Original Article

Development and validation of nomograms for predicting the prognosis of colorectal cancer patients

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Background: Accurate prognosis prediction is essential in colorectal cancer (CRC) for guiding treatment decisions, yet the traditional tumor-node-metastasis (TNM) staging system often lacks precision. This study aimed to develop improved prognostic tools for CRC patients.

Methods: Prognostic nomogram models were developed using data from 2,435 CRC patients who underwent curative resection. Parameters were selected via least absolute shrinkage and selection operator (LASSO) regression to include overall survival (OS) and disease-free survival (DFS) nomograms. The performance of these nomograms was evaluated against the TNM staging system using ROC analysis, calibration curves, and decision curve analysis (DCA).

Results: Critical prognostic factors identified included tumor invasion depth, distant metastasis, tumordifferentiation grade, extranodal tumor deposits (ENTD), R1 resection, and log odds of positive lymph nodes (LODDS). The OS nomogram demonstrated area under the curve (AUC) values of 0.786, 0.776, and 0.803 for predicting 1-, 3-, and 5-year survival, respectively, compared to 0.768, 0.750, and 0.782 for TNM staging. The DFS nomogram predicted 1-, 3-, and 5-year DFS with AUCs of 0.764, 0.777, and 0.789, respectively, compared to 0.762, 0.761, and 0.770 for TNM staging. Calibration plots indicated strong predictive capabilities, and DCA confirmed greater net benefits over TNM staging.

Conclusions: Our developed prognostic nomogram models offer enhanced accuracy over traditional TNM staging in predicting CRC prognosis. Integrating these models into clinical practice can potentially improve personalized treatment strategies for postoperative CRC patients, enhancing overall clinical outcomes.

Keywords: Colorectal cancer (CRC); prognosis; tumor-node-metastasis staging system (TNM staging system); predictive nomogram; pathology

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Introduction

Colorectal cancer (CRC) is an important health concern worldwide, ranking third in incidence and second in cancer-related mortality among all cancers (1). Despite advancements in treatment options that have improved the prognosis of CRC patients (2), the 5-year postoperative survival rate remains suboptimal (3).

Prognostic assessment of CRC patients is essential for implementing personalized treatment strategies and improving quality of life (4-6). Conventional pathological tumor-node-metastasis (TNM) staging has been a robust tool for stratifying patient prognosis and is widely used by oncologists (5,7). However, surgical specimens sometimes fail to meet the accuracy requirements for TNM staging, such as when the number of lymph nodes examined does

not reach the recommended minimum of twelve according to the National Comprehensive Cancer Network (NCCN) guidelines (8,9). Furthermore, high-risk factors for tumor recurrence, such as tumor differentiation grade, perineural invasion, and vascular invasion, are not included in the TNM staging system. These factors substantially impact the accuracy and effectiveness of the TNM staging system (10). In addition, CRC patients with the same pathological TNM stage often exhibit significantly different prognosis according to various studies (11), leading to the inclusion of risk factors such as vascular invasion and extranodal tumor deposits (ENTD) to enhance the predictive power of conventional pathological staging (12). This finding suggests that there is room for improvement in the ability of pathological TNM staging to predict CRC patient prognosis (13).

In the present study, based on a large sample of clinical data, we aimed to develop a prognostic prediction model with enhanced predictive ability by integrating common pathological parameters, offering a reference for clinical prognostic assessment and treatment decision-making. We present this article in accordance with the TRIPOD reporting checklist (available at https://tcr.amegroups.com/article/view/10.21037/tcr-24-1924/rc).

Highlight box

Key findings

- Prognostic nomogram models were constructed and offered enhanced accuracy over traditional tumor-node-metastasis (TNM) staging in predicting colorectal cancer (CRC) prognosis. These prediction models could potentially improve personalized treatment strategies for postoperative CRC patients, enhancing overall clinical outcomes.

What is known and what is new?

- Accurate prognosis prediction is essential in CRC for guiding treatment decisions, yet the traditional TNM staging system often lacks precision.
- We established nomogram models for overall survival and disease-free survival based on postoperative pathological information. These practical nomograms demonstrated good prognostic prediction capabilities and robust discriminative power, even surpassing the traditional TNM staging system in terms of prognostic precision.

What is the implication, and what should change now?

- We developed a prognostic prediction model with enhanced predictive ability by integrating common pathological parameters, offering a reference for clinical prognostic assessment and treatment decision-making.

Methods

Research population

This study included patients with CRC who underwent surgical treatment at the Department of Gastrointestinal Surgery, Tongji Hospital, Wuhan, from 2014 to 2018. The inclusion criteria were as follows: (I) diagnosis of CRC confirmed by biopsy and (II) completion of curative surgical treatment. The exclusion criteria were as follows: (I) patients younger than eighteen years; (II) patients with unclear primary tumor locations or multiple primary tumors; (III) patients with an American Society of Anesthesiologists (ASA) (14) grade ≥ IV; (IV) patients received any anti-tumor treatment before surgery, including chemotherapy, radiotherapy, targeted therapy and immunotherapy; and (V) patients with missing data. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Ethics Review Committee of Tongji Hospital, Wuhan (No. TJ-IRB202405086, May 31st, 2024) and informed consent was taken from all the patients.

