Tracking Early Readmission After Pancreatectomy to Index and Nonindex Institutions
A More Accurate Assessment of Readmission

Jeffrey J. Tosoian, MD, MPH; Caitlin W. Hicks, MD, MS; John L. Cameron, MD; Vicente Valero III, MD; Frederic E. Eckhauser, MD; Kenzo Hirose, MD; Martin A. Makary, MD, MPH; Timothy M. Pawlik, MD, MPH, PhD; Nita Ahuja, MD; Matthew J. Weiss, MD; Christopher L. Wolfgang, MD, PhD

IMPORTANCE Readmission after pancreatectomy is common, but few data compare patterns of readmission to index and nonindex hospitals.

OBJECTIVES To evaluate the rate of readmission to index and nonindex institutions following pancreatectomy at a tertiary high-volume institution and to identify patient-level factors predictive of those readmissions.

DESIGN, SETTING, AND PARTICIPANTS Retrospective analysis of a prospectively collected institutional database linked to statewide data of patients who underwent pancreatectomy at a tertiary care referral center between January 1, 2005, and December 2, 2010.

EXPOSURE Pancreatectomy.

MAIN OUTCOMES AND MEASURES The primary outcome was unplanned 30-day readmission to index or nonindex hospitals. Risk factors and reasons for readmission were measured and compared by site using univariable and multivariable analyses.

RESULTS Among all 623 patients who underwent pancreatectomy during the study period, 134 (21.5%) were readmitted to our institution (105 [78.4%]) or to an outside institution (29 [21.6%]). Fifty-six patients (41.8%) were readmitted because of a gastrointestinal or nutritional problem related to surgery and 42 patients (31.3%) because of a postoperative infection. On multivariable analysis, factors independently associated with readmission included age 65 years or older (odds ratio [OR], 1.80; 95% CI, 1.19-2.71), preexisting liver disease (OR, 2.28; 95% CI, 1.23-4.24), distal pancreatectomy (OR, 1.77; 95% CI, 1.11-2.84), and postoperative drain placement (OR, 2.81; 95% CI, 1.00-7.14).

CONCLUSIONS AND RELEVANCE In total, 21.5% of patients required early readmission after pancreatectomy. Even in the setting of a tertiary care referral center, 21.6% of these readmissions were to nonindex institutions. Specific patient-level factors were associated with an increased risk of readmission.

Published online December 23, 2014.
Hospital readmission has emerged as a central topic in the setting of health care policy and reform.\(^1,2\) Multiple health care organizations, including the Hospital Quality Alliance, Institute for Healthcare Improvement, and Department of Health and Human Services, consider readmission rates a measure of health care quality.\(^3,4\) and the Centers for Medicare & Medicaid Services has begun reducing reimbursements to hospitals with high readmission rates for some patient conditions.

One major criticism of linking reimbursement to readmission rates is that readmission may not always correlate with quality of care.\(^5,6\) This is particularly true following surgical procedures such as pancreatectomy for which follow-up is inherently complex.\(^9\) Patient-level factors, admission diagnoses, indicated procedures, and disease-specific prognosis likely have a role in determining whether a patient risks early hospital readmission. Furthermore, current methods that aim to adjust for these factors are imprecise and largely unproven.\(^10-15\)

While research aimed at readmission after pancreatectomy has increased dramatically in recent years, previous studies have been limited by an inability to track readmissions to institutions that did not perform the initial procedure (ie, non-index institutions). This flaw may be particularly prevalent in studying complex surgical procedures for which patients are more likely to travel to undergo treatment at a high-volume center. As such, it is likely that readmission rates in patients undergoing pancreatectomy have been consistently underestimated. Lacking an accurate baseline measure of readmissions, the possibility of linking this metric to reimbursement is increasingly problematic.

The objectives of the present study were to evaluate the rate of readmission to index and nonindex institutions following pancreatectomy at a tertiary high-volume institution and to identify patient-level factors predictive of those readmissions. Using a statewide data set in conjunction with an institutional database, we were able to capture readmissions to other institutions in addition to our own.

