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Outcomes for Patients With Locally Advanced Pancreatic Adenocarcinoma Treated With Stereotactic Body Radiation Therapy Versus Conventionally Fractionated Radiation

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Abstract

BACKGROUND—As systemic therapy has improved for locally advanced pancreatic cancer (LAPC), efforts to improve local control with optimal radiotherapy may be critical. Although conventionally fractionated radiation therapy (CFRT) has more recently shown a limited role in LAPC, stereotactic body radiation therapy (SBRT) is an emerging approach with promising results. With no studies to date comparing SBRT with CFRT for LAPC, this study used the National Cancer Data Base (NCDB) to evaluate these 2 modalities.

METHODS—With the NCDB, patients with American Joint Committee on Cancer cT2-4/N0-1/M0 adenocarcinoma of the pancreas diagnosed from 2004 to 2013 were analyzed. Radiation therapy delivered at 2 Gy was deemed CFRT, and radiation therapy delivered at 4 Gy per fraction was considered SBRT. Kaplan-Meier analysis, log-rank testing, and multivariate Cox

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CONFLICT OF INTEREST DISCLOSURES

The authors made no disclosures.

AUTHOR CONTRIBUTIONS

Jim Zhong: Planning and performance of the study, reporting, overall guarantor, contributions to the manuscript, reading of the manuscript, and agreement with the contents of the manuscript. **Kirtesh Patel:** Reporting, contributions to the manuscript, reading of the manuscript, and agreement with the contents of the manuscript. **Jeffrey Switchenko:** Reporting, contributions to the manuscript, reading of the manuscript, and agreement with the contents of the manuscript. **Richard J. Cassidy:** Reporting, contributions to the manuscript, reading of the manuscript, and agreement with the contents of the manuscript. **William A. Hall:** Reporting, contributions to the manuscript, reading of the manuscript, and agreement with the contents of the manuscript. **Theresa Gillespie:** Reporting, contributions to the manuscript, reading of the manuscript, and agreement with the contents of the manuscript. **Pretesh R. Patel:** Reporting, contributions to the manuscript, reading of the manuscript, and agreement with the contents of the manuscript. **David Kooby:** Reporting, contributions to the manuscript, reading of the manuscript, and agreement with the contents of the manuscript. **Jerome Landry:** Planning and performance of the study, reporting, overall guarantor, contributions to the manuscript, reading of the manuscript, and agreement with the contents of the manuscript.

proportional hazards regression were performed with overall survival (OS) as the primary outcome. Propensity score matching was used.

RESULTS—Among 8450 patients, 7819 (92.5%) were treated with CFRT, and 631 (7.5%) underwent SBRT. Receipt of SBRT was associated with superior OS in the multivariate analysis (hazard ratio, 0.84; 95% confidence interval, 0.75–0.93; $P < .001$). With propensity score matching, 988 patients in all were matched, with 494 patients in each cohort. Within the propensity-matched cohorts, the median OS (13.9 vs 11.6 months) and the 2-year OS rate (21.7% vs 16.5%) were significantly higher with SBRT versus CFRT ($P = .0014$).

CONCLUSIONS—In this retrospective review using a large national database, SBRT was associated with superior OS in comparison with CFRT for LAPC, and these findings remained significant in a propensity-matched analysis. Further prospective studies investigating these hypothesis-generating results are warranted.

Keywords

intensity modulated radiation therapy (IMRT); pancreatic cancer; radiation therapy (RT); stereotactic body radiation therapy (SBRT)

INTRODUCTION

Pancreatic adenocarcinoma is an aggressive malignancy: it is the fourth leading cause of cancer deaths in the United States with a 5-year overall survival (OS) rate less than 8%.¹ Although complete surgical resection has historically been the only curative treatment option, only 10% to 12% of patients have potentially resectable disease, with only a portion of these patients achieving a margin-negative (R0) resection.^{2–4} For patients with nonmetastatic, unresectable disease, the median survival is approximately 12 to 15 months.⁵ The optimal treatment for these locally advanced, unresectable tumors remains unknown and represents a significant clinical challenge.