A retrospective analysis of the clinicopathological data of patients with CRC was also conducted. The data included sex, age, body mass index (BMI), hypertension history, diabetes history, previous abdominal surgeries, pathological characteristics of the tumor, and follow-up information. Tumor staging was performed using the 8th edition American Joint Committee on Cancer (AJCC) staging system. The log odds of positive lymph nodes (LODDS) is an innovative lymph node staging system that contributes to accurate risk stratification in patients with insufficient lymph node retrieval (15-17). Thus, LODDS as a variable was also included in this study.

Follow-up

Regular follow-ups were conducted via outpatient visits and telephone consultations. The follow-up protocol was structured as follows: patients were evaluated quarterly during the first year, biannually in the second year, and annually thereafter until death. The primary objectives of these follow-ups included monitoring patient survival status, detecting serum tumor marker levels, performing abdominal computed tomography (CT) scans, and performing electronic colonoscopy examinations. Overall survival (OS) was defined as the interval from the surgery date to the date of death from any cause or the last follow-up. Disease-free survival (DFS) was defined as the time interval from surgery

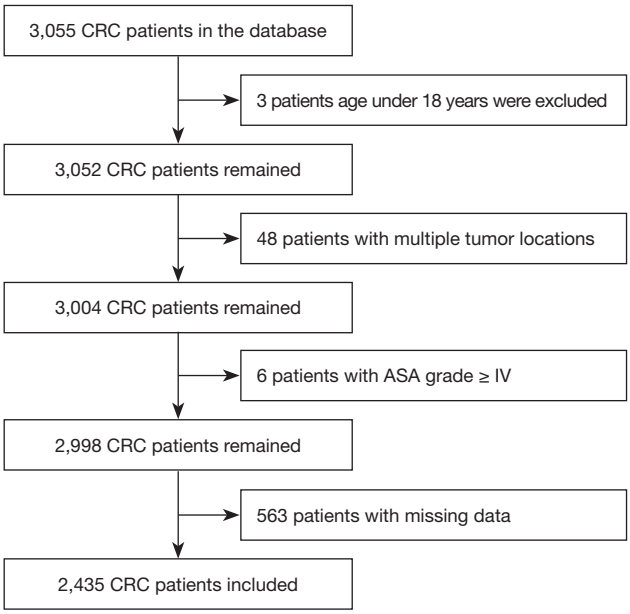

Figure 1 Flow chart of this single-center study. ASA, American Society of Anesthesiologists; CRC, colorectal cancer.

to the occurrence of tumor recurrence, death, or the last follow-up, whichever occurred first.

Statistical analysis

Quantitative data are expressed as the mean [standard deviation (SD)], and categorical data are presented as n (%). The patient cohort was randomly divided into development and validation sets at a ratio of 7:3. The Chi-squared test or Fisher's exact test was applied to assess the significance of differences in categorical variables. The Shapiro-Wilk test was used to evaluate the normality of continuous variables. The significance of differences in continuous variables was assessed using the Mann-Whitney *U* test or *t*-test. DFS and OS curves were plotted using the Kaplan-Meier method, and statistical analyses were performed using the log-rank test (Mantel-Cox test). Univariate and multivariate Cox regression analyses were subsequently performed to identify significant prognostic factors for OS and DFS in the study cohort. Schoenfeld residuals were calculated to ensure that the variables met the proportional hazards assumption. The least absolute shrinkage and selection operator (LASSO) regression method was employed to select independent variables for inclusion in the model. Risk factors identified by LASSO regression were used to construct nomograms for OS and DFS. Receiver operating characteristic (ROC) analysis was also conducted to compare the prognostic prediction capabilities of the nomograms and the conventional AJCC staging system, with larger areas under the curve (AUCs) indicating superior predictive performance. Calibration plots and decision curve analysis (DCA) were also employed for the evaluation of the nomogram models.

A two-tailed P value of less than 0.05 was considered to indicate statistical significance. All the statistical analyses were conducted using R software version 4.2.1 (http://www.r-project.org/).

Results

Demographic and clinicopathological characteristics

The records of the Gastrointestinal Surgery Department of Tongji Hospital in Wuhan were used to identify 3,055 CRC patients. According to the inclusion criteria and exclusion criteria, we finally had a cohort of 2,435 patients for the study (*Figure 1*). The cohort comprised 56.9% males, with an average age of 57.35±12.00 years (*Table 1*).

The study cohort was randomly divided into a development group and a validation group at a 7:3 ratio, with 1,707 patients in the former and 728 in the latter. A statistical test confirmed that the baseline characteristics were well balanced between these two subsets (*Table 1*). Additionally, Kaplan-Meier survival analysis revealed no significant differences in survival outcomes between the two groups (Figure S1).