### Methods

#### Study Design

We analyzed records from the institutional review board-approved Johns Hopkins Pancreatic Resection Database for patients undergoing pancreatic resection at The Johns Hopkins Hospital between January 1, 2005, and December 2, 2010. A waiver of informed consent was obtained in accord with the institutional review board given the use of deidentified data that were collected during routine care. Information provided by the Pancreatic Resection Database was supplemented by data from the Maryland Health Services Cost Review Commission Non-Confidential Inpatient Discharge data set in an effort to account for readmissions to other nonindex Maryland hospitals. Because patients who reside outside of Maryland are more likely to return for readmission out of state, we excluded all non-Maryland residents. Further details on the Pancreatic Resection Database, the Non-Confidential Inpatient Discharge data set, and the methods used to link the 2 data sources, as well as a validation assessment of the technique and rationale for the included study cohort, can be found in the eMethods in the Supplement.

Our primary outcome was early readmission, defined as unplanned admission to an acute care hospital within 30 days of discharge from the index admission. Patients who experienced a 30-day mortality (including death during the index admission) or underwent planned readmission were excluded from the analysis.\(^16-18\) Primary and secondary diagnoses were identified using International Classification of Diseases, Ninth Revision, codes (eTable 1 and eTable 2 in the Supplement). As in previous studies,\(^17,19\) the principal diagnosis code was considered the reason for readmission and was grouped into clinically relevant categories.

#### Statistical Analysis

Descriptive statistics were reported for preoperative, operative, and postoperative factors using threshold values previously described in the literature.\(^20,21\) The associations between patient-level factors and readmission (to the index institution [The Johns Hopkins Hospital] or to a nonindex institution [outside institution]) were compared using \(\chi^2\) test or Fisher exact test, as appropriate. Univariable analysis and multivariable analysis were used to explore the association of specific covariates with readmission. Variables with univariable significance of less than .05 were entered into the multivariable model, along with important clinical variables designated a priori. All statistical tests were 2-sided, and \(P < .05\) was considered statistically significant. Statistical analysis was performed using a software program (Intercooled STATA, version 11.0; StataCorp LP).

### Results

#### Patient Demographics

Among all 623 patients admitted to our institution for pancreatectomy, 13 (2.1%) died within 30 days of the operation (10 during the index hospitalization and 3 after the index discharge), and 15 (2.4%) were readmitted for planned reinterventions. Therefore, the total cohort for the study comprised 595 patients. In total, 134 patients were readmitted to a Maryland hospital within 30 days of discharge, yielding a readmission rate of 21.5%. Patient demographics and preoperative data associated with readmission are summarized in Table 1. Compared with the nonreadmitted cohort, readmitted patients were more frequently 65 years or older (\(P = .006\)) but were otherwise similar in terms of sex, race, and marital status. Among comorbidities, preexisting liver disease (defined by a concurrent diagnosis of viral hepatitis, cirrhosis, necrosis, other chronic liver disease, or liver disorder not otherwise specified) was significantly more common in the readmitted group (\(P = .04\)). A trend toward a higher prevalence of hypertension was observed among the readmitted group but failed to reach statistical significance (\(P = .06\)). The proportions of patients with diabetes mellitus (\(P = .74\)), hyperlipidemia (\(P = .31\)), ischemic heart disease (\(P = .13\)), and obesity (\(P > .99\)) did not differ based on readmission status.
Operative and Perioperative Course

An analysis of operative and perioperative factors based on readmission status is summarized in Table 2. The type of resection and indication for surgery did not differ significantly between readmitted and nonreadmitted patients, and operative characteristics such as operative time (P = .17) and the need for blood transfusion (P = .36) were similar between groups. Patients who experienced a postoperative complication were significantly more likely to be readmitted. Specifically, the incidences of wound complications and intra-abdominal abscess were statistically significant.

