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ORIGINAL RESEARCH

Surgical resection of a primary tumor improves survival of metastatic pancreatic cancer: a population-based study

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Introduction: Pancreatic cancer is a lethal disease with a very poor prognosis. This study investigates survival of patients diagnosed with metastatic pancreatic cancer (mPC) based on local treatment of the primary tumor.

Methods: Patients diagnosed with stage IV mPC between 2004 and 2013 were identified from the Surveillance, Epidemiology and End Results (SEER) database. Cancer-specific survival (CSS) and overall survival (OS) were examined. CSS and OS were examined by using the Kaplan–Meier method with the log-rank test. Multivariable survival analyses of CSS and OS were conducted using the Cox proportional hazard model.

Results: A total of 28918 patients with mPC were included in this analysis. There were 467 patients who received surgical resection (1.6%) and 28451 patients who did not (98.4%). Patients who were younger than 70 years (odds ratio [OR]=1.45, 95% CI=1.04–2.03, p=0.03), diagnosed from 2004 to 2008 (OR=1.49, 95% CI=1.25–1.80, p<0.001), female (OR=1.31, 95% CI=1.08–1.58, p<0.001), married (OR=1.56, 95% CI=1.27–1.90, p<0.001), at T3 stage (OR=3.53, 95% CI=1.10–11.37, p=0.035), at N1 stage (OR=2.05, 95% CI=1.68–2.50, p<0.001), presenting histological types other than adenocarcinoma (OR=2.04, 95% CI=1.43–2.94, p<0.001), and with tumor of the pancreatic head (OR=1.90, 95% CI=1.27–2.82, p=0.002) were more likely to be treated with surgical resection. The results of multivariate analysis showed that surgical resection of the primary tumor was associated with CSS (hazard ratio [HR]=0.58, 95% CI=0.52–0.64, p<0.001) and OS (HR=0.59, 95% CI=0.53–0.65, p<0.001) benefits. In addition, not receiving chemotherapy (HR=2.33, 95% CI=2.27–2.39, p<0.001), age >50 years (HR=1.25, 95% CI=1.09–1.42, p=0.001), male (HR=1.121, 95% CI=1.09–1.15, p<0.001), black ethnicity (HR=1.11, 95% CI=1.1–1.15, p<0.001), unmarried (HR=1.20, 95% CI=1.17–1.23, p<0.001), histological type of adenocarcinoma (HR=1.18, 95% CI=1.14–1.22, p<0.001), and primary site other than the pancreatic head (HR=1.08, 95% CI=1.05–1.11, p<0.001) are factors associated with poor survival.

Conclusion: This study reveals that local treatment has the primary benefit of both CSS and OS in patients with mPC. These results may guide the management of this patient population.

Keywords: pancreatic cancer, metastasis, surgical resection, survival, SEER

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Introduction

Pancreatic cancer is a lethal disease with very poor prognosis. Pancreatic cancer is the fourth leading cause of cancer-related deaths in the US in 2017 and is projected to become the second by 2030.[1,2] The early stage of pancreatic cancer is often asymptomatic and as a result, at the time of the first diagnosis it has often become an advanced cancer. More than 38% of pancreatic ductal adenocarcinoma (PDAC) patients were

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found to have metastasis, and only a small number of patients have the opportunity to receive surgical resection according to clinical guidelines. The 5-year overall survival (OS) rate among patients with metastatic pancreatic cancer (mPC) is ~2%[3,4] and has not improved for decades.