Predictor identification

The pathological factors analyzed in this study included tumor invasion depth, distant metastasis, tumor differentiation grade, tumor location, tumor size, perineural invasion, vascular invasion, ENTD, R1 resection status, number of lymph nodes harvested, number of positive lymph nodes, and LODDS. All pathological factors conformed to the proportional hazards assumption upon testing. Univariate Cox regression models were utilized to identify pathologic risk factors associated with survival (*Table 2*). The pathological factors significantly associated with OS were tumor invasion depth (P<0.001), distant metastasis (P<0.001), tumor differentiation grade (P<0.001), tumor size (P=0.050), perineural invasion (P=0.001), vascular invasion (P<0.001), ENTD (P<0.001), positive surgical margins (P=0.001), number of lymph nodes

Table 1 Baseline characteristics of the patients in the CRC cohort in this study

Variables	Overall (n=2,435)	Development set (n=1,707)	Validation set (n=728)	P
Age (years), mean (SD)	57.35 (12.00)	57.29 (12.08)	57.48 (11.82)	0.73
Sex, n (%)				0.17
Male	1,385 (56.9)	955 (55.9)	430 (59.1)	
Female	1,050 (43.1)	752 (44.1)	298 (40.9)	
BMI (kg/m^2), mean (SD)	22.42 (3.09)	22.43 (3.09)	22.41 (3.11)	0.89
Hypertension, n (%)	497 (20.4)	352 (20.6)	145 (19.9)	0.73
Diabetes, n (%)	159 (6.5)	114 (6.7)	45 (6.2)	0.72
Previous abdominal surgery, n (%)	466 (19.1)	333 (19.5)	133 (18.3)	0.51
ASA classification, n (%)				0.89
I	292 (12.0)	203 (11.9)	89 (12.2)	
II	1,912 (78.5)	1,339 (78.4)	573 (78.7)	
III	231 (9.5)	165 (9.7)	66 (9.1)	
Invasion depth, n (%)				0.96
Mucosa or submucosa	109 (4.5)	78 (4.6)	31 (4.3)	
Proper muscle	278 (11.4)	195 (11.4)	83 (11.4)	
Subserosa	1,321 (54.3)	929 (54.4)	392 (53.8)	
Serosa or adjacent organ	727 (29.9)	505 (29.6)	222 (30.5)	
Distant metastasis, n (%)	66 (2.7)	39 (2.3)	27 (2.7)	0.07
AJCC stage, n (%)				0.20
I	324 (13.3)	222 (13.0)	102 (14.0)	
IIA	780 (32.0)	560 (32.8)	220 (30.2)	
IIB	240 (9.9)	166 (9.7)	74 (10.2)	
IIC	66 (2.7)	48 (2.8)	18 (2.5)	
IIIA	47 (1.9)	39 (2.3)	8 (1.1)	
IIIB	616 (25.3)	424 (24.8)	192 (26.4)	
IIIC	296 (12.2)	209 (12.2)	87 (12.0)	
IV	66 (2.7)	39 (2.3)	27 (3.7)	
Differentiation grade, n (%)				0.95
Poorly	615 (25.3)	434 (25.4)	181 (24.9)	
Moderately	1,661 (68.2)	1,161 (68.0)	500 (68.7)	
Well	159 (6.5)	112 (6.6)	47 (6.5)	
Tumor location, n (%)				0.24
Cecum	221 (9.1)	155 (9.1)	66 (9.1)	
Ascending colon	323 (13.3)	218 (12.8)	105 (14.4)	
Hepatic flexure	190 (7.8)	126 (7.4)	64 (8.8)	

Table 1 (*continued*)

Table 1 (*continued*)

Variables	Overall (n=2,435)	Development set (n=1,707)	Validation set (n=728)	P
Transverse colon	152 (6.2)	119 (7.0)	33 (4.5)	
Splenic flexure	42 (1.7)	33 (1.9)	9 (1.2)	
Descending colon	80 (3.3)	55 (3.2)	25 (3.4)	
Sigmoid	250 (10.3)	180 (10.5)	70 (9.6)	
Sigmoid-rectum junction	88 (3.6)	57 (3.3)	31 (4.3)	
Rectum	1,089 (44.7)	764 (44.8)	325 (44.6)	
Tumor size (cm), mean (SD)	4.26 (1.85)	4.25 (1.87)	4.28 (1.78)	0.69
Perineural invasion, n (%)	104 (4.3)	73 (4.3)	31 (4.3)	>0.99
Vascular invasion, n (%)	137 (5.6)	93 (5.4)	44 (6.0)	0.63
ENTD, n (%)	226 (9.3)	151 (8.8)	75 (10.3)	0.29
R1 resection, n (%)	14 (0.6)	9 (0.5)	5 (0.7)	0.86
LNs dissected, mean (SD)	15.58 (9.34)	15.71 (9.40)	15.27 (9.20)	0.28
LNs involved, mean (SD)	1.54 (3.23)	1.51 (3.18)	1.59 (3.36)	0.62
LODDS, mean (SD)	–2.40 (1.50)	–2.42 (1.50)	–2.34 (1.52)	0.21

AJCC, American Joint Committee on Cancer; ASA, American Society of Anesthesiologists; BMI, body mass index; CRC, colorectal cancer; ENTD, extranodal tumor deposits; LNs, lymph nodes; LODDS, log odds of positive lymph nodes; SD, standard deviation.

harvested (P=0.002), number of positive lymph nodes (P<0.001), and LODDS (P<0.001). LASSO regression was employed to identify the most crucial variables associated with survival risk. The algorithm was iterated 1,000 times to ensure precision. Additionally, tenfold cross-validation was applied to mitigate the risk of overfitting (Figure S2). Six parameters with nonzero coefficients were selected for the final model: tumor invasion depth, distant metastasis, tumor differentiation grade, ENTD, R1 resection, and LODDS.