Table 1. Patient Demographics and Preoperative Characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total Cohort (N = 595)</th>
<th>Readmitted (n = 134)</th>
<th>Nonreadmitted (n = 461)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age ≥65 y</td>
<td>257 (43.2)</td>
<td>72 (53.7)</td>
<td>185 (40.1)</td>
<td>.006*</td>
</tr>
<tr>
<td>Female sex</td>
<td>303 (50.9)</td>
<td>70 (52.2)</td>
<td>233 (50.5)</td>
<td>.77</td>
</tr>
<tr>
<td>Black race</td>
<td>91 (15.3)</td>
<td>20 (14.9)</td>
<td>71 (15.4)</td>
<td>&gt;.99</td>
</tr>
<tr>
<td>Married</td>
<td>381 (64.0)</td>
<td>91 (67.3)</td>
<td>290 (62.9)</td>
<td>.31</td>
</tr>
<tr>
<td>Comorbidity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>290 (48.7)</td>
<td>75 (56.0)</td>
<td>215 (46.6)</td>
<td>.06</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>157 (26.4)</td>
<td>37 (27.6)</td>
<td>120 (26.0)</td>
<td>.74</td>
</tr>
<tr>
<td>Hyperlipidemia</td>
<td>148 (24.9)</td>
<td>38 (28.4)</td>
<td>110 (23.9)</td>
<td>.31</td>
</tr>
<tr>
<td>Obesity</td>
<td>75 (12.6)</td>
<td>17 (12.7)</td>
<td>58 (12.6)</td>
<td>&gt;.99</td>
</tr>
<tr>
<td>Ischemic heart disease</td>
<td>70 (11.8)</td>
<td>21 (15.7)</td>
<td>49 (10.6)</td>
<td>.13</td>
</tr>
<tr>
<td>Preexisting liver disease</td>
<td>55 (9.2)</td>
<td>19 (14.2)</td>
<td>36 (7.8)</td>
<td>&gt;.99</td>
</tr>
<tr>
<td>Abnormal laboratory value</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Albumin level ≤2.5 g/dL</td>
<td>97 (16.3)</td>
<td>23 (17.2)</td>
<td>74 (16.1)</td>
<td>.79</td>
</tr>
<tr>
<td>Creatinine level ≥1.3 mg/dL</td>
<td>42 (7.1)</td>
<td>11 (8.2)</td>
<td>31 (6.7)</td>
<td>.57</td>
</tr>
</tbody>
</table>

*Statistically significant.