Chemotherapy is the primary treatment for mPC.[5] Leucovorin, fluorouracil, irinotecan, and oxaliplatin (FOLFIRINOX) regimens and gemcitabine alone or in combination with other chemotherapeutic drugs is recommended according to the performance status (PS) and comorbidity profile of the patient.[4] Surgical resection of the primary tumor is not suggested by clinical guidelines and is not usually considered by practitioners. However, current evidence suggests that local treatment of the primary tumor results in prolonged survival in a variety of metastatic cancer types, including renal cell cancer,[6] colorectal cancer,[7] and prostate cancer.[8,9] Two recent large-scale population-based studies further demonstrated the survival benefit of local treatment in metastatic prostate cancer.[9,10] These findings have potential implications for the surgical management of mPC. For mPC patients, there is no consensus on the eligibility criteria for surgical resection of primary cancer in the current data. However, based on our clinical experience and literature reports,[11–13] the criteria may include at least four aspects: first, the patient can tolerate operation; second, the patient has a strong willingness to receive the operation; third, the operation may solve some other major symptoms, such as obstruction; and fourth, the operation can ensure total removal of the cancer tissues, including the metastases. In addition to the former two aspects, patients need to meet the third or the fourth. In the current study, we used the Surveillance, Epidemiology and End Results (SEER) database to investigate the survival outcomes of patients with mPC who were treated with or without surgical resection of the primary tumor in a contemporary cohort.

Methods

Patient cohort

The data of this study were extracted from the SEER-18 registry of the National Cancer Institute. The database is publicly available, and we retrieved the data using SEER*Stat software Version 8.3.4. Because the SEER database used deidentified data, this study was exempted from institutional review board oversight. We identified patients diagnosed between January 1, 2004, and December 31, 2013, with a primary site of "pancreas", with American Joint Committee on Cancer (AJCC) stage (sixth edition) IV and with International Classification of Diseases for Oncology, Third Edition (ICD-O-3) codes 8010, 8020, 8140, 8141, and 8144 from the SEER database (variants of adenocarcinoma). Patients with unknown survival data, with unknown surgery information, or treated with postoperative radiation were excluded. The process of patient selection is shown in Figure 1.

Data collection

The following demographic information was collected from each patient: age at diagnosis, year of diagnosis, gender, primary site of tumor, T stage, N stage, M stage, surgical resection of the primary site (yes or no), receipt of chemotherapy, marital status, SEER cause-specific death classification, survival months, and vital status. Pancreatic cancer-specific survival (CSS) was defined as the time from diagnosis to death from pancreatic cancer, and OS was defined as the duration from diagnosis to death from any cause. The PS, comorbidity profile of the patients, and regimen of chemotherapy were not provided by the SEER database. The last date of follow-up was on December 31, 2013.

Statistical analysis

The primary end point of this study was CSS, and the secondary end point was OS. The chi-square test was utilized to compare the differences in clinical and demographic features between patients treated with or without surgical resection. CSS and OS were assessed using the Kaplan–Meier method with the log-rank test. Associations between demographic factors with receipt of surgical resection were evaluated using logistic regression analysis. Multivariable survival analyses of CSS and OS were conducted using the Cox proportional hazards model. $p<0.05$ was considered as statistically significant. All statistical analyses were performed using IBM SPSS Statistics 22.0 (IBM Corporation, Armonk, NY, USA)

Results

Patient characteristics

A total of 28918 patients with mPC were included in the current analysis (Table 1). The median age was 68 years. Most patients were White (n=22784, 78.8%), and male patients comprised 52.8% (n=15270). There were 467 patients (1.6%) who received surgical resection and 28451 (98.4%) patients who did not. More than half of patients were married (n=15562, 53.8%). Compared with patients who did not receive surgical resection of the primary tumor, patients in the surgery group were younger (median age: 64 vs 68 years, $p<0.001$). Moreover, the surgery group had a larger proportion of N1 stage cancer (54.2% vs 26.9%). There was no significant difference among distributions of gender and

