

Development and validation of a nomogram to predict Bladder cancer in patients with different metastasis: a SEER database analysis

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Abstract

Purpose: Population-based data on the clinical correlates and prognostic value of the pattern of metastases among patients with bladder cancer are needed. Patients and methods: Surveillance, epidemiology and end results (SEER) database has been explored through SEER program. For each of four distant metastatic sites (bone, brain, liver, lung), relevant correlation with baseline characteristics were reported. Survival analysis has been conducted through Kaplan-Meier analysis, and multivariate analysis has been conducted through a cox proportional hazard model. The precision of the nomogram was evaluated and compared using concordance index (C-index), and the area under receiver operating characteristic curve (AUC). Results: A total 2715 patients with metastatic bladder cancer were identified from 2005-2019. Patients with medium risk have the best overall survival, followed by patients with low risk followed by patients with high risk metastases. Multivariate analysis showed that patients who were older than 80 at the time of diagnosis, single, no Chemotherapy, no complete cystectomy and bone metastases were associated with poor survival. A nomogram based on 7 independent risk factors has a good predictive power for the 12-month, 24-month and 36-month prognosis of patients with bladder cancer. The C index of the nomogram has high consistency in evaluating the survival rate of bladder cancer patients (C index = 0.722, 95% CI = 0.712-0.732). The values of AUC for 12-month, 24-month, and 36-month were 0.775, 0.73, and 0.692. Conclusion: Build Nomogram prediction method validation of bladder tumor, according to the results of the Nomogram has good capability of identification and correction, suggests that these column chart.

Introduction

As one of the most common urinary system tumors, bladder cancer has the second highest incidence of urinary system tumors in my country, and the seventh highest in male tumor incidence^[1-2]. In Western countries, the incidence and mortality of male bladder cancer are secondly only to In prostate cancer.^[3-5] The SEER program shows that in recent decades, the total incidence of bladder cancer has increased by 40%. Metastasis and recurrence are the primary reasons for its poor prognosis. Lymph nodes are the most common metastatic site for bladder cancer, and they have undergone radical cystectomy and pelvic resection. About 25%-30% of bladder cancer patients treated with lymph node dissection are found to have lymph node metastasis^[6-10]. Therefore, lymph node metastasis is an important factor affecting the prognosis of bladder cancer patients. The traditional TNM staging has certain limitations for better predicting the prognosis of patients. So we are trying to establish a simpler and more clinically relevant method to assess the prognosis of bladder cancer.

The nomogram is a graphical representation of complex mathematical formulas, and is a common tool for evaluating the prognosis of oncology and medicine. In recent years, nomograms have played an increasingly important role in predicting the prognosis of liver cancer, lung cancer and other cancers^[11-13]. The nomogram uses biological and clinical variables, such as patient age, gender, tumor grade, treatment methods, etc. To graphically depict statistical prognostic models that produce clinical practice

probability, such as cancer recurrence or death. Compared with the conventional TNM staging, it is easier and faster to help doctors predict the prognosis of patients and promote clinical decision-making. The SEER database is a database of cancer patients based on 20 regions of the United States established by the National Institutes of America, covering about 28% of the population of the United States and capturing about 97% of cancer cases in the United States^[14-16]. Therefore, this study uses the SEER database to extract clinical data of bladder cancer patients and establish a nomogram to guide clinical diagnosis and prognostic evaluation.

Materials And Methods

We collected the clinical data of 2715 patients with bladder cancer diagnosed from 2005 to 2019 in the database of the National Cancer Institute in the United States, collated and analyzed tumor-related clinical pathological parameters, demographic information, treatment methods, etc., and used COX proportional risk The regression model was used for statistical analysis to establish a nomogram to predict the prognosis of bladder cancer at 12 months, and use the consistency index (C-index) to verify the performance of the nomogram through the internal cohort to test the accuracy of the nomogram. Inclusion criteria: 1) Histopathological examination was diagnosed as bladder cancer; 2) Complete dates, follow-up records, known survival months and cause of death; 3) Sufficient/consistent information on variables, including age, gender, race, marriage, Tumor grade, TNM staging, lymph node metastasis, surgical treatment, radiotherapy and chemotherapy, etc. Exclusion criteria: 1) record controversial cases; 2) patients with secondary bladder cancer; 3) missing follow-up records or cause of death;

Statistical analyses

All data were processed by SPSS24.0 (IBM) and R software (version 3.4.5; <http://www.r-project.org>). Use SPSS24.0 to carry out relevant statistical description of demographic characteristics, and use the survival package of R software to carry out univariate and multivariate COX regression analysis of variables to estimate the mortality risk ratio. All statistical data are two-way tests, $P < 0.05$ considered the difference to be statistically significant.

