Original Article

Survival and analysis of prognostic factors for fibroblastic osteosarcoma patients: a population-based study

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Background: Osteosarcoma is the most common mesenchymal cell malignancy, 10% of which is fibroblastic osteosarcoma (FOS). Due to the low incidence of osteosarcoma, the impact of many pathological factors on survival is still unclear, especially FOS. The goal of this study was to assess the latest survival rates for FOS and the risk factors affecting survival using the Surveillance, Epidemiology, and End Results (SEER) database.

Methods: Age, sex, race, SEER stage, surgery, radiation, chemotherapy, site of FOS, and survival time were collected from the SEER database for survival and prognostic factor analysis. The patients were randomly assigned to either the training cohort or the testing cohort. The overall survival (OS) curves were obtained by Kaplan-Meier according to different factors. A multivariate Cox regression model and a predictive nomogram have also been constructed.

Results: The study enrolled a total of 120 patients. OS at 1, 3, and 5 years for all patients was 90.83%, 79.17%, and 70.83%, respectively. In the 5-year survival analysis, in distant of SEER stage (P<0.01), radiation (P=0.03), and no surgery (P<0.01) were associated with a worse prognosis in patients with FOS. Multivariate analysis showed that age, and in distant of SEER stage were independent indicators of unfavorable prognosis. A nomogram was used to predict the prognosis of FOS and a calibration curve was used to validate the nomogram prediction against the actual observed survival outcomes.

Conclusions: In summary, older age, and worse SEER stage were associated with poorer OS. The nomogram effectively predicted the probabilities of 1-, 3-, and 5-year OS, demonstrating strong concordance with the actual observed outcomes.

Keywords: Fibroblastic osteosarcoma (FOS); Surveillance, Epidemiology, and End Results (SEER); survival

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Introduction

Osteosarcoma is the most prevalent malignancy of mesenchymal cells, endowed with the capacity to generate osteoid or underdeveloped bone. It primarily affects long bones, including the femur, tibia, and humerus, and accounts for approximately 40% to 60% of primary malignant bone tumors (1). Classification of osteosarcomas is based on their histological presentation, and it has been classified into osteoblast, chondroblastic, and fibroblastic types, of which 76–80% are osteoblast, 10–13% are chondroblastic, 10% are fibroblastic, and other rare variants (2). Up until now, clinical and histopathological findings have been regarded as crucial in the diagnosis and decision-making process regarding osteosarcoma treatment strategies. Furthermore, fibroblastic osteosarcoma (FOS) has a more optimistic prognosis due to its favorable response to treatment (3).

Over the past few years, the 5 years survival rate for patients with osteosarcoma has improved dramatically, owing to the combination of surgery with chemotherapy (4,5). The impact of many pathological factors on survival is not well understood, especially for FOS, due to the low incidence of osteosarcoma. Therefore, recruiting a sufficient number of patients with FOS for a study cohort is quite a challenge. The goal of this study was to assess the latest survival status of FOS and the risk factors affecting on survival using the Surveillance, Epidemiology, and End Results (SEER) database. This database comprises 18 cancer registries, encompassing approximately 30% of the total US population. Consequently, this research aimed to identify the risk factors for patients with FOS and developed a nomogram tool to predict overall survival (OS) for FOS, with the aim of guiding clinical practice. We present this article in accordance with the TRIPOD reporting checklist (available at https://tcr.amegroups.com/article/view/10.21037/tcr-24-126/rc).

Highlight box

Key findings

- Older age and a more advanced stage were associated with poorer overall survival rates in patients with fibroblastic osteosarcoma (FOS).

What is known and what is new?

- FOS accounts for about 10% of osteosarcomas and is a rare type of bone tumor. Compared with other subtypes of osteosarcomas, it has a better prognosis.
- Factors such as older age (>60 years), advanced stage, radiation treatment, and the absence of surgery were associated with a poorer prognosis in patients with FOS.

What is the implication, and what should change now?

- For FOS, surgical treatment is crucial, and radiotherapy has a good effect on FOS. Chemotherapy does not seem to be as recommended as traditionally thought.

Methods

Clinical data and selection criteria

In SEER*Stat (version 8.3.5) software, we selected the "SEER research plus data, Nov. 2020 Sub (1975–2018)", which holds treatment information for FOS patients, including chemotherapy and radiation therapy. Finally, we selected 120 cases from the SEER database based on the following criteria for inclusion: (I) patients diagnosed with FOS according to third edition of the International Classification of Diseases for Oncology (ICD-O-3); (II) all patients were diagnosed between 1975 and 2018; (III) FOS of bones and joints or soft tissues where the first and only primary malignant tumor; (IV) histological codes: 9182/3; (V) complete clinical data, including age, gender, race, SEER stage, cancer-directed surgery, radiation, chemotherapy, and primary site; (VI) complete follow-up and knowledge of survival time.

