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Hospital readmission after distal pancreatectomy is predicted by specific intra- and post-operative factors

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ABSTRACT

Background: Distal pancreatectomy (DP) continues to carry a significant risk of morbidity resulting in hospital readmissions and increased costs. Prognostic factors predicting 30-day readmission after DP were evaluated.

Methods: Data were collected from 946 patients undergoing DP at the University of Verona Hospital Trust and the Massachusetts General Hospital between 2004 and 2014. Patients were divided into a derivation and a validation cohort.

Results: The 30-day readmission rate was 13.9%. Predictors of readmission were age over 60 years (OR 1.8), intraoperative transfusions (OR 2.02), CR-POPF (OR 2.4), abdominal abscesses (OR 3.9), and urinary tract infections (OR 5.9). The score generated by the derivation cohort was validated identifying three different categories with a progressively increased risk for readmission.

Conclusion: One out of seven patients undergoing DP will be readmitted within 30 days of discharge. Comorbidities seems not to affect the risk. A 10-point score predicts the risk of 30-days readmission.

1. Introduction

Short-term outcomes after a major pancreatic resection are affected by several peri-operative factors.[1–3] Morbidity and mortality associated with pancreatectomy has continued to decrease over the last decade, due to the evolution of surgical and perioperative care.[4] Distal pancreatectomies (DPs) are performed for lesions arising in the body-tail of the pancreas, originating from the left side of the gastroduodenal artery. Despite DP does not require an extensive reconstruction, as with the Whipple procedure, left-sided pancreatectomy continue to have a morbidity of 35–60% rate.[5,6] The most common complication is post-operative pancreatic fistula (POPF), which occurs in approximately 30% of cases.[7,8] The length of hospital stay (LOS) after DP has been significantly reduced due to the extensive use of minimally invasive approaches and enhanced recovery after surgery protocols[9–11] with clear advantages in terms of hospital costs. However, the cost benefit produced by a shorter LOS is often lost when patients are readmitted within 30 days of the operation.

The first aim of this study is to describe the causes and frequencies of hospital readmissions within 30 days of DP at two high-volume institutions. The second aim is to identify predictors of 30-day hospital readmission to create a clinical risk score which can predict 30-day readmission after DP.

2. Material and methods

A retrospective review of two prospectively collected databases of patients undergoing DP between January 2004 to December 2014 was performed. The internal review board of both institutions, the Department of General and Pancreatic Surgery – The Pancreas Institute, University of Verona Hospital Trust and the Department of General Surgery of the Massachusetts General Hospital (MGH), Harvard Medical School approved this study. Clinicopathological

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Table 1
Univariate Analysis of Factors associated with readmission after distal pancreatectomy.