Previous landmark studies by the Gastrointestinal Tumor Study Group have established the role of multimodality therapy with radiation therapy and chemotherapy for locally advanced tumors.^{6,7} However, recent studies, including the LAP-07 trial, have challenged the role of radiation therapy in the treatment of these tumors because of a lack of improvement in OS.^{8–10} These previous radiation trials used conventionally fractionated radiation therapy (CFRT) and delivered small fractions of radiation at 1.8 to 2.0 Gy daily over 5 to 6 weeks.^{6,7,11}

Modern systemic therapy regimens have significantly improved control of micrometastatic disease in locally advanced pancreatic cancer (LAPC).^{12,13} As such, strategies to optimize local control may play an increasing role in maximizing therapy. Stereotactic body radiation therapy (SBRT) uses recent advances in diagnostic imaging and radiation delivery techniques to allow the delivery of higher biological radiation doses for LAPC.^{14,15} SBRT offers the advantage of delivering radiation therapy over 1 to 2 weeks and thereby minimizing delays in full-dose chemotherapy delivery. SBRT also delivers smaller volumes of radiation with sharper dose gradients, and this potentially results in less irradiated normal

tissue. Our institution and others have reported single-arm, prospective studies showing promising early disease-related outcomes with tolerable toxicities with SBRT.^{16–20}

Despite these favorable findings with SBRT, there have been no studies comparing the outcomes with CFRT and SBRT for patients with locally advanced pancreatic adenocarcinoma, and SBRT has not been adopted as a standard treatment for pancreatic cancer. In this study, we used a large hospital-based registry, the National Cancer Data Base (NCDB), to investigate and compare clinical outcomes with CFRT and SBRT for patients with locally advanced, nonmetastatic pancreatic ductal adenocarcinoma. We also examined the utilization patterns of CFRT and SBRT in the United States for patients with locally advanced adenocarcinoma of the pancreas.

MATERIALS AND METHODS

Patient Cohorts

The NCDB registry for cases diagnosed between 2004 and 2012 was used to identify study subjects. The NCDB is a joint program of the Commission on Cancer of the American College of Surgeons and the American Cancer Society and captures 70% or more of newly diagnosed malignancies in the United States annually.^{21,22} The database contains parameters not included in other large national registries, including detailed radiotherapy information regarding the treatment area, radiation dose (grays), and number of radiation fractions. No patient or physician identifiers are collected. Consequently, this study was granted exempt status by the Emory institutional review board.

Patients whose first and only cancer diagnosis was pancreatic adenocarcinoma (diagnosed from 2004 to 2012) and who received radiation designated for the abdomen or pancreas were analyzed. Only tumors in the pancreatic head and/or body were included; tumors in the tail of the pancreas were excluded because these are typically treated with distal pancreatectomy and may have dissimilar outcomes.²³ Only patients diagnosed with histologically confirmed adenocarcinoma of the pancreas at American Joint Committee on Cancer (AJCC) clinical tumor stage 2 to 4 and nodal stage 0 to I were included. Exclusion criteria included a diagnosis of metastatic disease, receipt of radiation therapy after surgery, and brachytherapy.

Patients were grouped into the CFRT and SBRT cohorts on the basis of the prescribed dose per fraction, which was calculated as the total prescribed dose divided by the total prescribed number of fractions. Patients documented to receive radiation at a dose of 2 Gy per fraction were included in the CFRT cohort; patients receiving 4 Gy per fraction were included in the SBRT cohort. The NCDB does not specify whether the prescribed dose is to an isocenter or planning tumor volume. The fraction size of 4 Gy or more was chosen to account for possible institutional variations in SBRT practices.^{16–20} Patient demographics, tumor characteristics, and treatment details were also ascertained from the NCDB and included the following: age of diagnosis, sex, AJCC clinical TNM staging, tumor size (largest axial dimension), Charlson-Deyo comorbidity score, chemotherapy use, surgical procedure and margin status for patients after radical resection, and year of diagnosis. Unfortunately, the majority of the patients had missing carbohydrate antigen 19-9 values, so this laboratory

value was not included in the analysis. Patients who underwent partial pancreatectomy and duodenectomy with partial gastrectomy were categorized as receiving the Whipple procedure. Those who underwent oncologic variations of the Whipple procedure, including partial pancreatectomy and duodenectomy with or without partial gastrectomy, total pancreatectomy, or total pancreatectomy and subtotal gastrectomy or duodenectomy were categorized as receiving Whipple-variant procedures.