Results

3.1 patients characteristics

A total of 2715 patients with bladder cancer and distant metastases were identified in the period from 2005 to 2019 and were included into the analysis. Table 1 summarizes the distribution of different distant metastatic sites for included patients. 940 patients were diagnosed with isolated bone metastases, 72 patients were diagnosed with isolated brain metastases, 473 patients were diagnosed with isolated liver metastases, 863 patients were diagnosed with isolated lung metastases. Statistically significant correlations between different baseline characteristics and different sites of metastatic

disease are shown in Table 1. The following associations were noted between baseline characteristics and specific sites of metastases.:

Table 1
Clinicopathological features and metastatic sites (n = 2715).

| | Bone metastasis (%) | Brain metastasis (%) | Liver metastasis (%) | Lung metastasis (%) |
|---------------------|----------------------------|-----------------------------|-----------------------------|----------------------------|
| Features | Yes No | Yes No | Yes No | Yes No |
| Gender | P < 0.0001 | P = .670 | P = .286 | P = .087 |
| Female | 217(31.3%) 477(68.7%) | 18(2.6%) 676(97.4%) | 138(19.9%) 556(80.1%) | 253(36.5%) 441(63.5%) |
| Male | 723(38.9%) 1134(61.1%) | 54(2.9%) 1803(97.1%) | 335(18.0%) 1522(82.0%) | 610(32.8%) 1247(67.2%) |
| Age | P < 0.0001 | P = .169 | P = .798 | P = .096 |
| <50 | 49(41.2%) 70(58.8%) | 3(2.5%) 116(97.5%) | 20(16.8%) 99(83.2%) | 35(29.4%) 84(70.6%) |
| 50–70 | 443(41.3%) 629(58.7%) | 38(3.5%)1034(96.5%) | 195(18.2%) 877(81.8%) | 343(32.0%) 729(68.0%) |
| >70 | 448(32.9%) 912(67.1%) | 31(2.3%)1329(97.7%) | 258(19.0%) 1102(81.0%) | 485(35.7%) 875(64.3%) |
| Race | P = .970 | P = .964 | P = .680 | P = .226 |
| White | 803(36.8%) 1381(63.2%) | 63(2.9%) 212(197.1%) | 411(18.8%) 1773(81.2%) | 736(33.7%) 1448(66.3%) |
| Black | 92(37.1%) 156(62.9%) | 6(2.4%)242(97.6%) | 42(16.9%) 206(83.1%) | 93(37.5%) 155(62.5%) |
| Others | 45(37.8%) 74(62.2%) | 3(2.5%)116(97.5%) | 20(16.8%) 99(83.2%) | 34(28.6%) 85(71.4%) |
| Primary tumor sites | P = .743 | P = .062 | P = .188 | P = .087 |
| Trigone | 45(33.3%) 90(66.7%) | 2(1.5%) 133(98.5%) | 31(23.0%) 104(77.0%) | 39(28.9%) 96(71.1%) |
| Dome | 23(29.9%) 54(70.1%) | 6(7.8%) 71(92.2%) | 10(13.0%) 67(87.0%) | 21(27.3%) 56(72.7%) |
| Lateral wall | 98(35.0%) 182(65.0%) | 10(3.6%) 270(96.4%) | 43(15.4%) 237(84.6%) | 104(37.1%) 176(62.9%) |
| Anterior wall | 17(32.7%) 35(67.3%) | 0(0.0%) 52(100.0%) | 9(17.3%) 43(82.7%) | 12(23.1%) 40(76.9%) |
| Posterior wall | 57(36.5%) 99(63.5%) | 5(3.2%) 151(96.8%) | 32(20.5%) 124(79.5%) | 47(30.1%) 109(69.9%) |
| Bladder neck | 43(40.6%) 63(59.4%) | 5(4.7%) 101(95.3%) | 21(19.8%) 85(80.2%) | 28(26.4%) 78(73.6%) |

| | Bone metastasis (%) | Brain metastasis (%) | Liver metastasis (%) | Lung metastasis (%) |
|--------------------|----------------------------|-----------------------------|-----------------------------|----------------------------|
| Ureteric orifice | 13(36.1%) 23(63.9%) | 0(0.0%)36(100.0%) | 8(22.2%) 28(77.8%) | 16(44.4%) 20(55.6%) |
| Overlapping lesion | 173(39.5%) 265(60.5%) | 7(1.6%)431(98.4%) | 66(15.1%) 372(84.9%) | 159(36.3%) 279(63.7%) |
| Bladder, NOS | 471(37.1%) 797(62.9%) | 37(2.9%)1231(97.1%) | 253(20.0%) 1015(80.0%) | 437(34.5%) 831(65.5%) |
| Grade | P = .204 | P = .206 | P = .009 | P = .588 |
| I | 6(54.5%) 5(45.5%) | 0(0.0%) 11(100.0%) | 1(9.1%) 10(90.9%) | 3(27.3%) 8(72.7%) |
| II | 20(33.3%) 40(66.7%) | 4(6.7%) 56(93.3%) | 11(18.3%) 49(81.7%) | 26(43.3%) 34(56.7%) |
| III | 188(34.2%) 361(65.8%) | 16(2.9%) 533(97.1%) | 108(19.7%) 441(80.3%) | 189(34.4%) 360(65.6%) |
| IV | 563(36.8%) 967(63.2%) | 37(2.4%) 1493(97.6%) | 255(16.7%) 1275(83.3%) | 511(33.4%) 1019(66.6%) |
| Unknown | 163(40.6%) 238(59.4%) | 15(3.7%) 386(96.3%) | 98(24.4%) 303(75.6%) | 134(33.4%) 267(66.6%) |
| Histology | P = .171 | P = .749 | P = .326 | P < 0.0001 |
| Papillary TRC | 256(34.6%) 483(65.4%) | 19(2.6%) 720(97.4%) | 128(17.3%) 611(82.7%) | 296(40.1%) 443(59.9%) |
| TRC | 683(37.8%) 1122(62.2%) | 53(2.9%) 1752(97.1%) | 345(19.1%) 1460(80.9%) | 564(31.2%) 1241(68.8%) |
| Others | 1(14.3%) 6(85.7%) | 0(0.0%) 7(100.0%) | 0(0.0%) 7(100.0%) | 3(42.9%) 4(57.1%) |
| T stage | P = .048 | P = .423 | P < 0.0001 | P = .110 |
| T0 | 5(26.3%) 14(73.7%) | 0(0.0%)19(100.0%) | 4(21.1%) 15(78.9%) | 7(36.8%) 12(63.2%) |
| T1 | 150(38.1%) 244(61.9%) | 11(2.8%)383(97.2%) | 67(17.0%) 327(83.0%) | 152(38.6%) 242(61.4%) |
| T2 | 446(39.5%) 682(60.5%) | 38(3.4%)1090(96.6%) | 193(17.1%) 935(82.9%) | 386(34.2%) 742(65.8%) |
| T3 | 75(31.0%) 167(69.0%) | 4(1.7%)238(98.3%) | 32(13.2%) 210(86.8%) | 71(29.3%) 171(70.7%) |
| T4 | 163(33.1%) 329(66.9%) | 9(1.8%)483(98.2%) | 98(19.9%) 394(80.1%) | 150(30.5%) 342(69.5%) |