Table 2. Operative and Perioperative Course

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total Cohort (N = 595)</th>
<th>Readmitted (n = 134)</th>
<th>Nonreadmitted (n = 461)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pancreatoduodenectomy</td>
<td>368 (61.8)</td>
<td>80 (59.7)</td>
<td>288 (62.5)</td>
<td>.61</td>
</tr>
<tr>
<td>Distal pancreatectomy</td>
<td>201 (34.1)</td>
<td>50 (37.3)</td>
<td>151 (33.2)</td>
<td>.41</td>
</tr>
<tr>
<td>Total pancreatectomy</td>
<td>24 (4.0)</td>
<td>4 (3.0)</td>
<td>20 (4.3)</td>
<td>.62</td>
</tr>
<tr>
<td>Malignant indication</td>
<td>409 (68.7)</td>
<td>94 (70.1)</td>
<td>315 (68.3)</td>
<td>.75</td>
</tr>
<tr>
<td>Operative time &gt;8 h</td>
<td>80 (13.8)</td>
<td>22 (16.2)</td>
<td>58 (13.4)</td>
<td>.17</td>
</tr>
<tr>
<td>Need for blood transfusion</td>
<td>150 (25.2)</td>
<td>38 (28.2)</td>
<td>112 (24.1)</td>
<td>.36</td>
</tr>
<tr>
<td>Postoperative complication</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any complication</td>
<td>279 (46.9)</td>
<td>75 (56.0)</td>
<td>204 (44.3)</td>
<td>.02*</td>
</tr>
<tr>
<td>Delayed gastric emptying</td>
<td>101 (17.0)</td>
<td>23 (17.2)</td>
<td>78 (16.9)</td>
<td>&gt;.99</td>
</tr>
<tr>
<td>Wound complication</td>
<td>75 (12.6)</td>
<td>24 (17.9)</td>
<td>51 (11.1)</td>
<td>.04*</td>
</tr>
<tr>
<td>Pancreatic fistula</td>
<td>77 (12.9)</td>
<td>15 (11.2)</td>
<td>62 (13.4)</td>
<td>.56</td>
</tr>
<tr>
<td>Intra-abdominal abscess</td>
<td>35 (5.9)</td>
<td>19 (14.2)</td>
<td>16 (3.5)</td>
<td>&lt;.001*</td>
</tr>
<tr>
<td>Anastomotic leak</td>
<td>34 (5.7)</td>
<td>11 (8.2)</td>
<td>23 (5.0)</td>
<td>.20</td>
</tr>
<tr>
<td>Other</td>
<td>68 (11.4)</td>
<td>20 (14.9)</td>
<td>48 (10.4)</td>
<td>.17</td>
</tr>
<tr>
<td>Postoperative intervention</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intravenous antibiotics</td>
<td>101 (17.0)</td>
<td>37 (27.6)</td>
<td>64 (13.9)</td>
<td>&lt;.001*</td>
</tr>
<tr>
<td>Parenteral nutrition</td>
<td>73 (12.3)</td>
<td>23 (17.2)</td>
<td>50 (10.8)</td>
<td>.05</td>
</tr>
<tr>
<td>Endoscopy</td>
<td>49 (8.2)</td>
<td>13 (9.7)</td>
<td>36 (7.8)</td>
<td>.48</td>
</tr>
<tr>
<td>Postoperative drain placement</td>
<td>44 (7.4)</td>
<td>23 (17.2)</td>
<td>21 (4.6)</td>
<td>&lt;.001*</td>
</tr>
<tr>
<td>Reoperation</td>
<td>26 (4.4)</td>
<td>7 (5.2)</td>
<td>19 (4.1)</td>
<td>.63</td>
</tr>
<tr>
<td>Initial hospital length of stay</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>quartile, d</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤6</td>
<td>162 (27.2)</td>
<td>27 (20.1)</td>
<td>135 (29.3)</td>
<td>.04*</td>
</tr>
<tr>
<td>7-8</td>
<td>151 (25.4)</td>
<td>35 (26.1)</td>
<td>116 (25.2)</td>
<td>.82</td>
</tr>
<tr>
<td>9-13</td>
<td>142 (23.9)</td>
<td>32 (23.9)</td>
<td>110 (23.9)</td>
<td>&gt;.99</td>
</tr>
<tr>
<td>≥14</td>
<td>140 (23.5)</td>
<td>40 (29.9)</td>
<td>100 (21.7)</td>
<td>.06</td>
</tr>
</tbody>
</table>

*Statistically significant.

SI conversion factors: To convert albumin level to grams per liter, multiply by 10; to convert creatinine level to micromoles per liter, multiply by 88.4.
scess, as well as the need for treatment with intravenous antibiotics and postoperative drain placement, were greater in the readmitted group ($P \leq .04$). An initial hospital length of stay of 6 days or less was significantly more prevalent among the nonreadmitted group ($P = .04$), while a length of stay of 14 days or longer showed a trend toward occurring more frequently among the readmitted group ($P = .06$).

**Independent Predictors of Readmission**

Multivariable modeling was used to control for potential confounding and identify patient-level factors independently associated with readmission. On multivariable analysis, factors independently associated with readmission included age 65 years or older, preexisting liver disease, distal pancreatectomy, and postoperative drain placement ($P \leq .03$) (Table 3).

