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***Retrospective Cohort Study***

**Nomogram established using risk factors of early gastric cancer for predicting the lymph node metastasis**

Jiang XC *et al*. Nomogram for predicting lymph node metastasis

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**Abstract**

BACKGROUND

For the prognosis of patients with early gastric cancer (EGC), lymph node metastasis (LNM) plays a crucial role. A thorough and precise evaluation of the patient for LNM is now required.

AIM

To determine the factors influencing LNM and to construct a prediction model of LNM for EGC patients.

METHODS

Clinical information and pathology data of 2217 EGC patients downloaded from the Surveillance, Epidemiology, and End Results database were collected and analyzed. Based on a 7:3 ratio, 1550 people were categorized into training sets and 667 people were assigned to testing sets, randomly. Based on the factors influencing LNM determined by the training sets, the nomogram was drawn and verified.

RESULTS

Based on multivariate analysis, age at diagnosis, histology type, grade, T-stage, and size were risk factors of LNM for EGC. Besides, nomogram was drawn to predict the risk of LNM for EGC patients. Among the categorical variables, the effect of grade (well, moderate, and poor) was the most significant prognosis factor. For training sets and testing sets, respectively, area under the receiver-operating characteristic curve of nomograms were 0.751 [95% confidence interval (CI): 0.721-0.782] and 0.786 (95%CI: 0.742-0.830). In addition, the calibration curves showed that the prediction model of LNM had good consistency.

CONCLUSION

Age at diagnosis, histology type, grade, T-stage, and tumor size were independent variables for LNM in EGC. Based on the above risk factors, prediction model may offer some guiding implications for the choice of subsequent therapeutic approaches for EGC.

**Key Words:** SEER; Early gastric cancer; Lymph node metastasis; Risk factors; Nomogram

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**Core Tip:** A model was constructed to evaluate the impact of various indicators in an integrated manner to serve as a base for predicting lymph node metastasis (LNM) in early gastric cancer (EGC) patients. Age at diagnosis, histology type, grade, T-stage, and tumor size were independent hazard elements for LNM in EGC.

**INTRODUCTION**

Gastric cancer (GC), as the third most common cancer-related cause of death worldwide[1], for which risk indicators include *Helicobacter pylori* (*H. pylori*) infection, gender, eating habits, smoking and family history[2]. Screening may be done for GC using markers of atrophy in the stomach (a precursor lesion of GC), such as serum pepsinogens[3] or serum ghrelin[4]; or serum antibodies to Hp, the main risk factor for GC[5]; or examining the stomach mucosa using endoscopy[6].

Early gastric cancer (EGC) is classified as a GC limited to the mucosa or submucosa, irrespective of the presence of territorial lymph node metastasis (LNM)[7]. Compared to advanced GC, EGC has a better opportunity to be surgically removed successfully, which resulting in a better survival status. Endoscopic resection (ER), which is suitable for low LNM rate of EGC, is the first-choice therapy for EGC. Endoscopic submucosal dissection (ESD) and endoscopic mucosal resection (EMR) are two main operations of ER[8]. Operable advanced GC could be radically resected by surgery including D2 Lymphadenectomy[9].

Although the incidence of GC has decreased in the past 3 decades in developed countries[10], the general prognosis for GC was still poor. For example, the five-year survival rate for GC is about 20 percent[11]. LNM had good predictive value for prognosis[12]. Therefore, in patients with EGC, the presence or absence of LNM is a crucial factor to be evaluated comprehensively.

Corresponding clinicopathological information of a large sample size of EGC patients was obtained from the Surveillance, Epidemiology, and End Results (SEER) database[13], including clinicopathological parameters and information of patients. Factors that may be associated with the prognosis of patients with EGC were enrolled into our research to explore their influence. There are very few researches, to our knowledge, exploring the factors influencing LNM in EGC patients. Therefore, we plotted a predictive model that allows a comprehensive assessment of the effects of various indicators and provides a platform for prediction of LNM of patients with EGC.

**MATERIALS AND METHODS**

***Data source and patient selection***

Clinicopathological information were obtained from the SEER database. The standards used for exclusion are listed below: (1) Patients who have undergone pre-operative neoadjuvant therapy; (2) patients with residual GC; (3) patients without complete clinical and pathological data; (4) retrieved unknown lymph nodes; and (5) patients without confirmed as EGC *via* biopsy.

Finally, a total of 2217 patients participated in this study and were analyzed in the next step. According to the ratio of seven to three, all patients were separately assigned to training and testing sets (1550:667).

***Clinicopathological parameters***

The relationship between individual clinicopathological features and LNM was evaluated to identify independent influencing variables for LNM in EGC. The clinicopathological features were examined as follow: Race, age when EGC is confirmed, gender, tumor location, histological type, degree of differentiation, TNM stage, T-stage, tumor size, LNM, survival months, status, first malignant primary indicator, sequence number, insurance recode, marital status. First malignant primary indicator, which means whether it is the first primary tumor, was divided into two subgroups: No and yes.

