The Value of Splenic Preservation With Distal Pancreatectomy

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Hypothesis: Splenic-preserving distal pancreatectomy for benign or low-grade malignant disease is associated with decreased perioperative morbidity compared with conventional distal pancreatectomy with splenectomy.

Design: A retrospective review of a prospective database of patients.

Setting: Memorial Sloan-Kettering Cancer Center, New York, NY.

Patients: All patients (N=211) undergoing distal pancreatectomy.

Main Outcome Measures: Perioperative complications, length of postoperative stay, and overall survival times were analyzed.

Results: After excluding patients with adenocarcinoma and those who had other major organ resection, 125 patients underwent distal pancreatectomy for benign or low-grade malignant disease with splenectomy (n=79) or splenic preservation (n=46). Perioperative complications occurred in 39 (49%) of the 79 patients following splenectomy and 18 (39%) of the 46 patients following splenic preservation (P=.21). Perioperative infectious complications and severe complications were significantly higher in the splenectomy group (28% and 11%) compared with the splenic preservation group (9% and 2%) (P=.01 and .05), respectively. Length of hospital stay was 9 days (range, 5-41 days) following splenectomy and 7 days (range, 5-26 days) following splenic preservation (P<.01). No difference in length of surgery, units of blood transfused, or perioperative mortality was noted between groups.

Conclusions: Splenic preservation following distal pancreatectomy for benign or low-grade malignant disease is safe and is associated with a reduction in perioperative infectious complications, severe complications, and length of hospital stay compared with conventional distal pancreatectomy with splenectomy. Therefore, splenic preservation should be considered in this group of patients.

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Distal pancreatectomy is the operation of choice for benign or malignant disease of the body and tail of the pancreas. This procedure has traditionally included splenectomy. Over the past decade the addition of splenectomy to other major upper abdominal organ resection has been associated with increased postoperative morbidity, especially infectious complications, and therefore, whenever possible, splenic preservation is considered the standard of care in patients undergoing gastric or colon resection.1,3

Splenic preservation has been described in conjunction with distal pancreatectomy.4,6 Although proponents of splenic preservation suggest that it confers benefit, little data exist regarding the outcome following splenic-preserving distal pancreatectomy. The few reports in the literature comparing distal pancreatectomy with or without splenectomy include patients who had surgery mainly for trauma or pancreatitis,4,5 or include small numbers of patients.6

Splenectomy in conjunction with distal pancreatectomy is clearly indicated in most patients with adenocarcinoma of the pancreas, as splenic preservation may compromise the oncologic resection. However, for benign and low-grade malignant diseases, the issue of splenic preservation remains controversial. To allow splenic preservation, the splenic artery and vein should be uninvolved by tumor, or in rare cases, adequate blood supply and venous drainage via gastro-splenic vessels should be preserved. Many authors suggest that splenic preservation is more difficult, takes more time, and has increased blood loss from small venous tributaries. Thus, the goal of this study was...
SUBJECTS, MATERIALS, AND METHODS

From a prospective database maintained by the Department of Surgery, Memorial Sloan-Kettering Cancer Center, New York, NY, since 1983, patients undergoing distal pancreatectomy for diseases other than adenocarcinoma of the pancreas were identified. Clinical, operative, and pathologic details were noted for 154 patients. In particular, inpatient and outpatient records were thoroughly reviewed to determine clinical course. Anesthesia records were reviewed to verify operative time and blood loss.

Experienced pancreatic surgeons performed all procedures. Surgical technique was at the discretion of the attending surgeon. In general, in the cases of splenic preservation, the pancreas was dissected off the splenic vessels, commencing at the level of the neck or proximal body and proceeding in a retrograde fashion, with preservation of both the splenic artery and vein. After adequate mobilization, where a plane was developed among the pancreas and the splenic, portal, or superior mesenteric vein, the pancreas was transected either with the stapler, sharply divided, and then oversewn, or stapled and oversewn. When the pancreatic duct was identified following transection, it was ligated separately. The dissection continued toward the splenic hilum, ligating or clipping branches of the splenic artery and vein.