Study variables

The variables utilized in our study encompassed age at diagnosis, race, gender, SEER stage, cancer-directed surgery, radiation therapy, chemotherapy, and primary tumor site. The age at diagnosis was divided into three distinct categories: those under 20 years old, those between 20 and 60 years old, and those over 60 years old. Gender was categorized as female and male. The racial classification was white, black, and other ethnicities. The SEER stage included localized, regional, and distant. Patients were treated with or without surgery, radiation, and chemotherapy. The primary site was classified as bones and joints or soft tissues. OS, defined as the time from diagnosis to death from all possible causes, was the endpoint of interest.

Ethical statement

The study adhered strictly to the principles outlined in the Declaration of Helsinki (as revised in 2013), and received

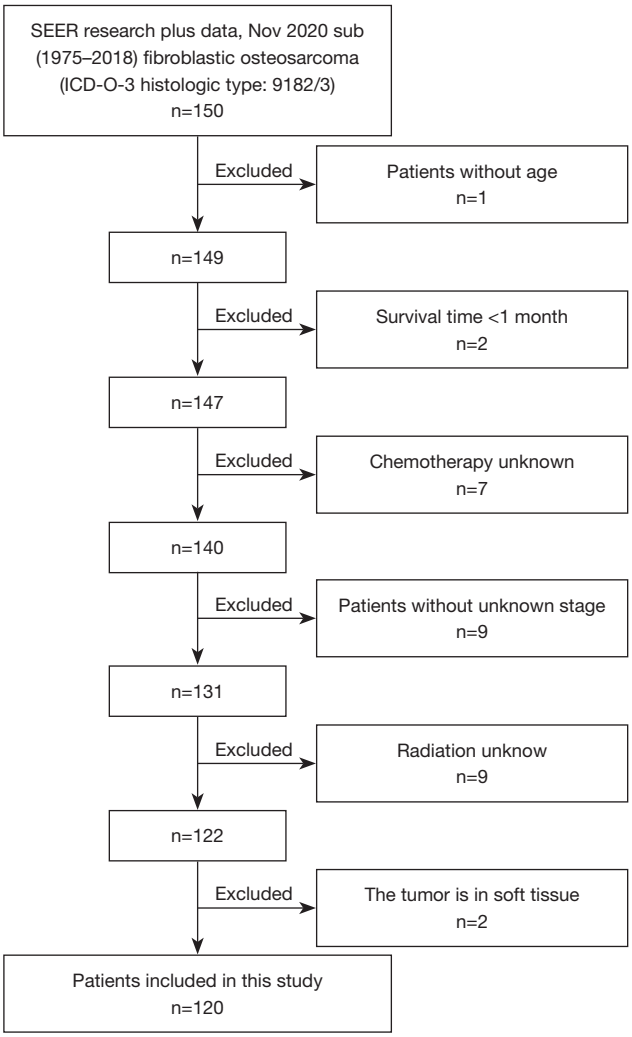

Figure 1 The flowchart for the selection of the study population. SEER, Surveillance, Epidemiology, and End Results; ICD-O-3, third edition of the International Classification of Diseases for Oncology.

approval from the Ethics Committee of Children's Hospital of Soochow University (No. 2023016).

Statistical analysis

The statistical analysis was carried out using IBM SPSS Statistics 25.0 (IBM Corporation, Armonk, NY, USA) and R version 4.0.2 (https://www.r-project.org/). The categorical variables were described in terms of frequencies and percentages, while the continuous variables were presented as the median and interquartile range (IQR). To investigate between-group differences for categorical variables, the χ^2 test was utilized, while the Wilcoxon rank-sum test was applied for continuous variables. We considered a two-sided P value of less than 0.05 to be statistically significant. We performed Kaplan-Meier survival analysis for each variable, determined the significance of differences between survival curves using the log-rank test, and utilized Landmark analysis if the survival curves crossed. Multivariate Cox regression analysis was conducted to identify the risk factors associated with survival. The nomogram model (6) was constructed to predict the prognosis of FOS. According to the model, the risk score can be obtained and divided into high group and low group. To evaluate the prognostic accuracy of the model, internal validation was performed using the concordance index (C-index) and calibration curve. To assess the accuracy of the nomogram model in predicting 1-, 3-, and 5-year survival rates, we used time-dependent receiver operating characteristic (ROC) curves by analyzing the area under the curve (AUC). Finally, we conducted external validation by utilizing the nomogram to evaluate each patient in the testing cohort. Moreover, decision curve analysis (DCA) was conducted to assess the clinical utility and potential benefit of the prediction nomogram model.

Results

Patient baseline characteristics

The total number of patients diagnosed with FOS was found to be 150. After screening for inclusion and exclusion criteria, 120 patients were eventually included in our study (*Figure 1*). Of these patients, 58 males and 62 females, the median age (IQR) of the population was 27 years (17 to 46 years). Thirty-eight were less than 20 years of age, and 16 were over 60 years of age. Of those, 93 were white, 16 were black, and 11 were in other races. According to the SEER stage, 50 cases were localized, 55 cases were regional, and 15 cases were distant. Most of the patients were underwent surgery. There were only nine cases where surgery was not performed. Eleven were treated with radiation and 78 with chemotherapy. During follow-up, OS at 1, 3, and 5 years was 90.83%, 79.17%, and 70.83%, respectively, for all patients (*Table 1*). All patients were randomly divided into training cohort and testing cohort. For all the variables examined in both the training and testing cohorts, the statistical analysis results were with P values greater than 0.05 (*Table 2*).

