

# The Nomogram Application to Predict the Overall and Disease-specific Survival in Synovial Sarcoma: A Population Study

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## Research Article

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# Abstract

**Background:** Synovial sarcoma is an uncommon soft sarcoma that lacks prognostic prediction models. The nomograms were employed to predict patients' survival of synovial sarcoma.

**Methods:** Materials collected from 1941 synovial sarcoma cases in the SEER database were analyzed. We employed univariate and multivariate cox analyses to identify the independent prognostic variables. Based on these outcomes, the nomograms were built for predicting 1-, 3-, and 5- year overall survival rate and disease-specific survival rate and then validated in external dataset. C-indices, calibration plots and ROC curves were applied to assess nomogram accuracy.

**Results:** Patients were randomly classified into the training (n=1361) and testing (n=580) cohorts. Age, race, sex, primary anatomic site, chemotherapy, subtypes, surgery, SEER historic stage and tumor size were identified as independent prognostic variables ( $P < 0.05$ ) and then the nomogram of overall survival was constructed. Similarly, the nomogram of disease-specific survival was constructed. C-indices of training cohort for predicting overall and disease-specific survival were 0.779 and 0.779, respectively. Corresponding values of testing cohort were 0.769 and 0.765, respectively. The AUC values of prognostic model in the training cohort at 1-, 3-, 5- years of overall survival were 0.845, 0.785, and 0.788, respectively. Corresponding of disease-specific survival were 0.835, 0.783, and 0.787, respectively. The calibration plots illustrated excellent consistency between the survival rate of predicted and actual survival.

**Conclusion:** we constructed the reliable nomograms for synovial sarcoma patients to predict overall and disease-specific survival, which can offer precise and personalized survival prediction.

## Introduction

Synovial sarcoma is a rare subtype of soft sarcomas, which include roughly 5% to 10% of all soft sarcomas(1-3). It commonly affects adolescents and adults under 30 years of age with an incidence 800-1000 case per year in the USA (4). Lower limbs are the primary sites of the majority of synovial sarcoma, particularly the thigh area. Synovial sarcoma commonly appears to small round cell sarcoma in morphology, among which over 90% have the special chromosome translocation - t (X; 18) (p11. 2; q11. 2), producing SS18-SSX mixture gene(5, 6). Currently, wide resection, chemotherapy or excision combine with chemotherapy and/or radiotherapy have been abroad employed to cure synovial sarcoma(7). The 5- and 10-year survival rate of most of synovial sarcoma are 60% and 50%, respectively(8). Although several prognosis factors for synovial sarcoma including age, tumor size, tumor localization, tumor stage, tumor depth and surgery have been explored(9-11). Most of previous studies only served these variables as a solitary quota to assess prognosis, which restricted the influence for precisely predicting individualized survival of synovial sarcoma patients. Given this limitation, we were the first to construct the innovative prognostic models. Nomogram is an effective and convenient prognostic tool to assess the patients' prognosis of tumor(12). In this study, the nomograms of overall and disease-specific survival were built, which can assess the survival probability of personal more precisely than a single quota via combining all prognostic factors. Owing to its powerful robustness and more precisely predictive capacity, the nomogram can enhance the precise prediction of personal prognosis(13). The Surveillance, Epidemiology, and End Results (SEER) dataset between 1975 and 2016 collected clinical materials of synovial sarcoma patients from 18 national registries represents about 30% of overall population in the USA that permitted detailed analyses of

survival of synovial sarcoma(14). The aim of this study was the first to build powerful prognostic nomograms for predicting the 1-, 3-, and 5-year overall survival and disease-specific survival rates for synovial sarcoma patients.

## Materials And Variables

We performed a retrospective review of synovial sarcoma patients utilizing the Surveillance, Epidemiology, and End Results (SEER) database between January 1975 and December 2016 published in November 2018. The SEER\*Stat software (version 8.3.5) was applied to obtain patient information.

For present study, we employed the International Classification of Disease for Oncology morphology (ICD-O-3) codes to extract patients with synovial sarcoma from the database (9040/3, 9041/3, 9042/3, and 9043/3 for not otherwise specified (NOS), spindle cell, epithelioid cell, and biphasic). Clinicopathological features including age, sex, race (white, black, and others/unknown), subtypes of synovial sarcoma (spindle cell, epithelioid cell, biphasic, and NOS), anatomical site (upper limb, lower limb, pelvis, head and neck and other), grade (I, II, III, IV, and unknown), marital status (single/domestic partner, married, DWS (divorced, widowed and separated), and unknown), SEER historic stage (localized, regional, and distant), and tumor size. The cutoff value of age and tumor size were evaluated through X-tile software, which was formerly proved to identify optimal cut-points of variables(15). The best cutoffs of age were 19 and 59 years, so patients were divided into three groups ( $\leq 18$ ,  $19 \leq 59$ , or  $\geq 60$  years) (Fig.1). The optimal tumor size cutoff was 9.5 cm, so patients also were classified as two clusters ( $\leq 9.5$  cm, or  $>9.5$  cm) (Fig.1). Besides, the information of radiation therapy, chemotherapy, and surgery was also obtained. Radiation therapy, and chemotherapy, and surgery were categorized as yes or no/unknown. Surgery was categorized as yes or no.