| | Bone metastasis (%) | Brain metastasis (%) | Liver metastasis (%) | Lung metastasis (%) |
|---------------|----------------------------|-----------------------------|-----------------------------|----------------------------|
| Tx | 101(36.6%) 175(63.4%) | 10(3.6%)266(96.4%) | 79(28.6%) 197(71.4%) | 97(35.1%) 179(64.9%) |
| N stage | P = .005 | P = .032 | P = .015 | P < 0.0001 |
| Node negative | 299(33.1%) 604(66.9%) | 15(1.7%) 888(98.3%) | 151(16.7%) 752(83.3%) | 261(28.9%) 642(71.1%) |
| Node positive | 540(39.7%) 821(60.3%) | 47(3.5%) 1314(96.5%) | 252(18.5%) 1109(81.5%) | 490(36.0%) 871(64.0%) |
| Unknown | 101(35.2%) 186(64.8%) | 10(3.5%) 277(96.5%) | 70(24.4%) 217(75.6%) | 112(39.0%) 175(61.0%) |

·Bone metastasis:

Bone metastasis were more commonly associated with age at diagnosis < 70 years(p < 0.001), Male gender(P < 0.001), node positive(P < 0.001),T2 stage(P = 0.048).

·Brain metastasis:

Brain metastasis: were associated with node positive(P = 0.032).

·Liver metastasis:

Liver metastasis were associated with higher grade(p = 0.009),T0 stage(p < 0.0001) and node positive(p = 0.015).

·Lung metastasis:

Lung metastasis were associated with papillary TRC and Node positive(p < 0.0001).

The above associations have,however ,to be interpreted cautiously given the presence of “unknown” category in many of the variables which may have confounded the Chi-square association testing. Lung metastasis were associated with papillary TRC and Node positive(p < 0.0001).

3.2 Survival outcomes

The overall survival (OS) of bladder cancer patients analyzed by utilizing Kaplan-Meier survival curves. OS analysis was performed by stratifying different risks of bladder cancer. Statistically significant differences were identified with regard to risks (high risk vs. Medium risk, P < 0.001 ;Fig .1).

3.3 Prognostic factors

A cox proportional hazards regression model was constructed to evaluate predictors of OS (Table 2). Univariate analysis of OS revealed the risk of mortality was significantly higher for patients that were

aged > 80(P < 0.001),widowed(P < 0.001), non-complete cystectomy(P < 0.001),no Chemotherapy(P < 0.001), multiple sites metastasis(P < 0.001).

Table 2
Univariate analysis of distant metastasis of BC patients

| Variables | HR (95% CI) | p-value |
|---|---------------------|---------|
| Statistically significant factors | | |
| Gender (male vs. female) | 1.110 (1.016–1.212) | 0.020 |
| Age at diagnosis (years) | | |
| ≥80 vs. <40 | 0.439 (0.227–0.847) | 0.014 |
| ≥ 80 vs. 40–49 | 0.543 (0.424–0.696) | < 0.001 |
| ≥ 80 vs. 50–59 | 0.655 (0.574–0.747) | < 0.001 |
| ≥ 80 vs. 60–69 | 0.666 (0.597–0.744) | < 0.001 |
| ≥80 vs. 70–79 | 0.766 (0.692–0.849) | < 0.001 |
| Marital status at diagnosis | | |
| Married vs. divorced/separated | 1.135 (1.005–1.282) | 0.042 |
| Married vs. widowed | 1.254 (1.127–1.397) | < 0.001 |
| Married vs. single | 1.135 (1.017–1.268) | 0.024 |
| Grade | | |
| High (III-IV) vs. unknown | 1.182 (1.063–1.314) | 0.002 |
| High (III-IV) vs. low (I-II) | 0.909 (0.716–1.153) | 0.431 |
| Histology | | |
| PTCC vs. others | 1.143 (0.571–2.289) | 0.706 |
| PTCC vs. TCC | 0.765 (0.700-0.835) | < 0.001 |
| Surgery of primary site | | |
| Complete cystectomy vs. no | 2.184 (1.839–2.594) | < 0.001 |
| Complete cystectomy vs. non-complete cystectomy | 1.668 (1.428–1.947) | < 0.001 |
| Surgery of lymph node (yes vs. no) | 1.686 (1.454–1.956) | < 0.001 |
| Chemotherapy (yes vs. no) | 2.507 (2.312–2.718) | < 0.001 |
| Metastasis pattern | | |
| Bone only vs. lung only | 0.895 (0.793–1.010) | 0.073 |
| Bone only vs. liver only | 1.210 (1.036–1.414) | 0.016 |
| PTCC: papillary transitional cell carcinoma; TCC: transitional cell carcinoma | | |