***Statistical analysis***

Numerical variables were represented as mean ± SD and examined using *t*-test. Categorical variables were represented as frequency and proportion and analyzed by Pearson’s *χ2* or Fisher’s exact tests. In the logistic regression, variables that were significantly different in the univariate analysis were included in the multivariate analysis. Factors of influence of training sets were determined and results were displayed as odds ratio (OR) and 95% confidence intervals (CIs).

Furthermore, the LNM prediction model was plotted. In addition, 850 patients in the testing set, as the external validation sets, were included in the follow-up validation analysis. The power of identification of the prediction model is calculated using the consistency index, which corresponds to the area under the receiver-operating characteristic curve (AUC) in the logistic regression.

SPSS software (version 22.0; IBM Corp.) and R software (version 4.0.5) were used to analyze the data. Two-sided *P* < 0.05 was considered to be statistically significantly different.

**RESULTS**

***Characteristics of patients***

Two thousand two hundred and seventeen suitable patients were included in the present research (Figure 1). Of the included EGC patients, 1214 (54.8%) were male and 1003 (45.2%) were female. 1247 (56.2%) were white, 355 (16.0%) were black, and 615 (27.7%) were put in the “other” race subgroup. Moreover, T stage, 356 (16.1%) were T1/T1NOS, 801 (36.1%) were T1a, 1060 (47.8%) were T1b. Of the EGC patients, 337 (15.2%) were diagnosed with LNM totally, 1880 (84.8%) were not. The LNM rates of EGC patients were 15.6% (242/1550) in the training sets and 14.2% (95/667) in the testing sets, respectively (Table 1).

***Prognostic variables of patients with EGC***

Univariate logistic regression analysis showed that some factors, such as age when EGC is confirmed, histology type, grade, TNM stage, T-stage, size, primary, were influenced variables of LNM of EGC (Table 2). Those variables treated as significant prognostic factors for LNM were included in the multivariate logistic regression model. Age at diagnosis [odd ratio (OR): 0.003, *P* = 0.012], histology type (OR: 1.382, *P* = 0.019), grade (OR: 1.825, *P* < 0.001), T-stage (OR: 1.985, *P* < 0.001), and size (OR: 1.319, *P* < 0.001) were independent influenced variables for LNM (Table 3).

***Construction of the prediction model for EGC patients***

A nomogram prediction model was constructed (Figure 2). In the model, the points of each variable ranged from 0 to 100. Each indicator has its corresponding score row, in which each patient has a score that is derived from the corresponding first row. The total point is the sum of the points of all variable. And then, the total score for each patient corresponds to the probability of the bottom which is the probability of occurrence of LNM.

***Evaluation of the nomogram***

The calibration curves of the training and testing sets used to compare the forecasted situation with the actual situation, both showed satisfactory consistency (Figure 3). The AUC of internal validation was 0.751 (95%CI: 0.721-0.782) and of external validation was 0.786 (95%CI: 0.742-0.830), respectively (Figure 4).

**DISCUSSION**

GC has a significant impact worldwide[14]. GC, occurs in the epithelium of the gastric mucosa, tendency to undergo hematogenous or LNM even in the early stages[15]. As the understanding of GC becomes more comprehensive and deeper, the rate of occurrence and mortality is decreasing year by year[16]. The average of age at diagnosis of GC patients was lower and lower in recent year[1].

Based on Japanese Gastric Cancer Treatment Guidelines 2018[17], EGC can be treated by EMR or ESD, with acceptable results in the west[18]. EMR is primarily indicated for mucosal cancers without ulcer and with a mucosal diameter of ≤ 2 cm to be excised, which was the first endoscopic treatment for EGC. Compared to EMR, ESD is not limited by tumor size or ulceration, which is facilitate curative tumor resection[19]. The operation is judged to be a radical resection if all of the followings are met: en bloc resection, intestinal-differentiated-type, pathological-T1a, tumor size ≤ 2 cm, negative surgical cut edge (both lateral and vertical), and absence of lymphovascular invasion[20].

LNM has a clear correlation with poor prognosis in patients with EGC[21]. The presence or absence of LNM determines the choice of treatment. Precisely predicting the presence or absence of LNM in EGC patients helps to select the best treatment modality, which is of great importance in the clinical treatment process. Therefore, construction of the prediction model for EGC patients may help find those who were be prone to LNM and prolong survival time after surgery[22].

The process of nomogram development was clarified in previous study[22]. In our study, age when EGC is confirmed (OR: 0.003, *P* = 0.012), histology type (OR: 1.382, *P* = 0.019), grade (OR: 1.825, *P* < 0.001), T-stage (OR: 1.985, *P* < 0.001), and tumor size (OR: 1.319, *P* < 0.001) were independent influenced variables for LNM. Those variables were used to construct the predict model. Our clinical prediction models are more believable and more convincing because they are internally validated and externally validated.

Among the categorical data, the degree of differentiation is the most important influencing factor, which was consistent with previous findings[23]. Xiang *et al*[24] indicated that miR-145-5p was capable to induce the differentiation of GC and affect the LNM of GC.

Early-stage cancers less than 4 cm have a very low LNM rate and can be evaluated for local excision[25]. Other study showed that tumor with large diameter and deep invasion were independent risk factors for LNM[26]. Sekiguchi *et al*[27] reported that tumor with large diameter, depth, and histological type were confirmed to be the independent influencing element of LNM.

