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OPINION REVIEW

- 1 Necessary problems in re-emergence of COVID-19
Chen S, Ren LZ, Ouyang HS, Liu S, Zhang LY

REVIEW

- 8 COVID-19: An overview and a clinical update
Krishnan A, Hamilton JP, Alqahtani SA, Woreta TA

ORIGINAL ARTICLE**Retrospective Cohort Study**

- 24 Log odds of positive lymph nodes is a better prognostic factor for oesophageal signet ring cell carcinoma than N stage
Wang F, Gao SG, Xue Q, Tan FW, Gao YS, Mao YS, Wang DL, Zhao J, Li Y, Yu XY, Cheng H, Zhao CG, Mu JW
- 36 Modified procedure for prolapse and hemorrhoids: Lower recurrence, higher satisfaction
Chen YY, Cheng YF, Wang QP, Ye B, Huang CJ, Zhou CJ, Cai M, Ye YK, Liu CB
- 47 Angiotensin converting enzymes inhibitors or angiotensin receptor blockers should be continued in COVID-19 patients with hypertension
Tian C, Li N, Bai Y, Xiao H, Li S, Ge QG, Shen N, Ma QB

Retrospective Study

- 61 Massively prolapsed intervertebral disc herniation with interlaminar endoscopic spine system Delta endoscope: A case series
Meng SW, Peng C, Zhou CL, Tao H, Wang C, Zhu K, Song MX, Ma XX
- 71 Primary lung cancer with radioiodine avidity: A thyroid cancer cohort study
Lu YL, Chen ST, Ho TY, Chan WH, Wong RJ, Hsueh C, Lin SF
- 81 Is traumatic meniscal lesion associated with acute fracture morphology changes of tibia plateau? A series of arthroscopic analysis of 67 patients
Chen YD, Chen SX, Liu HG, Zhao XS, Ou WH, Li HX, Huang HX

Observational Study

- 91 Role of relaxin in diastasis of the pubic symphysis peripartum
Wang Y, Li YQ, Tian MR, Wang N, Zheng ZC

SYSTEMATIC REVIEWS

- 102 Chinese medicine formulas for nonalcoholic fatty liver disease: Overview of systematic reviews
Dai L, Zhou WJ, Zhong LLD, Tang XD, Ji G

- 118 Comparative profile for COVID-19 cases from China and North America: Clinical symptoms, comorbidities and disease biomarkers

Badawi A, Vasileva D

META-ANALYSIS

- 133 Polymerase chain reaction-based tests for detecting *Helicobacter pylori* clarithromycin resistance in stool samples: A meta-analysis

Gong RJ, Xu CX, Li H, Liu XM

CASE REPORT

- 148 Surgery-first for a patient with mild hemifacial microsomia: A case report and review of literature

Song JY, Yang H, He X, Gao S, Wu GM, Hu M, Zhang Y

- 163 Late-onset non-islet cell tumor hypoglycemia: A case report

Matsumoto S, Yamada E, Nakajima Y, Yamaguchi N, Okamura T, Yajima T, Yoshino S, Horiguchi K, Ishida E, Yoshikawa M, Nagaoka J, Sekiguchi S, Sue M, Okada S, Fukuda I, Shirabe K, Yamada M

- 170 Risk of group aggregative behavior during COVID-19 outbreak: A case report

Zuo H, Hu ZB, Zhu F

- 175 Low-grade fibromyxoid sarcoma of the liver: A case report

Dugalic V, Ignjatovic II, Kovac JD, Ilic N, Sopta J, Ostojic SR, Vasin D, Bogdanovic MD, Dumic I, Milovanovic T

- 183 Treatment of Stanford type A aortic dissection with triple pre-fenestration, reduced diameter, and three-dimensional-printing techniques: A case report

