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ORIGINAL ARTICLE

Influence of facility type on survival outcomes after pancreatectomy for pancreatic adenocarcinoma

Quyen D. Chu[1,4], Meijiao Zhou[2,5], Prakash Peddi[3,4], Kaelen L. Medeiros[2,5], Gazi B. Zibari[1,6], Hosein Shokouh-Amiri[1,6] & Xiao-Cheng Wu[2,5]

[1]Department of Surgery, [2]Louisiana Tumor Registry & Epidemiology, [3]Department of Medicine, [4]The Feist-Weiller Cancer Center, Louisiana State University Health Sciences Center-Shreveport, Shreveport, LA, USA, [5]School of Public Health, Louisiana State University Health Sciences Center, New Orleans, LA, USA, and [6]John C McDonald Regional Transplant Center, Willis Knighton Health System, Shreveport, LA, USA

Abstract

Introduction: Although a volume-outcome relationship has been well established for pancreatectomy, little is known about differences in mortality by facility type. The objective of this study is to evaluate the impact of facility type on short-term and long-term survival outcomes for patients with pancreatic adenocarcinoma who underwent pancreatectomy and identify determinants of overall survival (OS).

Methods: A cohort of 33,382 patients with Stage I–III pancreatic adenocarcinoma diagnosed between 1998 and 2011 were evaluated from the National Cancer Data Base. Clinicopathological, sociodemographic and treatment variables were compared among three facility types where patients received resection: (i) community cancer program (CCP), (ii) comprehensive community cancer program (CCCP), and (iii) academic research program (ARP). 5-year OS was calculated using the Kaplan–Meier method.

Results: Despite ARP having significantly higher percentage of poorly differentiated tumors, higher T-stage tumors, more positive lymph nodes, and greater circle distance compared to the other facilities, it had the highest 5-yr OS. The 5-yr OS for CCP, CCCP, and ARP was 11.2%, 13.2%, and 16.6%, respectively ($P < 0.0001$) and the median survival time (months) was 12.4, 15.6 and 19.1, respectively.

Conclusion: Patients receiving pancreatic resection at an ARP yielded a higher 5-year OS compared to CCP or CCCP.

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Correspondence

Prakash Peddi, Division of Hematology and Oncology, Louisiana State University Health Sciences Center-Shreveport, Feist-Weiller Cancer Center, Shreveport, LA 71130, USA. E-mail: ppeddi@lsuhsc.edu

Introduction

Adenocarcinoma of the pancreas is a formidable disease. It is the fourth leading cause of cancer-related deaths in the U.S.[1] It is estimated that in 2016, 53,070 new cases of pancreatic cancer will be diagnosed, of which 41,780 deaths will occur in the United States.[1] Surgery remains the only treatment for potential cure and long-term survival depends on several factors.

Multiple studies have demonstrated that patients who underwent complex operations such as pancreatectomy at high-volume centers experience lower mortality.[2–4] The lower mortality at these high-volume centers may be related to their ability to better rescue patients.[5–7] Despite this knowledge, no studies have evaluated how the volume-outcome relationship is affected by facility type. In other words, are there specific components of care, besides volume, within a specific facility that contribute toward better outcomes than other facilities? In addition, are there differences in referral patterns, socioeconomic factors, or access to care that might give specific centers an advantage over another center? Finally, do particular facilities have better quality of care (i.e. less likely to have positive surgical margins following a pancreatectomy) than others that translates to improved outcomes? Of note, although data on the volume-outcome relationship exist, most if not all are based on short-term perioperative mortality (i.e. 30-days or 90-days mortality) rather than on long-term outcomes such as overall survival (OS). The objective of this study is to evaluate the impact of facility type on short-term and long-term survival outcomes for patients with pancreatic adenocarcinoma who underwent pancreatectomy and evaluate the impact of volume on long-term surgical outcomes.

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Methods

Data source

The nationally recognized National Cancer Data Base (NCDB) is a joint project of the Commission on Cancer (CoC) of the American College of Surgeons and the American Cancer Society. More than 1500 CoC-accredited facilities contribute clinical information to the database. Approximately 70% of newly diagnosed cancer cases in the U.S and 30 million historical records are captured in the database. The data sets in the PUF were de-identified and were in compliant with the privacy requirements of the Health Insurance Portability and Accountability Act (HIPAA). The study was exempted from Institutional Review Board (IRB) approval by the Louisiana State University Health Sciences Center-Shreveport.