Besides, age at diagnosis, tumor size, T-stage, and histology type were also the independent influenced variables for LNM. Gurzu *et al*[28] found that in younger patients with GC, the expression of VEGF is more active, which increases the probability of tumor invasion and LMN in GC. Bao *et al*[29] argued that increased expression of MDM4 could correlate with LNM and lead to poorer survival status of GC especially in younger patients. Park *et al*[30] study revealed that the tissue of GC is more invasive in younger patients than in older patients. The LNM rates in young EGC patients were higher than in other patients probably related to the higher malignant potential of their tumors[31].

This is the fact that tumor infiltrating into the submucosa of the stomach is related to the increased significantly incidence of LNM[32,33], which our study came to the similar findings. Radical surgical resection and lymph node dissection are suitable for deeply infiltrated GC[34].

However, our research has some limitations. First of all, only patients with EGC who underwent surgery were included in this study for retrospective analysis Secondly, “others/unknown” expanded applicability of the predicted model which could be influenced the precision of the model. Thirdly, the molecular pathologic characteristics, family history, and *H. pylori* infection are not enrolled in analysis.

**CONCLUSION**

Age at diagnosis, histology type, grade, T-stage, and tumor size were independent risk variables for LNM in EGC. Based on these, the predictive model was built for predicting possibilities of LNM in EGC patients. Both internal and external validation proved the credibility and persuasiveness which demonstrated by the receiver operating characteristic and the calibration curve.

**ARTICLE HIGHLIGHTS**

***Research background***

Lymph node metastasis (LNM) has a major influence on the postoperative survival status of patients with early gastric cancer.

***Research motivation***

Our aim was to improve early gastric cancer (EGC) patients’ prognosis.

***Research objectives***

To improve EGC patients’ prognosis.

***Research methods***

Clinical information and pathology data of 2217 EGC patients were collected and analyzed. Based on a 7:3 ratio, 1550 people were grouped to training sets and 667 people were assigned to testing sets, randomly. The predictive model was built based on the training set for predicting possibilities of LNM in EGC patients. Both internal and external validation proved the credibility and persuasiveness which demonstrated by the receiver operating characteristic (ROC) and the calibration curve.

***Research results***

Age at diagnosis, histology type, grade, T-stage, and size were risk factors of LNM for EGC. Besides, nomogram was drawn to predict the risk of LNM for EGC patients. Among the categorical variables, the effect of grade (well, moderate, and poor) was the most significant prognosis factor. For training sets and testing sets, respectively, area under the receiver-operating characteristic curve of nomograms were 0.751 [95% confidence interval (CI): 0.721-0.782] and 0.786 (95%CI: 0.742-0.830). In addition, the calibration curves showed that the prediction model of LNM had good consistency.

***Research conclusion***

Based on these independent risk variables, the predictive model was built for predicting possibilities of LNM in EGC patients. Both internal and external validation proved the credibility and persuasiveness which demonstrated by the ROC and the calibration curve.

***Research perspectives***

We analyzed the independent influenced variables for LNM in EGC patients. Based on the independent risk factors, the prediction model was plotted. After internal validation and external validation, the ROC and the calibration curve were built, which validated the credible and persuasive of the nomogram.

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**Footnotes**

**Institutional review board statement:** Institutional review board statementwas not acquired sincedata were obtained from the SEER database that covering approximately 28% of the cases in the United States.

**Informed consent statement:** Patients were not required to give informed consent to the study because the analysis used anonymous clinical data that were obtained after each patient agreed to treatment by written consent.

**Conflict-of-interest statement:** The authors declare that they have no conflict of interest.

**Data sharing statement:** The data can be obtained from the correspondence. The collection of patient information did not require informed consent nor institutional review because such information was publicly available.

**STROBE statement:** The authors have read the STROBE Statement—checklist of items, and the manuscript was prepared and revised according to the STROBE Statement—checklist of items.

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**Peer-review report’s scientific quality classification**