Zhang M, Tong YH, Liu C, Li XQ, Liu CJ, Liu Z

- 190 Hyperprolactinemia due to pituitary metastasis: A case report

Liu CY, Wang YB, Zhu HQ, You JL, Liu Z, Zhang XF

- 197 Pulmonary thromboembolism after distal ulna and radius fractures surgery: A case report and a literature review

Lv B, Xue F, Shen YC, Hu FB, Pan MM

- 204 Myeloid neoplasm with eosinophilia and rearrangement of platelet-derived growth factor receptor beta gene in children: Two case reports

Wang SC, Yang WY

- 211 Sclerosing angiomatoid nodular transformation of the spleen: A case report and literature review

Li SX, Fan YH, Wu H, Lv GY

- 218 Late recurrence of papillary thyroid cancer from needle tract implantation after core needle biopsy: A case report

Kim YH, Choi IH, Lee JE, Kim Z, Han SW, Hur SM, Lee J

- 224 Atypical adult-onset Still's disease with an initial and sole manifestation of liver injury: A case report and review of literature
Yu F, Qin SY, Zhou CY, Zhao L, Xu Y, Jia EN, Wang JB
- 232 Type A aortic dissection developed after type B dissection with the presentation of shoulder pain: A case report
Yin XB, Wang XK, Xu S, He CY
- 236 Hemosuccus pancreaticus caused by gastroduodenal artery pseudoaneurysm associated with chronic pancreatitis: A case report and review of literature
Cui HY, Jiang CH, Dong J, Wen Y, Chen YW
- 245 Endoscopic treatment for acute appendicitis with coexistent acute pancreatitis: Two case reports
Du ZQ, Ding WJ, Wang F, Zhou XR, Chen TM
- 252 Residual tumor and central lymph node metastasis after thermal ablation of papillary thyroid carcinoma: A case report and review of literature
Hua Y, Yang JW, He L, Xu H, Huo HZ, Zhu CF
- 262 Endoscopic salvage treatment of histoacryl after stent application on the anastomotic leak after gastrectomy: A case report
Kim HS, Kim Y, Han JH
- 267 Immunosuppressant treatment for IgG4-related sclerosing cholangitis: A case report
Kim JS, Choi WH, Lee KA, Kim HS
- 274 Intraparenchymal hemorrhage after surgical decompression of an epencephalon arachnoid cyst: A case report
Wang XJ
- 278 Krukenberg tumor with concomitant ipsilateral hydronephrosis and spermatic cord metastasis in a man: A case report
Tsao SH, Chuang CK
- 284 Simultaneous bilateral acromial base fractures after staged reverse total shoulder arthroplasty: A case report
Kim DH, Kim BS, Cho CH

ABOUT COVER

Editorial Board Member of *World Journal of Clinical Cases*, Dr. Antonio Corvino is a PhD in the Motor Science and Wellness Department of University of Naples "Parthenope". After obtaining his MD degree from the School of Medicine, Second University of Naples (2008), he completed a residency in Radiology at the University of Naples Federico II (2014). Following post-graduate training at the Catholic University of Rome, yielding a second level Master's degree in "Internal Ultrasound Diagnostic and Echo-Guided Therapies" (2015), he served on the directive board of Young Directive of Italian Society of Ultrasound in Medicine and Biology (2016-2018). His ongoing research interests involve ultrasound and ultrasound contrast media in abdominal and non-abdominal applications, mainly in gastrointestinal, hepatic, vascular, and musculoskeletal imaging. (L-Editor: Filipodia)

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Retrospective Cohort Study

Log odds of positive lymph nodes is a better prognostic factor for oesophageal signet ring cell carcinoma than N stage

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Abstract

BACKGROUND

Signet ring cell carcinoma is a rare type of oesophageal cancer, and we hypothesized that log odds of positive lymph nodes (LODDS) is a better prognostic factor for oesophageal signet ring cell carcinoma.

AIM

To explore a novel prognostic factor for oesophageal signet ring cell carcinoma by comparing two lymph node-related prognostic factors, log odds of positive LODDS and N stage.