| Variables | HR (95% CI) | p-value |
|---|---------------------|----------------|
| Bone only vs. brain only | 1.119 (0.755–1.657) | 0.575 |
| Bone only vs. multiple sites | 1.519 (1.349–1.712) | < 0.001 |
| Bone only vs. others | 0.726 (0.649–0.811) | < 0.001 |
| Statistically non-significant factors | | |
| Race | | |
| White vs. others | 0.937 (0.773–1.136) | 0.505 |
| White vs. black | 1.062 (0.931–1.212) | 0.371 |
| Radiotherapy (yes vs. no) | 0.979 (0.890–1.077) | 0.667 |
| PTCC: papillary transitional cell carcinoma; TCC: transitional cell carcinoma | | |

In the multivariate analysis (Table 3), age > 80 years old (OS, P = 0.002), Single (OS, P = 0.014), TCC (OS, P < 0.001), no Chemotherapy (OS, P < 0.001), no complete cystectomy (OS, P = 0.016), bone metastasis (OS, P < 0.001), were associated with poorer OS rates.

Table 3
Multivariate analysis of distant metastasis of BC patients

| Variables | HR (95% CI) | p-value |
|---|---------------------|---------|
| Statistically significant factors | | |
| Age at diagnosis (years) | | |
| ≥80 vs. <40 | 0.722 (0.371–1.404) | 0.337 |
| ≥ 80 vs. 40–49 | 0.664 (0.514–0.857) | 0.002 |
| ≥ 80 vs. 50–59 | 0.822 (0.712–0.948) | 0.007 |
| ≥ 80 vs. 60–69 | 0.872 (0.773–0.984) | 0.026 |
| ≥80 vs. 70–79 | 0.943 (0.846–1.051) | 0.288 |
| Marital status at diagnosis | | |
| Married vs. divorced/separated | 1.094 (0.966–1.239) | 0.155 |
| Married vs. widowed | 0.987 (0.878–1.110) | 0.828 |
| Married vs. single | 1.153 (1.029–1.292) | 0.014 |
| Grade | | |
| High (III-IV) vs. unknown | 0.897 (0.795–1.013) | 0.080 |
| High (III-IV) vs. low (I-II) | 0.715 (0.561–0.910) | 0.006 |
| Histology | | |
| PTCC vs. others | 0.894 (0.443–1.804) | 0.755 |
| PTCC vs. TCC | 0.771 (0.705–0.844) | < 0.001 |
| Surgery of primary site | | |
| Complete cystectomy vs. no | 1.457 (1.071–1.983) | 0.016 |
| Complete cystectomy vs. non-complete cystectomy | 1.204 (0.903–1.605) | 0.207 |
| Chemotherapy (yes vs. no) | 2.423 (2.224–2.640) | < 0.001 |
| Metastasis pattern | | |
| Bone only vs. lung only | 0.884 (0.781-1.000) | 0.050 |
| Bone only vs. liver only | 1.110 (0.948–1.299) | 0.195 |
| Bone only vs. brain only | 1.408 (0.949–2.089) | 0.089 |
| Bone only vs. multiple sites | 1.561 (1.384–1.760) | < 0.001 |
| PTCC: papillary transitional cell carcinoma; TCC: transitional cell carcinoma | | |

| Variables | HR (95% CI) | p-value |
|---|---------------------|---------|
| Bone only vs. others | 0.804 (0.718-0.900) | < 0.001 |
| Statistically non-significant factors | | |
| Gender (male vs. female) | 1.046 (0.954–1.147) | 0.334 |
| Surgery of lymph node (yes vs. no) | 1.260 (0.955–1.664) | 0.103 |
| PTCC: papillary transitional cell carcinoma; TCC: transitional cell carcinoma | | |

3.4 Prediction model nomogram development and verification

A nomogram was established based on the results of the multivariate analysis. The 12-month,24-month,36-month overall survival prediction was estimated by A weighted total score calculated from each variable(Fig. 2).The performance of the nomogram was internally validated by discrimination and calibration methods. The nomogram(Fig. 4) also showed good accuracy with C-indexes of 0.722(95%CI = 0.712–0.732).The calibration plots revealed a good correlation observed OS and nomogram prediction OS(Fig. 3).