		All patients (n = 946)	Not readmitted (n = 814)	Readmitted (n = 132)	p
Institution	#1	514 (54.3)	481 (59.1%)	33 (25%)	<.01
	#2	432 (45.7%)	333 (40.9%)	99 (75%)	
Sex	Male	385 (40.7%)	323 (39.7%)	62 (47%)	.06
	Female	561 (59.3%)	491 (60.3%)	70 (53%)	
Age (median, range)		60 (12–93)	59 (12–93)	63 (24–87)	< **.01**
Age >60 years		440 (46.5%)	370 (45.5%)	70 (53%)	**.05**
BMI (median, range, Kg/m^2)		25 (15–49)	25 (15–47)	26.5 (16–49)	< **.01**
BMI	<25 Kg/m^2	502 (55.6%)	446 (57.5%)	56 (43.8%)	< **.01**
	>25 Kg/m^2	401 (44.4%)	32 (42.5%)	73 (52.6%)	
CCI (median, range)		1 (0–7)	1 (0–7)	2 (0–6)	<**.01**
Previous MI		229 (24.2%)	188 (23.1%)	41 (31.1%)	**.03**
COPD		38 (4%)	29 (3.6%)	9 (6.8%)	.07
Liver cirrhosis		18 (1.9%)	12 (1.5%)	6 (4.5%)	**.02**
Diabetes		141 (14.9%)	118 (14.5%)	23 (17.4%)	.22
Chronic kidney failure		9 (1%)	5 (0.6%)	4 (3%)	**.02**
ASA score	1	23 (2.4%)	19 (2.3%)	4 (3%)	.07
	2	774 (81.85)	678 (83.3%)	96 (72.7%)	
	3	141 (14.9%)	109 (13.4%)	32 (24.2%)	
	4	8 (0.8%)	8 (1%)	0	
ASA score $\geq$ 3		149 (15.8%)	117 (14.4%)	32 (24.2%)	< **.01**
Preoperative pancreatitis		106 (11.2%)	91 (11.2%)	14 (11.4%)	.5
Previous abdominal surgery		245 (25.9%)	206 (25.3%)	39 (29.5%)	.1
Extended pancreatectomy (multivisceral resection)		129 (13.6%)	110 (13.5%)	19 (14.4%)	.4
Splenectomy		773 (81.7%)	664 (81.6%)	109 (82.6%)	.4
Minimally invasive		207 (21.9%)	175 (21.5%)	32 (24.2%)	.2
Robotic		11 (1.2%)	10 (1.2%)	1 (0.8%)	.5
Stump closure	Suture	358 (37.8%)	324 (39.8%)	34 (25.8%)	< **.01**
	Stapler	446 (47.1%)	369 (45.3%)	77 (58.3%)	
	other	142 (15%)	121 (14.9%)	21 (15.9%)	
Intraoperative Transfusion		98 (10.4%)	72 (8.8%)	26 (19.7%)	< **.01**
OP time (median, range, min)		200 (54–660)	200 (54–600)	197 (60–660)	.94
Tumor size (median, range, mm)		34 (1–390)	34 (1–390)	34.5 (5–190)	.82
Morbidity (overall)		585 (61.8%)	466 (57.2%)	119 (90.2%)	< **.01**
POPF		360 (38.1%)	270 (33.2%)	90 (68.2%)	< **.01**
	A	157 (16.6%)	143 (17.6%)	14 (10.6%)	< **.01**
	B	189 (20%)	123 (15.1%)	66 (50%)	
	C	14 (1.4%)	4 (0.5%)	10 (7.6%)	
CR-POPF		202 (21.4%)	127 (15.6%)	75 (56.8%)	< **.01**
DGE		8 (0.8%)	8 (1%)	0	.29
Colic fistula		3 (0.3%)	2 (0.2%)	1 (0.8%)	.36
PPH		33 (3.5%)	27 (3.3%)	6 (4.5%)	.3
Wound infection		31 (3.3%)	21 (2.6%)	10 (7.6%)	< **.01**
Sepsis		15 (1.6%)	9 (1.1%)	6 (4.5%)	**.01**
Abscess		136 (14.4%)	74 (9.1%)	62 (47%)	< **.01**
Fluid collection		389 (41.1%)	290 (35.6%)	99 (75%)	< **.01**
Pneumonia		209 (22.1%)	177 (21.7%)	32 (24.2%)	.29
Myocardial infarction		40 (4.2%)	33 (4.1%)	7 (5.3%)	.31
AKI		4 (0.4%)	2 (0.2%)	2 (1.5%)	.09
Urinary tract infection		29 (3.1%)	19 (2.3%)	10 (7.6%)	< **.01**
LOS (median, range, days)		8 (2–376)	8 (2–376)	7 (3–140)	< **.01**
Clavien-Dindo	0	361 (38.2%)	348 (42.8%)	13 (9.8%)	< **.01**
	1	152 (16.1%)	139 (17.1%)	13 (9.8%)	
	2	272 (28.8%)	242 (29.7%)	30 (22.7%)	
	3	119 (12.6%)	53 (6.5%)	66 (50%)	
	4	29 (3.1%)	22 (2.7%)	7 (5.3%)	
	5	13 (1.4%)	10 (1.2%)	3 (2.3%)	
Reoperation		49 (5.2%)	35 (4.3%)	14 (10.6%)	< **.01**
Mortality (in hospital)		13 (1.4%)	10 (1.2%)	3 (2.3%)	**.4**

factors included were: past medical history, peri- and intra-operative factors, such as transfusion requirement, technique for stump closure, operative time, morbidity, mortality and post-operative outcomes like complications, reoperation, readmission, in-hospital death and LOS. Surgical technique as well as the definition of each complication were similar in the two participating institutions. Intra-abdominal fluid collection is defined as the presence of a fluid collection within the abdomen larger that 5 cm in diameter. Abscess is defined as the presence of a fluid collection presenting radiological signs of infection like gas bubbles and determining an increase of white blood cells count or C reactive protein. Surgical drains management as well as post-operative clinical pathways were similar in both institution and consistent with the concomitant evolution of enhancement recovery after surgery protocols.[9,11,12] Complications analyzed for the purpose of this study were all detected before discharge from the hospital during the index admission. After discharge, readmission was defined as a hospital admission within 30 days of the operation. Efforts were made to identify readmissions to outside hospitals other than the participating centers, by reviewing post-operative follow-up notes, clinical records, and patients' phone calls. Pancreas surgery-specific morbidity after the operation was

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