METHODS

A total of 259 cases of oesophageal signet ring cell carcinoma after oesophagectomy were obtained from the Surveillance, Epidemiology, and End Results database between 2006 and 2016. The prognostic value of LODDS and N stage for oesophageal signet ring cell carcinoma was evaluated by univariate and multivariate analyses. The Akaike information criterion and Harrell's C-index were used to assess the value of two prediction models based on lymph nodes. External validation was performed to further confirm the conclusion.

RESULTS

The 5-year cancer-specific survival (CSS) and 5-year overall survival (OS) rates of all the cases were 41.3% and 27.0%, respectively. The Kaplan-Meier method showed that LODDS had a higher score of log rank chi-squared (OS: 46.162, CSS: 41.178) than N stage (OS: 36.215, CSS: 31.583). Univariate analyses showed that

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insurance, race, T stage, M stage, TNM stage, radiation therapy, N stage, and LODDS were potential prognostic factors for OS ($P < 0.1$). The multivariate Cox regression model showed that LODDS was a significant independent prognostic factor for oesophageal signet ring carcinoma patients after surgical resection ($P < 0.05$), while N stage was not considered to be a significant prognostic factor ($P = 0.122$). Model 2 (LODDS) had a higher degree of discrimination and fit than Model 1 (N stage) (LODDS *vs* N stage, Harell's C-index 0.673 *vs* 0.656, $P < 0.001$; Akaike information criterion 1688.824 *vs* 1697.519, $P < 0.001$). The results of external validation were consistent with those in the study cohort.

CONCLUSION

LODDS is a superior prognostic factor to N stage for patients with oesophageal signet ring cell carcinoma after oesophagectomy.

Key Words: Oesophageal neoplasms; Signet ring cell; Lymph nodes; Prognosis; Log odds of positive lymph nodes; TNM stage

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Core Tip: This study showed that log odds of positive lymph nodes (LODDS) was an independent prognostic factor for oesophageal signet ring carcinoma patients after surgical resection, while N stage was not considered to be a significant prognostic factor. Prognosis model based on LODDS had a higher degree of discrimination and fit than the model based on N stage. In conclusion, LODDS is a superior prognostic factor to N stage for patients with signet ring cell carcinoma after oesophagectomy.

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INTRODUCTION

Signet ring cell (SRC) carcinoma is a rare subtype of adenocarcinomas. The first article describing SRC carcinoma in the oesophagus was published in 1978^[1]. According to relevant literature reports, approximately 3.5%–5.0% of oesophageal carcinomas are SRC carcinoma^[2-4]. SRC is characterized by the appearance of a large vacuole containing mucin, which squeezes the nucleus to the periphery of the cancer cell, making the shape of cell look like a signet ring^[5,6]. Based on the World Health Organization classification system, the definition of SRC carcinoma is an adenocarcinoma in which isolated or groups of signet ring cells can be observed in more than 50% of the tumour stroma^[7]. SRCs are currently found in colorectal cancer, prostate cancer, bladder cancer, breast cancer, gastric cancer, and other adenocarcinomas. Several studies have shown that as a highly malignant tumour, SRC carcinoma had a worse prognosis^[2-8]. Because SRC carcinoma is more common in gastric cancer, more research on SRC carcinoma focuses on gastric cancer. Currently, there are few studies on SRC carcinoma of the oesophagus.

Currently, according to the 8th edition of American Joint Committee on Cancer (AJCC) TNM staging system, N stage based on the number of metastatic lymph nodes is still the most commonly used prognostic indicator for oesophageal cancer^[9]. However, incomplete lymph node dissection may result in an inaccurate number of positive lymph nodes, which is less than the actual number. This phenomenon is known as stage migration^[10,11].