Notes:Age at diagnosis: 1(< 40);, 2(40–49), 3(50–59), 4(60–69), 5(70–79), 6(\geq 80);Marital Status:1(Divorced/Separated),2(Widowed),3(Single (never married)),4(Married (including common law));Grade:0(unknown),1(low grade I-II),2(High grade III-IV);Histology type:1: Other(8020/3: Carcinoma, undifferentiated, NOS)8031/3: Giant cell carcinoma)8082/3: Lymphoepithelial carcinoma),2(8130/3: Papillary transitional cell carcinoma),3(8120/3: Transitional cell carcinoma); Surgery of Primary Site:0(NO),1(incomplete cystectomy)Local tumor excision)Partial cystectomy),2(Complete cystectomy)Complete cystectomy with reconstruction)Pelvic exenteration)Radical cystectomy PLUS ileal conduit); Chemotherapy:0(NO),1(YES);Metastasis pattern:2(Lung only),2(Liver only),4(Brain only),5(other),6(Multiple sites),7(bone only).

3.4.1 predictive value of distant metastasis

The values of the AUC of the nomogram for predicting bladder cancer 12-month,24-month,36-month survival rates are 0.775,0.730,0.692(Fig. 4).

Discussion

As one of the most common urinary system tumors, bladder cancer has high morbidity and mortality. The primary cause of poor prognosis is metastasis and recurrence. The common ones are lymph node metastasis, bone metastasis, brain metastasis, liver metastasis and lung metastasis^[17–18]. Mainly originated from bladder epithelial tissue and interstitial tissue. Smoking, occupational exposure (insecticides, especially, dyes and other industrial chemical products) are the main carcinogenic risk factors^[19]. The histological types can be divided into bladder urothelial carcinoma, bladder non-urothelial carcinoma (squamous cell carcinoma, glandular Cancer, small cell carcinoma, etc.), some of which are

mixed, and 90% of patients are bladder urothelial carcinoma (transitional cell carcinoma)^[20]. The main cause of patient death is tumor metastasis and recurrence. Previous studies have shown that about 25–30% of bladder cancer patients undergoing radical cystectomy and pelvic lymphadenectomy are found to have lymph nodes and other distant sites. Patients with metastases and distant metastases have a higher rate of tumor recurrence after surgery. The prognosis of patients with bladder cancer varies depending on the site of metastasis. Therefore, accurate judgment of whether there is metastasis and the location and extent of metastasis has an important reference value for evaluating the prognosis of patients with bladder cancer, and is one of the foundations for formulating treatment plans and judging the prognosis.

We conducted a deeper study on the large sample data of the SEER database. By extracting the clinical data of bladder cancer patients in the SEER database that fit this study, we found that gender, age, T stage, and N stage are related to bone metastases. Prognosis is relevant. In brain metastases, N stage is related to its prognosis. In liver metastasis, tumor grade, T stage, and N stage are related to its prognosis. In lung metastasis, histological type and N stage are related to its prognosis. Data on the prognostic value of different metastatic sites should help to segment bladder cancer patients and guide tailored individualized treatment strategies. For the risk stratification of the nomogram, we can easily divide patients into different risk sub-layers, which may be meaningful for clinicians to develop further treatment plans. For example, patients with high stratification may require further treatment or a shorter follow-up period to improve survival.

From this we developed a nomogram that includes age at diagnosis, marital status, tumor grade, histopathological type, primary site surgery, chemotherapy, and metastasis type. The C index of the nomogram performed well in predicting the survival rate of bladder cancer patients at 12 and 24 months. But it is only 0.692 in predicting the 36-month survival probability of bladder cancer patients.

Current studies have shown that patients with single metastasis have a better prognosis than patients with multiple metastases, which is consistent with other solid tumor data^[21]. In the univariate analysis of patients with distant metastases, gender, age, marital status, high grade, histopathological type, radical surgical resection, chemotherapy, and metastasis type are the main factors affecting the prognosis. The multi-factor analysis of patients with distant metastasis showed that age, marital status, grade, histopathological type, radical surgical resection or not, and type of distant metastasis were the main factors affecting the prognosis.

For a specific individual, our chart is very intuitive and accurate. The laboratory indicators included in our nomogram are easy to obtain, such as age, marital status, tumor grade, histopathological type, primary site surgery, chemotherapy, and metastasis type. And the indicators included in our nomogram are objective, avoiding the adverse effects of the surgeon's subjectivity. However, our study also has certain limitations. Our model has good accuracy in predicting the 12-month and 24-month prognostic survival rate of patients with distant metastasis of bladder cancer. It can predict the 36-month survival of bladder cancer patients. The probability is only 0.692.

In summary, we have developed an accurate and intuitive tool to predict the survival rate of patients with bladder cancer in 12 months, 24 months, and 36 months. This chart can provide corresponding treatment assistance for patients with bladder cancer and provide basis for clinicians to make treatment decisions. However, whether the model is applicable to patients in other countries and regions is still subject to a large number of clinical studies to verify the treatment.

Declarations

Ethical approval This article does not contain any studies with human participants or animals performed by any of the authors. Informed consent: as this study is based on a publicly available database without identifying patient information, informed consent was not needed.

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Data Availability Statement: The datasets generated during and/or analysed during the current study are available in the SEER database's website link (<https://seer.cancer.gov/data>) repository, or can be obtained by contacting the corresponding author.

Competing interests The authors declare that they have no competing interests

Author contribution Ning Xiao Topic selection, data collection and fund support.

Yongfu Long Topic selection, data collection and fund support.

Weijian Lin Processing data, making graphs and tables and writing papers.

Qi Tang Processing data.

Sheng Zhu Processing data.

Bin Jin Paper modify.

Zexiang Xin: Processing data.