Statistical Analyses

Descriptive statistics were compiled to summarize the patient, disease, and treatment characteristics. Associations of patient and other cancer-related variables were tested with Pearson's chi-square test and an analysis of variance for categorical and numerical variables, respectively. OS was calculated from the date of disease diagnosis to the patient's death or last follow-up. Univariate associations of patient or disease characteristics with OS were assessed with the log-rank test. Univariate and multivariate Cox proportional hazards regression models were fit for OS. The collinearity among the all baseline patient and disease characteristics was verified by the calculation of variance inflation factors. Variables with variance inflation factors >10 were not considered in the multivariate analysis. Statistical analyses were performed with SAS 9.4 with software macros generated at the Winship Cancer Institute's Department of Biostatistics and Bioinformatics.²⁴

To minimize the treatment selection bias, a propensity score matching method was used. A logistic regression model predicting CFRT treatment versus SBRT treatment was used to calculate propensity scores for covariates of interest. The covariates chosen were ones found to be significant in the multivariate analysis or ones thought to be clinically significant and included the following: patient age, AJCC clinical T and N staging, chemotherapy use, Charlson-Deyo comorbidity score, year of diagnosis, and receipt of definitive surgery. Patients from each study cohort were matched to each other at a ratio of 1:1 on the basis of the propensity score with a greedy 5-1 digit match algorithm; after matching, the covariate balance between 2 cohorts was evaluated by the standardized differences, and a value <0.1 was considered to indicate negligible imbalance.²⁵ The effects were estimated in the matched sample with a Cox model with a robust variance estimator for OS.²⁶

RESULTS

A total of 10,534 patients with pancreatic head or body ductal adenocarcinoma who met the inclusion criteria between 2004 and 2013 were identified from the NCDB. Figure 1 illustrates the patient selection and exclusion criteria. Of these patients, 7819 (92.5%) met our inclusion criteria for CFRT, and 631 (7.5%) met our criteria for SBRT. Patient and tumor characteristics by cohort are presented in Table 1. Most notably, the SBRT cohort was older (median age, 69 vs 66 y; $P < .001$) and had lower rates of chemotherapy utilization (87.3% vs 96.1%; $P < .001$). The SBRT cohort contained a lower proportion of T4 tumors (43.7% with SBRT vs 49.0% with CFRT; $P = .013$), although there were no significant differences in tumor size. The CFRT cohort contained a larger proportion of node-positive patients (32.3% with SBRT vs 37.0% with CFRT; $P = .02$) and a lower percentage of patients with a Charlson-Deyo comorbidity score of 0 (73.8% with SBRT vs 69.8% with CFRT; $P = .044$).

The median dose per fraction and the median number of fractions for the CFRT and SBRT cohorts were 1.8 Gy and 28 fractions and 8 Gy and 5 fractions, respectively. Patients were found to undergo resection at similar rates between the 2 cohorts (10.8% with SBRT vs 9.2% with CFRT; $P = .41$). The rate of negative-resection margins for the subset of patients undergoing radical surgery was 92% for SBRT and 84% for CFRT ($P = .062$). Kaplan-Meier curves for the 2 cohorts are displayed in Figure 2A and demonstrate 2-year OS rates of 20.3% and 16.3% for the SBRT and CFRT groups, respectively ($P < .001$).

In the multivariate analysis (Table 2), treatment with SBRT was associated with significantly improved OS with a hazard ratio of 0.84 (95% confidence interval, 0.75–0.93; $P < .001$). In addition, as expected, the patient age at diagnosis, Charlson-Deyo comorbidity index, AJCC clinical N stage, chemotherapy use, year of diagnosis, and receipt of surgical resection all demonstrated a significant impact on OS ($P < .001$). The AJCC clinical T stage and the tumor size were not significant predictors of survival in the multivariate analysis.

Propensity-Matched Outcomes

With matched propensity score analysis, a total of 988 patients were analyzed, with 494 patients in each cohort. Table 3 displays the propensity-matched groups for the following variables: patient age, Charlson-Deyo comorbidity score, AJCC clinical T and N staging, tumor size, chemotherapy use, year of diagnosis, and receipt of surgery. The median follow-up time was 26 months. After propensity matching, SBRT usage continued to be associated with significantly improved OS with a median survival of 13.9 months versus 11.6 months ($P < .001$). Kaplan-Meier curves for the propensity-matched groups are displayed in Figure 2B, and they demonstrate a significantly better OS curve for the SBRT cohort ($P = .0014$) with 2-year OS rates of 21.7% and 16.5% for the SBRT and CFRT groups, respectively ($P = .001$).