**Reason for Readmission by Site**

Of 134 patients readmitted, 105 (78.4%) were readmitted to our institution, and 29 (21.6%) were readmitted to an outside institution (Table 4). Gastrointestinal or nutritional problems (eg, pain, obstruction, and dehydration) and surgical infections were the most common reasons for readmission (41.8% and 31.3%, respectively). Compared with those patients who returned for readmission to another institution, a greater proportion of patients who returned to our institution had a gastrointestinal or nutritional problem ($P = .21$) or a surgical infection ($P = .18$), although these trends did not reach statistical significance. Nine patients (6.7%) were readmitted because of a vascular problem, while genitourinary, pulmonary, and cardiac concerns each accounted for less than 5% of readmissions. Other diagnoses (eg, uncontrolled diabetes mellitus, abnormal hematologic findings, orthopedic conditions, and psychiatric problems) accounted for 12.7% of all readmissions and were more likely to be seen at an outside institution ($P < .001$).

**Discussion**

The use of early readmission as a measure of healthcare quality is controversial, especially for complex diagnoses that may require multiple high-risk interventions. These concerns are particularly relevant when considering pancreatic surgery. Although the mortality associated with pancreatectomy has improved significantly during the past several years,22,23 early readmission after pancreatectomy is a frequent occurrence and imposes a significant burden on the health care system.19,24 In an effort to better understand this phenomenon, research aimed at postpancreatectomy readmission has increased dramatically in recent years.17,25-30 Despite this, sev-

---

**Table 3. Logistic Regression Analysis for Variables Associated With Readmission**

<table>
<thead>
<tr>
<th>Predictive Factor</th>
<th>Univariable</th>
<th></th>
<th></th>
<th>Multivariable</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR (95% CI)</td>
<td>$P$ Value</td>
<td>OR (95% CI)</td>
<td>$P$ Value</td>
<td></td>
</tr>
<tr>
<td>Age $\geq 65$ y</td>
<td>1.73 (1.18-2.55)</td>
<td>.005</td>
<td>1.80 (1.19-2.71)</td>
<td>.005*</td>
<td></td>
</tr>
<tr>
<td>Preexisting liver disease</td>
<td>1.95 (1.07-3.52)</td>
<td>.03</td>
<td>2.28 (1.23-4.24)</td>
<td>.009*</td>
<td></td>
</tr>
<tr>
<td>Procedure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pancreatoduodenectomy</td>
<td>1 [Reference]</td>
<td>NA</td>
<td>1 [Reference]</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Distal pancreatectomy</td>
<td>1.20 (0.80-1.79)</td>
<td>.38</td>
<td>1.77 (1.11-2.84)</td>
<td>.02*</td>
<td></td>
</tr>
<tr>
<td>Total pancreatectomy</td>
<td>0.68 (0.23-2.02)</td>
<td>.49</td>
<td>0.88 (0.28-2.74)</td>
<td>.82</td>
<td></td>
</tr>
<tr>
<td>Wound complication</td>
<td>1.75 (1.03-2.98)</td>
<td>.04</td>
<td>1.59 (0.85-2.97)</td>
<td>.15</td>
<td></td>
</tr>
<tr>
<td>Intra-abdominal abscess</td>
<td>4.60 (2.29-9.21)</td>
<td>&lt;.001</td>
<td>1.74 (0.63-4.78)</td>
<td>.28</td>
<td></td>
</tr>
<tr>
<td>Intravenous antibiotics</td>
<td>2.37 (1.49-3.75)</td>
<td>&lt;.001</td>
<td>1.41 (0.78-2.56)</td>
<td>.21</td>
<td></td>
</tr>
<tr>
<td>Postoperative drain placement</td>
<td>4.34 (2.32-8.13)</td>
<td>&lt;.001</td>
<td>2.81 (1.10-7.14)</td>
<td>.03*</td>
<td></td>
</tr>
<tr>
<td>Initial hospital length of stay quartile, d</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\leq 6$</td>
<td>1 [Reference]</td>
<td>NA</td>
<td>1 [Reference]</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>7-8</td>
<td>1.51 (0.86-2.64)</td>
<td>.15</td>
<td>1.78 (0.99-3.20)</td>
<td>.06</td>
<td></td>
</tr>
<tr>
<td>9-13</td>
<td>1.45 (0.52-2.57)</td>
<td>.20</td>
<td>1.57 (0.74-2.93)</td>
<td>.16</td>
<td></td>
</tr>
<tr>
<td>$\geq 14$</td>
<td>2.00 (1.15-3.47)</td>
<td>.01</td>
<td>1.32 (0.67-2.63)</td>
<td>.42</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: NA, not applicable; OR, odds ratio.