Rongyu Tang: Processing data.

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Figures

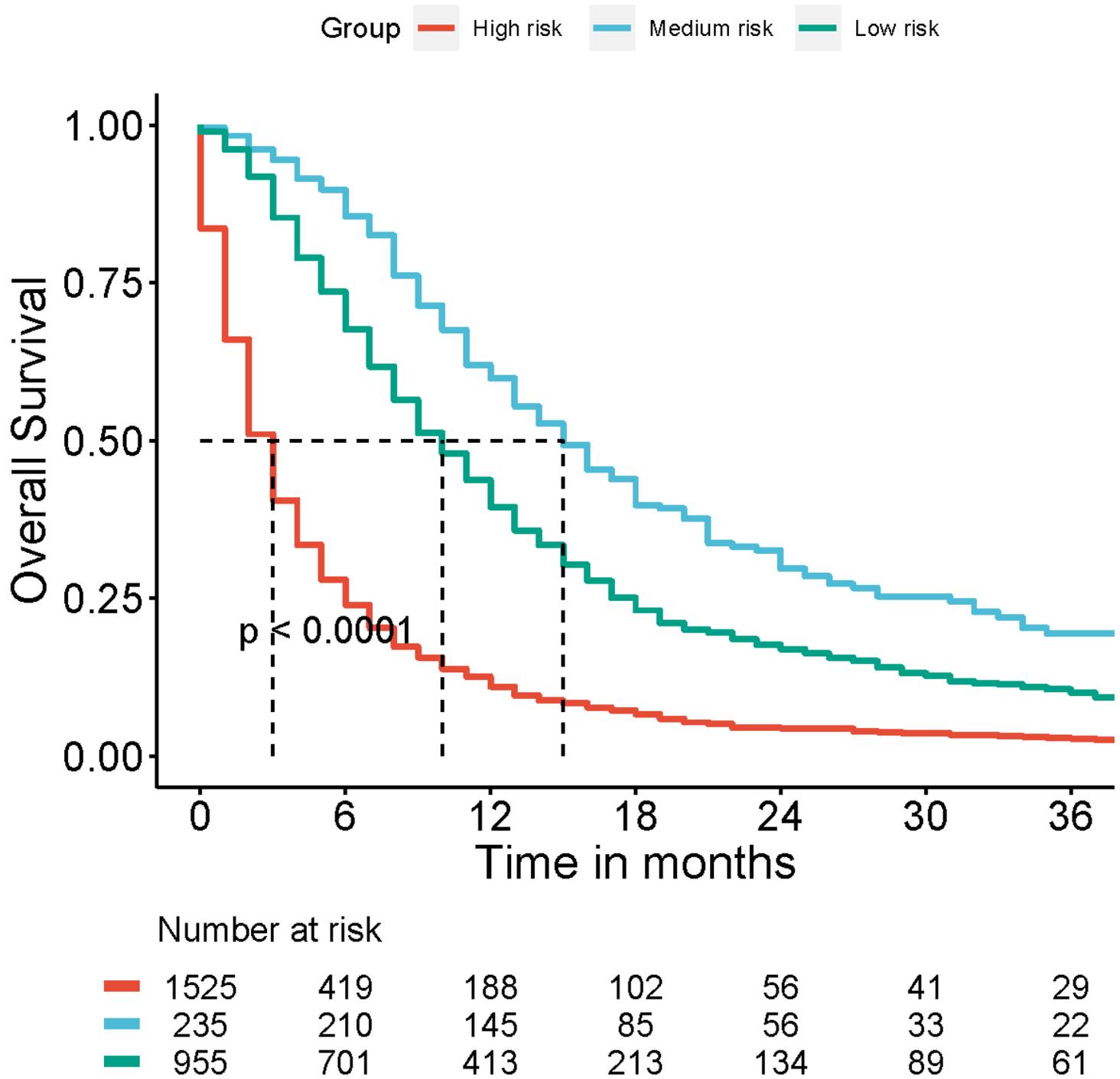


Figure 1

Kaplan-Meier curves for overall survival rate according to the site of distant metastatic risks.