Subset Analysis

Figure 3 demonstrates multivariate subgroup analyses of the effects of patient demographics, disease characteristics, and treatment details on OS for CFRT and SBRT. Within the subset of patients who received chemotherapy, the receipt of SBRT continued to be significantly associated with improved survival (hazard ratio, 0.77; 95% confidence interval, 0.69–0.85). Similarly, for patients who did not undergo surgical resection, SBRT use was also significantly associated with better OS (hazard ratio, 0.83; 95% confidence interval, 0.76–0.92). In addition, the following subgroups all appeared to significantly benefit from SBRT versus CFRT: age ≥ 69 years, T3/T4 tumors, N1 disease, tumor size ≤ 3.5 cm, and Charlson-Deyo comorbidity index of 0. There were no subgroups of patients who appeared to significantly benefit from CFRT versus SBRT.

DISCUSSION

The objective of this study was to compare survival outcomes for patients with locally advanced, nonmetastatic ductal adenocarcinoma of the pancreas who were treated with either SBRT or CFRT. Our data demonstrate a significant OS benefit for patients who received SBRT rather than CFRT, and these findings remained significant in a propensity-

matched analysis controlled for age, comorbidities, receipt of chemotherapy, tumor stage, tumor size, and year of treatment. The increased survival remained for the subsets of patients who received chemotherapy as well as those who never underwent radical resection. We believe that the survival benefit associated with SBRT treatment cannot likely be explained by confounding factors alone because of our rigorous propensity matching as well as our strict inclusion criteria. The median OS of 13.9 months for the propensity-matched SBRT cohort is consistent with recent institutional reports of outcomes with SBRT for locally advanced disease (range, 11.8–20 months).^{16–19} Our study also validates patient and disease factors known to affect prognoses, such as patient age, comorbid status, nodal positivity, chemotherapy, and surgery.²⁷

Prolonged survival after SBRT in our study may be explained by multiple factors. The median SBRT dose in this study was 40 Gy in 5 fractions, whereas the dose was 45 Gy in 28 fractions for CFRT. On the basis of the linear-quadratic model, under the assumption of an α/β value of 10 Gy for pancreatic adenocarcinoma, the median biologically effective dose (BED) was 74.6 Gy for SBRT and 59.5 Gy for CFRT. Indeed, the techniques used for CFRT deliver a homogeneous radiation dose to the pancreas as well as adjacent organs; the prescribed total dose is often limited by normal-tissue tolerance. SBRT, on the other hand, can deliver much higher doses to the target while minimizing normal-tissue exposure by using sharp dose gradients. Higher radiation doses have been associated with superior local control in pancreatic cancer.²⁸ Moreover, previously reported local control rates for SBRT compare favorably with the local control rates of 68% to 75% reported for CFRT.^{7,17,18,29,30} Although we hypothesize that improved local control with SBRT affected OS, local control data cannot be ascertained from the NCDB. However, the higher rates of R0 resection after SBRT in this series support this hypothesis.

In the recently reported LAP-07 trial, CFRT was associated with improved local control but had no impact on OS. However, in this study, induction and adjuvant gemcitabine alone was used. Recent landmark trials have shown that FOLFIRINOX (5-FU, irinotecan, oxaliplatin) and gemcitabine plus nab-paclitaxel are superior to gemcitabine alone.^{12,13} As more patients (particularly younger patients with a good performance status) are treated with these modern regimens, local control will likely play a greater role in shaping ultimate disease outcomes in LAPC.

Initial experiences with SBRT for pancreatic cancer showed concerning rates of high-grade toxicity. Using a single fraction of 25 Gy (BED₁₀, 87.5 Gy), Stanford investigators demonstrated promising local control (84% at 1 year) but with a grade 2 or higher toxicity rate of 25% and median survival of 6.4 months for patients with locally advanced disease.¹⁴ Maturation of the SBRT technique has led many, including our institution, to target smaller volumes and use lower doses per fraction. In our experience, when 45 Gy was delivered in 3 fractions, no grade 3 or higher toxicities were observed.²⁰ Similarly, Herman et al³¹ recently reported a multi-institutional experience with gemcitabine before and after SBRT (33 Gy in 5 fractions) with acute and late grade 2 or higher gastrointestinal toxicity rates of merely 2% and 11%, respectively. Although toxicity data are unavailable in the NCDB, the 5% survival advantage of SBRT at 2 years is encouraging in that high-grade toxicity does not nullify the survival benefit of radiation dose intensification.

