A Novel Risk Scoring System Reliably Predicts Readmission after Pancreatectomy

Vicente Valero III, MD, Joshua C Grimm, MD, Arman Kilic, MD, Russell L Lewis, BS, Jeffrey J Tosoian, MD, MPH, Jin He, MD, James F Griffin, MD, John L Cameron, MD, Matthew J Weiss, MD, Charles M Vollmer Jr, MD, Christopher L Wolfgang, MD, PhD, The Pancreas Readmission Assessment Group Study

BACKGROUND: Postoperative readmissions have been proposed by Medicare as a quality metric and can impact provider reimbursement. Because readmission after pancreatectomy is common, we sought to identify factors associated with readmission to establish a predictive risk scoring system.

STUDY DESIGN: A retrospective analysis of 2,360 pancreatectomies performed at 9 high-volume pancreatic centers between 2005 and 2011 was performed. Forty-five factors strongly associated with readmission were identified. To derive and validate a risk scoring system, the population was randomly divided into 2 cohorts in a 4:1 fashion. A multivariable logistic regression model was constructed and scores were assigned based on the relative odds ratio (OR) of each independent predictor. A composite Readmission after Pancreatectomy (RAP) score was generated and then stratified to create risk groups.

RESULTS: Overall, 464 (19.7%) patients were readmitted within 90 days. Eight pre- and postoperative factors, including earlier MI (OR = 2.03), American Society of Anesthesiologists class ≥3 (OR = 1.34), dementia (OR = 6.22), hemorrhage (OR = 1.81), delayed gastric emptying (OR = 1.78), surgical site infection (OR = 3.31), sepsis (OR = 3.10), and short length of stay (OR = 1.51) were independently predictive of readmission. The 32-point RAP score generated from the derivation cohort was highly predictive of readmission in the validation cohort (area under the receiver operating curve = 0.72). The low-risk (0 to 3), intermediate-risk (4 to 7), and high-risk (>7) groups correlated with 11.7%, 17.5%, and 45.4% observed readmission rates, respectively ($p < 0.001$).

CONCLUSIONS: The RAP score is a novel and clinically useful risk scoring system for readmission after pancreatectomy. Identification of patients with increased risk of readmission using the RAP score will allow efficient resource allocation aimed to attenuate readmission rates. It also has potential to serve as a new metric for comparative research and quality assessment. (J Am Coll Surg 2015; 220:701−713. © 2015 by the American College of Surgeons)

Health care expenditures currently represent nearly one fifth of the gross domestic product of the United States, and this proportion has increased steadily during the last several decades. In an attempt to control expansion of health care costs, the Centers for Medicare and Medicaid Services (CMS) has instituted measures to curb health care spending by eliminating waste. In this regard, the CMS has estimated that preventable readmissions account for nearly $12 billion every year.[1] In 2012, the CMS, under the auspices of the Affordable Care Act's Hospital Readmissions Reduction Program, required reduced payment to hospitals with a high frequency of preventable readmissions.[2] By 2017, readmission rates after orthopaedic and cardiac surgery will be used as a quality metric that guides reimbursement to providers, with underperforming centers receiving up to a 3% payment reduction.[3] Moving forward, readmission will likely function as a quality benchmark for other complex operations, including pancreatectomy. It should be noted

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From the Department of Surgery, The Johns Hopkins University School of Medicine, Baltimore, MD (Valero, Grimm, Kilic, Tosoian, He, Griffin, Cameron, Weiss, Wolfgang) and Department of Surgery, The University of Pennsylvania School of Medicine, Philadelphia, PA (Lewis, Vollmer).