Postoperative complications were dichotomized as either infections or other. Urinary tract infection and intra-abdominal abscess were determined by the results of microbiologic cultures. Patients having pneumonia were classified based on the findings of fever, increased white blood cell count, and an infiltrate on chest radiograph. Wound sepsis was separated into either cellulitis, requiring intravenous or oral antibiotics only, and wound infection, requiring incision and drainage. Pancreatic fistula was defined as a drained fluid with an amylase concentration 3 times that of the serum concentration or a fluid collection requiring drainage by either reoperation or interventional radiology. Postdischarge complications of diabetes mellitus were those that were of new onset since the surgical procedure, and pancreatic insufficiency was defined as patients requiring oral pancreatic enzyme replacement.

Severity of complication was determined by a grading system used at Memorial Sloan-Kettering Cancer Center. This places complications into 5 categories with the more severe complications being grades III through V. The grading system is as follows: I, requiring oral antibiotics or treatment; II, requiring intravenous treatment; III, requiring operative or radiological intervention; IV, resulting in significant chronic disability; and V, death as a result of the complication.

χ² Test and the Fisher exact test were used to compare complications between groups. The Spearman correlation was used to measure the association between continuous data; the Mann-Whitney test was applied to compare continuous data (eg, hospital stay, blood loss, tumor size, and duration of operation) between splenectomy and splenic preservation groups with 2-sided statistical significance defined as P<.05.

RESULTS

Between October 1, 1983, and July 1, 2000, 1259 patients underwent a pancreatic resection at our institution. Of these, 211 underwent distal pancreatectomy, 154 of which were resected for diseases other than adenocarcinoma of the pancreas. In 4 cases complete records were unavailable, and in an additional 25, pancreatic resection was a component of a multiorgan resection. These included adrenalectomy or major liver, gastric, or colon resection. These patients were excluded from the study. Therefore, 125 patients formed the cohort for this study.

Although 13 surgeons performed at least 1 procedure, 6 (including M.F.B. and K.C.C.) performed most of the surgical procedures for these cases (n=112) included in this period. Splenectomy was performed in 79 patients (63%) and splenic preservation in 46 patients (37%). Of all patients, 43 were men and 82 were women, with a median age of 64 years (age range, 22-84 years).

Table 1 details the histopathologic features of all 125 resections. The most common histopathologic conditions were neuroendocrine tumors [n=45] and benign cystic tumors [n=44].

Patients undergoing splenectomy with distal pancreatectomy demonstrated a significantly higher estimated blood loss (600 vs 350 mL) (P<.01). In addition,
length of operation tended to be longer in the splenectomy group, but this did not reach statistical significance (P = .07) (Table 2).

Perioperative complications occurred in 57 patients (46%). These were analyzed as either infectious or noninfectious as shown in Figure 1. An infectious episode occurred in 26 patients (21%). These were infections that necessitated intervention including antibiotic administration, radiological drain placement, or open wound drainage. The incidence of infection was 28% in the splenectomy group compared with 9% in the splenic preservation group, and this was statistically significant (P = .01). The severity of the complication by grade was analyzed. The incidence of grade I or II complications was not different between groups as shown in Figure 2. The incidence of grade III through V complications was 11% in the splenectomy group compared with 2% in those patients having splenic preservation (P = .05). The occurrence of either a postoperative infection or a severe complication (grades III through V) significantly predicted an increased length of hospital stay as given in Table 3 (P<.01 for both). Ten postdischarge complications occurred in 9 patients, and included diabetes mellitus in 6 patients (5%), severe diarrhea in 2 patients (2%), and Clostridium difficile and small-bowel obstruction in 1 patient each (1%); these were not different between groups. There was no difference in postoperative infection rate by surgeon.

The median size of the tumor was significantly larger in those patients undergoing splenectomy (4.9 cm; range, 0.4-18 cm) than those with splenic preservation (2.9 cm; range, 0.3-15 cm) (P<.01). However, tumor size failed to demonstrate any correlation with estimated blood loss (r = 0.19), length of operation (r = 0.02), length of hospital stay (r = 0.05), infection (r = 0.08), or all complications (r = 0.11). The pancreatic remnant was handsewn in 74 patients, stapled in 43 patients, and both handsewn and stapled in 8 patients; this did not correlate with infection or severe complication (P = .7 for both). The individual surgeon did not correlate with complications (P = .40).