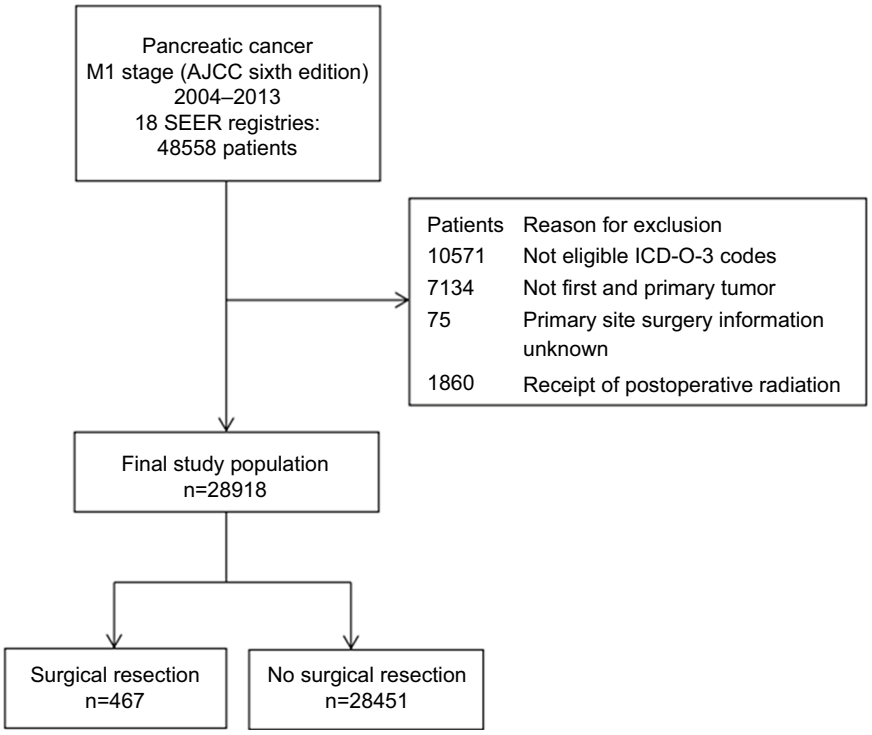

Figure 1 Flowchart of the selection process of eligible patients from the SEER database.
Abbreviations: SEER, Surveillance, Epidemiology and End Results; AJCC, American Joint Committee on Cancer; ICD-O-3, International Classification of Diseases for Oncology, Third Edition.

race between the groups. The detailed patient characteristics are shown in Table 1.

Factors associated with receipt of surgical resection

To better understand the method of patient selection, we analyzed the clinicopathological factors associated with removal of the primary tumor. As shown in Table 2, the univariate analysis demonstrated that age <80 years, diagnosed at 2004–2008, married, T3 stage, N1 stage, other histological types other than adenocarcinoma, and receipt of chemotherapy, and tumor of the pancreatic head were associated with an increased possibility of receiving surgery, compared to each referent group. The multivariate analysis showed that patients younger than 70 years, diagnosed at 2004–2008, female, married, at T3 stage, at N1 stage, and having a tumor of the pancreatic head were more likely to be treated with surgical resection.

Survival outcomes

Of a total of 28918 patients, mortality occurred in 27113 (93.8% of 28918) patients at the end of the follow-up. In addition, 25899 (89.6% of 28918) patients were dead due to pancreatic cancer. Regarding CSS, the 1-year CSS rates were 31.1% in the surgery group and 10.4% in the nonsurgery group. The median survival time was 7 months (95% CI=6.04–7.96) for the surgery group and 2 months (95% CI=1.94–2.06) for the nonsurgery group ($p<0.001$). Concerning OS, the 1-year OS rates were 28.9% and 9.4% in the surgery group and nonsurgery group, respectively. The median survival time was 7 months (95% CI=6.2–7.8) for the surgery group and 2 months (95% CI=1.94–2.06) for the nonsurgery group ($p<0.001$). The survival curves of CSS and OS are shown in Figure 2. After adjusting for treatment, age, year of diagnosis, gender, race, marital status, T stage, N stage, chemotherapy receipt, histological type, and tumor size, the multivariate Cox regression analysis revealed that receipt of surgical resection was associated with a better CSS (hazard ratio [HR]=0.58, 95% CI=0.52–0.64) and OS (HR=0.59, 95% CI=0.53–0.65; Table 3). Moreover, the results demonstrated that factors associated with poor CSS include the following: age >50 years, male, black ethnicity, unmarried, no receipt of chemotherapy, adenocarcinoma, and a primary site other than the pancreatic head. In addition, poor OS was inclined to occur in patients with the following characteristics: age >50 years, male, black ethnicity, unmarried, no receipt of chemotherapy, adenocarcinoma, and primary site other than pancreatic head. Taken together, these data define a high-risk population profile of patients with mPC.