Grade A (Excellent): 0

Grade B (Very good): 0

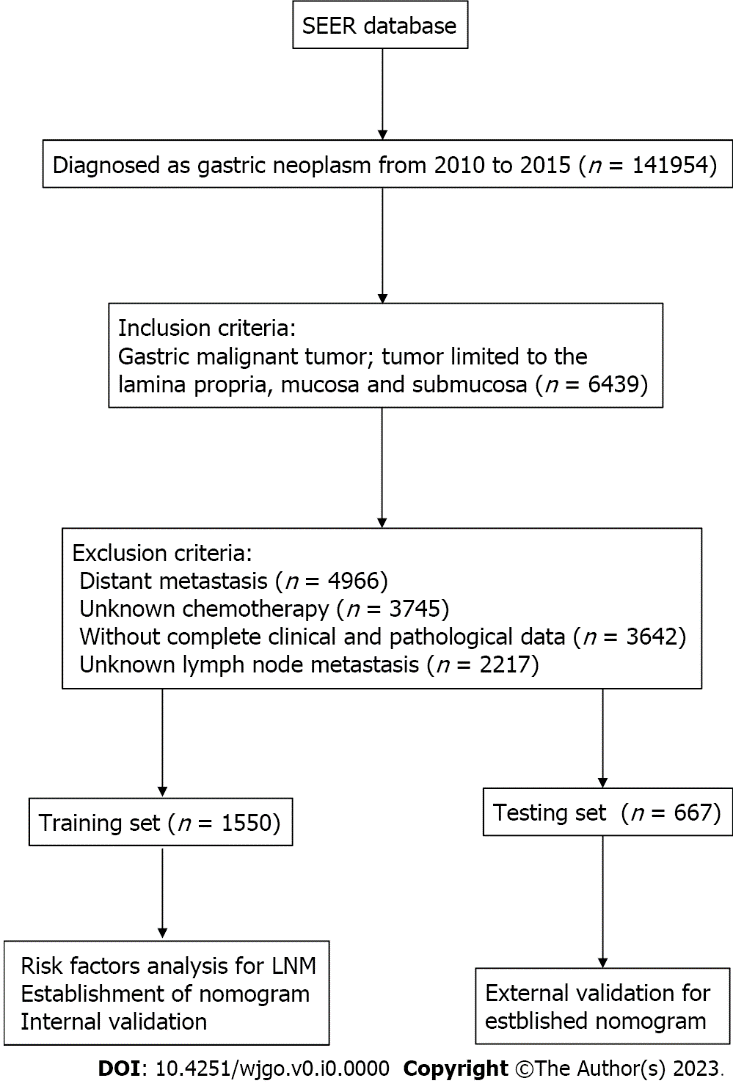
Grade C (Good): C, C

Grade D (Fair): 0

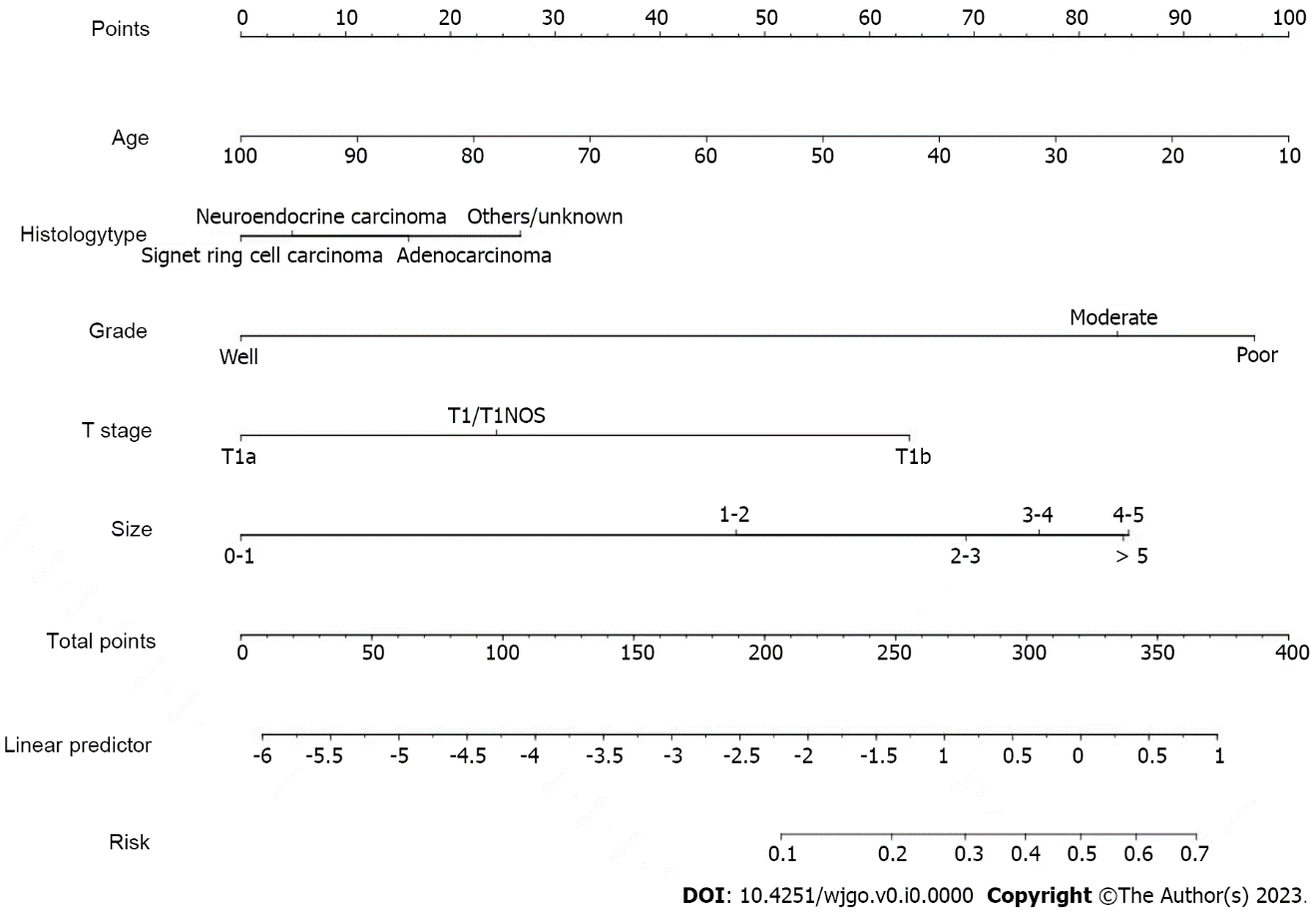
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**P-Reviewer:** Li DH, China; Senchukova M, Russia **S-Editor:** Chen YL **L-Editor:** A **P-Editor:** Chen YL