Overall mortality was 1.6% (n = 2). One patient died of multisystem failure following intra-abdominal sepsis. The second patient was an unstable, high-risk cardiac patient who had fatal gastrointestinal bleeding. Both mortalities occurred in the splenectomy group. With a median follow-up of 21 months, no patient developed postsplenectomy sepsis. There were no postdischarge mortalities for those patients with benign cysts. In patients with neuroendocrine tumors or other neoplastic conditions, there was no significant difference in overall survival between splenectomy and splenic preservation groups (Figure 3).

Mayo1 first described the technique of distal pancreatic resection in 1913, but it was not until 1943 that Mallet-Guy and Vachon6 outlined the procedure of splenic-preserving distal pancreatectomy. Since then, splenic preservation, although advocated by many surgeons, has not been routinely performed. Warshaw9 described a technique of distal pancreatectomy with splenic preservation in which splenic vessels are ligated at the splenic hilum. Others10-12 have described the technique of preserving both the splenic artery and vein. However, analyses of the usefulness of splenic-preserving distal pancreatectomy has been limited to trauma1 or pancreatitis,7 with little information on its benefit for other benign or low-grade malignant tumors.6

Concern for splenic-preserving distal pancreatectomy for both benign and low-grade malignant tumors stems from the concept that this technique is more time-consuming, with higher intraoperative blood loss, perioperative infection rate, and subsequent increased morbidity.6 Three retrospective reviews have compared outcome following distal pancreatectomy and splenic preservation.14-16 Richardson and Scott-Conner14 reported no differences in complication rates between groups, concluding that splenectomy should not be a routine part of distal pancreatic resection. As described in their article, 21 dis-

### Table 2. Operative Variables*

<table>
<thead>
<tr>
<th>Variables</th>
<th>Splenectomy Group (n = 79)</th>
<th>Splenic Preservation Group (n = 46)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of surgery, h</td>
<td>3.1 (1-7)</td>
<td>2.9 (1-6)</td>
<td>.07</td>
</tr>
<tr>
<td>Estimated blood loss, mL</td>
<td>600 (50-3250)</td>
<td>350 (50-2000)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Packed red cells transfused, U</td>
<td>9 (0-13)</td>
<td>9 (0-8)</td>
<td>.10</td>
</tr>
</tbody>
</table>

*Data are given as median (range).
The study, most had surgery for chronic pancreatitis. This may include pancreatic fistula (REPRINTED) ARCH SURG/ VOL 137, FEB 2002 WWW.ARCHSURG.COM

Figure 2. Incidence of severe complications following distal pancreatectomy. Patients undergoing splenectomy had a higher rate of grades III through V complications compared with those undergoing splenic preservation (11% vs 2%, respectively).

Table 3. Length of Stay and Complications*

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. of Patients</th>
<th>Length of Hospital Stay, d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Splenectomy</td>
<td>79</td>
<td>9</td>
</tr>
<tr>
<td>Splenic preservation</td>
<td>46</td>
<td>7†</td>
</tr>
<tr>
<td>Infectious complication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>99</td>
<td>8</td>
</tr>
<tr>
<td>Yes</td>
<td>26</td>
<td>11†</td>
</tr>
<tr>
<td>Severe complications‡</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade I or II</td>
<td>47</td>
<td>9</td>
</tr>
<tr>
<td>Grades III-V</td>
<td>10</td>
<td>13†</td>
</tr>
</tbody>
</table>

*Data are given as the median number of days.
†P<.01.
‡The Memorial Sloan-Kettering Cancer Center severity of complication grades are defined as follows: I, requiring oral antibiotics or treatment; II, requiring intravenous treatment; III, requiring operative or radiological intervention; IV, resulting in significant chronic disability; and V, death as a result of the complication.

Figure 3. Overall survival for all patients. There is no statistically significant difference between the groups (P=.40).