Table 1 Baseline characteristics of metastatic pancreatic patients included in the analysis (N=28918)

Characteristics	Total, n (%) N=28918	Surgical resection, n (%) n=467	No surgical resection, n (%) n=28451	*p*-value
Age (years)				<0.001
<40	261 (0.9)	9 (1.9)	252 (0.9)	
40–49	1628 (5.6)	47 (10.1)	1581 (5.6)	
50–59	5539 (19.2)	112 (24)	5427 (19.1)	
60–69	8317 (28.8)	140 (30)	8177 (28.7)	
70–79	7752 (26.8)	110 (23.6)	7642 (26.9)	
>80	5421 (18.7)	49 (10.5)	5372 (18.9)	
Year of diagnosis				0.003
2004–2008	13386 (46.3)	248 (53.1)	13138 (46.2)	
2009–2013	15532 (53.7)	219 (46.9)	15313 (53.8)	
Gender				0.322
Male	15270 (52.8)	236 (50.5)	15034 (52.8)	
Female	13648 (47.2)	231 (49.5)	13417 (47.2)	
Race				0.574
White	22784 (78.8)	361 (77.3)	22423 (78.8)	
Black	3838 (13.3)	63 (13.5)	3775 (13.3)	
Others	2296 (7.9)	43 (9.2)	2253 (7.9)	
Marital status				<0.001
Married	15562 (53.8)	300 (64.2)	15262 (53.6)	
Unmarried	12265 (42.4)	150 (32.1)	12115 (42.6)	
Unknown	1091 (3.8)	17 (3.6)	1074 (3.8)	
T stage				<0.001
T0	320 (1.1)	3 (0.6)	317 (1.1)	
T1	618 (2.1)	11 (2.4)	607 (2.1)	
T2	6285 (21.7)	56 (12)	6229 (21.9)	
T3	7032 (24.3)	246 (52.7)	6786 (23.9)	
T4	4804 (16.6)	93 (19.9)	4711 (16.6)	
TX	9859 (34.1)	58 (12.4)	9801 (34.4)	
N stage				<0.001
N0	13010 (45)	175 (37.5)	12835 (45.1)	
N1	7912 (27.4)	253 (54.2)	7659 (26.9)	
NX	7996 (27.7)	39 (8.4)	7957 (28)	
Tumor location				<0.001
Pancreatic head	10166 (35.2)	233 (49.9)	9933 (34.9)	
Pancreatic body/tail	9619 (33.3)	129 (27.6)	9490 (33.4)	
Other	6579 (22.8)	77 (16.5)	6502 (22.9)	
Overlapping lesion	2554 (8.8)	28 (6)	2526 (8.9)	
Chemotherapy				<0.001
No/unknown	15841 (54.8)	222 (47.5)	15619 (54.9)	
Yes	13077 (45.2)	245 (52.5)	12832 (45.1)	
Histology type				<0.001
Adenocarcinoma	24580 (85)	425 (91)	24155 (84.9)	
Others	4338 (15)	42 (9)	4296 (15.1)	
Tumor size				<0.001
≤20 mm	19578 (67.7)	361 (77.4)	19217 (67.5)	
>20 mm	115 (0.4)	4 (0.8)	111 (0.4)	
Unknown	9225 (31.9)	102 (21.8)	9123 (32.1)	