An additional benefit of SBRT over CFRT is the shorter treatment duration. CFRT is typically given over 5 to 6 weeks, and this leaves significant chances for interruptions and delays in radiation, chemotherapy, or both if they are given concurrently. In contrast, SBRT can typically be safely delivered in 1 to 2 weeks, and this is more convenient for patients, particularly those who live at a distance. Gurka et al³² reported SBRT to be associated with fewer interruptions in chemotherapy in comparison with CFRT. Consequently, the incorporation of SBRT into modular treatment platforms for LAPC may afford multidisciplinary care teams greater ability to deliver personalized combinations of systemic and local therapy.

This study has limitations inherent in the structure of the NCDB. A critical limitation of this analysis is that we could not control for the specific type of chemotherapy (type of agent or agents and number of cycles) in propensity matching because this information is not captured by the NCDB. This limitation presents a potential confounder in that SBRT patients tended to be treated more recently and potentially received more effective systemic therapy. We attempted to address this confounder by controlling for the year of treatment, which can be viewed as a surrogate for the dominant type of chemotherapy regimen administered. Even after the year of treatment was included in the propensity-matched analysis, SBRT treatment remained superior with respect to OS. In addition, data regarding local control and the cause of death are not captured by the NCDB, and this presents a further limitation.

Finally, this study also used a large fraction size as a surrogate to define SBRT under the assumption that practitioners also used other critical components of therapy while delivering SBRT, including organ motion management, advanced imaging, radiation delivery techniques, and patient immobilization. The NCDB does not clearly specify whether the prescribed dose was to a 3-dimensional volume or isocenter. We have provided the dose and fractionation of the SBRT cohort to serve as an internal validation of our selection parameters, and we do not encourage practitioners to use this study as a guide to ideal SBRT dosing. The decision to make 4 Gy per fraction or higher as the cutoff for SBRT was made to include institutional variations, although it could be argued that these fractionations may have been used with palliative intent. However, our data demonstrate that regardless of the intent of the radiation oncologist, patients who received the higher dose per fraction had better survival than patients who received standard fractionation.

Despite these limitations, this study encapsulates the majority of patients treated in the United States in the past decade and is the best available resource outside multicenter, randomized trials. To our knowledge, this study is the only report of a direct comparison of outcomes between SBRT and CFRT in a large patient population. Although SBRT demonstrated better survival, this treatment, along with all currently available treatments for LAPC, still has significant limitations. Currently, it is still clear that there does not exist any treatment that can be substituted for surgical resection, and better results are clearly needed in this patient population. Despite these challenges, we believe that the survival advantage seen with SBRT treatment versus CFRT provides the basis for the consideration of future randomized trials in this setting.

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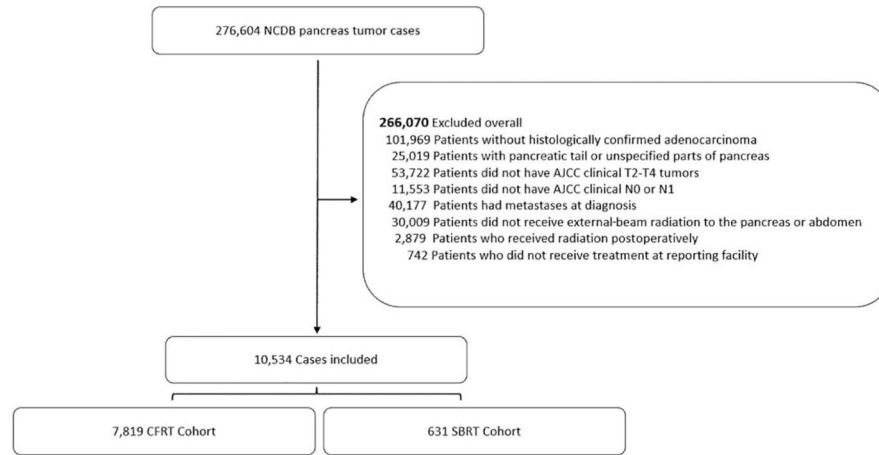


Figure 1. Patient Consolidated Standards of Reporting Trials diagram. AJCC indicates American Joint Committee on Cancer; CFRT, conventionally fractionated radiation therapy; NCDB, National Cancer Data Base; SBRT, stereotactic body radiation therapy.