### Statistical analysis

The variables of categorical are presented as frequencies and ratios and compared with the chi-squared tests. X-tile software was employed to evaluate the optimal cutoff values for age and tumor size on the foundation of overall survival. Univariate and multivariate analysis were employed to determine the variables correlated with overall survival and disease-specific survival via using univariate and multivariate cox proportional hazards regression analyses. The nomograms were built for predicting the 1-, 3-, and 5-year overall and disease-specific survival rates. The risk score of each patient was calculated according the following formula: risk score  $= \sum i \text{coefficient (prognostic variables)} \times \text{prognostic variables } i$ .

### Validation and evaluation of nomogram:

The training and testing cohorts were used to validate the nomograms. Receiver operating characteristic (ROC) curves were employed to assess the performance of nomograms using the R package "survivalROC". The calibration plots were applied to evaluate the consistency between the predicted survival rate and actual survival. Besides, concordance-index (C-index) was performed to assess the performance of nomograms, which was a practical assessment value close to counting the AUC value of ROC(16). The construction and verification of nomograms were applied utilizing the R package "rms". The univariate and multivariate cox proportional hazards regression analyses and chi-squared tests were employed with R software (version 4.1.0).  $P < 0.05$  of two-sided tests was regarded as statistically significant.

# Results

## Basic characteristics of patients

1941 synovial sarcoma patients between 1975 and 2016 were obtained from the SEER database. To construct and validate nomograms, we randomly divided 0.7 and 0.3 of the patients into the training cohort (n=1361) and testing cohort (n=580). Of these patients, most of them were 19~59 years old (71.12% and 72.76% in the training and testing cohorts, respectively), white (79.79% and 82.24%) and male (53.12% and 52.76%). The majority of primary anatomic location of these synovial sarcoma patients were lower limb (55.99% and 50.17%). With respect to SEER historic stage, localized tumors (62.97% and 63.10%) took the majority, followed by regional tumor (23.07% and 23.62%), distant tumor (10.51% and 9.48%) and unstaged tumor (3.45% and 3.79%). With regard to subtypes of synovial sarcoma, NOS (not otherwise specified) (42.47% and 41.38%) was most frequent followed by spindle cell (35.42% and 34.48%), biphasic cell (21.75% and 23.79%) and epithelioid cell (0.37% and 0.34%). Regarding marital status, single/domestic partner (46.29% and 43.79%) and married (42.98% and 45.34%) took the majority. In two cohorts, the majority of patients had undergone radiation therapy, chemotherapy and surgery. In regard to tumor size, the majority of tumors were less than 9.5cm (90.67% and 86.72%). All of synovial sarcoma patients' clinicopathological features are shown in Table 1.

## Univariate and multivariate cox regression analyses results for overall survival and disease-specific survival

In the training cohort, univariate and multivariate analyses were developed to determine independent prognostic variables for overall survival and disease-specific survival. As is listed in Table 2, race, age, sex, primary anatomic site, subtypes, radiation therapy, chemotherapy, surgery, marital status, SEER historic stage and tumor size were notably correlated with overall survival in univariate analyses. Thus, these eleven factors were further subject to multivariate cox analysis. The results of multivariate cox analysis showed that nine variables (age, race, sex, primary anatomic site, subtypes, chemotherapy, surgery, SEER historic stage and tumor size) were independent prognostic variables for overall survival. Similarly, as is listed in Table 3, age, race, sex, primary anatomic site, radiation therapy, grade, subtypes, chemotherapy, surgery, marital status, SEER historic stage and tumor size were notably correlated with disease-specific survival in univariate analysis. Thus, these twelve variables were further subject to multivariate cox analysis. The results of multivariate cox analysis illustrated that nine variables (sex, age, race, primary anatomic site, chemotherapy, subtypes, surgery, SEER historic stage and tumor size) were independent prognostic variables for disease-specific survival.

## Construction of the nomograms

The nine significant independent variables (age, race, sex, subtypes, primary anatomic site, chemotherapy, surgery, SEER historic stage and tumor size) from multivariate cox analysis were applied to construct the nomogram for predicting the 1-, 3-, and 5-year overall survival rates (Fig.2A). Similarly, the nine significant independent variables (age, sex, race, primary anatomic site, subtypes, chemotherapy, surgery, SEER historic stage and tumor size) from multivariate cox analysis were applied to construct the nomogram for predicting the 1-, 3-, and 5-year disease-specific survival rates (Fig.2B). The total points of all variables on the nomogram were summed and then exchanged into the probability rate of 1-, 3-, and 5- year overall survival or disease-specific survival with guideline of the linear parallel lines. The nomogram of overall survival illustrated that race (being black), having the largest absolute values, was the strongest factor to the negative prognosis, followed by distant tumor (metastasis), age, subtypes (epithelioid cell), anatomic site, tumor size (>9.5 cm), nonsurgical treatment,

chemotherapy, and being male. The nomogram of disease-specific survival indicated that being black, having the largest absolute values, was the strongest factor to the negative prognosis, followed by distant tumor (metastasis), subtypes (epithelioid cell), age, anatomic site, tumor size (>9.5 cm), nonsurgical treatment, chemotherapy, and being male.