Table 1 Demographic and clinical characteristics of 120 patients with FOS identified in the SEER database from 1975 to 2018

Category	Value
Age (years), mean ± SD	33.92±19.80
Age (years), median [IQR]	27 [17–46]
Survival time (months), median [IQR]	153 [45–259]
Age (years), n	
<20	38
20–60	66
>60	16
Sex, n	
Male	58
Female	62
Race, n	
White	93
Black	16
Others	11
SEER stage, n	
Localized	50
Regional	55
Distant	15
Surgery, n	
Yes	111
No	9
Radiation, n	
Yes	11
No	109
Chemotherapy, n	
Yes	78
No	42
OS rate, n	
1-year	109
3-year	95
5-year	85

FOS, fibroblastic osteosarcoma; SEER, Surveillance, Epidemiology, and End Results; SD, standard deviation; IQR, interquartile range; OS, overall survival.

Univariate and multivariate Cox proportional hazards analyses

The results of univariate and multivariate Cox regression for OS in the training cohort are presented in *Table 3*. The results of univariate analysis revealed that age, SEER stage, and radiotherapy were significant factors influencing OS. In the multivariate analysis of OS in the training cohort, it was observed that only SEER stage was statistically significant. The results of univariate and multivariate Cox regression for OS in the testing cohort were presented in *Table 4*. The results of univariate analysis indicated that age, SEER stage, and surgery were significant factors influencing OS. In the multivariate analysis of OS in the testing cohort, it was determined that age and SEER stage were statistically significant. It can be seen that the results of the training cohort and test cohort were similar. Using data from 120 patients with FOS, we explored predictors of death due to FOS. The univariate analysis showed that age, in distant of SEER stage, and undergoing radiation were indicators of unfavorable prognosis, however, undergoing surgery was indicator of favorable prognosis. The multivariate analysis demonstrated that older than age, and in distant of SEER stage were independent indicators of unfavorable prognosis (*Table 5*).

Prognostic factors for survival in FOS

After using Kaplan-Meier survival analysis for 5 years OS, it was found that FOS in the distant stage of SEER (P<0.01) (*Figure 2A*), not undergoing surgery (P<0.01) (*Figure 2B*), and undergoing radiation (P=0.03) (*Figure 2C*) had significantly worse prognoses. There were no significant difference in 5 years survival between FOS patients by age (P=0.09) (*Figure 2D*), sex (P=0.36) (*Figure 2E*), race (P=0.25) (*Figure 2F*), and chemotherapy (P=0.41) (*Figure 2G*).

Construction and validation of prognostic nomogram

We then incorporated all clinicopathological factors to develop a nomogram to predict the probability of OS at 1, 3, and 5 years for FOS (*Figure 3A*). After successful development of the nomograms, a series of indicators were used for internal verification. The risk score was calculated based on the model, and the survival time of the high-

Table 2 The demographics and clinical characteristics of patients in training cohort and testing cohort

Characteristics	Total (n=120)	Training cohort (n=83)	Testing cohort (n=37)	P value
Age (years), mean ± SD	33.92±19.80	32.41±17.86	37.29±23.51	0.21
Age (years), median [IQR]	27 [5–85]	28 [5–73]	27 [11–85]	0.21
Survival time (months), median [IQR]	153 [3–493]	153 [4–490]	155 [3–493]	0.97
Age (years), n				0.20
<20	38	28	10	
20–60	66	47	19	
>60	16	8	8	
Sex, n				0.84
Male	58	41	17	
Female	62	42	20	
Race, n				0.29
White	93	61	32	
Black	16	13	3	
Others	11	9	2	
SEER stage, n				0.12
Localized	50	37	13	
Regional	55	39	16	
Distant	15	7	8	
Surgery, n				>0.99
Yes	111	77	34	
No	9	6	3	
Radiation, n				>0.99
Yes	11	8	3	
No	109	75	34	
Chemotherapy, n				0.10
Yes	78	58	20	
No	42	25	17	
Vital, n				0.11
Alive	66	50	16	
Dead	54	33	21	

SD, standard deviation; IQR, interquartile range; SEER, Surveillance, Epidemiology, and End Results.

risk and low-risk groups is displayed in *Figure 3B*. The AUC values for the nomogram model were 0.74, 0.76, and 0.77 for 1-, 3-, and 5-year OS, respectively (*Figure 3C*). Comparing the predicted and actual probabilities of OS at 1, 3, and 5 years for the FOS, the calibration plot was found to show that the predict risk curve is very close to the ideal curve, indicating a good predictive power (*Figure 3D*). The DCA results indicated the model provided good net benefits to FOS patients (*Figure 3E-3G*). In the external validation of the training cohort, the AUC values for the nomogram

Table 3 Univariate and multivariate Cox analysis of 5-year OS in patients with FOS in training cohort (n=83)