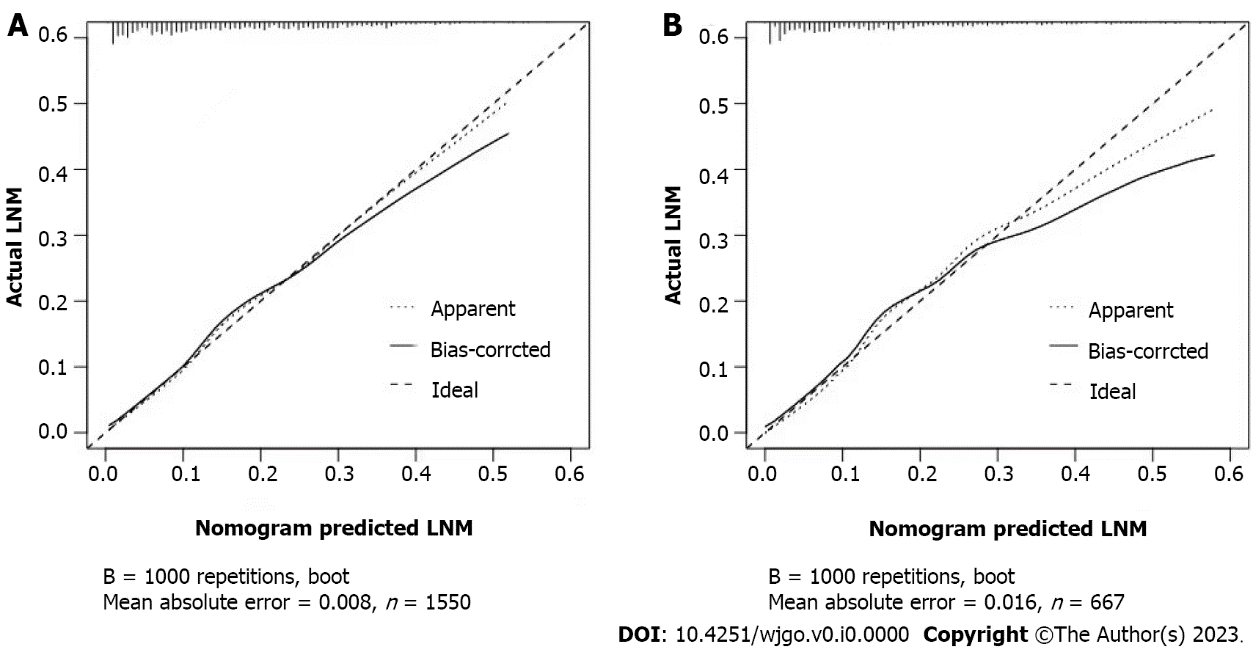
**Figure Legends**

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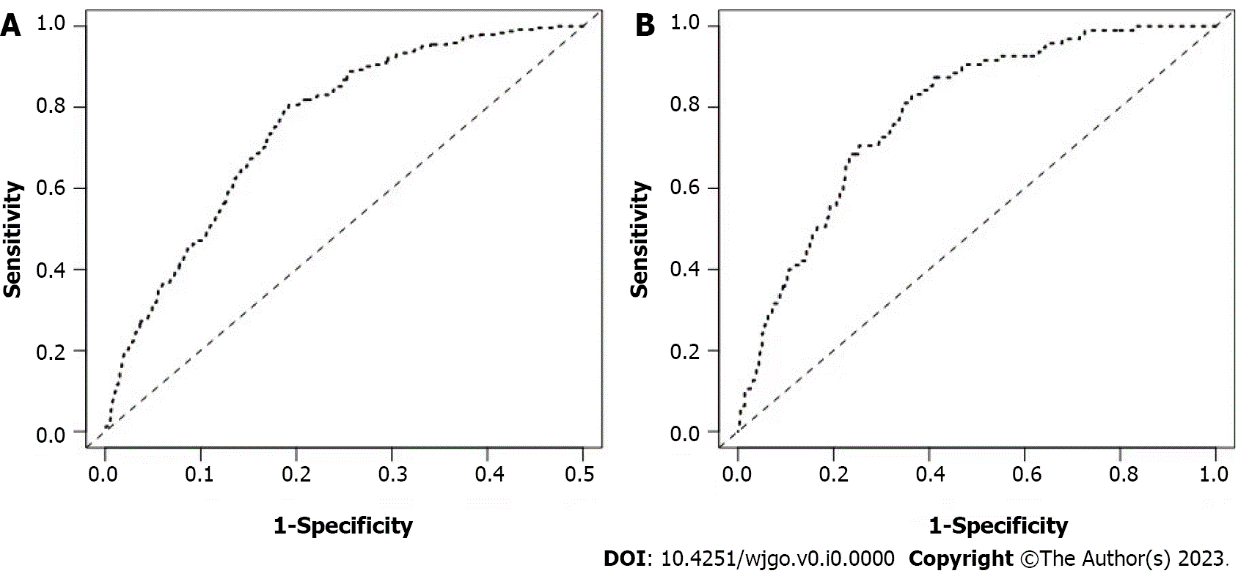
**Figure 1 The flowchart of data collection and grouping for patients with early gastric cancer.** LNM: Lymph node metastasis; SEER: Surveillance, Epidemiology, and End Results.