#### Performance and verification of nomograms

C-index values for overall survival nomogram and disease-specific survival nomogram were as high as 0.779 and 0.779, respectively in the training cohort. Similarly, corresponding values for overall survival nomogram and disease-specific survival nomogram in the testing cohort were also high at 0.769 and 0.765, respectively. The areas under the curve (AUC) values of the prognostic model at 1-, 3-, 5- years of overall survival were 0.845, 0.785, and 0.788, respectively (Fig.3A). Similarly, corresponding values of the prognostic model at 1-, 3-, 5- years of disease-specific survival were 0.835, 0.783, and 0.787, respectively (Fig.3B). Both of findings demonstrated the models of overall survival and disease-specific survival owned the favorable discriminative capability. Finally, the prognostic nomograms of survival overall and disease-specific survival were validated in both two cohorts. The calibration plots illustrated wonderful agreement between the survival of predicted probability and actual survival (Fig.4).

## Discussion

Synovial sarcoma is a malignant mesenchymal neoplasm with incomplete epithelial differentiation that comprise about 5 % ~ 10% of all soft tissue sarcomas(3). It is highly correlated with recurrence and metastases, which occur in about 50% to 70% of cases(17). The 5- and 10-year survival rate of synovial sarcoma are about 60% and 50%, respectively(8). Because of the low incidence of synovial sarcoma amid the population, it was a big challenge for doctors to research this soft sarcoma among large patient populations(18). In this study, utilizing a large synovial sarcoma patient cohort from the SEER dataset, we were first to construct two novel, efficient and convenient nomograms for assessing individual overall survival and disease-specific survival rates for patients with a rare cancer—synovial sarcoma. The nomograms illustrated successful accuracy and robustness when applied to both training and testing cohorts, which demonstrated good clinical capacity of the nomograms for this uncommon soft sarcoma.

In order to precisely filter the optimal prognostic factors, we employed univariate and multivariate cox proportional hazards regression analyses to determine independent prognostic variables. The results indicated that age, sex, race, primary anatomic site, chemotherapy, subtypes, surgery, SEER historic stage and tumor size are independent prognostic factors for overall survival and disease-specific survival of synovial sarcoma patients. In past studies, growing age of patient was correlated with a statistically notable decline in the survival rate of synovial sarcoma patients(4, 19, 20). Pan et al found that synovial sarcoma patients over 50 years old had poorer survival results(10). Similarly, we confirmed growing age of patient is an independent risk variable for synovial sarcoma patients. X-tile software was applied to cluster the data of patient age on the foundation of survival status and time. The optimal cut-points of variables were identified and it was originally used in breast cancer. We identified that the best values of age of synovial sarcoma patients were 19 and 59 years. Similarly, tumor size is also an independent risk factor of synovial sarcoma patients. Some studies found that patients with larger tumor sizes had a worse survival and poorer prognosis (11, 21, 22). Similarly, we confirmed increasing tumor size of patient is a negative factor for synovial sarcoma patients. X-tile software was also employed to

achieve the optimal cut-point of tumor size. We showed that the best tumor size cut-point of synovial sarcoma patients was 9.5 cm. Aytekin et al showed that male and being colored individual of synovial sarcoma patients had poorer prognosis(23). We also noticed that sex had a significant influence on synovial sarcoma patient survival rate and race was correlated with overall survival. Besides, we also identified that surgery had a positive influence on synovial sarcoma patient survival rate. similar results have been reported by previous studies(24, 25).

In our study, we determined that SEER historic stage and anatomic site were the most important prognostic variables for synovial sarcoma patients. As for tumor stage at diagnosis, previous studies reported that synovial sarcoma patients with metastases own a remarkably poorer survival prognosis(10, 26, 27). It was reported that patients with lung metastases only and treated with curative metastasectomy have better relative survival(24). Similarly, we found that synovial sarcoma patients with distant metastases had the highest risk of death. Synovial sarcoma appear mostly in the lower extremities, while it is less common in the upper limbs, trunk and head and neck(28). Sultan et al and Xiong et al indicated that tumors located in the extremities of synovial sarcoma patients had better prognosis(20, 29). Similarly, compared with lower limb and central lesions, tumors located in upper limb associated with increased overall survival(11). Our study also illustrated that tumor site was associated with the survival of synovial sarcoma patients. Besides, we identified chemotherapy as an independent risk prognostic negative variable for patients of synovial sarcoma. Despite wide application, the benefits of chemotherapy for synovial sarcoma patients remain controversial. Some previous studies reported that chemotherapy was not associated with better survival(30, 31). However, some studies reported that chemotherapy had a positive effect on survival rate and reducing distant metastasis(32, 33). Patients who received no chemotherapy and patients who were unknown for having been received chemotherapy or not had the same code. Therefore, there was some certain deviation in the accuracy of chemotherapy data. More robust evidence about the benefits of chemotherapy are needed from future studies. Besides, we found that different subtypes of synovial sarcoma have different overall survival and disease-specific survival and subtype is an independent prognostic variable. And pervious study has proved that among different subtypes of synovial sarcoma, the subtype of biphasic owned the best survival, but the subtype of epithelioid cell favoured the worst survival(34).

Based on the abovementioned independent prognostic variables, we constructed prognostic nomograms that provide an efficient and convenient method to assess 1-, 3-, and 5-year overall survival and disease-specific survival for synovial sarcoma patients. The nomograms can enhance the accuracy of predicting individual survival results of synovial sarcoma patients at a specific time point.

Although the nomograms in our study demonstrated favorable predictive capability, there are some limitations should be admitted. First, the data information about chemotherapy were limited in the SEER database, which may lead to some relevant bias. Second, the database contains a certain number of missing data, which might have reduced the amounts of eligible patients. Finally, the performance of our prognostic nomograms should be externally validated in another independent, large-scale database.