Characteristics	Total, n	Univariate analysis		Multivariate analysis	
		Hazard ratio (95% CI)	P value	Hazard ratio (95% CI)	P value
Age	83	1.02 (1.00–1.04)	0.03	1.02 (0.99–1.04)	0.13
Race					
Others	9	Reference			
White	61	0.80 (0.27–2.35)	0.68		
Black	13	1.63 (0.48–5.51)	0.44		
Sex					
Male	41	Reference			
Female	42	0.74 (0.37–1.47)	0.40		
SEER stage					
Distant	7	Reference		Reference	
Localized	37	0.13 (0.05–0.35)	<0.01	0.10 (0.03–0.31)	<0.01
Regional	39	0.17 (0.06–0.45)	<0.01	0.21 (0.08–0.58)	<0.01
Surgery					
Yes	77	Reference		Reference	
No	6	2.52 (0.96–6.62)	0.06	1.87 (0.52–6.79)	0.33
Radiation					
Yes	8	Reference		Reference	
No	75	0.35 (0.14–0.84)	0.02	0.33 (0.09–1.15)	0.08
Chemotherapy					
No	25	Reference			
Yes	58	1.02 (0.49–2.13)	0.96		

OS, overall survival; FOS, fibroblastic osteosarcoma; CI, confidence interval; SEER, Surveillance, Epidemiology, and End Results.

model were 0.70, 0.73, and 0.74 for 1-, 3-, and 5-year OS, respectively (*Figure 4A*). The calibration plots indicated that the predicted 1-, 3-, and 5-year OS rates based on the column line plots were consistent with the actual OS rates (*Figure 4B*). In the high-risk group, the survival time was shorter (*Figure 4C*). The DCA results indicated the model provided good net benefits to FOS patients (*Figure 4D-4F*). In the testing cohort for external validation, similar results were found (*Figure 4G-4L*). These findings suggest that the nomogram is a more precise and practical tool for predicting OS in patients with FOS.

Discussion

Osteosarcoma, a common primary bone tumor in humans, has a fairly constant OS rate for >20 years (7). The pathologic signature of osteosarcoma is the presence of malignant osteocytes, and thus seven tumor cell types have been reported in osteosarcoma based on the basic neoplastic cell type. They are chondroblast-like, fibroblast-like, histiocyte-like, myofibroblast, osteoclast-like, and angioblast-like cells (8). Based on the histological presentation, osteosarcoma is subdivided into osteoblastic, chondroblastic, fibroblastic, telangiectatic, low-grade osteosarcoma, small-cell osteosarcoma, parosteal osteosarcoma, and periosteal osteosarcoma (9).

FOS in osteosarcoma is not very common, accounting for only 10% of osteosarcomas, as previously reported in the literature (3). A study, conducted by some German scholars, counted bone tumor data from the SEER database

Table 4 Univariate and multivariate Cox analysis of 5-year OS in patients with FOS in testing cohort (n=37)

Characteristics	Total, n	Univariate analysis		Multivariate analysis	
		Hazard ratio (95% CI)	P value	Hazard ratio (95% CI)	P value
Age	37	1.05 (1.02–1.06)	<0.01	1.05 (1.02–1.07)	<0.01
Race					
White	32	Reference			
Others	2	4.38 (0.92–20.66)	0.06		
Black	3	1.36 (0.31–6.04)	0.68		
Sex					
Male	17	Reference			
Female	20	0.87 (0.36–2.04)	0.74		
SEER stage					
Distant	8	Reference		Reference	
Localized	13	0.24 (0.07–0.79)	0.01	0.19 (0.04–0.74)	0.01
Regional	16	0.24 (0.07–0.74)	0.01	0.16 (0.03–0.66)	0.01
Surgery					
Yes	34	Reference		Reference	
No	3	7.44 (1.81–30.61)	<0.01	1.19 (0.23–6.12)	0.83
Radiation	37				
No	34	Reference			
Yes	3	1.31 (0.29–5.81)	0.72		
Chemotherapy					
Yes	20	Reference			
No	17	1.60 (0.66–3.86)	0.29		

OS, overall survival; FOS, fibroblastic osteosarcoma; CI, confidence interval; SEER, Surveillance, Epidemiology, and End Results.

between 1973 and 2012, the results showed that there were 12,931 primary malignant bone tumors in the United States over a 39-year period, of which only 3,730 were osteosarcomas, and only 281 were osteosarcomas with FOS, suggesting that FOS accounted for approximately 7.53% of osteosarcomas (10). It has been shown that the incidence of FOS is not high. However, the 5 years survival rate for osteosarcoma has not improved significantly in the last 20 years, despite continued improvements in diagnostic and therapeutic techniques. Optimistically, FOS is a preferred histological type in osteosarcoma and has a better prognosis because it responds well to treatment (11,12). We searched the previous literature and found only sporadic case reports on FOS. Last year, a case report on FOS was documented by some Chinese scholars, who identified a 60-year-old male patient with primary FOS of the sternum, the patient underwent three resections and two reconstruction procedures; however, the tumor size was only 3 cm, indicating a high risk of recurrence of FOS (13). While in 2017 some Indian scholars reported that they had treated a patient with FOS of the jaw, a 35-year-old female individual (8). However, due to the low incidence, no systematic analysis of FOS has been performed in the literature until now. Because SEER contains a large amount of clinical data on oncology patients, we systematically analyzed the prognosis and associated risk factors for FOS using the SEER database.