Recently, positive lymph node ratio (LNR), defined as the ratio of metastatic lymph nodes to total dissected lymph nodes, has shown a better correlation with prognosis than N stage, especially when the lymph node dissection during surgery is inadequate. However, some different conclusions suggest that LNR is not superior in

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predicting prognosis^[12,13]. In particular, when no metastatic lymph nodes were dissected, evaluation methods based on LNR could not accurately distinguish the heterogeneity.

Log odds of positive lymph nodes (LODDS) is a novel prognostic factor associated with lymph nodes. LODDS is calculated as the natural logarithm of the ratio of positive to negative lymph nodes^[14]. In several studies, LODDS has already been confirmed to be a better prognostic factor for bladder cancer, pancreatic cancer, rectal cancer, lung cancer, and oesophageal cancer^[15-20]. However, the predictive value of LODDS in oesophageal SRC carcinoma has not been studied.

In this study, by comparing the value of LODDS and traditional N stage as prognostic factors for oesophageal SRC carcinoma, we expected to propose a better lymph node staging indicator for oesophageal SRC carcinoma to improve the current lymph node staging scheme.

MATERIALS AND METHODS

Patient selection

All the cases in the study cohort were from the Surveillance, Epidemiology, and End Results (SEER) database (SEER 18 registries database with the additional treatment field, released in April 2019, www.seer.cancer.gov), which includes approximately 30% of the United States population. SEER*Stat 8.3.6 software was installed to extract the information of patients with oesophageal SRC carcinoma diagnosed between 2006 and 2016 by surgical resection (Site recode is oesophagus, Histology code is 8490/3 signet ring cell carcinoma; Year of diagnosis is 2006-2016; Surgery Primary Site codes is 30, 40, 50-55, 80, 90). The exclusion criteria were: (1) Cases with unknown TNM stage; and (2) Cases without accurate lymph node dissection information. Ultimately, 259 cases were enrolled in our study cohort (Figure 1).

To validate the result of the study cohort, a total of 138 oesophageal SRC carcinoma patients were selected as a validation cohort from the Department of Thoracic Surgery of Cancer Hospital, Chinese Academy of Medical Sciences from 2005 to 2019. All the included patients had definite TNM stage, accurate lymph node dissection information, and follow-up information.

Outcomes

A total of 17 variables were obtained from the SEER (18 registries custom database with additional treatment fields) database: Age, insurance, marital status, sex, race, pathology grade, T stage, N stage, M stage, AJCC TNM stage, radiation sequence with surgery, chemotherapy, the number of total lymph nodes dissected, the number of positive lymph nodes, cause of death, survival time, and vital status. Patient deaths from all causes were regarded as uncensored cases for the overall survival (OS) analysis, while the cancer-specific survival (CSS) analysis only involved deaths caused by oesophageal SRC cancer.

All cases were restaged to the latest TNM staging system according to the AJCC Cancer Staging Manual (8th edition)^[9]. Age as a continuous variable was divided into three groups (≤ 60 years, 61-70 years, and > 70 years). The variable of marital status was classified into three category variables: Married, single (divorced, separated, unmarried or domestic partner, never married, widowed), and unknown. The variable insurance was divided into three groups: Insured (any Medicaid, insured, or insured/no specifics), uninsured, and unknown. LODDS was calculated as $\log_e [(PLN + 0.5) / (NLN + 0.5)]^{[21]}$, where PLN is the number of positive lymph nodes, and NLN is the number of negative lymph nodes. The numerator and denominator were increased by 0.5 to avoid singularity.