## Conclusion

The present study identified age, sex, race, anatomic site, chemotherapy, subtypes, surgery, SEER historic stage and tumor size as independent prognostic factors for both the overall survival and disease-specific survival of

synovial sarcoma patients. These independent prognostic factors were combined to construct the nomograms for predicting prognosis of synovial sarcoma patients. Using our nomogram, the 1-, 3- and 5-year overall survival and disease-specific survival rates for synovial sarcoma patients can be assessed, which enable surgeons to evaluate personalized survival rate more reliable and accurate and identify mortality risk.

## Declarations

### **Ethics approval and consent to participate:**

Not applicable.

### **Consent for publication:**

Not applicable.

### **Availability of data and materials:**

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

### **Competing interests:**

The authors declare that they have no competing interests.

### **Funding:**

None.

### **Authors' contributions:**

Bo Xiao designed the research study; Bo Xiao, Zhuoyuan Chen and Liyan Liu performed the literature search and statistical analysis; and Bo Xiao, Pingxiao Wang and Cheng Xiang interpreted the data and drafted the manuscript. Both Hui Li and Tao Xiao are corresponding authors. Bo Xiao, Hui Li and Tao Xiao critically revised the manuscript. All authors read and approved the final manuscript.

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## Tables

Table1: Basic and clinical features of patients in this study.		
Variable n (%)	Training Cohort (n=1361)	Testing Cohort (n=580)
Age		
<=18	247 (18.15)	97 (16.72)
19~59	968 (71.12)	422 (72.76)
>=60	146 (10.73)	61 (10.52)
Race		
White	1086 (79.79)	477 (82.24)
Black	160 (11.76)	46 (7.93)
Others	105 (7.71)	51 (8.79)
Unknown	10 (0.734)	6 (1.03)
Sex		
Female	638 (46.88)	274 (47.24)
Male	723 (53.12)	306 (52.76)
Anatomic site		
Upper limb	245 (18.00)	131 (22.59)
Lower limb	762 (55.99)	291 (50.17)
Pelvis	75 (5.51)	26 (4.48)
Head and Neck	73 (5.36)	35 (6.03)
Other	206 (15.14)	97 (16.72)
Grade		
I	30 (2.20)	5 (0.86)
II	181 (13.30)	91 (15.69)
III	326 (23.95)	145 (25.00)
IV	245 (18.00)	97 (16.72)
Unknown	579 (42.54)	242 (41.72)
Subtypes		
Biphasic	296 (21.75)	138 (23.79)
Epithelioid cell	5 (0.37)	2 (0.34)

Spindle cell	482 (35.42)	200 (34.48)
NOS*	578 (42.47)	240 (41.38)
Radiation therapy		
No/Unknown	560 (41.15)	214 (36.90)
Yes	801 (58.85)	366 (63.10)
Chemotherapy		
No/Unknown	708 (52.02)	310 (53.45)
Yes	653 (47.98)	270 (46.55)
Surgery		
No	105 (7.71)	310 (53.45)
Yes	1256 (92.29)	270 (46.55)
Marital status		
Single/Domestic partner	630 (46.29)	254 (43.79)
Married	585 (42.98)	263 (45.34)
DSW*	106 (7.79)	50(8.62)
Unknown	40 (2.94)	13 (2.24)
SEER historic stage		
Localized	857 (62.97)	366 (63.10)
Regional	314 (23.07)	137 (23.62)
Distant	143 (10.51)	55 (9.48)
Unstaged	47 (3.45)	22 (3.79)
Tumor size		
<=9.5 cm	1234 (90.67)	503 (86.72)
>9.5 cm	127 (9.33)	77 (13.28)

Table 2: The overall survival results of univariate and multivariate analyses in the training cohort.