Using the SEER database, 150 cases diagnosed with FOS in "plus data, Nov. 2020 Sub (1975–2018)" dataset were identified. Finally, only 120 cases were included in

Table 5 Univariate and multivariate Cox analysis of 5-year OS in patients with FOS (n=120)

Characteristics	Total, n	Univariate analysis		Multivariate analysis	
		Hazard ratio (95% CI)	P value	Hazard ratio (95% CI)	P value
Age	120	1.03 (1.02–1.05)	<0.01	1.03 (1.02–1.05)	<0.01
Race					
Others	11	Reference			
White	93	0.69 (0.29–1.62)	0.39		
Black	16	1.18 (0.43–3.29)	0.75		
Sex					
Male	58	Reference			
Female	62	0.78 (0.46–1.33)	0.36		
SEER stage					
Distant	15	Reference		Reference	
Localized	50	0.15 (0.07–0.33)	<0.01	0.16 (0.07–0.36)	<0.01
Regional	55	0.19 (0.09–0.40)	<0.01	0.24 (0.11–0.53)	<0.01
Surgery					
Yes	111	Reference		Reference	
No	9	3.20 (1.51–6.89)	<0.01	2.54 (0.86–7.54)	0.09
Radiation					
Yes	11	Reference		Reference	
No	109	0.45 (0.21–0.95)	0.03	0.82 (0.27–2.45)	0.72
Chemotherapy					
No	42	Reference			
Yes	78	0.79 (0.46–1.38)	0.41		

OS, overall survival; FOS, fibroblastic osteosarcoma; CI, confidence interval; SEER, Surveillance, Epidemiology, and End Results.

the present study. During follow-up, 35 patients died, and OS at 5 years was 70.83% for all patients. Survival rates for patients diagnosed with osteosarcoma in the past two decades ranged from 55% to 70%, according to previous reports (14-16). Yao *et al.* counted 123 Chinese patients with advanced osteosarcoma, of whom 48 were non-metastatic, with a 5-year survival rate of 52.1% (17). Another study in 2021 based on the SEER database analyzed 835 patients and found a 5-year survival rate of 55% (18). This revealed that FOS has a higher 5-year survival rate and is a subtype of osteosarcoma with a good prognosis, which is similar to the previous literature (3,11).

In survival analysis, it was found that age (>60 years) was a poor prognostic indicator of FOS. As previously reported in the literature, there are two peaks in the age of osteosarcoma onset, 10–20 years and older than 60 years (19). In this study, we found that older patients with FOS had a poorer prognosis compared to younger patients. In addition, a distant stage in the SEER phase and not performing surgery are also poor prognostic indicators of FOS. These are similar to many solid tumors, in which failure to perform surgery and distant metastases are both poor prognostic factors (4,20). According to the records in the SEER database, these patients were unable to undergo surgery due to various reasons. Among them, three patients did not receive radiotherapy or chemotherapy, one patient received both radiotherapy and chemotherapy, four patients underwent radiotherapy only, and one patient underwent chemotherapy only. In order to provide more valuable references for clinical decision-making, the effectiveness

