

ORIGINAL ARTICLE

Distal pancreatectomy with celiac axis resection: what are the added risks?

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Abstract

Background: Reported series of a distal pancreatectomy with celiac axis resection (DP-CAR) are either small or not adequately controlled. The aim of this analysis was to report a multicentre series of modified Appleby procedures with a comparison group to determine the relative operative risk.

Methods: Data were gathered through the American College of Surgeons-National Surgical Quality Improvement Program (ACS-NSQIP) Pancreatectomy Demonstration Project. Over 14 months, 822 patients underwent a distal pancreatectomy at 43 institutions. Twenty of these patients (2.4%) also underwent a celiac axis resection. DP-CAR patients were matched by age, gender, BMI, serum albumin, ASA class, gland texture, duct size and pathology to 172 patients undergoing DP alone.

Results: The majority of DP and DP-CAR patients had adenocarcinomas (61% and 60%). The median operative time for a DP alone was shorter than for a DP-CAR (207 versus 276 min, $P < 0.01$). Post-operative acute kidney injury (1% versus 10%, $P < 0.03$) and 30-day mortality were higher after a DP-CAR (1% versus 10%, $P < 0.03$).

Conclusion: A distal pancreatectomy with celiac axis resection is associated with increased operative time, post-operative acute kidney injury and a 10% operative mortality. The decision to offer a modified Appleby procedure for a body of pancreas tumour should be made with full disclosure of the increased risks.

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Introduction

Pancreatic cancer remains the fifth leading cause of cancer death in the United States. A pancreatectomy provides the only chance of long-term survival for patients with pancreatic cancer and has become safer over the past three decades owing to advancements in radiographical imaging, surgical technique and critical care.¹ As experience performing a pancreatectomy has grown, some surgeons have taken a more aggressive operative approach towards locally advanced pancreatic tumours of the body and tail of the pancreas with involvement of the celiac axis.²

In 1953, Lyon Appleby proposed *en bloc* resection of the celiac trunk with a total gastrectomy and a distal pancreatectomy for the treatment of locally advanced gastric cancer.³ A modification of the Appleby procedure has been described for locally advanced adenocarcinoma of the body and tail of the pancreas that invades the celiac axis. This operation consists of a distal pancreatectomy with *en bloc* celiac axis resection (DP-CAR) with preservation of the stomach.^{4,5} Previous reports indicate that outcomes after a DP-CAR are comparable to a distal pancreatectomy (DP) alone but mostly summarize small, single-institution, retrospective experiences without a control cohort.⁵⁻⁸

Using data gathered through the American College of Surgeons-National Surgical Quality Improvement Program (ACS-NSQIP) Pancreatectomy Demonstration Project (PDP), we report a multi-institutional series of modified Appleby procedures

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with a comparison group of distal pancreatectomies to determine the relative risks of each operation.

Patients and methods

Pancreatectomy Demonstration Project

The ACS-NSQIP is a standardized programme that prospectively collects patient characteristics, processes of care and adverse outcomes within 30 days of operation in order to evaluate risk-adjusted hospital performance with regards to surgical care.⁹ Together with ACS-NSQIP, the PDP is a collection of 256 Health Insurance Portability and Accountability Act (HIPAA) compliant variables gathered prospectively on 2805 patients undergoing a pancreatic resection from 43 institutions (median = 63 per institution, range 3–213) from November 2011 through to December 2012 and has been previously described.^{10–14} This study was exempt from review by the Institutional Review Board at Indiana University School of Medicine.

Patient population

The ACS-NSQIP PDP database was queried to identify patients having undergone an elective DP-CAR, also known as a modified Appleby procedure. Patients treated with DP-CAR were matched to patients undergoing a DP without a celiac trunk resection according to age, gender, body mass index (BMI), serum albumin, American Society of Anesthesiologists (ASA) class, pancreatic gland texture, pancreatic duct size, and pathological diagnosis. These parameters were chosen because other analyses of the PDP and ACS-NSQIP databases have demonstrated that they are independent variables that predict adverse outcomes. Data were not available on which patients also had a splenectomy.

Surgical outcomes

Post-operative complications documented as part of ACS-NSQIP and the respective definitions have been published previously.¹⁵ In addition to the standard ACS-NSQIP variables, 24 additional pancreas-specific variables were collected as part of the PDP and include the presence of pre-operative jaundice or a biliary stent, chemotherapy and/or radiation in the 90 days prior to surgery, operative approach, pancreatic duct size, pancreatic gland texture, vascular resection, pancreatic reconstruction, intestinal reconstruction, intra-operative drain placement, drain amylase on post-operative day one, the last day of drain removal, a post-operative pancreatic fistula, delayed gastric emptying, organ-space infection requiring percutaneous drainage and pancreatic pathology.¹⁰ Criteria for diagnosis of a pancreatic fistula included persistent drainage (a drain output of any measurable volume of fluid on or after post-operative day 3) of amylase-rich fluid (an amylase content >3 times the serum amylase activity) AND one of the three following criteria: drain continued longer than 7 days, percutaneous drainage performed, or reoperation performed. Alternatively, if a clinical

diagnosis of a pancreatic fistula determined by the attending surgeon was made and one of the previous three criteria were met, then the patient was diagnosed with a pancreatic fistula. Complications were classified by the Clavien–Divido methodology.¹⁶ Of the variables collected by the PDP, pathological information was recorded, but the completeness of a resection, as measured by R classification, was not collected. Standardization of the R classification for pancreatic cancer remains an important area of current controversy. For the purpose of the present study, margin status was neither standardized across institutions nor was this information collected.

Statistical analysis

Continuous variables were expressed as median with range or mean \pm standard error of mean (SEM) and compared using the Student's *t*-test for 2 \times 2 comparison. Categorical variables were compared using two-tailed Fisher's exact and Wilcoxon's rank sum when appropriate. Statistical significance was set at $P \leq 0.05$.

Results

Patient demographics

Over 14 months, data were collected on 822 patients who underwent a distal pancreatectomy at 43 institutions. Twenty of these patients (2.4%) underwent a DP-CAR. DP-CAR was reported from 16 institutions (37%), with a range of 1–3 patients per institution. While we have not collected the number of pancreatectomies performed annually at each institution by national standards, 37 out of 43 (86%) were considered high-volume centres. Patients within the DP-CAR group were matched for age, gender, BMI, pre-operative serum albumin, ASA class, pancreatic gland texture and duct size as well as pathology to 172 patients undergoing DP without CAR. Comparison of patient demographics of the two cohorts is shown in Table 1. Within the group of patients with adenocarcinoma, 25% of those who underwent a DP-CAR received neoadjuvant therapy (chemotherapy \pm radiotherapy) compared with 8% of patients who underwent DP alone ($P = 0.10$).

Operative factors

Operative details of the two cohorts are shown in Table 2. The operative approach (open versus minimally invasive) was similar in both groups. Two DP-CAR operations were completed laparoscopically (10%). Five patients (25%) who underwent a DP-CAR were started laparoscopically, most likely for staging, but three of these were converted to an open operation. Patient cohorts were similar with respect to both pancreatic gland texture and intra-operative drain placement. A trend was noted towards a decreased number of patients requiring blood transfusions after a DP alone compared with DP-CAR (18% versus 35% $P = 0.08$) (Fig. 1). The median operative time for DP alone was over 60 min less than for a DP-CAR (207 versus 276 min, $P < 0.01$) (Table 2, Fig. 1).

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