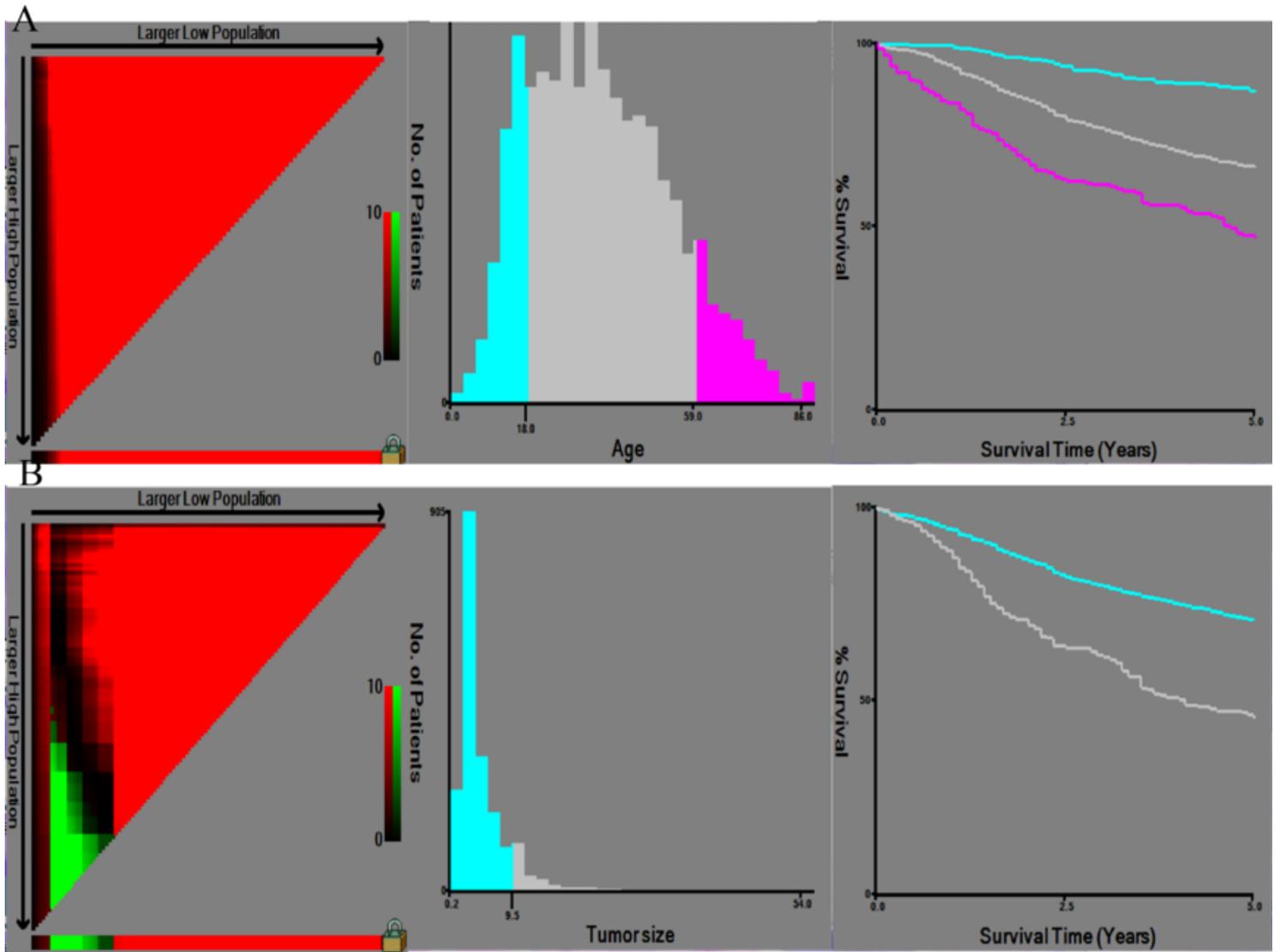
Variable	Univariate analysis			Multivariate analysis		
	HR	95%CI	P	HR	95%	P
Age						
<=18	Reference			Reference		
19~59	2.303	1.722~3.080	1.87e-08	2.289	1.6608~3.1535	4.17e-07
>=60	4.838	3.432~6.821	< 2e-16	5.644	3.7832~8.4194	< 2e-16
Race						
White	Reference			Reference		
Black	1.718e+00	1.3595~2.170	5.81e-06	1.522	1.1979~1.9335	0.000585
Others	1.082e+00	0.7687~1.523	0.652	1.065	0.7519~1.5084	0.723105
Unknown	3.194e-07	0.0000~Inf	0.988	1.813e-07	0.0000~Inf	0.988043
Sex						
Female	Reference			Reference		
Male	1.375	1.153~1.64	0.000403	1.323	1.1030~1.5858	0.002538
Anatomic site						
Upper limb	Reference			Reference		
Lower limb	1.830	1.370~2.443	4.23e-05	1.638	1.2218~2.1967	0.000973
Pelvis	2.384	1.548~3.673	8.13e-05	1.772	1.1394~2.7553	0.011112
Head and Neck	2.041	1.287~3.238	0.00242	1.971	1.2319~3.1533	0.004658
Other	3.505	2.538~4.842	2.74e-14	2.652	1.9062~3.6908	7.15e-09
Grade						
I	Reference			NI		
II	0.744	0.3947~1.403	0.3608			
III	1.764	0.9780~3.183	0.0593			
IV	1.561	0.8590~2.838	0.1439			
Unknown	1.084	0.6054~1.941	0.7860			
Subtypes						
Biphasic	Reference					
Epithelioid cell	3.412	1.254~9.284	0.01626	3.858	1.3941~10.6744	0.009329

Spindle cell	1.317	1.025~1.694	0.03147	1.299	1.0061~1.6783	0.044768
NOS*	1.399	1.101~1.777	0.00597	1.341	1.0493~1.7128	0.019013
Radiation therapy						
No/Unknown	Reference			Reference		
Yes	0.815	0.6843~0.9707	0.0218	8.525e-01	0.7126~1.0199	0.080992
Chemotherapy						
No/Unknown	Reference			Reference		
Yes	1.788	1.499~2.133	1.09e-10	1.375	1.1281~1.6761	0.001615
Surgery						
No	Reference			Reference		
Yes	-1.3122	0.1295~ -10.13	<2e-16	6.592e-01	0.4941~0.8795	0.004611
Marital status						
Single/Domestic partner	Reference			Reference		
Married	1.2815	1.0662~1.540	0.00823	8.262e-01	0.6695~1.0197	0.075346
DSW	1.3592	0.9822~1.881	0.06404	8.720e-01	0.6144~1.2375	0.443039
Unknown	1.09786	0.4276~1.520	0.50566	5.810e-01	0.3030~1.1139	0.101990
SEER historic stage						
Localized	Reference			Reference		
Regional	2.230	1.8153~2.740	2.2e-14	1.798	1.4522~2.2257	7.24e-08
Distant	8.857	7.0214~11.172	< 2e-16	5.835	4.4747~7.6085	< 2e-16
Unstaged	1.232	0.7044 ~2.155	0.464	8.721e-01	0.4859~1.5653	0.646577
Tumor size						
<=9.5cm	Reference			Reference		
>9.5cm	2.619	2.099~3.268	<2e-16	1.807	1.4345~2.2760	5.07e-07