* Statistically significant.

**Table 4. Reason for Readmission by Site**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total (n = 134)</th>
<th>Index Institution (n = 105)</th>
<th>Nonindex Institution (n = 29)</th>
<th>$P$ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastrointestinal or nutritional problem</td>
<td>56 (41.8)</td>
<td>47 (44.8)</td>
<td>9 (31.0)</td>
<td>.21</td>
</tr>
<tr>
<td>Surgical infection</td>
<td>42 (31.3)</td>
<td>36 (34.3)</td>
<td>6 (20.7)</td>
<td>.18</td>
</tr>
<tr>
<td>Vascular problem</td>
<td>9 (6.7)</td>
<td>9 (8.6)</td>
<td>0</td>
<td>.20</td>
</tr>
<tr>
<td>Genitourinary problem</td>
<td>4 (3.0)</td>
<td>3 (2.9)</td>
<td>1 (3.4)</td>
<td>&gt;.99</td>
</tr>
<tr>
<td>Pulmonary problem</td>
<td>3 (2.2)</td>
<td>2 (1.9)</td>
<td>1 (3.4)</td>
<td>.52</td>
</tr>
<tr>
<td>Cardiac problem</td>
<td>3 (2.2)</td>
<td>1 (1.0)</td>
<td>2 (6.9)</td>
<td>.12</td>
</tr>
<tr>
<td>Other</td>
<td>17 (12.7)</td>
<td>7 (6.7)</td>
<td>10 (34.5)</td>
<td>&lt;.001*</td>
</tr>
</tbody>
</table>

* Statistically significant.
eral essential tasks remain incomplete, such as establishing a reasonable baseline rate of expected readmissions or a norm for this metric. Studies of postpancreatectomy readmission have been performed in single-institution settings and in association with larger, population-based databases, with cited rates of readmission ranging from 12% to 59%. Much of this variation can be accounted for by the wide range of follow-up times studied. For example, estimates of 30-day readmission have ranged from 12% to 20%, with surgical complications reported as a frequent reason for readmission. Other studies have measured readmissions occurring months to years after the index admission and in some cases report rates in excess of 30%. Not surprisingly, up to 60% of these late readmissions are secondary to cancer progression and are not related to the index operation.

However, after accounting for the time course, a persistent obstacle to establishing a baseline rate of readmission is the inability to track readmissions to nonindex hospitals. This limitation leads to underestimation of the true readmission rate. Yermilov et al showed that up to 47% of all readmissions occurring within 1 year of pancreatectomy occur at an institution other than where the original surgical procedure was performed. The frequency of returning to a nonindex institution may be lower in the early postoperative phase, but this finding underscores the critical limitation associated with a failure to account for outside readmissions. While Yermilov et al helped characterize readmission patterns, the characteristics surrounding 30-day and 1-year readmissions differ greatly.

In the present study, we analyzed the records of 623 patients who underwent pancreatectomy at our institution in an attempt to identify an overall rate of early readmissions to our institution and to others. We selected 30-day readmissions because we believe this time course is most reflective of postoperative complications and, perhaps more important, because this is the time course outlined in the Patient Protection and Affordable Care Act for which hospitals are held financially accountable for readmissions. Our analysis revealed an overall 30-day readmission rate of 21.5%, which is slightly greater than that in a study not accounting for nonindex institutions and in a study excluding admissions deemed unrelated to the initial procedure, but it is similar to the recently reported readmission rate of 21.3% by Hyder et al. In that study, the authors reported 30-day readmissions following pancreatectoduodenectomy using Medicare data from the Surveillance, Epidemiology, and End Results program database, which is able to capture readmissions to multiple institutions from a large population. The 30-day readmission rate to our (index) institution was 17.6% overall, or 78.4% of all readmissions. These findings are consistent with the 12% to 20% overall index readmission rate previously described in the literature.