Discussion

mPC has a very poor prognosis, with a median survival ranging from 4 to 6 months.[14] Systemic chemotherapy as the mainstay treatment is suggested by the American Society of Clinical Oncology Clinical Practice Guideline.[4] Few studies have investigated the role of surgical resection in the treatment of mPC. We were inspired by the encouraging results from studies on local treatment for metastatic renal cell cancer and colorectal cancer.[6,7] We explored the association between local treatments on mPC and the survival outcomes, relying on the SEER database. The results showed that surgical resection of the primary tumor was associated with

Table 2 Factors associated with receipt of surgical resection of the primary tumor

Variables	Univariate model		Multivariate model	
	OR (95% CI)	*p*-value	OR (95% CI)	*p*-value
Age (years)				
<40	3.92 (1.9–8.1)	<0.001	2.78 (1.34–5.81)	0.006
40–49	3.26 (2.18–4.88)	<0.001	2.42 (1.6–3.66)	<0.001
50–59	2.26 (1.61–3.17)	<0.001	1.72 (1.22–2.44)	0.002
60–69	1.88 (1.35–2.6)	<0.001	1.45 (1.04–2.03)	0.03
70–79	1.58 (1.13–2.21)	0.008	1.34 (0.95–1.89)	0.092
≥80	1 (referent)		1 (referent)	
Year of diagnosis				
2004–2008	1.32 (1.01–1.59)	0.003	1.49 (1.24–1.8)	<0.001
2009–2013	1 (referent)		1 (referent)	
Gender				
Male	1 (referent)		1 (referent)	
Female	1.1 (0.91–1.32)	0.322	1.31 (1.08–1.58)	0.006
Race				
White	1 (referent)		1 (referent)	
Black	1.04 (0.79–1.36)	0.794	1.11 (0.84–1.47)	0.47
Others	1.19 (0.86–1.63)	0.296	1.21 (0.87–1.69)	0.255
Marital status				
Married	1.59 (1.3–1.93)	<0.001	1.56 (1.27–1.9)	<0.001
Unmarried	1 (referent)		1 (referent)	
Unknown	0.81 (0.49–1.32)	0.389	0.91 (0.55–1.5)	0.718
T stage				
T0	1 (referent)		1 (referent)	
T1	1.92 (0.53–6.91)	0.321	1.82 (0.49–6.74)	0.367
T2	0.95 (0.3–3.05)	0.931	1 (0.3–3.3)	1
T3	3.83 (1.22–12.03)	0.021	3.53 (1.1–11.37)	0.035
T4	2.09 (0.66–6.62)	0.212	1.79 (0.55–5.82)	0.331
TX	0.63 (0.2–2.01)	0.43	0.8 (0.25–2.61)	0.715
N stage				
N0	1 (referent)		1 (referent)	
N1	2.42 (1.99–2.94)	<0.001	2.05 (1.68–2.5)	<0.001
NX	0.36 (0.25–0.51)	<0.001	0.43 (0.3–0.62)	<0.001
Tumor location				
Pancreatic head	2.12 (1.43–3.14)	<0.001	1.89 (1.27–2.82)	0.002
Pancreatic body/tail	1.23 (0.81–1.85)	0.331	1.26 (0.83–1.91)	0.275
Other	1.07 (0.69–1.65)	0.766	1.79 (1.14–2.8)	0.011
Overlapping lesion	1 (referent)		1 (referent)	
Chemotherapy				
No/unknown	1 (referent)		1 (referent)	
Yes	1.34 (1.13–1.61)	<0.001	1.11 (0.92–1.33)	0.272
Histological type				
Adenocarcinoma	1 (referent)		1 (referent)	
Others	2.5 (1.72–3.57)	<0.001	2.04 (1.43–2.94)	<0.001
Tumor size				
≤20 mm	1 (referent)		1 (referent)	
>20 mm	1.84 (0.68–5)	0.233	1.84 (0.66–2.47)	<0.001
Unknown	0.59 (0.48–0.74)	<0.001	0.87 (0.68–1.12)	<0.001

Abbreviations: OR, odds ratio; TX, unknown T stage; NX, unknown N stage.

a survival benefit ($p<0.001$). Patients younger than 70 years, female, married, at T3 stage, at N1 stage, and with tumor of the pancreatic head are likely to be treated with surgery. In addition, multivariate Cox regression confirmed that patients receiving surgical resection had a better CSS and OS. To our knowledge, this is the first study to investigate the role of local treatment in mPC on the population level.