Table 3: The disease-specific survival outcomes of univariate and multivariate analyses in the training cohort.						
Variable	Univariate analysis			Multivariate analysis		
	HR	95%CI	P	HR	95%	P
Age						
<=18	Reference			Reference		
19~62	2.249	1.667~3.035	1.14e-07	2.071	1.4847~2.890	1.82e-05
>=63	3.562	2.453~5.173	2.49e-11	4.152	2.7004~6.382	8.74e-11
Race						
White	Reference			Reference		
Black	1.741	1.3634~2.223	8.8e-06	1.497	1.1648~1.924	0.00162
Others	1.071	0.7456~1.539	0.710	1.084	0.7464~1.576	0.67058
Unknown	3.194e-07	0.0000~Inf	0.989	1.553e-07	0.0000~Inf	0.98817
Sex						
Female	Reference			Reference		
Male	1.396	1.159~1.682	0.000449	1.340	1.1054~1.624	0.00288
Anatomic site						
Upper limb	Reference			Reference		
Lower limb	2.042	1.4880~2.802	9.82e-06	1.776	1.2872~2.450	0.00047
Pelvis	2.741	1.7345~4.332	1.57e-05	1.871	1.1705~2.989	0.00884
Head and Neck	1.615	0.9349~2.791	0.0857	1.557	0.8915~2.720	0.11967
Other	3.848	2.7095~5.465	5.14e-14	2.909	2.0335~4.162	5.09e-09
Grade						
I	Reference					
II	0.7538	0.3769~1.507	0.4240	9.479e-01	0.4717~1.905	0.88057
III	1.9502	1.0250~3.710	0.0418	1.710e+00	0.8924~3.275	0.10592
IV	1.6511	0.8604~3.168	0.1316	1.627e+00	0.8405~3.149	0.14870
Unknown	1.1445	0.6052~2.164	0.6779	1.164e+00	0.6115~2.215	0.64396
Subtypes						
Biphasic	Reference					
Epithelioid cell	3.833	1.405~10.461	0.00871	3.203	1.1404~8.994	0.02715
Spindle cell	1.355	1.037~1.770	0.02581	1.284	0.9774~1.687	0.07249

NOS*	1.471	1.140~1.898	0.00299	1.387	1.0677~1.801	0.01426
Radiation therapy						
No/Unknown	Reference			Reference		
Yes	0.823	0.6844~0.9898	0.0386	8.399e-01	0.6929~1.018	0.07547
Chemotherapy						
No/Unknown	Reference			Reference		
Yes	1.965	1.628~2.371	1.95e-12	1.327	1.0718~1.643	0.00944
Surgery						
No	Reference			Reference		
Yes	0.2678	0.2053~0.3493	<2e-16	6.981e-01	0.5146~0.947	0.02090
Marital status						
Single/Domestic partner	Reference			Reference		
Married	1.2381	1.0207~1.502	0.0302	8.605e-01	0.6902~1.073	0.18203
DSW	1.2446	0.8760~1.768	0.2221	8.392e-01	0.5762~1.222	0.36078
Unknown	0.6959	0.3432~1.411	0.3148	5.212e-01	0.2525~1.076	0.07800
SEER historic stage						
Localized	Reference			Reference		
Regional	2.337	1.8792~2.905	2.21e-14	1.897	1.5128~2.378	2.87e-08
Distant	9.648	7.5908~12.264	< 2e-16	5.868	4.4497~7.739	< 2e-16
Unstaged	1.091	0.5776~2.059	0.789	8.805e-01	0.4573~1.695	0.70326
Tumor size						
<=9.5cm	Reference			Reference		
>9.5cm	2.826	2.248~3.554	<2e-16	2.003	1.5730~2.552	1.80e-08