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**Figure 2 Nomogram prediction model for lymph node metastasis in** **early gastric cancer patients.**

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**Figure 3 Calibration curve of the nomogram prediction model for early gastric cancer patients.** A: Internal validations for the nomogram prediction model for the training set of early gastric cancer (EGC) patients; B: External validations for the nomogram prediction model for the testing set of EGC patients. LNM: Lymph node metastasis.

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**Figure 4 Receiver operating characteristic curve of the nomogram prediction model for early gastric cancer patients.** A: Internal validations for the nomogram prediction model for the training set of early gastric cancer (EGC) patients; B: External validations for the nomogram prediction model for the testing set of EGC patients.

**Table 1 Characteristic of 2217 patients with early gastric cancer from Surveillance, Epidemiology, and End Results**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variables** | **Level** | **LNM (-)** | **LNM (+)** | ***P* value** |
| ***n* = 1880** | ***n* = 337** |
| Age (mean ± SD) |  | 70.87 (12.82) | 68.74 (12.59) | 0.0051 |
| Race (%) | White | 1065 (56.6) | 182 (54.0) | 0.554 |
|  | Black | 295 (15.7) | 60 (17.8) |  |
|  | Other | 520 (27.7) | 95 (28.2) |  |
| Gender (%) | Male | 1025 (54.5) | 189 (56.1) | 0.638 |
|  | Female | 855 (45.5) | 148 (43.9) |  |
| Location (%) | Body of stomach | 314 (16.7) | 51 (15.1) | 0.116 |
|  | Gastric antrum | 710 (37.8) | 133 (39.5) |  |
|  | Fundus of stomach | 97 (5.2) | 13 (3.9) |  |
|  | Greater curvature of stomach NOS | 127 (6.8) | 25 (7.4) |  |
|  | Lesser curvature of stomach NOS | 264 (14.0) | 47 (13.9) |  |
|  | Stomach, NOS | 64 (3.4) | 14 (4.2) |  |
|  | Pylorus | 186 (9.9) | 21 (6.2) |  |
|  | Overlapping lesion of stomach | 118 (6.3) | 33 (9.8) |  |
| Histologytype (%) | Neuroendocrine carcinoma | 80 (4.3) | 1 (0.3) | 0.0021 |
|  | Signet ring cell carcinoma | 336 (17.9) | 57 (16.9) |  |
|  | Adenocarcinoma | 1349 (71.8) | 250 (74.2) |  |
|  | Others/unknown | 115 (6.1) | 29 (8.6) |  |
| Grade (%) | Well | 377 (20.1) | 12 (3.6) | < 0.0011 |
|  | Moderate | 638 (33.9) | 115 (34.1) |  |
|  | Poor | 865 (46.0) | 210 (62.3) |  |
| Stage (%) | I | 80 (4.3) | 0 (0.0) | < 0.0011 |
|  | IA | 1793 (95.4) | 0 (0.0) |  |
|  | IB | 7 (0.4) | 225 (66.8) |  |
|  | IIA | 0 (0.0) | 80 (23.7) |  |
|  | IIB | 0 (0.0) | 32 (9.5) |  |
| T-stage (%) | T1/T1NOS | 317 (16.9) | 39 (11.6) | < 0.0011 |
|  | T1a | 745 (39.6) | 56 (16.6) |  |
|  | T1b | 818 (43.5) | 242 (71.8) |  |
| Tumorsize (%) | 0-1 cm | 449 (23.9) | 15 (4.5) | < 0.0011 |
|  | < 2 cm | 496 (26.4) | 71 (21.1) |  |
|  | < 3 cm | 338 (18.0) | 75 (22.3) |  |
|  | < 4 cm | 228 (12.1) | 64 (19.0) |  |
|  | < 5 cm | 132 (7.0) | 42 (12.5) |  |
|  | > 5 cm and more | 237 (12.6) | 70 (20.8) |  |
| Primary (%) | No | 387 (20.6) | 54 (16.0) | 0.063 |
|  | Yes | 1493 (79.4) | 283 (84.0) |  |
| Order (%) | One primary only | 1323 (70.4) | 259 (76.9) | 0.0461 |
|  | 1st of 2 or more primaries | 146 (7.8) | 21 (6.2) |  |
|  | 2nd of 2 or more primaries | 310 (16.5) | 47 (13.9) |  |
|  | 3rd of 3 or more primaries | 74 (3.9) | 6 (1.8) |  |
|  | 4th of 4 or more primaries | 20 (1.1) | 3 (0.9) |  |
|  | 5th of 5 or more primaries | 6 (0.3) | 0 (0.0) |  |
|  | 6th of 6 or more primaries | 1 (0.1) | 0 (0.0) |  |
|  | 7th of 7 or more primaries | 0 (0.0) | 1 (0.3) |  |
| Maritalstatus (%) | Married (including common law) | 1057 (56.2) | 188 (55.8) | 0.386 |
|  | Divorced | 127 (6.8) | 26 (7.7) |  |
|  | Separated | 20 (1.1) | 5 (1.5) |  |
|  | Single (never married) | 243 (12.9) | 49 (14.5) |  |
|  | Widowed | 353 (18.8) | 55 (16.3) |  |
|  | Unmarried or Domestic Partner | 2 (0.1) | 2 (0.6) |  |
|  | Unknown | 78 (4.1) | 12 (3.6) |  |
| Insurance (%) | Insured | 1129 (60.1) | 201 (59.6) | 0.575 |
|  | Insured/nospecifics | 338 (18.0) | 53 (15.7) |  |
|  | Any medicaid | 344 (18.3) | 69 (20.5) |  |
|  | Uninsured | 39 (2.1) | 10 (3.0) |  |
|  | Insurance status unknown | 30 (1.6) | 4 (1.2) |  |