Liver is the most common site of pancreatic cancer metastasis due to its anatomical situation.[15] Previous studies have found that a "metastatic niche" already existed in the liver

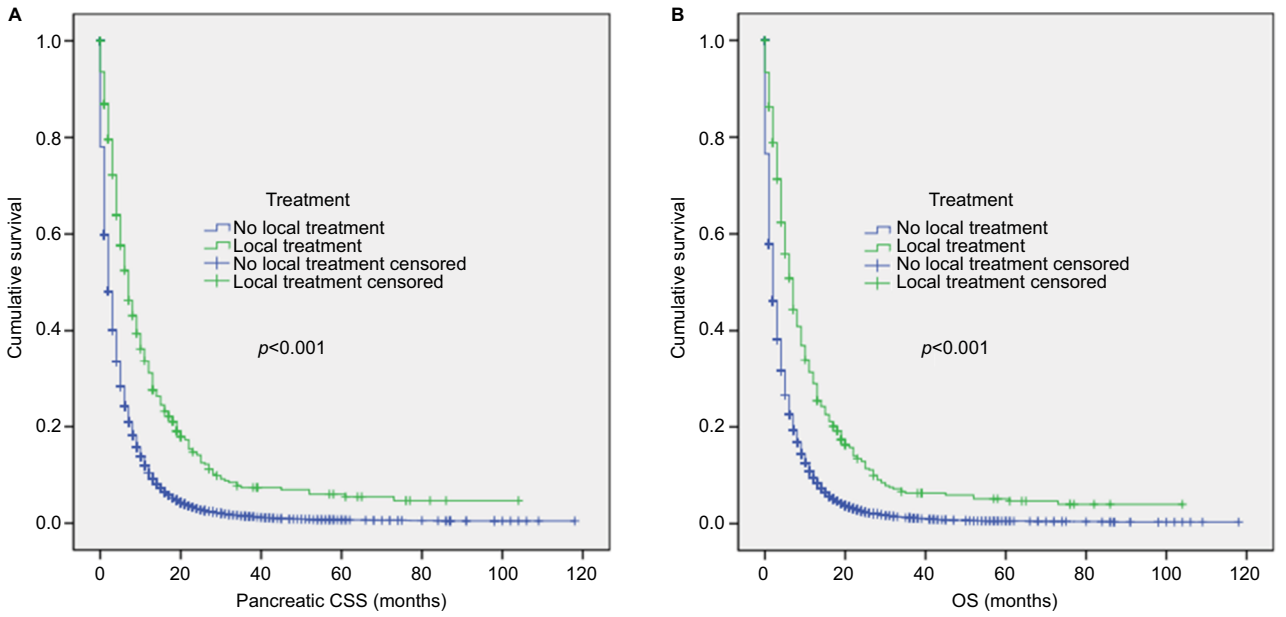

Figure 2 Survival curves with the log-rank test of (**A**) CSS ($p<0.001$) and (**B**) OS ($p<0.001$).
Abbreviations: CSS, cancer-specific survival; OS, overall survival.