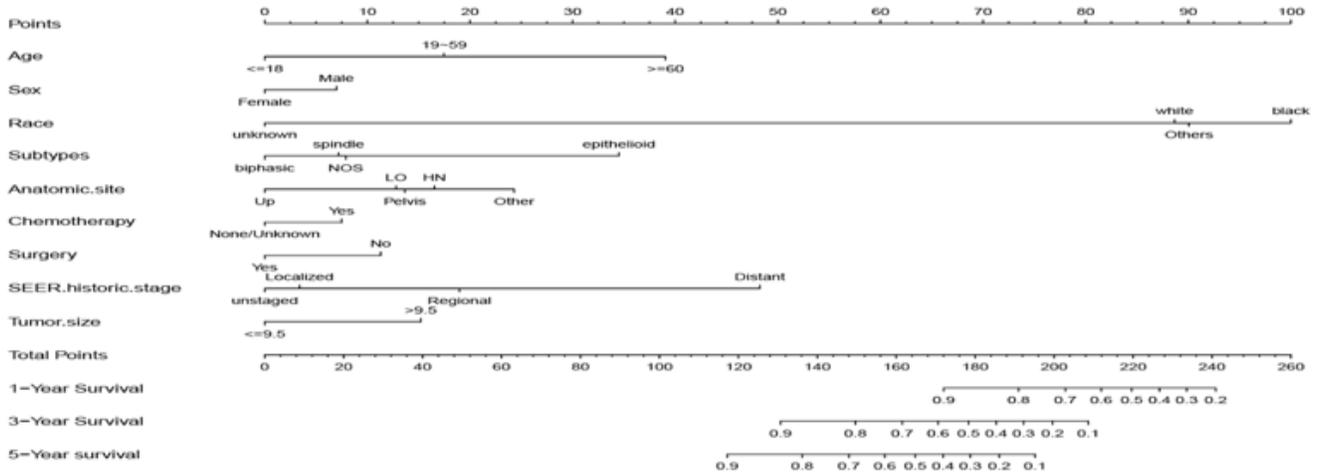
## Figures



**Figure 1**

Picking out the best cutoffs of age (a) and tumor size (b). The best cutoffs of age were 19 and 62 years on the foundation of overall survival. The best cutoffs of tumor size were 2.3 cm and 8.0 cm on the foundation of overall survival. Histogram and K–M analysis were plotted on the foundation of outcomes of cutoffs.

A



B

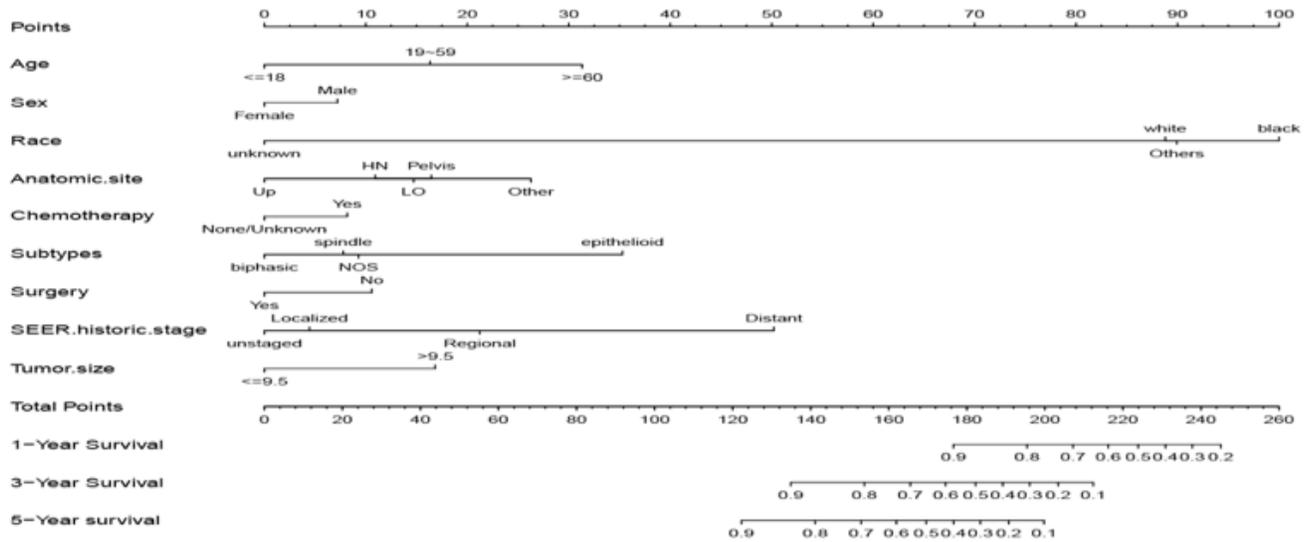
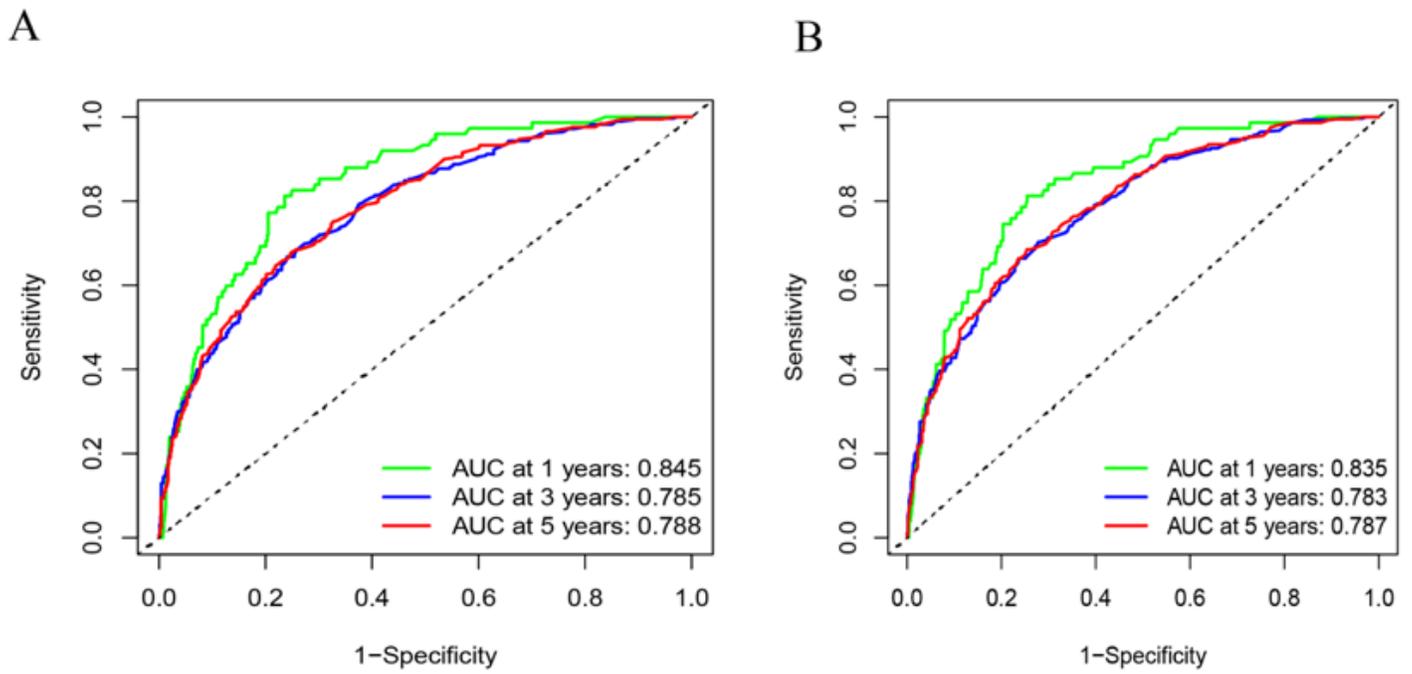