1It means statistically significant.

LMN: Lymph node metastasis; EGC: Early gastric cancer.

**Table 2 Univariate analysis for lymph node metastasis of patients with early gastric cancer**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Variables** | **Level** | **Training sets** | | ***P* value** | **Testing sets** | | ***P* value** |
| **LNM (-)** | **LNM (+)** | **LNM (-)** | **LNM (+)** |
| ***n* = 1308** | ***n* = 242** | ***n* = 572** | ***n* = 95** |
| Age at diagnosis (mean ± SD) |  | 71.07 (12.82) | 68.64 (12.82) | 0.0071 | 70.42 (12.80) | 69.02 (12.03) | 0.319 |
| Race (%) | White | 733 (56.0) | 122 (50.4) | 0.237 | 332 (58.0) | 60 (63.2) | 0.584 |
|  | Black | 202 (15.4) | 45 (18.6) |  | 93 (16.3) | 15 (15.8) |  |
|  | Other | 373 (28.5) | 75 (31.0) |  | 147 (25.7) | 20 (21.1) |  |
| Gender (%) | Male | 710 (54.3) | 136 (56.2) | 0.631 | 315 (55.1) | 53 (55.8) | 0.985 |
|  | Female | 598 (45.7) | 106 (43.8) |  | 257 (44.9) | 42 (44.2) |  |
| Location (%) | Body of stomach | 215 (16.4) | 38 (15.7) | 0.239 | 99 (17.3) | 13 (13.7) | 0.444 |
|  | Gastric antrum | 479 (36.6) | 90 (37.2) |  | 231 (40.4) | 43 (45.3) |  |
|  | Fundus of stomach | 67 (5.1) | 12 (5.0) |  | 30 (5.2) | 1 (1.1) |  |
|  | Greater curvature of stomach | 86 (6.6) | 19 (7.9) |  | 41 (7.2) | 6 (6.3) |  |
|  | Lesser curvature of stomach | 192 (14.7) | 35 (14.5) |  | 72 (12.6) | 12 (12.6) |  |
|  | Stomach, NOS | 51 (3.9) | 10 (4.1) |  | 13 (2.3) | 4 (4.2) |  |
|  | Pylorus | 131 (10.0) | 13 (5.4) |  | 55 (9.6) | 8 (8.4) |  |
|  | Overlapping lesion of stomach | 87 (6.7) | 25 (10.3) |  | 31 (5.4) | 8 (8.4) |  |
| Histology type (%) | Neuroendocrine carcinoma | 53 (4.1) | 1 (0.4) | 0.0031 | 27 (4.7) | 0 (0.0) | 0.088 |
|  | Signet ring cell carcinoma | 238 (18.2) | 43 (17.8) |  | 98 (17.1) | 14 (14.7) |  |
|  | Adenocarcinoma | 940 (71.9) | 173 (71.5) |  | 409 (71.5) | 77 (81.1) |  |
|  | Others/unknown | 77 (5.9) | 25 (10.3) |  | 38 (6.6) | 4 (4.2) |  |
| Grade (%) | Well | 252 (19.3) | 7 (2.9) | < 0.0011 | 125 (21.9) | 5 (5.3) | < 0.0011 |
|  | Moderate | 448 (34.3) | 85 (35.1) |  | 190 (33.2) | 30 (31.6) |  |
|  | Poor | 608 (46.5) | 150 (62.0) |  | 257 (44.9) | 60 (63.2) |  |
| Stage (%) | I | 53 (4.1) | 0 (0.0) | < 0.0011 | 27 (4.7) | 0 (0.0) | < 0.0011 |
|  | IA | 1250 (95.6) | 0 (0.0) |  | 543 (94.9) | 0 (0.0) |  |
|  | IB | 5 (0.4) | 166 (68.6) |  | 2 (0.3) | 59 (62.1) |  |
|  | IIA | 0 (0.0) | 54 (22.3) |  | 0 (0.0) | 26 (27.4) |  |
|  | IIB | 0 (0.0) | 22 (9.1) |  | 0 (0.0) | 10 (10.5) |  |
| T-stage (%) | T1/T1NOS | 216 (16.5) | 30 (12.4) | < 0.0011 | 101 (17.7) | 9 (9.5) | < 0.0011 |
|  | T1a | 514 (39.3) | 37 (15.3) |  | 231 (40.4) | 19 (20.0) |  |
|  | T1b | 578 (44.2) | 175 (72.3) |  | 240 (42.0) | 67 (70.5) |  |