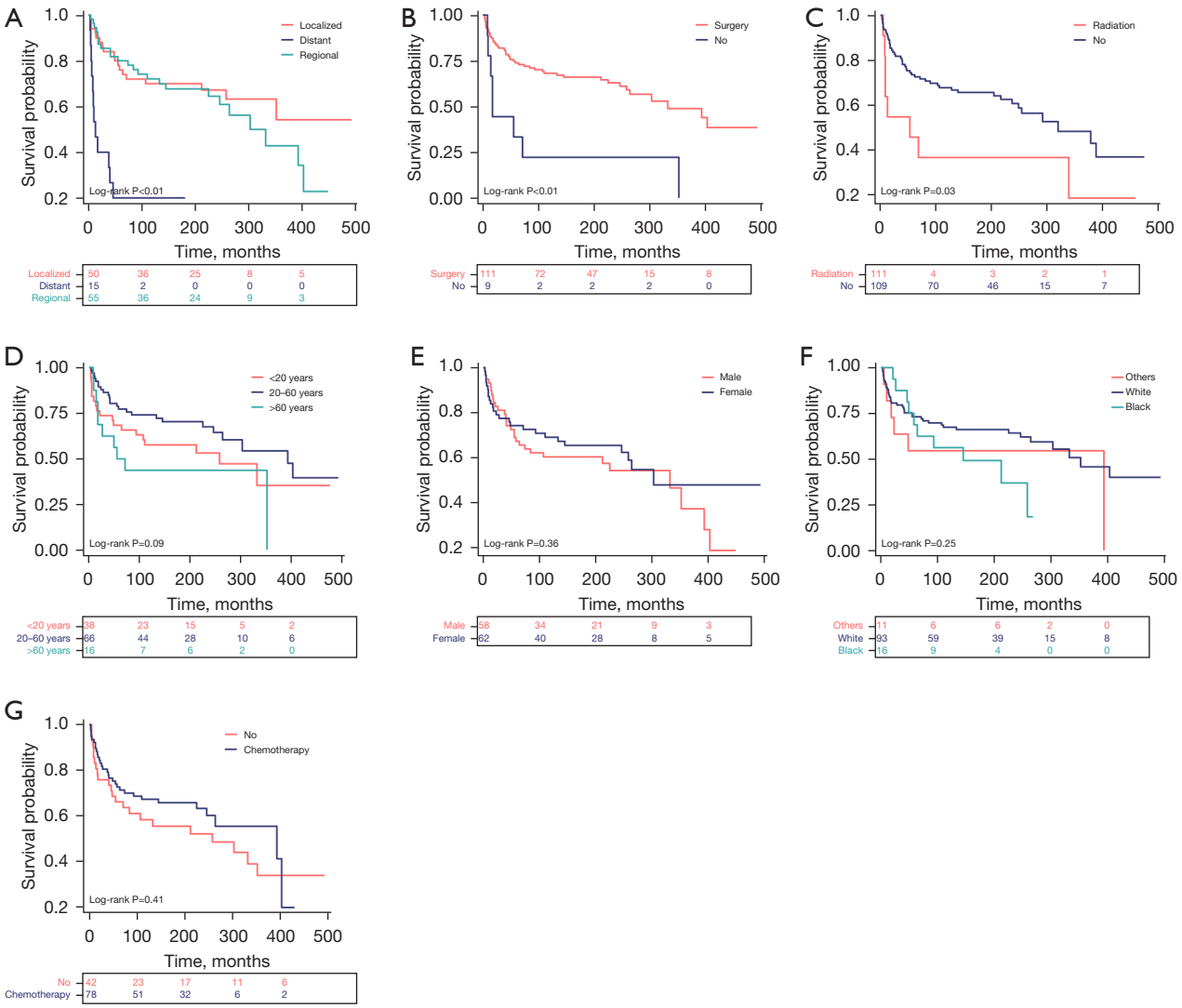

Figure 2 Kaplan-Meier survival curves for 5-year OS in patients with FOS. (A) SEER stage; (B) surgery; (C) radiation; (D) age; (E) sex; (F) race; (G) chemotherapy. OS, overall survival; FOS, fibroblastic osteosarcoma; SEER, Surveillance, Epidemiology, and End Results.

of these treatments and the prognosis of the patients remain to be further studied. Interestingly, patients with FOS who underwent radiotherapy had a worse prognosis and a shorter survival time than those who did not undergo radiotherapy. This is at odds with the current view that osteosarcoma is a radiation-resistant tumor and that radiation therapy does not improve osteosarcoma survival (21). We analyzed and thought that this was related to the following: first, the late tumor stage of the tumor in patients undergoing radiotherapy, and second, the small number of included cases. In our study, a total of 11 patients received radiotherapy. Among these 11 patients, four received radiotherapy alone, one received both radiotherapy and chemotherapy, four underwent radiotherapy in combination with surgery, and the remaining two patients received surgery, radiotherapy, and chemotherapy. However, due to the small sample size, it is difficult to conduct subgroup analysis when dividing the patients into those receiving single and those receiving combined therapy. To furnish clinicians with more insightful references for decision-making, further investigation is needed into the efficacy of these treatments and the patients' prognoses.

In addition, we found no significant difference in FOS survival between sex, ethnicity, chemotherapy, and primary