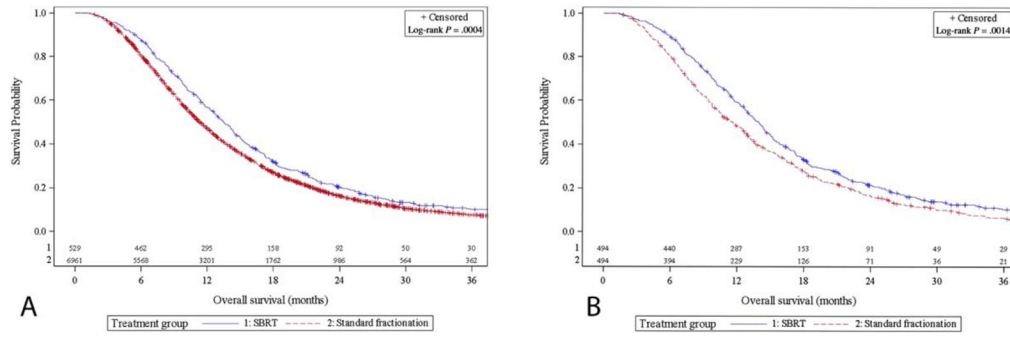


Figure 2. Kaplan-Meier curves demonstrating overall survival for (A) unmatched cohorts and (B) propensity-matched cohorts. SBRT indicates stereotactic body radiation therapy.

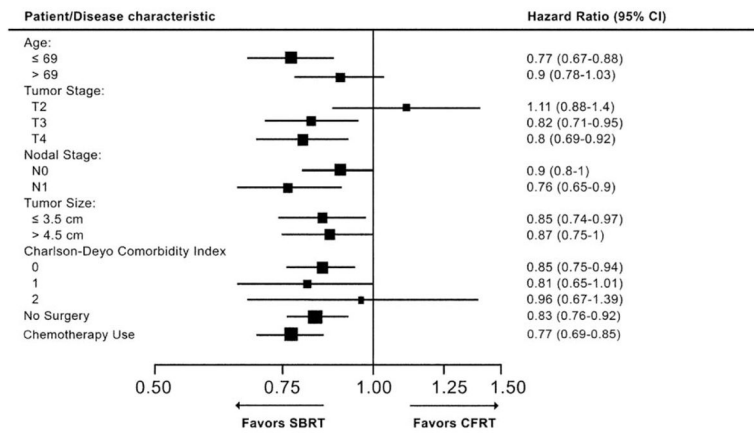


Figure 3. Multivariate subgroup analyses of the effects of patient demographics, disease characteristics, and treatment details on overall survival with CFRT versus SBRT. CI indicates confidence interval; CFRT, conventionally fractionated radiation therapy; SBRT, stereotactic body radiation therapy.