Similarly, in the analysis of DFS (*Table 2* and Figure S2), tumor invasion depth, distant metastasis, tumor differentiation grade, ENTD, and LODDS were determined as the final variables for inclusion in the nomogram model.

Nomogram construction

For OS and DFS, we constructed corresponding OS-nomograms (*Figure 2A*) and DFS-nomograms (*Figure 2B*) utilizing six and five predetermined parameters, respectively, as described above. Patients in the cohort were stratified into high-risk and low-risk groups based on the median risk scores calculated from the nomograms. Kaplan-Meier analysis revealed a significant difference in survival outcomes between these two groups (Figure S3).

The ROC analysis demonstrated that the six-parameter OS nomogram showed robust predictive performance in the training cohort, with AUCs of 0.812, 0.771, and 0.791 for 1-, 3-, and 5-year OS, respectively (*Figure 3A*). In the validation set, the OS nomogram maintained its efficacy, yielding AUCs of 0.783, 0.787, and 0.774 for 1-, 3-, and 5-year OS, respectively (*Figure 3B*). Calibration plots indicated that the nomogram reliably predicted OS outcomes in both the training and validation sets (*Figure 3C,3D*).

Regarding the DFS nomogram, which utilized five parameters, the area under the curve (AUC) in the training set for 1-, 3-, and 5-year DFS was 0.783, 0.784, and 0.772, respectively (*Figure 4A*). In the validation cohort, the AUC was 0.805, 0.758, and 0.743 for 1-, 3-, and 5-year DFS, respectively (*Figure 4B*). Calibration plots confirmed the accuracy of the nomogram for predicting DFS (*Figure 4C,4D*).

Comparison with the AJCC staging system

We conducted a comparative analysis of the predictive performance of the developed nomogram and the conventional AJCC staging system for predicting survival outcomes in the whole CRC cohort. According to the ROC

Table 2 Univariate Cox regression results of pathological parameters for overall survival and disease-free survival

Variables	OS		DFS	
	HR (95% CI)	P	HR (95% CI)	P
Invasion depth				
Mucosa or submucosa	Ref	<0.001	Ref	<0.001
Proper muscle	3.550 (0.824–15.300)	0.09	1.054 (0.412–2.693)	0.91
Subserosa	7.088 (1.757–28.597)	0.006	2.521 (1.116–5.695)	0.03
Serosa or adjacent organ	16.649 (4.130–67.114)	<0.001	5.308 (2.349–11.991)	<0.001
Distant metastasis	3.684 (2.367–5.734)	<0.001	4.600 (3.034–6.974)	<0.001
Differentiation grade				
Poorly	Ref	<0.001	Ref	<0.001
Moderately	0.436 (0.351–0.542)	<0.001	0.435 (0.349–0.542)	<0.001
Well	0.309 (0.178–0.534)	<0.001	0.425 (0.263–0.686)	<0.001
Tumor location				
Cecum	Ref	0.43	Ref	0.02
Ascending colon	1.291 (0.842–1.981)	0.24	1.112 (0.742–1.666)	0.61
Hepatic flexure	1.060 (0.646–1.739)	0.82	1.060 (0.646–1.739)	0.68
Transverse colon	0.988 (0.593–1.646)	0.96	0.802 (0.490–1.315)	0.38
Splenic flexure	0.905 (0.354–2.315)	0.84	0.464 (0.143–1.500)	0.20
Descending colon	0.642 (0.297–1.387)	0.26	0.647 (0.323–1.294)	0.23
Sigmoid	0.893 (0.555–1.437)	0.64	0.599 (0.369–0.970)	0.04
Sigmoid-rectum junction	0.665 (0.308–1.436)	0.20	0.532 (0.249–1.137)	0.10
Rectum	0.915 (0.630–1.329)	0.64	0.701 (0.493–0.997)	0.048
Tumor size	1.055 (1.000–1.113)	0.050	1.040 (0.985–1.098)	0.16
Perineural invasion	2.050 (1.329–3.162)	0.001	2.340 (1.556–3.521)	<0.001
Vascular invasion	2.259 (1.560–3.272)	<0.001	2.262 (1.570–3.258)	<0.001
ENTD	2.487 (1.854–3.336)	<0.001	2.535 (1.894–3.393)	<0.001
R1 resection	5.202 (1.937–13.967)	0.001	3.951 (1.265–12.341)	0.02
LNs dissected	0.980 (0.968–0.993)	0.002	0.983 (0.971–0.995)	0.007
LNs involved	1.143 (1.123–1.163)	<0.001	1.132 (1.111–1.153)	<0.001
LODDS	1.587 (1.498–1.681)	<0.001	1.517 (1.432–1.607)	<0.001

CI, confidence interval; DFS, disease-free survival; ENTD, extranodal tumor deposits; HR, hazard ratio; LNs, lymph nodes; LODDS, log odds of positive lymph nodes; OS, overall survival; Ref, reference.