Correspondence address: Christopher L Wolfgang, MD, PhD, Department of Surgery, The Johns Hopkins University School of Medicine, 600 N Wolfe St, 685 Blalock, Baltimore, MD 21287. email: cwolfga2@jhmi.edu

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Abbreviation and Acronyms

ACS = American College of Surgeons
ASA = American Society of Anesthesiologists
CCI = Charlson Comorbidity Index
CMS = Centers for Medicare and Medicaid Services
DGE = delayed gastric emptying
LOS = length of stay
OR = odds ratio
PMI = Postoperative Morbidity Index
RAP = Readmission after Pancreatectomy
SSI = surgical site infection

that, despite the enactment of readmission as a quality indicator after complex operations, the validity of this metric remains debatable.[4]

Recent interest on the subject of readmission after complex surgical procedures has resulted in the establishment of baseline rates of readmission and correlation with outcomes. Patients undergoing thoracic, vascular, or hepatobiliary surgery experience a readmission rate of 11.1%, 11.9%, and 15.8%, respectively.[5] Additionally, complex gastrectomies, pneumonectomies, and mitral valve replacements exhibit even higher readmission frequencies of 16.6%, 18.1%, and 22.2%, respectively.[6] In addition, readmission after major surgical procedures is associated with increased morbidity and mortality.[5,7-12]

During the past several decades, mortality after pancreatic surgery has decreased, largely attributable to technical improvements and a regionalization of care.[13-15] However, postoperative morbidity remains high, leading to a readmissions rate ranging from approximately 20% to as high as 60%.[5,13-17] Although much is currently known about readmission after pancreatectomy, no method to identify the risk of readmission in an individual patient exists. The development of such a risk scoring system would allow for the identification of high-risk patients and facilitate focused preventive measures either before discharge or in the early post-discharge period. Accordingly, the objective of this study was to identify factors predictive of readmission and to develop a risk scoring system, called the Readmission after Pancreatectomy (RAP) score. We demonstrate that the RAP score is a clinically relevant risk scoring system that accurately assigns risk of readmission to an individual patient after a major pancreatic resection.

METHODS

Study population

The study cohort was derived from the Postoperative Morbidity Index (PMI) Study Group dataset.[18] Briefly, this cohort was assembled from 9 high-volume pancreatic centers (49 total surgeons) participating in the American College of Surgeons (ACS) NSQIP. Participating institutions kept retrospective databases that assessed severity-based complications and 90-day readmission status after pancreatectomy.[18] Merging these datasets resulted in the formation of the deidentified Pancreatectomy Readmission Assessment Group Study. Each academic center's IRB approved this study.

Operation, postoperative variables, definitions, and readmission

Patients who had a major pancreatic resection (ie, pancreaticoduodenectomy, distal pancreatectomy, or central pancreatectomy) from 2005 to 2011 were identified and data were abstracted from the ACS NSQIP database at each participating institution. All patients included in the study cohort were taken to the operating theater for resection of a cyst or tumor of the pancreas. Those pancreatectomies performed for trauma or chronic pancreatitis were excluded. Patient selection for resection, operative technique, and postoperative management were not protocolized but, rather, at the discretion of the attending surgeon at each institution. The definitions of pancreas-specific postoperative outcomes were determined before data extraction and graded according to the Modified Accordion Classification System.[19-21] General postoperative complications examined were pneumonia, sepsis, acute renal failure, surgical site infection (SSI), reinsertion of the endotracheal tube, deep venous thrombosis, and urinary tract infection as defined by the ACS NSQIP.[22] Readmission was designated into 30-day and 90-day readmission from the date of the index operation. Those patients who were readmitted more than once during the 90-day period were counted only once for the derivation of the model.

SCORE GENERATION AND DATA ANALYSIS

To generate the readmission score, the study population was randomly divided in a 4:1 fashion to derivation ($n = 1,888$) and validation cohorts ($n = 472$), respectively. The similarity of these cohorts was confirmed by comparing the baseline characteristics, operative variables, and postoperative outcomes. Forty-five clinical variables with plausibility of predicting readmission were identified and analyzed using exploratory univariate logistic regression modeling. Twenty-nine variables that were significantly associated with readmission ($p < 0.20$) at the univariate level were then incorporated in a forward/backward fashion by referencing the Akaike information criterion, likelihood ratio test, the area under the receiver