| Tumor size (%) | 0-1 cm | 313 (23.9) | 12 (5.0) | < 0.0011 | 136 (23.8) | 3 (3.2) | < 0.0011 |
|  | < 2 cm | 331 (25.3) | 51 (21.1) |  | 165 (28.8) | 20 (21.1) |  |
|  | < 3 cm | 241 (18.4) | 59 (24.4) |  | 97 (17.0) | 16 (16.8) |  |
|  | < 4 cm | 158 (12.1) | 45 (18.6) |  | 70 (12.2) | 19 (20.0) |  |
|  | < 5 cm | 89 (6.8) | 28 (11.6) |  | 43 (7.5) | 14 (14.7) |  |
|  | > 5 cm and more | 176 (13.5) | 47 (19.4) |  | 61 (10.7) | 23 (24.2) |  |
| Primary (%) | No | 268 (20.5) | 34 (14.0) | 0.0251 | 119 (20.8) | 20 (21.1) | 0.956 |
|  | Yes | 1040 (79.5) | 208 (86.0) |  | 453 (79.2) | 75 (78.9) |  |
| Order (%) | One primary only | 918 (70.2) | 190 (78.5) | 0.146 | 405 (70.8) | 69 (72.6) | 0.332 |
|  | 1st of 2 or more primaries | 104 (8.0) | 16 (6.6) |  | 42 (7.3) | 5 (5.3) |  |
|  | 2nd of 2 or more primaries | 215 (16.4) | 31 (12.8) |  | 95 (16.6) | 16 (16.8) |  |
|  | 3rd of 3 or more primaries | 51 (3.9) | 3 (1.2) |  | 23 (4.0) | 3 (3.2) |  |
|  | 4th of 4 or more primaries | 14 (1.1) | 2 (0.8) |  | 6 (1.0) | 1 (1.1) |  |
|  | 5th of 5 or more primaries | 5 (0.4) | 0 (0.0) |  | 1 (0.2) | 0 (0.0) |  |
|  | 6th of 6 or more primaries | 1 (0.1) | 0 (0.0) |  | 0 (0.0) | 0 (0.0) |  |
|  | 7th of 7 or more primaries | 0 (0.0) | 0 (0.0) |  | 0 (0.0) | 1 (1.1) |  |
| Marital status (%) | Married | 743 (56.8) | 131 (54.1) | 0.444 | 314 (54.9) | 57 (60.0) | 0.431 |
|  | Divorced | 80 (6.1) | 15 (6.2) |  | 47 (8.2) | 11 (11.6) |  |
|  | Separated | 13 (1.0) | 4 (1.7) |  | 7 (1.2) | 1 (1.1) |  |
|  | Single | 165 (12.6) | 36 (14.9) |  | 78 (13.6) | 13 (13.7) |  |
|  | Widowed | 251 (19.2) | 46 (19.0) |  | 102 (17.8) | 9 (9.5) |  |
|  | Unmarried or Domestic Partner | 2 (0.2) | 2 (0.8) |  | 0 (0.0) | 0 (0.0) |  |
|  | Unknown | 54 (4.1) | 8 (3.3) |  | 24 (4.2) | 4 (4.2) |  |
| Insurance (%) | Insured | 784 (59.9) | 149 (61.6) | 0.515 | 345 (60.3) | 52 (54.7) | 0.771 |
|  | Insured/no specifics | 234 (17.9) | 34 (14.0) |  | 104 (18.2) | 19 (20.0) |  |
|  | Any medicaid | 243 (18.6) | 48 (19.8) |  | 101 (17.7) | 21 (22.1) |  |
|  | Uninsured | 28 (2.1) | 8 (3.3) |  | 11 (1.9) | 2 (2.1) |  |
|  | Insurance status unknown | 19 (1.5) | 3 (1.2) |  | 11 (1.9) | 1 (1.1) |  |

1It means statistically significant.

LMN: Lymph node metastasis; EGC: Early gastric cancer.

**Table 3 Multivariate analysis for lymph node metastasis in training set with early gastric cancer**

|  |  |  |  |
| --- | --- | --- | --- |
| **Variables** | ***P* value** | **OR** | **95%CI** |
| Age | 0.012 | 0.986 | 0.975-0.997 |
| Histology type | 0.019 | 1.382 | 1.057-1.813 |
| Grade | 0.000 | 1.825 | 1.452-2.315 |
| T-stage | 0.000 | 1.985 | 1.596-2.494 |
| Size | 0.000 | 1.319 | 1.208-1.442 |
| Primary | 0.152 | 1.344 | 0.907-2.040 |

95%CI: 95% confidence interval; OR: Odds ratio.