analysis, the OS nomogram exhibited AUC values of 0.786, 0.776, and 0.803 for 1-, 3-, and 5-year OS, respectively, surpassing the AUC values of 0.768, 0.750, and 0.782, respectively, for the AJCC staging system (*Figure 5A-5C*). And the DCA results indicated a greater net benefit with the nomogram than with the AJCC staging system for 1-, 3- and 5-year forecasts (*Figure 5D-5F*). For DFS prediction, the DFS nomogram yielded AUC values of 0.764, 0.777, and 0.789 for 1-, 3-, and 5-year forecasts, respectively, which were larger than the AUC values of 0.762, 0.761, and 0.770

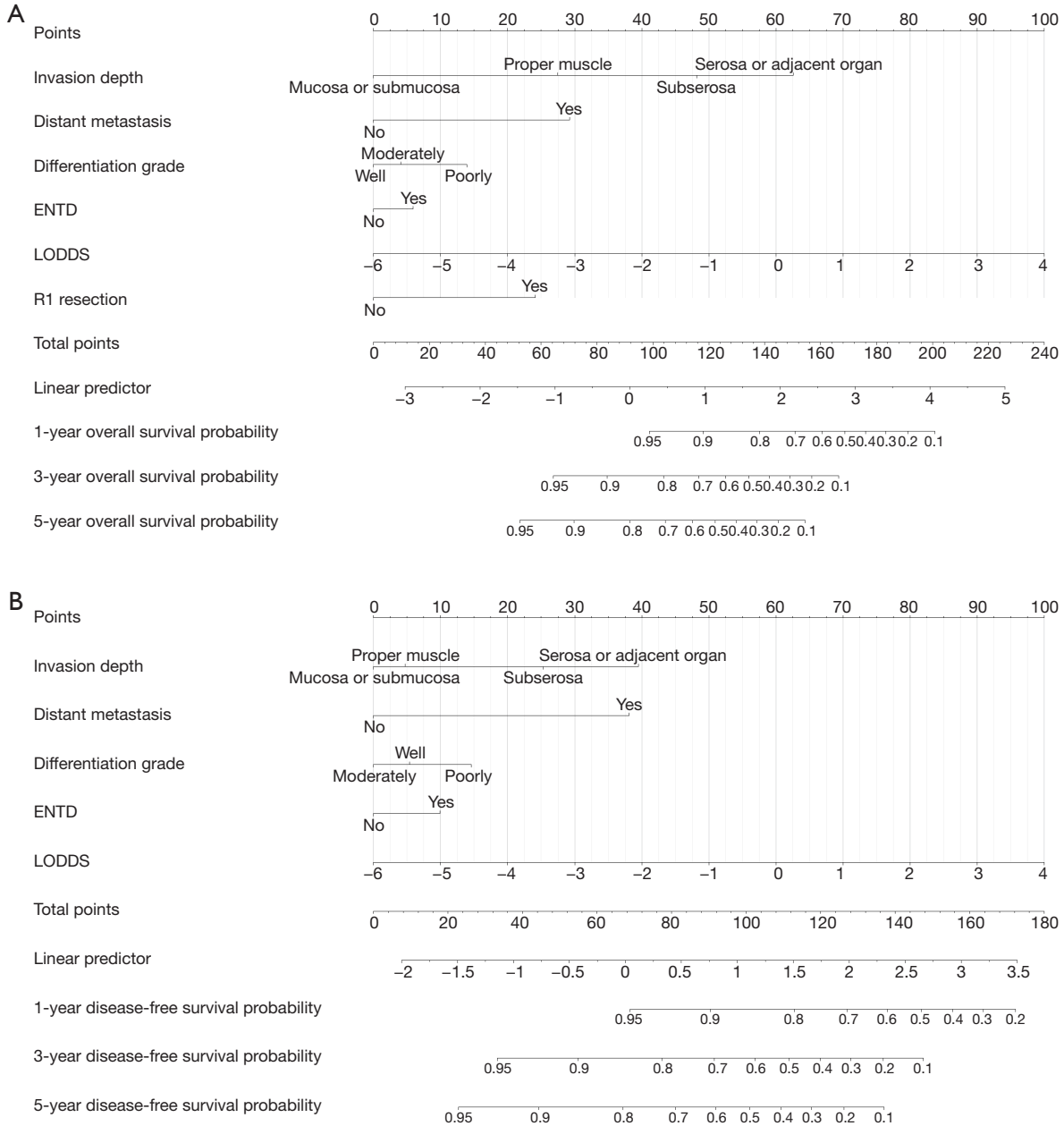

Figure 2 Nomograms for predicting survival of CRC patients. (A) The nomogram for predicting OS. (B) The nomogram for predicting DFS. CRC, colorectal cancer; DFS, disease-free survival; ENTD, extranodal tumor deposits; LODDS, log odds of positive lymph nodes; OS, overall survival.

obtained with the AJCC staging system (*Figure 5G-5I*). ROC analysis further revealed that, across all patients, the AUC values of the nomogram were consistently greater than those of the AJCC staging system. Additionally, the DCA results also indicated a greater net benefit with the nomogram than with the AJCC staging system for 1-, 3- and 5-year forecasts (*Figure 5J-5L*). These findings demonstrated the good prognostic prediction capability of our constructed nomogram for predicting shot-term survival (especially for 1- and 3-year OS and DFS).