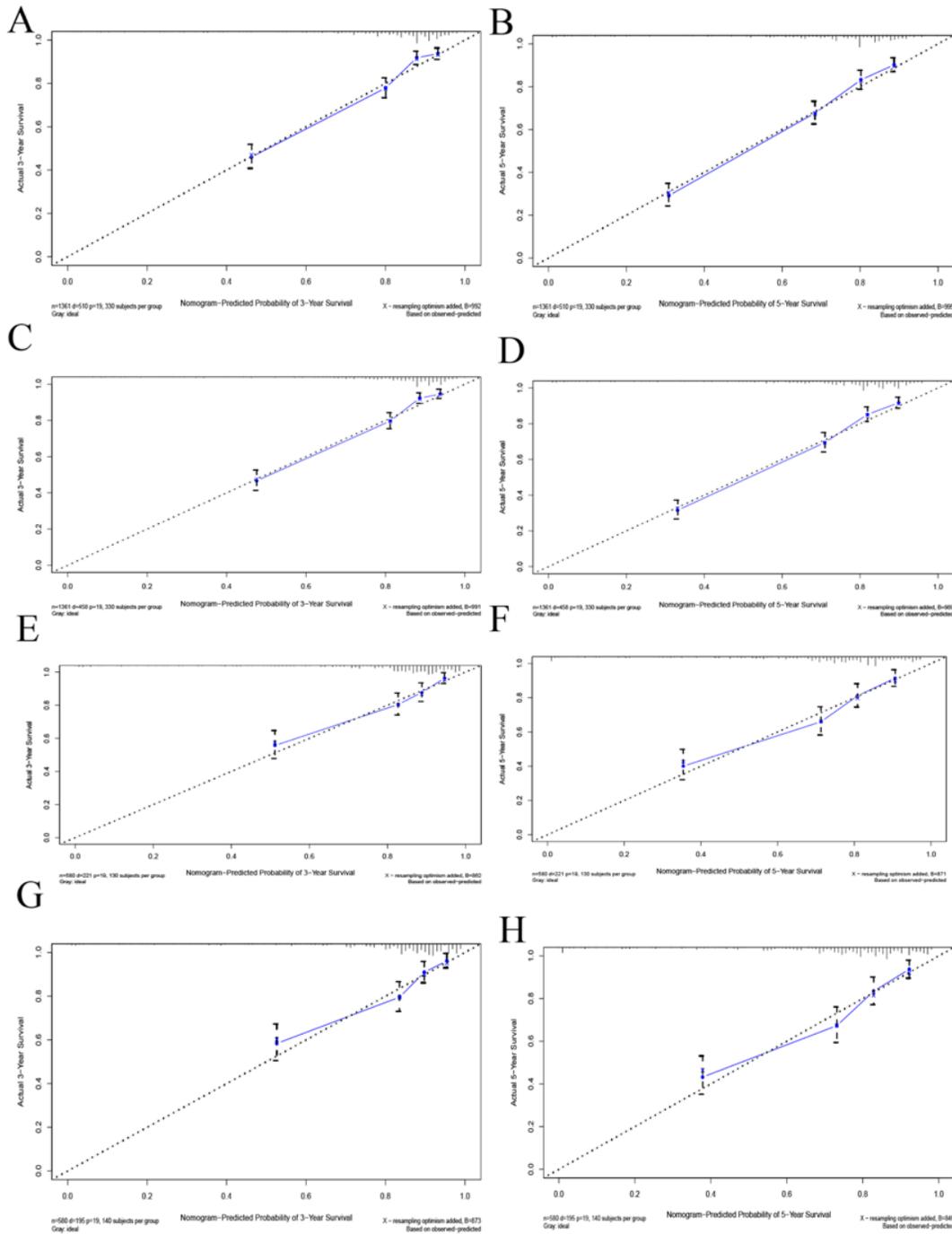
Figure 2

Nomograms to predict 1-, 3- and 5-year overall survival (a) and disease-specific survival (b) for synovial sarcoma patients. \*HN: head and neck. Up: Upper limb. LO: lower limb. epithelioid: epithelioid cell. spindle: spindle cell.



**Figure 3**

ROC curves of 1-, 3- and 5-year overall survival (a) and disease-specific survival (b) in the training cohort.



**Figure 4**

Calibration curves of 3- and 5-year overall survival (a, b) and disease-specific survival (c, d) in the training cohort. Calibration curves of 3- and 5-year overall survival (e, f) and disease-specific survival (g, h) in the testing cohort.