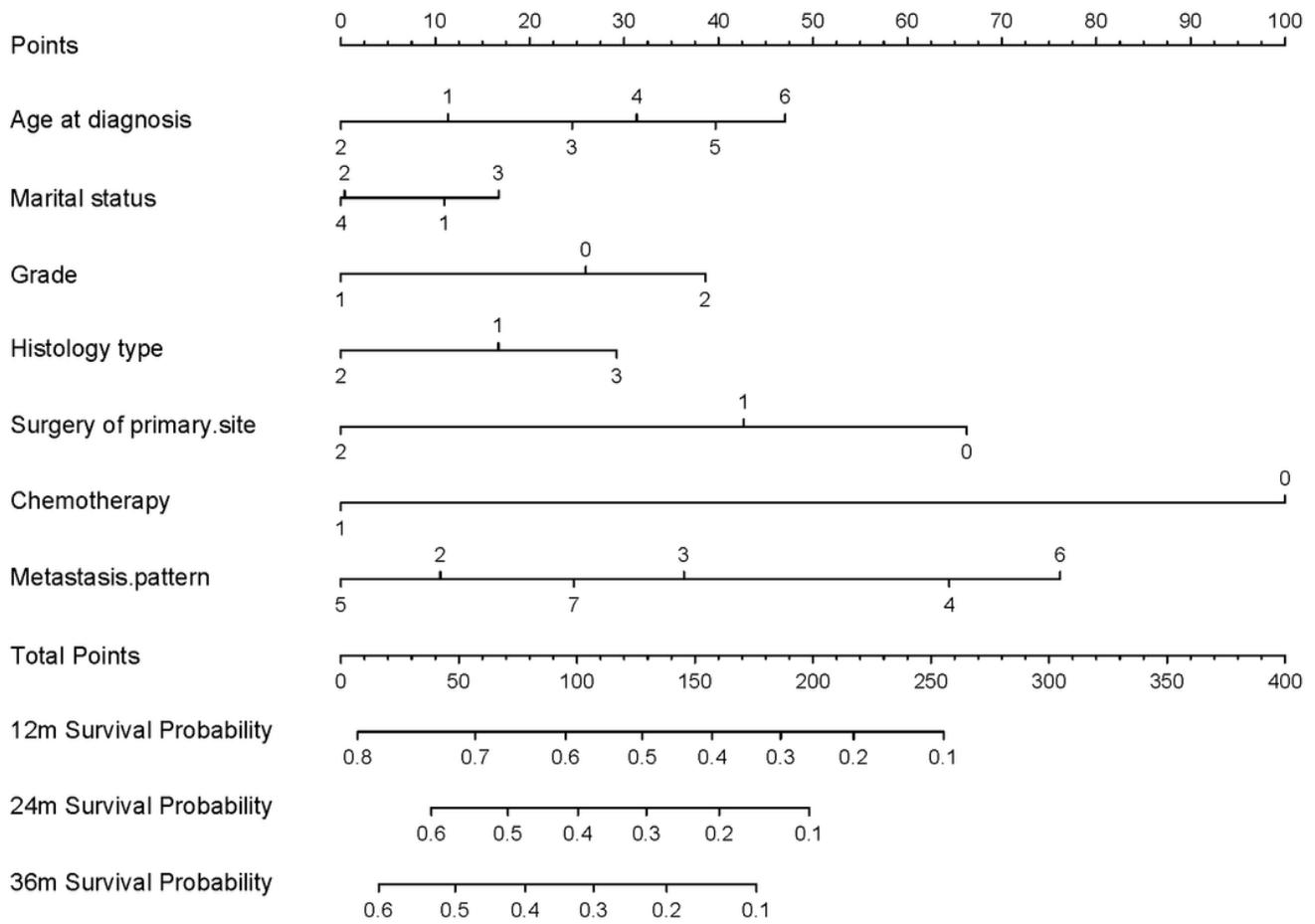


Figure 2

A nomogram for predicting the 12-month, 24-month, 36-month OS of bladder cancer

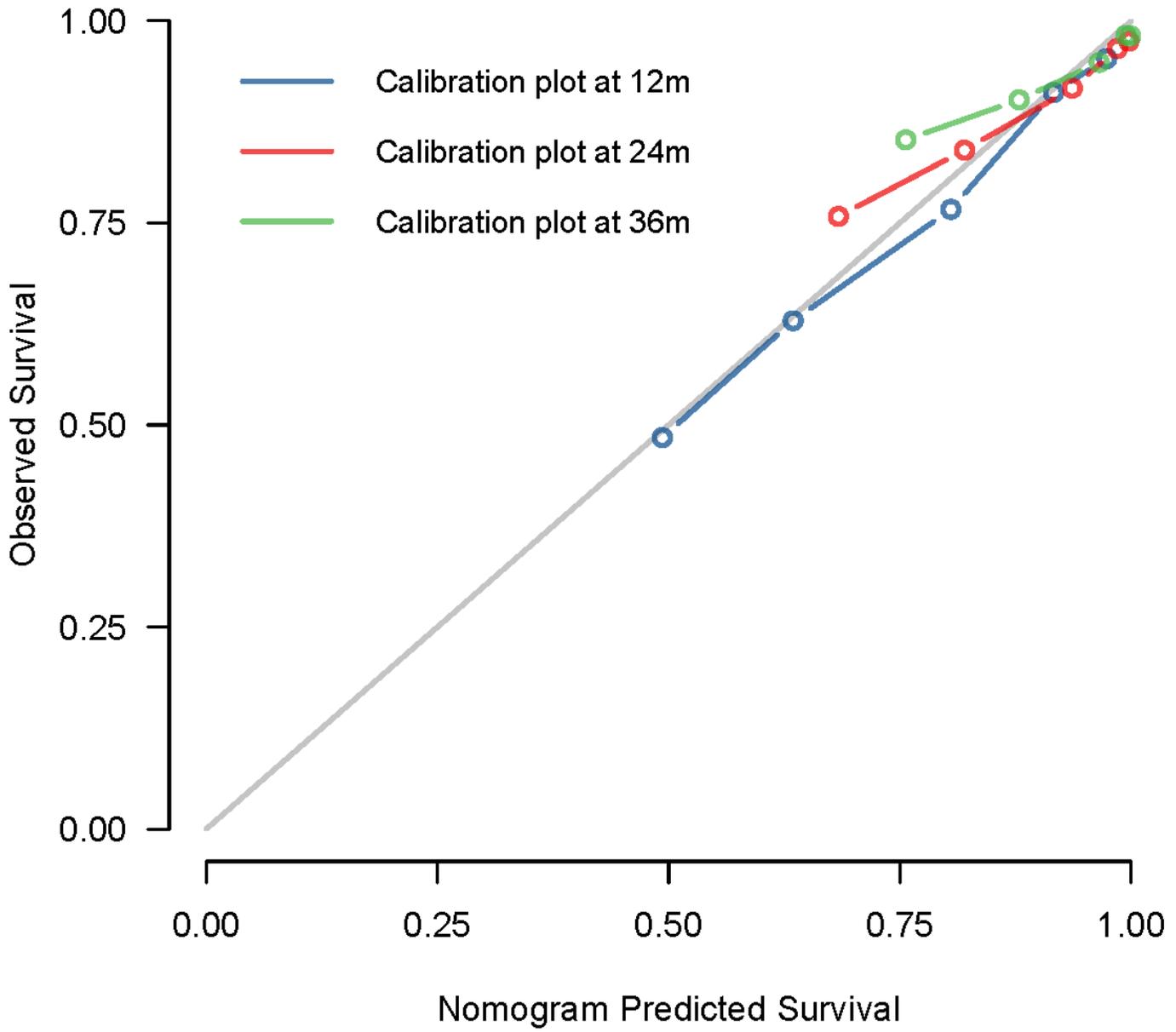