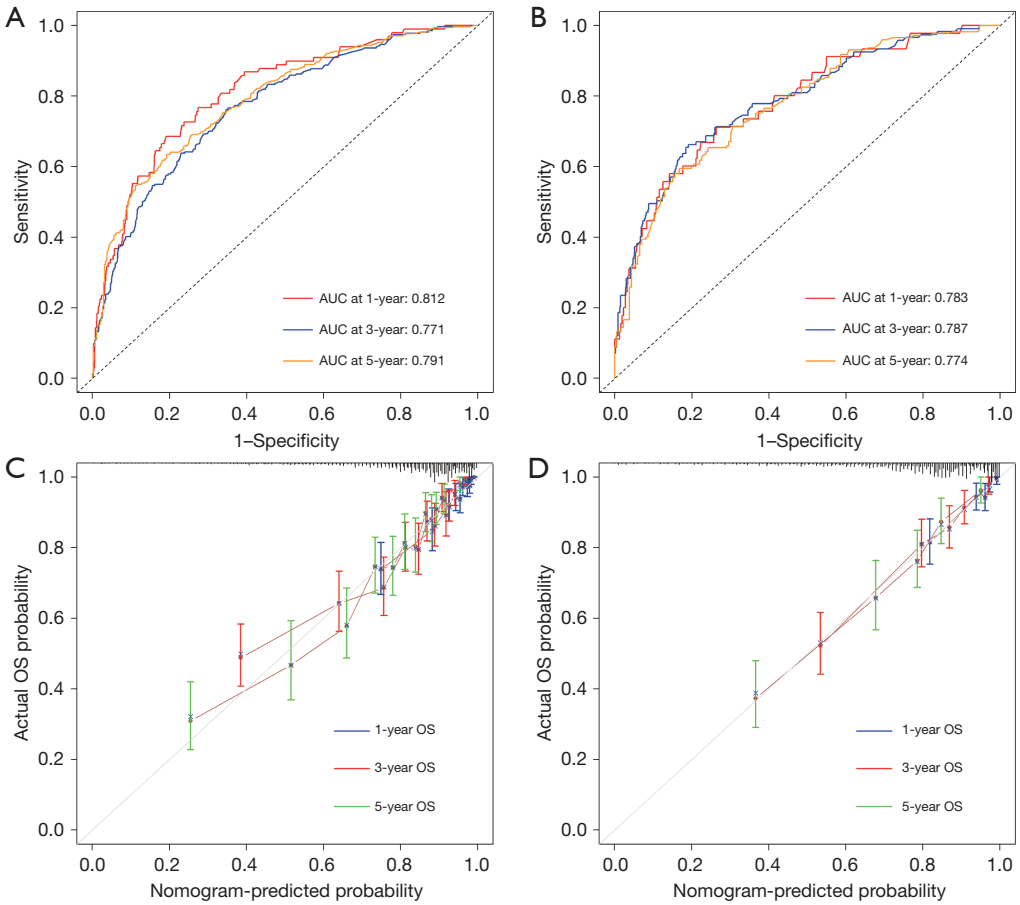

Figure 3 ROC analysis and calibration curve for verifying the OS prediction ability of the nomogram in development and validation sets. (A,B) ROC analyses for verifying the discrimination of the nomogram in development set and validation set, respectively. (C,D) Calibration curves for verifying the accuracy of the nomogram in development set and validation set, respectively. AUC, area under the curve; OS, overall survival; ROC, receiver operating characteristic.

Discussion

Nomograms are statistical tools that offer predictions through straightforward methods and have been extensively utilized in prognosticating outcomes for cancer patients (18). In this study, we developed nomograms for predicting OS and DFS in CRC patients based on pathological data from a single-center cohort. These nomograms had been demonstrated to have robust predictive performance, underscoring their potential utility in postsurgical prognostication for CRC patients.

The strength of this study lies in the development of our nomogram model within a large cohort, bolstered by extensive longitudinal follow-up. The large sample size enabled robust internal validation, leading to more reliable conclusions (19). ROC analysis was instrumental in determining the diagnostic capabilities of the model, while calibration plots provided valuable insights, particularly for models with a narrow range of predictions (20). In our development cohort, the AUC values for 5-year OS and DFS were 0.791 and 0.774, respectively, indicating the favorable discriminative ability of these nomograms. Additionally, calibration plots, as shown in *Figures 3,4*, demonstrated good estimations of survival probabilities. These prognostic nomograms are valuable decision-making tools that utilize clinically accessible variables and offer the advantage of integrating multiple risk factors for probability estimation as opposed to relying on singular variables.