Study population

A cohort of 33,382 cases of patients with stage I–III pancreatic adenocarcinoma (ICD-0-3; C25.0-C25.9) who were diagnosed in 1998–2011 and received surgery (the site-specific codes ranged from 25 to 90 in the SEER 2003 and Site-Specific Surgery of Primary Site Codes), with known vital status in the NCDB was analyzed to determine significant factors associated with overall survival (OS). Patients were staged based on the 7th edition of the AJCC/TNM staging system.[8] According to the NCDB's PUF dictionary, facility type was classified as (i) community cancer program (CCP), (ii) comprehensive community cancer program (CCCP), (iii) academic research program (ARP), and (iv) others.[9] Community cancer programs are those that treat between 100 and 500 newly diagnosed cancer patients each year, and patients may be referred to another facility for part of their diagnosis or treatment.[9] Comprehensive community cancer programs are those that treat more than 500 newly diagnosed cancer patients each year.[9] Academic and research institutions are those that treat more than 500 newly diagnosed cancer patients each year while offering postgraduate medical education programs.[9] The treating facility was the hospital where the patients received their pancreatic cancer surgery.

Facility location was categorized into regions within the United States based on the U. S. Census Regions and Divisions: (i) New England, (ii) Mid-Atlantic, (iii) South Atlantic, (iv) East North Central, (v) East South Central, (vi) West North Central, (vii) West South Central, (viii) Mountain, and (ix) Pacific.

Race/ethnicity was categorized as White, Black, American Indian/Aleutian or Eskimo, Asian or Pacific Islander, and Others. Insurance status was classified as (i) uninsured, (ii) private insurance/managed care, (iii) Medicaid, (iv) Medicare, and (v) other governmental insurance. Patients with both private insurance and Medicare were grouped in the private insurance category. Median household income level was classified as (i) <$38,000, (ii) $38,000–$47,999, (iii) $48,000–$62,999, and (iv) ≥$63,000. Education level was classified into percentage of adults (age ≥ 25 years) who did not graduate from high school in the area based on the 2012 American Community Survey data: (i) ≥21%, (ii) 13–20.9%, (iii) 7–12.9%, and (iv) <7%. Charlson/Deyo comorbidity score has been recorded since 2003 and was reported as 0, 1 or 2.[10,11]

Population density was classified as (i) metropolitan with ≥1 million, (ii) metropolitan with 250,000 to 1 million, (iii) metropolitan with <250,000, (iv) urban with ≥20,000 and adjacent to a metropolitan area, (v) urban with ≥20,000 but not adjacent to a metropolitan area, (vi) urban with <20,000 and adjacent to a metropolitan area, (vii) urban with <20,000 but not adjacent to a metropolitan area, (viii) rural with <2500 and adjacent to a metropolitan area, and (ix) rural with <2500 but not adjacent to a metropolitan area. Great circle distance is measured in miles and defined as being between the patient's residence at diagnosis and the hospital that reported the case.

Annual Hospital volume (AHV) was defined as the average number of pancreatic surgeries per year, which was based on the cases each hospital reported to the NCDB. The mean AHV of pancreatectomies was calculated for currently accredited CoC hospitals during the study period (1998–2011), and grouped as 4 categories: <5 patients, 5–<10 patients, 10–<20 patients and ≥20 patients.

Statistical analysis

The nonparsimonious approach using variables such as age, race/ethnicity, etc. was used to construct models. Descriptive statistics for the different variable were reported. Univariable analysis of each variable was performed using chi-square test for categorical data and ANOVA for numerical data. The Kaplan–Meier method was used for survival analysis. Univariable Cox proportional hazard regression was used to identify factors significantly associated with the risk of deaths for all causes. Factors that were statistically significant in univariable analysis were included in the multivariable model. The multivariable Cox proportional hazards regression analysis was used to determine independent significant factors associated with the risk of death for all causes, and the hazard ratios (HR) and confidence intervals (CI) were calculated. A p-value ≤0.05 was considered statistically significant. Multicollinearity was detected using Variance Inflation Factors (VIF). VIF greater than 4 indicates multicollinearity. All statistical analyses were performed using SAS Version 9.4 statistical software, (SAS Institute Inc., Cary, NC, U.S.A., 2013).

Results

The median follow-up was 16.3 months. Summary statistics on patient characteristics and treatment outcomes are shown in Table 1. The median age of the entire cohort was 67 years (range, 18–90). The proportion of males and females was similar. Most patients were White (86%) and managed in an academic research program (60%). South Atlantic region had the highest percentage of patients (21.9%) while the New England region had the

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