even before the metastases formed.[16,17] The tumor microenvironment in the metastatic niche is created with the help of a variety of immune cells, including natural killer (NK) cells, T cells, and neutrophils.[16,18] A subpopulation of migrating $CD133^{+}CXCR4^{+}$ cancer stem cells (CSC) is essential for tumor metastasis in pancreatic adenocarcinoma.[19] Cytokines such as TNF-α and TGF-β are found to be upregulated in the tumor microenvironment and may enhance metastasis through inducing epithelial-to-mesenchymal transition (EMT).[20] Circulating tumor cells (CTCs) can also colonize their tumors of origin, which is termed tumor self-seeding.[21] These changes in tumor biology in pancreatic cancer metastasis could be implicated in the process of cancer cell dissemination and could shed light on the rationale for using primary tumor resection. Moreover, evidence showed that the presence of a primary tumor suppresses T-cell and antibody responses; however, surgical removal of the primary tumor restores immunocompetence and enhances the antitumor activity of the immune system.[22] In addition, surgical removal of the primary tumor also inhibits or delays the process of "self-seeding"; as a result, patients receiving surgical resection experience a better prognosis.[23]

Current evidence shows that the local treatment of the primary tumor by either radiation therapy or surgery demonstrates a survival benefit in both OS and CSS in patients with metastatic prostate cancer.[9,24,25] Culp et al[9] used the SEER database to show that the 5-year OS and predicted disease-free survival are each significantly higher in patients undergoing radical prostatectomy (67.4% and 75.8%, respectively) or brachytherapy (52.6% and 61.3%, respectively) compared with patients who have no local treatment (22.5% and 48.7%, respectively; $p<0.001$). These results are in line with those of the current study. Moreover, 10 studies in the literature reported that surgical removal of the primary lesion in metastatic breast cancer was associated with a significantly higher OS rate with a pooled HR of 0.65 (95% CI 0.59–0.72), favoring the patients undergoing surgery.[26] Another population-based study also revealed that in stage IV colorectal cancer, patients who received primary-cancer-directed surgery (CDS) had a longer OS (median: 10 months) than patients who did not (median: 3 months; $p<0.05$).[7] Therefore, the benefit of primary tumor removal in metastatic cancer has been shown in previous and in the current studies. Of note, the results showed that in recent years of diagnosis, married status and location on the pancreatic head are predictive of a favorable prognosis. Because patients diagnosed in recent years (2009–2013) have had a relatively short follow-up, the end point event (death) might compare less to the patient cohort recruited several years before (2004–2008). Moreover, married status has been shown to play a favorable prognostic role in various cancers, including PC,[27–29] which highlights the potentially significant impact of social support on cancer treatment and survival. Pancreatic head cancer is symptomatic earlier than cancer in other locations, and therefore, pancreatic head cancer is relatively easy to diagnose and treat early. We noted that, for CSS analysis,