Despite important advancements in multimodal treatment strategies such as surgery, chemotherapy, radiotherapy, and immunotherapy, the survival outcomes

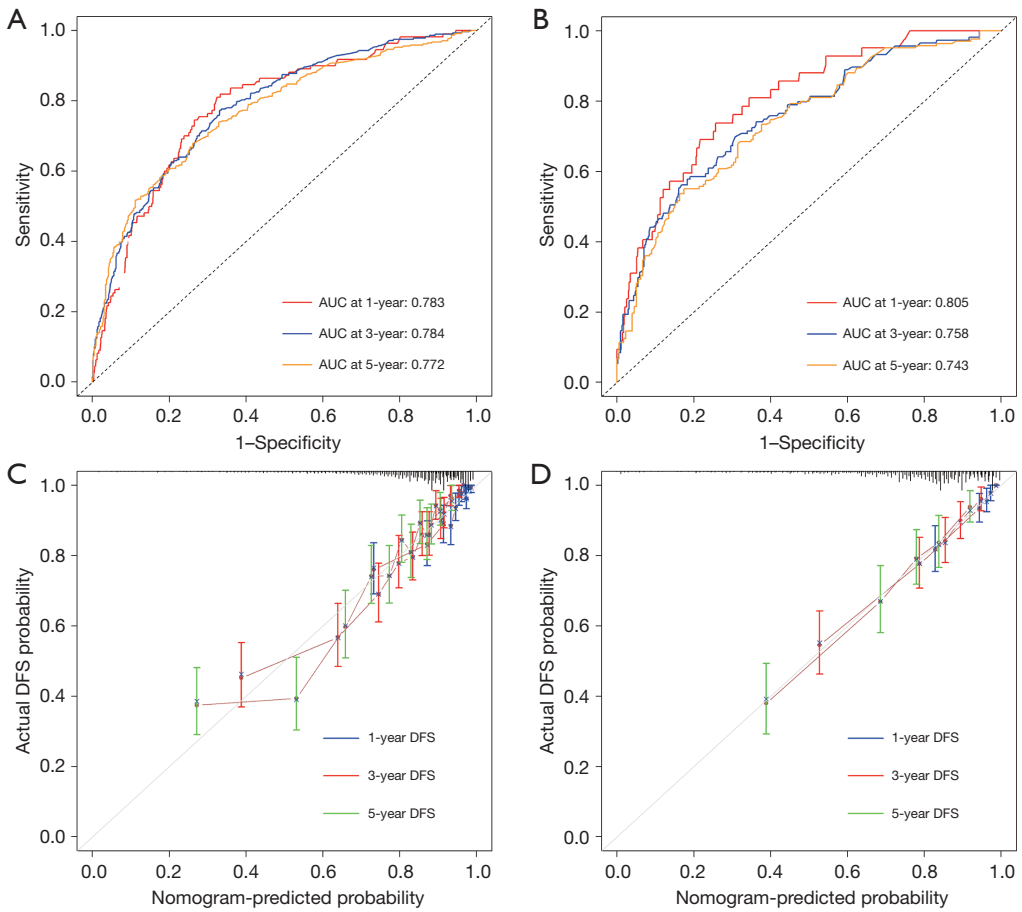

Figure 4 ROC analysis and calibration curve for verifying the DFS prediction ability of the nomogram in development and validation sets. (A,B) ROC analyses for verifying the discrimination of the nomogram in development set and validation set, respectively. (C,D) Calibration curves for verifying the accuracy of the nomogram in development set and validation set, respectively. AUC, area under the curve; DFS, disease-free survival; ROC, receiver operating characteristic.

in CRC patients are still unclear (21-23). To improve the survival and quality of life of CRC patients, accurate prognosis prediction and personalized treatment plans are imperative (24). Prognostic predictions and postoperative management strategies for CRC largely depend on postsurgical pathological staging information (24,25), with different pathological stages dictating varied postoperative treatment modalities, i.e., either more aggressive adjuvant therapies or conservative observation. Our study compared the performance of our developed nomogram model with that of traditional TNM staging for prognostic prediction in CRC patients. Both the ROC analysis and DCA indicated that our developed nomogram had predictive performance superior to that of the traditional TNM staging system. These findings suggested that our developed nomogram model has strong clinical applicability and may be more suitable as a reference for formulating treatment strategies for CRC patients.

The pathological parameters included in our developed nomogram model have been extensively validated (26-29). Emerging evidence suggests a strong correlation between positive lymph nodes and poor OS, positioning the former as a potent risk factor in advanced CRC patients and potentially guiding subsequent adjuvant treatment and monitoring strategies (30). Moreover, for accurate N staging in CRC, the widely accepted recommendation for number is a minimum of 12 lymph nodes (9). However, studies have indicated that nearly half of patients have insufficient lymph node data available, partly due to the complexities related to tumor size, invasion depth, and tumor