Figure 3

Nomogram model calibration curves

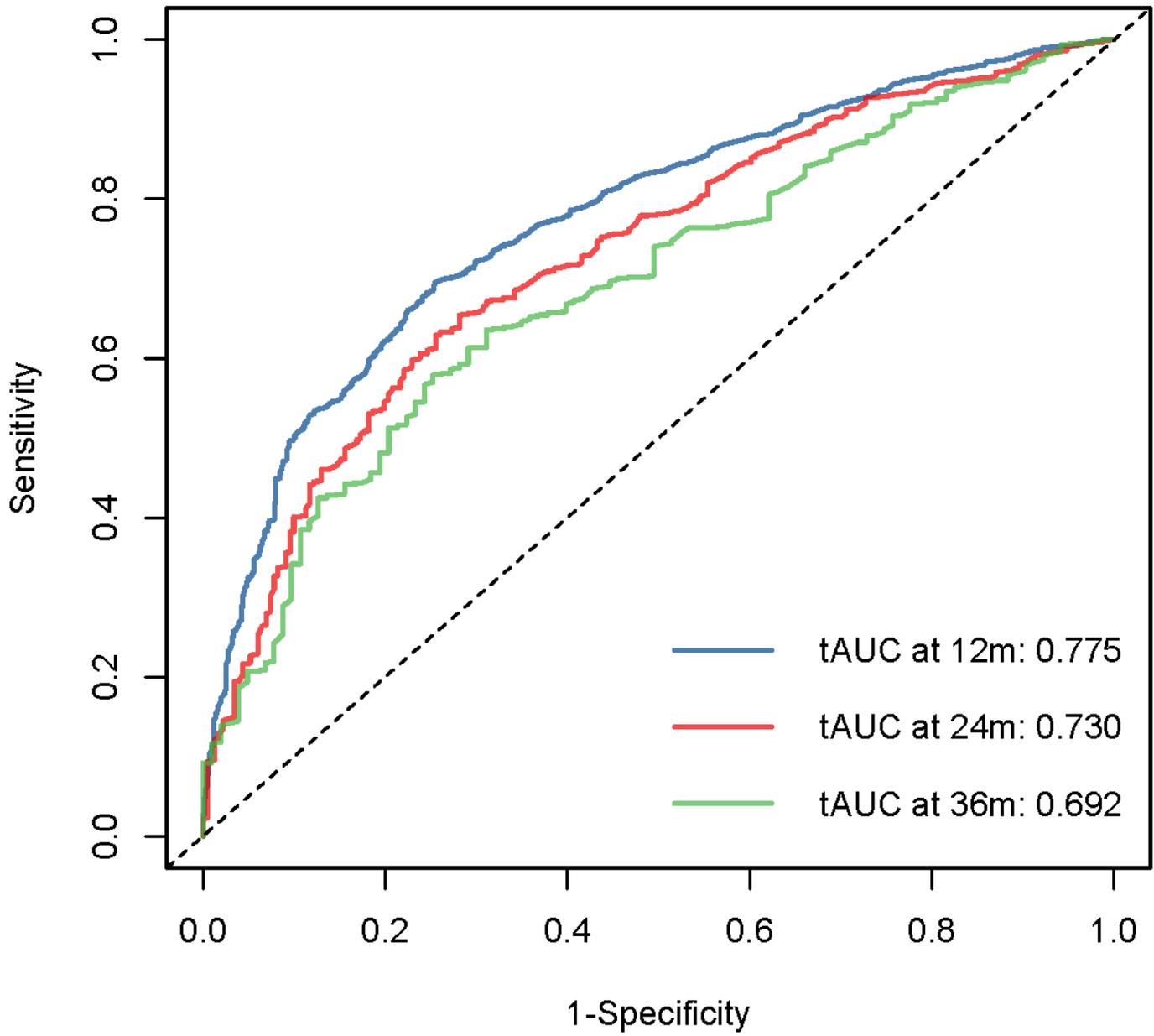


Figure 4

The roc curve of the prognostic nomogram. Notes: ROC, receiver operating characteristic.