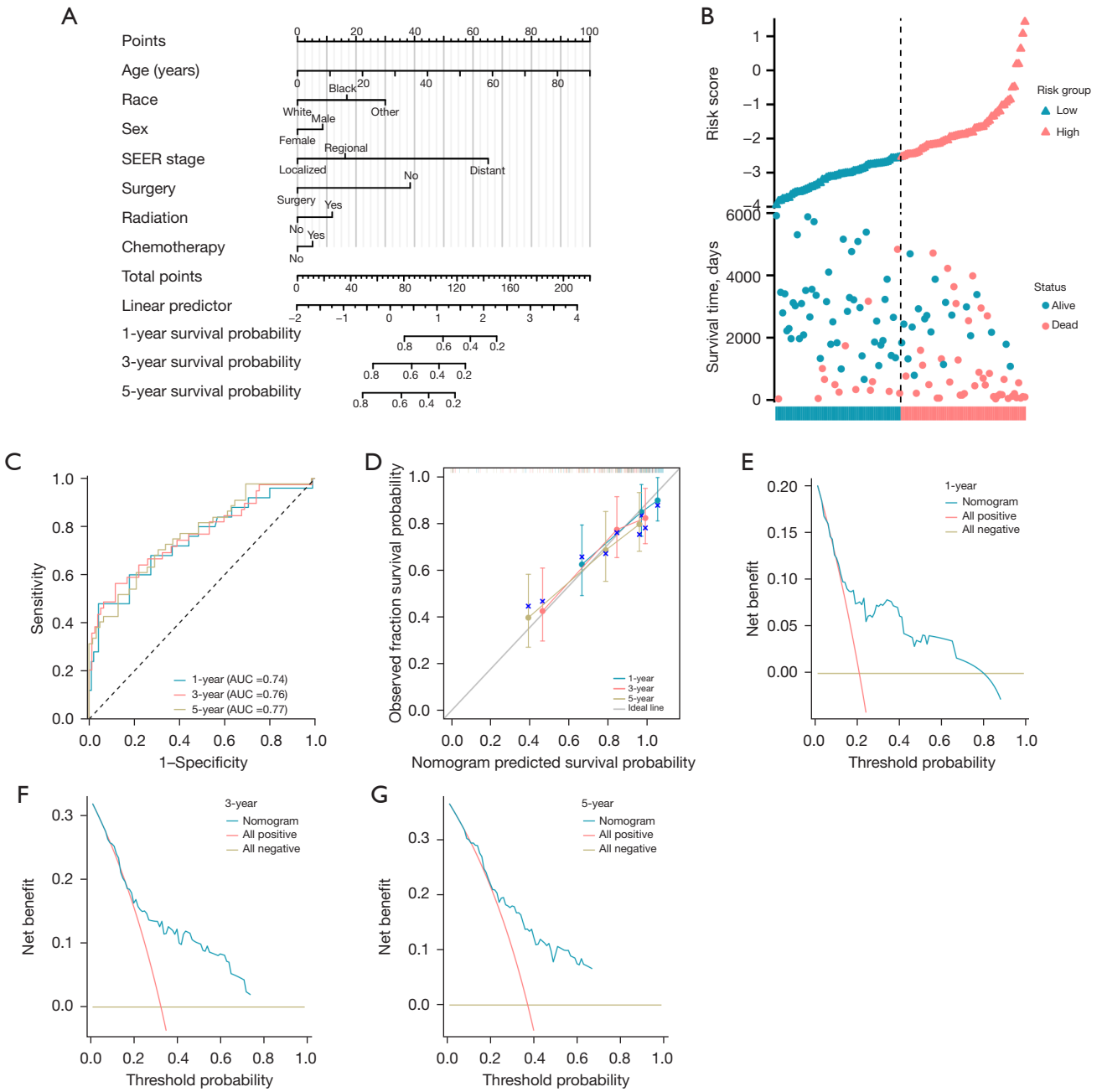

Figure 3 Construction of prognostic nomogram and internal validation. (A) Nomogram for 1-, 3-, and 5-year survival rate of children with FOS; (B) the survival time of the high-risk and low-risk groups among the 120 patients; (C) time-dependent ROC curve analysis of the nomogram for 1-, 3-, and 5-year; (D) calibration plot of the nomogram for the 1-, 3-, and 5-year OS rates in children with FOS; (E) the DCA of the nomogram at 1-year; (F) the DCA of the nomogram at 3-year; (G) the DCA of the nomogram at 5-year. SEER, Surveillance, Epidemiology, and End Results; AUC, area under the curve; FOS, fibroblastic osteosarcoma; ROC, receiver operating characteristic; OS, overall survival; DCA, decision curve analysis.