Table 3 Multivariate analysis of CSS and OS in mPC

Variables	CSS		OS	
	HR (95% CI)	*p*-value	HR (95% CI)	*p*-value
Treatment				
No surgical resection	1 (referent)		1 (referent)	
Surgical resection	0.58 (0.52–0.64)	<0.001	0.59 (0.53–0.65)	<0.001
Age (years)				
<40	1 (referent)		1 (referent)	
40–49	1.1 (0.96–1.27)	0.182	1.1 (0.96–1.27)	0.171
50–59	1.24 (1.08–1.42)	0.002	1.25 (1.09–1.42)	0.001
60–69	1.38 (1.21–1.58)	<0.001	1.39 (1.22–1.59)	<0.001
70–79	1.62 (1.41–1.85)	<0.001	1.64 (1.43–1.87)	<0.001
≥80	2.16 (1.89–2.48)	<0.001	2.2 (1.93–2.52)	<0.001
Year of diagnosis				
2004–2008	1 (referent)		1 (referent)	
2009–2013	0.93 (0.91–0.95)	<0.001	0.93 (0.91–0.96)	<0.001
Gender				
Male	1 (referent)		1 (referent)	
Female	0.89 (0.87–0.92)	<0.001	0.89 (0.87–0.91)	<0.001
Race				
White	1 (referent)		1 (referent)	
Black	1.09 (1.05–1.13)	<0.001	1.11 (1.07–1.15)	<0.001
Others	0.95 (0.9–0.99)	0.02	0.96 (0.92–1.01)	0.105
Marital status				
Married	1 (referent)		1 (referent)	
Unmarried	1.19 (1.16–1.22)	<0.001	1.2 (1.17–1.23)	<0.001
Unknown	1.07 (1–1.15)	0.036	1.08 (1.01–1.15)	0.028
T stage				
T0	1 (referent)		1 (referent)	
T1	0.81 (0.7–0.93)	0.003	0.89 (0.77–1.02)	0.094
T2	0.96 (0.85–1.08)	0.512	1.02 (0.91–1.15)	0.761
T3	0.87 (0.77–0.98)	0.018	0.93 (0.82–1.04)	0.208
T4	0.89 (0.79–1)	0.044	0.93 (0.82–1.04)	0.212
TX	1.05 (0.94–1.18)	0.397	1.1 (0.98–1.23)	0.116
N stage				
N0	1 (referent)		1 (referent)	
N1	1.02 (0.99–1.05)	0.158	1.02 (0.99–1.05)	0.268
NX	1.07 (1.04–1.1)	<0.001	1.06 (1.02–1.09)	0.001
Tumor location				
Pancreatic head	1 (referent)		1 (referent)	
Pancreatic body/tail	1.09 (1.06–1.12)	<0.001	1.08 (1.05–1.11)	<0.001
Other	1.12 (1.08–1.16)	<0.001	1.13 (1.09–1.17)	<0.001
Overlapping lesion	1.12 (1.07–1.17)	<0.001	1.11 (1.06–1.16)	<0.001
Chemotherapy				
Yes	1 (referent)		1 (referent)	
No/unknown	2.3 (2.24–2.36)	<0.001	2.33 (2.27–2.39)	<0.001
Histological type				
Adenocarcinoma	1.16 (1.12–1.2)	<0.001	1.18 (1.14–1.22)	<0.001
Others	1 (referent)		1 (referent)	
Tumor size				
≤20 mm	1 (referent)		1 (referent)	
>20 mm	1.11 (0.91–1.35)	0.291	1.11 (0.92–1.34)	0.297
Unknown	1.02 (0.99–1.06)	0.088	1.03 (0.99–1.06)	0.128

Abbreviations: CSS, cancer-specific survival; OS, overall survival; mPC, metastatic pancreatic cancer; HR, hazard ratio.

patients with T1, T3, and T4 stages had a better survival than patients with T0 stage. The possible reason is that mPC with T0 stage may have a stronger tendency for invasiveness and metastasis than mPC with T4, as the metastasis of T0-staged mPC occurred at an earlier stage. Therefore, survival of mPC patients with T0 could be poorer.

Pancreatoduodenectomy is the gold standard operation for malignant disease of the pancreas.[30] In clinical practice, to reduce postoperative complications, particularly pancreatic fistula, different surgical techniques and their modifications have been proposed. Because the best method to address a pancreatic stump is still controversial and remains a matter of speculation, surgeons should master multiple techniques to manage the pancreatic remnant.[30] In addition, when faced with pancreatic neuroendocrine tumors, surgeons should also take conservative observational management and parenchyma-sparing pancreas resections into consideration.[31]

There are several limitations to the present study. First, it is limited by the retrospective nature of the analysis; therefore, selection bias could occur. Second, demographic information provided by the SEER database did not include comorbidity, PS, smoking, alcohol consumption, and other detailed factors. The contribution of these factors to the survival benefit could not be evaluated. Third, data on the interval from the surgery until the start of chemotherapy and the regimen of chemotherapy could also have an impact on survival outcomes and provide important implications for clinical practice. However, since the SEER database does not include this information, the influence of these factors could not be evaluated. Despite the stated limitations, our study is a population-based study that included a large number of mPC patients, and the results are convincing.

Conclusion

Our study reveals that local treatment of the primary cancer benefits both CSS and OS in patients with mPC. This result may suggest better procedures for the management of this patient population. Further prospective trials are still needed to validate our results.

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Disclosure

The authors report no conflicts of interest in this work.

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