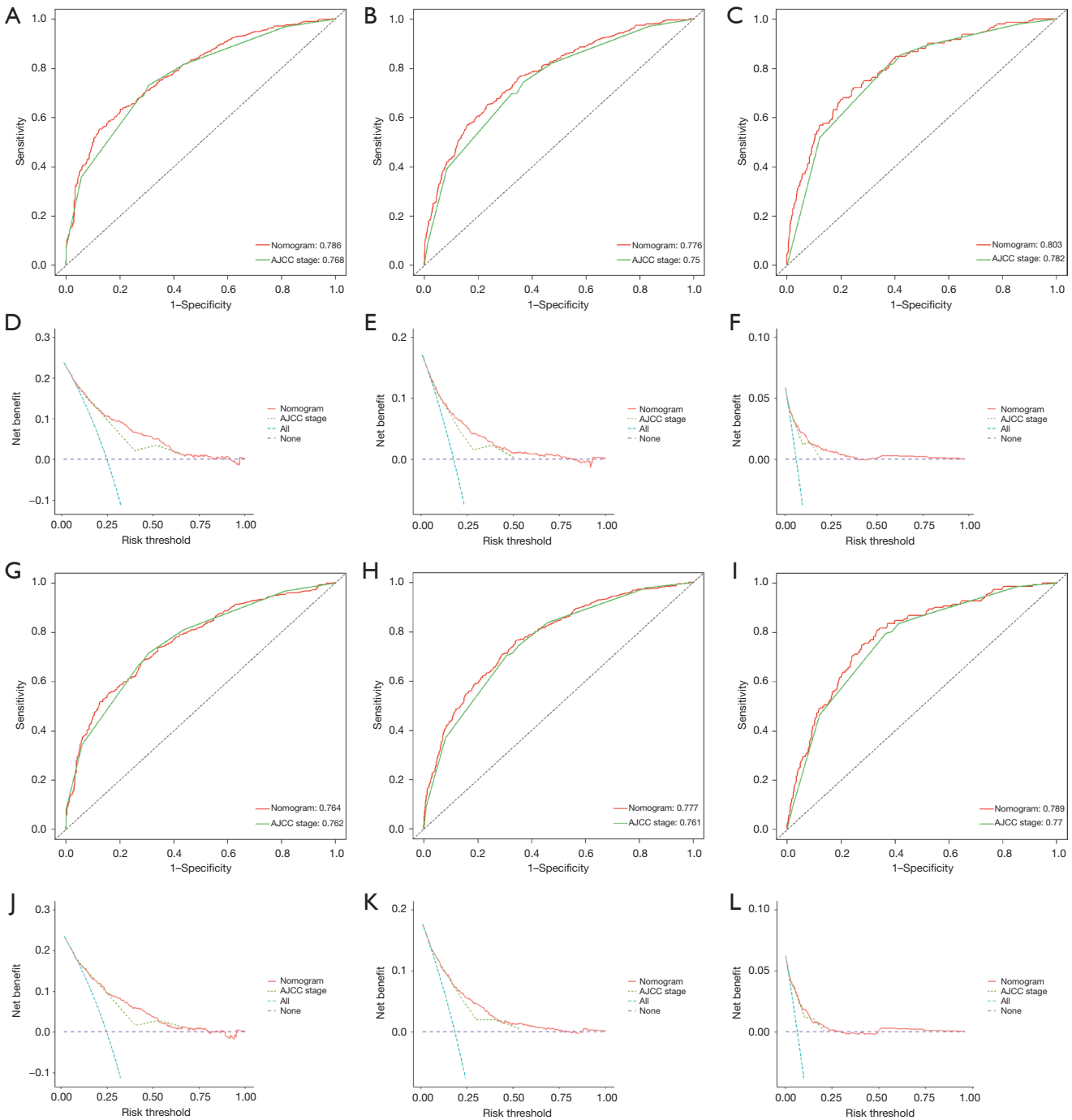

Figure 5 The comparison of the predictive ability of the nomogram constructed in this study and AJCC staging system for the prognosis of CRC. (A-C) Prediction performance comparison of the nomogram and AJCC staging system by ROC analysis for 1-year (A), 3-year (B), and 5-year (C) OS, respectively. (D-F) Prediction performance comparison of the nomogram and AJCC staging system by DCA analysis for 1-year (D), 3-year (E), and 5-year (F) OS, respectively. (G-I) Prediction performance comparison of the nomogram and AJCC staging system by ROC analysis for 1-year (G), 3-year (H), and 5-year (I) DFS, respectively. (J-L) Prediction performance comparison of the nomogram and AJCC staging system by DCA analysis for 1-year (J), 3-year (K), and 5-year (L) DFS, respectively. AJCC, American Joint Committee on Cancer; CRC, colorectal cancer; DCA, decision curve analysis; DFS, disease-free survival; OS, overall survival; ROC, receiver operating characteristic.

microenvironment (31). The LODDS is an emerging staging system that describes lymph node status. Increasing evidence has shown that the LODDS is more accurate than traditional N staging and the lymph node ratio in evaluating survival in CRC patients (27,32,33). Consistent with the findings of previous reports, our Cox regression analysis indicated that the LODDS played a pivotal role in the progression and development of CRC. Furthermore, the retention of the LODDS in LASSO regression screening underscores its strong predictive capability for CRC, making it a valuable indicator for patients.

While tumor multimodal sequencing provides a wealth of biological information and is a promising tool for cancer prognosis prediction, it undoubtedly increases the economic burden on patients (34). Given the superior accessibility of postoperative pathological information, prognostic models based on postsurgical tumor pathology align more closely with the practical needs of clinical practice.

Our study has certain limitations. First, its retrospective nature and partial lack of data may introduce biases in data interpretation. Second, as the data were exclusively sourced from an Eastern Asian single center, the findings might not be generalizable to other populations. Additionally, our study lacked information on aspects such as tumor microsatellite stability and genomic data that could be beneficial for prognostic predictions. Moreover, robust external validation of our results could enhance the credibility of the findings.

Conclusions

In conclusion, we developed nomogram models for OS and DFS based on postoperative pathological information. These practical nomograms demonstrated good prognostic prediction capabilities and robust discriminative power, even surpassing the traditional TNM staging system in terms of prognostic precision.

Acknowledgments

None.

Footnote

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