. In our institution we do not utilize postoperative percutaneous stents and therefore did not experience any stent-related episodes of cholangitis such as those documented in the series reported by Emick *et al.*[7] In addition, the average LoS for patients who experienced complications was 16 days in our institution vs. 7 days for patients in the Hopkins series. Thus, it is

Table 7 Factors associated with recidivism as identified in the literature

Study	Cohort, *n*	Recidivism	Mortality[a]	Race	Age	CCI score	Cancer stage	OR time	EBL	Transfusion	LoS	Postoperative complications[b]
Emick *et al.* (2006)[7]	1643	26%	22%	White $P = 0.01$	$P < 0.001$	–	–	$P < 0.001$	$P = 0.02$	$P = 0.04$	$P = 0.02$	$P = 0.03$
Yermilov *et al.* (2009)[6]	2023	59%	31%	NS	$P < 0.003$	$P < 0.01$	$P < 0.003$	–	–	–	$P < 0.01$	–
Balcom *et al.* (2001)[13]	733	11%	<2%	–	–	–	–	–	–	–	–	–
van Geenan *et al.* (2001)[16]	283	38%	–	–	–	–	–	–	–	–	–	–
Sperti *et al.* (1994)[17]	31	11%	–	–	–	–	–	–	–	–	–	–

[a]Mortality rate at 1 year post-surgery.
[b]Postoperative complications included pancreatic fistula ($P = 0.0003$), wound infection ($P < 0.001$), intra-abdominal abscess ($P < 0.001$), bile leak ($P = 0.04$) and cholangitis ($P = 0.03$).
CCI, Charlson Comorbidity Index; OR, operating room; EBL, estimated blood loss; LoS, length of stay; NS, not significant.

possible that some of our complications were recognized and treated during initial hospitalization, thereby obviating the need for subsequent readmission. The factors that appear to be the most consistent predictors for readmission after PD in all studies include postoperative hospital LoS and need for blood transfusion. These most probably reflect the complexity of the operation and subsequent postoperative care.

Our study did not find any correlation between patient demographics and preoperative factors and need for readmission. As witnessed by their increased rates of complications and longer LoS, patients who required intraoperative blood transfusion had more complicated postoperative stays. These patients were also significantly more likely to require readmission during the 30–90-day period, as well as within 90 days of discharge. However, other factors, such as vessel resection, which is also traditionally associated with more complicated procedures, were not associated with increased complications, longer LoS or increased recidivism. The only postoperative factor associated with increased recidivism was hospital LoS. Furthermore, although LoS was associated with increased complications, as well as an increased rate of recidivism, there was no association between recidivism and postoperative complications. The connection between an increased LoS and recidivism was not related to the increased rate of complications as patients with increased LoS were readmitted for malnutrition and dehydration, rather than factors relating to postoperative complications.

Major indications for PD include chronic pancreatitis and malignancy. Patients who underwent PD for chronic pancreatitis were younger and, as evidenced by their overall lower CCI score, had less comorbidity at the time of operation than patients who underwent PD for pancreatic cancer. These patients also had shorter operations and significantly less blood loss. Yet, this study found that patients who underwent PD for chronic pancreatitis were significantly more likely to require readmission within 30 days and within 90 days of surgery compared with patients who underwent PD for malignancy. To the best of our knowledge, this is the first study to document this correlation.

Not surprisingly, the most common reasons for the readmission of chronic pancreatitis patients were inadequate pain control (35.7%) and malnutrition (14.3%). Most postoperative care pathways do not distinguish between patients with malignancy and those with chronic pancreatitis. In general, patients with chronic pancreatitis have a component of malnutrition and exocrine insufficiency. Most, if not all, of these patients are also narcotic-dependent. It is now our practice to impose a low threshold for starting exocrine supplementation and enteral nutrition, and for involving an anaesthesia pain specialist in the postoperative setting.

Our finding of a higher frequency of readmission among patients with chronic pancreatitis undergoing PD may be best explained by differences in these patients' access to care. Most patients who undergo procedures for chronic pancreatitis have chronic pain and restricted access to care. These patients frequently have trouble maintaining employment, personal relationships and even care with accessible community physicians. As a result, postoperative symptoms are often evaluated only after some delay and a resultant worsening of symptoms, and often in an emergency room (ER) rather than in a clinic run by a primary care doctor or a gastroenterologist. Additionally, higher tolerance to pain medications may make these patients more difficult to palliate in an outpatient or even an ER setting, leading to admissions. By contrast, cancer patients typically require less postoperative pain medication and have a better support system (including family, friends and caregivers), which facilitates a more efficient response to illness. Nonetheless, regardless of PD indication, our data suggest that some patients, including those with chronic pancreatitis, those with longer initial hospital LoS and those

requiring intraoperative transfusions, may benefit from expedited postoperative follow-up care.

This retrospective review of our institution's experience shows an alarmingly high rate of recidivism, despite the many improvements that have been made in the treatment of patients requiring PD. Our study shows that patients with certain risk factors, such as chronic pancreatitis, need for intraoperative transfusion and increased hospital LoS, are more likely to require readmission after discharge from hospital and should be monitored more closely. Pain management and malnutrition were two of the most common indicators for readmission; these should be addressed in every patient before discharge from hospital.

Conflicts of interest

None declared.

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