In this study, we demonstrated an overall complication rate for all patients of 46% with a pancreatic fistula rate of 7.6%, which closely resembles that of other reports.14-16 Our results show that distal pancreatectomy can be safely performed with preservation of the spleen for benign or low-grade malignancy of the distal pancreas. Those patients undergoing splenic preservation had a reduced estimated blood loss, hospital stay, and incidence of perioperative infection requiring intervention. There was no difference between groups for either operative time or need for blood transfusion. In those patients whose spleen was preserved, the operative time was shorter. In patients with malignant tumors, splenic preservation did not affect disease-specific survival.

The addition of splenectomy has consistently been shown to increase infectious complications during resection of other gastrointestinal organs. Brady et al17 found that patients undergoing splenectomy following curative gastrectomy for carcinoma had a significantly higher rate of infectious complications than those having splenic preservation (73% vs 47%). In addition, concurrent splenectomy at the time of colorectal resection has been shown to result in significantly higher infective complications.2,3 Despite these reports, the effect of splenectomy following distal pancreatectomy has not previously been demonstrated.

One could express concern that in our analysis, the explanation for the improved outcome with splenic preservation is due to the increase in tumor size in patients having concomitant splenectomy. While tumor size was significantly increased in this group, tumor size itself did not correlate with hospital stay, blood loss, incidence of infection, or other complications.

While our study was not designed to measure immune competence, it is interesting to note the significant difference in infectious complications during the perioperative period. Previously, incidental splenectomy in nonmalignant conditions has been shown to be associated with an increase in infectious complications.17 This association has been linked to changes in the patient’s immune system, such as a decrease in circulating antibody concentrations and a reduced ability of Kupffer cells to opsonize particulate matter and respond to antigenic challenge following splenectomy.18,19 Whether the alterations in the immune system played a role in the increased rate of infectious complications following conventional splenectomy was not addressed in this article.

We have demonstrated that, in our hands, splenic-preserving distal pancreatectomy is safe and can be performed with decreased perioperative morbidity compared with conventional pancreatectomy with splenectomy. For this reason, splenic preservation is our operation of choice, when feasible, for distal pancreatic disease other than adenocarcinoma.
This investigation was supported by a grant from the Barn-nice and Milton Stern Foundation, New York, NY.

This study was presented as a poster at the annual meeting of the Society for Surgery of the Alimentary Tract, Atlanta, Ga, May 20-23, 2001.

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REFERENCES


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Applicability of Cholesterol-Lowering Primary Prevention Trials to a General Population: The Framingham Heart Study

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Background: Four large trials have shown cholesterol-reduction therapy to be effective for primary prevention of coronary heart disease (CHD).

Methods: To determine the generalizability of these trials to a community-based sample, we compared the total cholesterol and high-density lipoprotein cholesterol (HDL-C) distributions of patients in the 4 trials with those of Framingham Heart Study subjects. Lipid profiles that have not been studied were identified. Twelve-year rates of incident CHD were compared between subjects who met eligibility criteria and those who did not.

Results: The Framingham sample included 2498 men and 2870 women aged 30 to 74 years. Among Framingham men, 23.4% to 42.0% met eligibility criteria for each of the 4 trials based on their lipid levels; 60.2% met eligibility criteria for at least 1 trial. For the 1 trial that included women, 20.2% of Framingham women met eligibility criteria. In general, subjects with desirable total cholesterol levels and lower HDL-C levels and subjects with average total cholesterol levels and average to higher HDL-C levels have not been included in these trials. Among subjects who developed incident CHD during follow-up, 25.1% of men and 66.2% of women would not have been eligible for any trial. Most ineligible subjects who developed CHD had isolated hypertriglyceridemia (>2.25 mmol/L; >200 mg/dL).

Conclusions: In our sample, 40% of men and 80% of women had lipid profiles that have not been studied in large trials to date. We observed a large number of CHD events in ‘ineligible’ subjects in whom hypertriglyceridemia was common. Further studies are needed to define the role of lipid-lowering therapy vs other strategies for primary prevention in the general population.

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