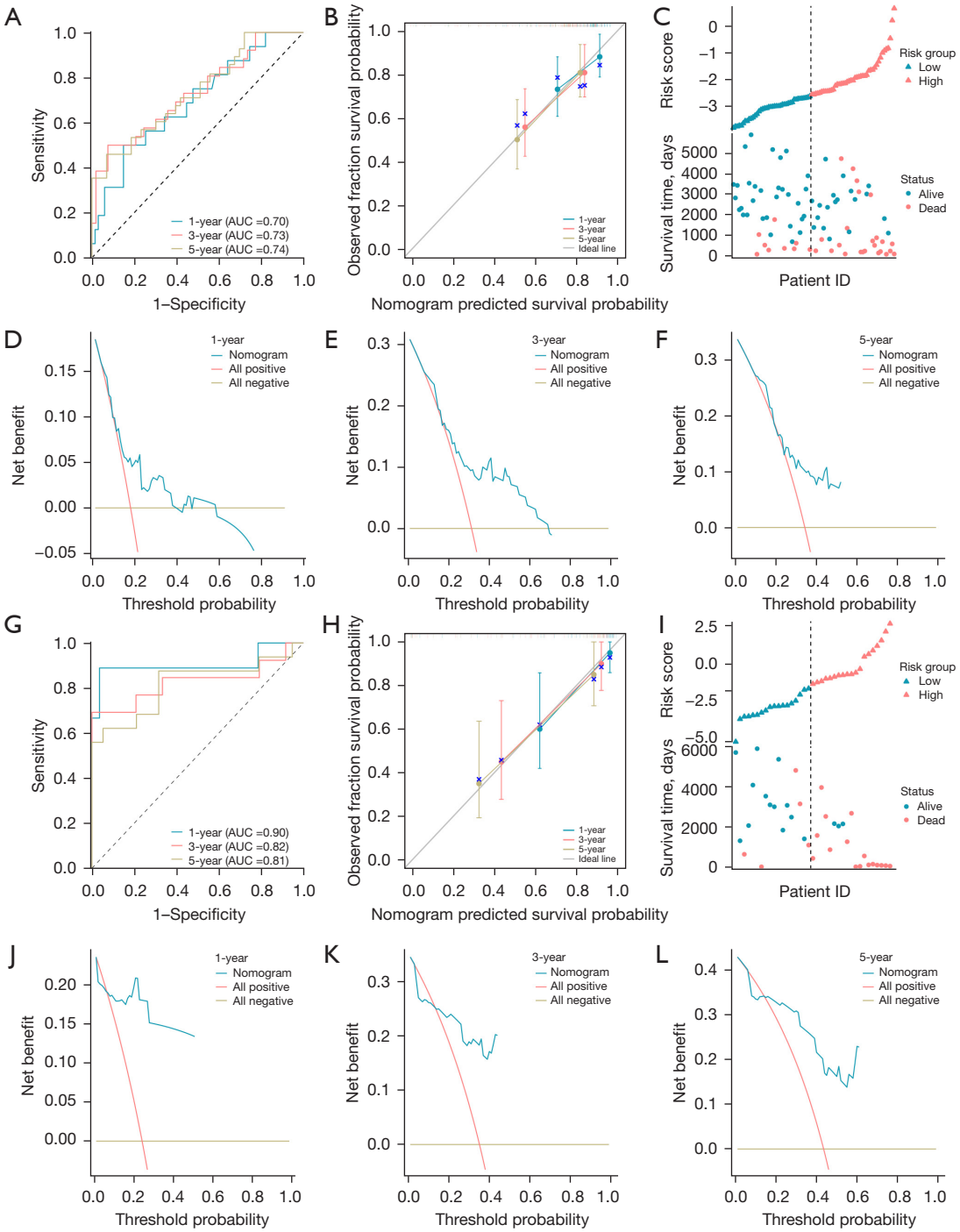

Figure 4 External validation of the prognostic nomogram. (A) Time-dependent ROC curve analysis of the nomogram for the 1-, 3-, and 5-year in training cohort; (B) the calibration plot of the nomogram displays the 1-, 3-, and 5-year OS rates in children with FOS in the training cohort; (C) the survival time of the high- and low-risk groups among the 85 patients in the training cohort; (D-F) the DCA of the nomogram in the training cohort at 1-, 3-, and 5-year; (G) time-dependent ROC curve analysis of the nomogram for the 1-, 3-, and 5-year in testing cohort; (H) the calibration plot of the nomogram displays the 1-, 3-, and 5-year OS rates in children with FOS in the testing cohort; (I) the survival time of the high-risk and low-risk groups among the 37 patients in testing cohort; (J-L) the DCA of the nomogram in the testing cohort at 1-, 3-, and 5-year. AUC, area under the curve; ROC, receiver operating characteristic; OS, overall survival; FOS, fibroblastic osteosarcoma; DCA, decision curve analysis.

tumor site. According to previous reports, chemotherapy improves the survival of patients with osteosarcoma (22). However, we found that for FOS, the presence or absence of chemotherapy did not affect patient survival. It is possible that previous studies of osteosarcoma did not specifically distinguish between the histological subtypes of osteosarcoma. It is also possible that different chemotherapy regimens are the cause, but the SEER database does not include chemotherapy regimens, which may limit our in-depth understanding and accurate assessment of the differences. Perhaps the difference in diagnosis periods is the reason. Although limiting the diagnosis period may result in a reduction of the total population, it can help include a more uniform patient group and reduce confounding chemotherapy parameters. Moreover, previous reports on the chemotherapeutic effects of osteosarcoma did not specifically categorize the pathological subtype of FOS.

In our study, multivariate analysis indicated that age >60 years and in distant of SEER stage were independent indicators of unfavorable prognosis for FOS. The above findings are consistent with many previous reports on osteosarcoma (18), suggesting that FOS and osteosarcoma are consistent in some respects.

Finally, we developed a nomogram to predict FOS survival with age, sex, ethnicity, surgery, radiation, chemotherapy, and primary site. By considering the personalized information and its corresponding values, we can calculate a total score that is utilized to predict the survival rate. The calibration plots showed that the predicted risk curve is very close to the ideal curve, indicating that the nomogram which, indicted it, has a good predictive power.

There are some limitations of our study that are worth noting. First, the information was not detailed, particularly the chemotherapy regimen; second, due to the limited clinical detail available in the SEER database, certain analyses, such as such as those related to disease-specific survival, event-free survival, 10-year OS, and recurrence rates were not performed; third, the majority of races in the SEER database were white; forth, this was a large retrospective study; in the end, the sample size was small. Thus, large, comprehensive population-based analyses clarifying important patterns of FOS incidence and survival, which should be further investigated in future studies.

Conclusions

The present study identified risk factors for survival in patients with FOS. We identified age and SEER stage as independent prognostic factors of FOS. It would be helpful for clinicians to better understand the characteristics of FOS and its prognosis.

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Footnote

Reporting Checklist: The authors have completed the TRIPOD reporting checklist. Available at https://tcr.amegroups.com/article/view/10.21037/tcr-24-126/rc

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://tcr.amegroups.com/article/view/10.21037/tcr-24-126/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study adhered strictly to the principles outlined in the Declaration of Helsinki (as revised in 2013). This study was approved by the Ethics Committee of Children's Hospital of Soochow University (2023016).

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