One objective in studying readmission after pancreatectomy is to identify risk factors that may predispose a patient to returning after discharge. For example, Hyder et al demonstrated that patient-level factors are the chief predictors of readmission, more so than hospital-level or surgeon-level factors. Specifically, the authors showed that patient comorbidities represent the greatest risk factor for postoperative readmission within 30 days of surgery. However, that study evaluated comorbidities as a single score in a binary fashion, so specific patient-level characteristics were not identified. In our study, we demonstrated that baseline patient-level factors, including age and preexisting liver disease, were predictive of readmission. The independent association between preexisting liver disease and more frequent readmission described herein had not been shown previously, to our knowledge. One explanation for this is that previous studies have not considered liver disease among baseline comorbidities. Given a prevalence of 9.2% among our population and the physiological plausibility that comorbid liver disease would contribute to an increased postoperative morbidity, we thought this was a pertinent consideration. The role of hepatic insufficiency should be studied further in additional populations because the ability to risk stratify will be essential in comparing readmission rates among diverse patient populations.

Patients undergoing distal pancreatectomy in our study also exhibited a higher risk of readmission than patients undergoing pancreatectoduodenectomy. Previous comparisons of these 2 procedures are limited, but our findings are consistent with those by Reddy et al, who found an increased readmission rate among those who underwent distal pancreatectomy. This may be reflective of an increased risk of pancreatic leak after distal pancreatectomy, likely because of a tendency for softer pancreas texture, higher blood loss in the setting of concomitant splenectomy, or other factors. Postoperative morbidity rates following distal pancreatectomy range from 22% to 37% based on available data including a 26% incidence of pancreatic fistula. New trends toward fewer concomitant splenectomies and improved pancreatic stump closure methods may facilitate lower postoperative morbidity rates in the future. Nonetheless, the significant difference in readmission rates between procedures points to the importance of establishing procedure-specific baseline readmission rates, rather than relying on more generalized organ-based or diagnosis-based benchmarks.

While identifying preoperative characteristics predicting readmission has proven to be difficult, certain postoperative factors have been consistently associated with readmission. The length of stay during the index hospitalization has been studied extensively. Fong et al found that an admission of 7 days or longer was associated with an increased risk of readmission, and Reddy et al demonstrated similar findings using a threshold of 10 days. On univariable analysis, we found that the quartile of patients with the shortest length of stay (≤6 days) was less likely to be readmitted, while the quartile with the longest length of stay (≥14 days) showed a trend toward more frequent readmission. However, in the multivariable model accounting for confounding factors, the length of stay was not associated with the readmission rate. Our findings are consistent with those reported by Hyder et al, who demonstrated that the index length of stay was not independently associated with readmission following pancreatectoduodenectomy. The data suggest that the length of hospital stay in and of itself does not contribute to frequent readmission, but rather is associated with other factors such as surgical complications that ultimately lead to more frequent readmissions.
Tracking Early Readmission After Pancreatectomy

Author Contributions: Dr Wolfgang had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Tosoian, Cameron, Eckhauser, Hirose, Makary, Pawlik, Weiss, Wolfgang. Acquisition, analysis, or interpretation of data: Tosoian, Hicks, Valero, Pawlik, Ahuja, Weiss, Wolfgang.

Conclusions

Early readmission after pancreatectomy is a common phenomenon, occurring in one-fifth of patients. Specific patient-level factors may identify patients at an increased risk of early readmission, as well as those at an increased risk of subsequent mortality. We used novel methods to assess readmissions to our institution and to others and validated the 21.3% readmission rate reported by Hyder et al as a realistic baseline when accounting for readmissions to index and nonindex institutions. Pancreatectomy is a complex procedure for which we believe most readmissions are not a reflection of health care quality, but rather the expected variation in a complicated postoperative course. Plans to associate reimbursement schemes with readmission rates will need to consider these factors, particularly in the setting of complex procedures such as pancreatectomy.

Copyright 2015 American Medical Association. All rights reserved.
Tracking Early Readmission After Pancreatectomy