TABLE 1

Patient and Clinical Characteristics and Treatment Details by Cohort Group

Variable	SBRT (n 5631)	Standard Fractionation (n 57819)	<i>p</i> ^a
Age at diagnosis, median, y	69	66	<.001
Sex, No. (%)			
Male	311 (49.29)	3932 (50.29)	.629
Female	320 (50.71)	3887 (49.71)	
AJCC clinical T stage, No. (%)			
2	97 (15.37)	1238 (15.83)	.013
3	258 (40.89)	2753 (35.21)	
4	276 (43.74)	3828 (48.96)	
AJCC clinical N stage, No. (%)			
0	427 (67.67)	4929 (63.04)	.02
1	204 (32.33)	2890 (36.96)	
Tumor size			
Mean, cm	3.69	3.93	.072
Median, cm	3.5	3.5	
Unknown, No. (%)	42 (6.67)	875 (11.2)	
Charlson-Deyo score, No. (%)			
0	466 (73.85)	5459 (69.82)	.044
1	123 (19.49)	1867 (23.88)	
2	42 (6.66)	493 (6.31)	
Chemotherapy, No. (%)			
No	75 (12.71)	297 (3.87)	<.001
Yes	515 (87.29)	7381 (96.13)	
Surgical procedure, No. (%)			.41
No surgery	563 (89.22)	7098 (90.78)	
Whipple	59 (9.35)	635 (8.12)	
Whipple variant	9 (1.43)	86 (1.1)	
Surgical margins, No. (%)			
Negative	60 (0.92)	566 (0.84)	.062
Positive	5 (0.08)	105 (0.16)	
Year of diagnosis, No. (%)			
2004–2008	205 (32.49)	4295 (54.93)	<.001
2009–2013	426 (67.51)	3524 (45.07)	
Fraction size received, Gy			
Mean	10.7	1.8	<.001
Median	8.0	1.8	
10th, 90th percentiles	5.0, 20.0	1.8, 1.9	
No. of fractions			
Mean	5.2	26.9	<.001
Median	5.0	28.0	

Variable	SBRT (n 5631)	Standard Fractionation (n 57819)	<i>P</i> ^a
10th, 90th percentiles	2, 5	21, 31	

Abbreviations: AJCC, American Joint Committee on Cancer; SBRT, stereotactic body radiation therapy.

^aBolded *P* values are significant.

Unknown values for each variable omitted, if applicable.

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TABLE 2

Multivariate Subgroup Analysis of Overall Survival for the SBRT and CFRT Cohorts

Variable	Hazard Ratio (95% CI)	<i>p</i> ^a
Treatment group		
Standard fractionation	—	—
SBRT	0.84 (0.75–0.93)	<.001
Age at diagnosis (median)	1.01 (1.01–1.01)	<.001
AJCC clinical T stage		
2	—	—
3	0.98 (0.90–1.07)	.701
4	0.92 (0.85–1.01)	.068
Tumor size (cm)	1.01 (1.00–1.01)	.268
AJCC clinical N stage		
0	—	—
1	1.13 (1.07–1.19)	<.001
Surgical procedure		
No surgery	—	—
Whipple	0.32 (0.29–0.36)	<.001
Whipple variant	0.30 (0.22–0.41)	<.001
Charlson-Deyo score		
0	0.88 (0.78–0.98)	.017
1	0.99 (0.88–1.11)	.835
2	—	—
Chemotherapy use		
No	—	—
Yes	0.66 (0.58–0.76)	<.001
Year of diagnosis		
2004–2008	1.23 (1.16–1.31)	<.001
2009–2013	—	—

Abbreviations: AJCC, American Joint Committee on Cancer; CFRT, conventionally fractionated radiation therapy; CI, confidence interval; SBRT, stereotactic body radiation therapy.

^aBolded *P* values are significant.

TABLE 3

Patient and Disease Characteristics and Treatment Details for Propensity-Matched Cohort Groups

Variable	SBRT (n = 5494)	Standard Fractionation (n = 5494)	P
Age at diagnosis, median, y	67.91	68.95	.148
AJCC clinical T stage, No. (%)			
2	72 (14.57)	87 (17.61)	.335
3	197 (39.88)	200 (40.49)	
4	225 (45.55)	207 (41.9)	
Tumor size, median, cm	3.67	3.78	.267
AJCC clinical N stage, No. (%)			
0	334 (67.61)	340 (68.83)	.682
1	160 (32.39)	154 (31.17)	
Chemotherapy, No. (%)			
Yes	429 (86.84)	437 (88.46)	.439
No	65 (13.16)	57 (11.54)	
Surgical procedure, No. (%)			
No surgery	445 (90.08)	448 (90.69)	.81
Whipple	43 (8.7)	42 (8.5)	
Whipple variant	6 (1.21)	4 (0.81)	
Charlson-Deyo score, No. (%)			
0	366 (74.09)	352 (71.26)	.575
1	96 (19.43)	104 (21.05)	
2	32 (6.48)	38 (7.69)	
Year of diagnosis, No. (%)			
2004–2008	192 (38.87)	183 (37.04)	.555
2009–2013	302 (61.13)	311 (62.96)	

Abbreviations: AJCC, American Joint Committee on Cancer; SBRT, stereotactic body radiation therapy.