Statistical analysis

X-Tile software version 3.6.1 (Yale University, United States) was used to establish the optimal cut-off values for OS analysis of LODDS in the study cohort. The LODDS was converted to three categorical variables: LODDS1 ($4.55 \leq LODDS \leq 1.90$), LODDS2 ($1.89 \leq LODDS \leq 0.15$), and LODDS3 ($0.16 \leq LODDS \leq 4.27$). OS and CSS were estimated by the Kaplan-Meier method. Univariate and multivariate analyses were performed using a Cox proportional hazard regression model. Variables with statistical significance ($P < 0.1$) in univariate analysis were included in the multivariate analysis. The Akaike information criterion (AIC) and Harrell's C-index were used to estimate the discriminative power of the Cox multivariate regression model (lower AIC indicates better model fit, and higher Harrell's C-index indicates better degree of

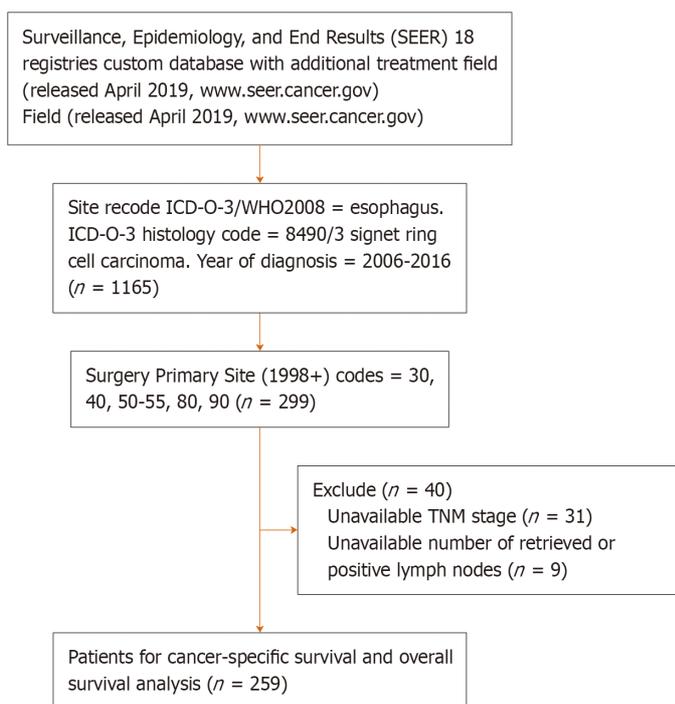


Figure 1 Study flow diagram of selection process. ICD-O-3: The third edition of the International Classification Disease for Oncology; WHO: World Health Organization.

discrimination). All the statistical analyses were performed using SPSS version 25.0 (IBM, United States) and R software version 4.0.0 (R Foundation, Vienna, Austria). The statistical significance level was set at a *P* value less than 0.05.

RESULTS

Baseline characteristics

The baseline characteristics of the study cohort are shown in [Table 1](#). A total of 259 oesophageal SRC patients with surgical resection were retained. Most of them were male (89.2%), married (77.2%), insured (83.8%), and non-Hispanic white (86.1%). The age of the majority of cases were 61-70 years (43.2%). Due to the high degree of malignancy and rapid progression of SRC, more patients were pathologically graded as grade III-IV (82.6%), and more patients had stage III disease (50.2%) according to the TNM stage system (as stage IV patients were rarely treated by surgery, without accurate lymph node information, they were excluded from the cohort). The mean follow-up time of this study cohort was 30 mo (range, 1-127 mo). Calculated by Kaplan-Meier method, the 5-year OS and 5-year CSS rates were 27.0% and 41.3%, as shown in [Figure 2](#).

Comparison of survival outcomes for LODDS and N stage

In the study cohort, the Kaplan-Meier survival curves drawn with the N stage and LODDS categories as univariates are shown in [Figure 3](#). The analysis showed that OS and CSS decreased with the increasing N stage (log rank chi-squared score: OS: 36.215, *P* < 0.001, CSS: 31.583, *P* < 0.001; [Figure 3 A and B](#)). For LODDS, we observed that the LODDS category increased with decreasing OS and CSS (log rank chi-squared score: OS: 46.162, *P* < 0.001, CSS: 41.178, *P* < 0.001; [Figure 3 C and D](#)). The log rank chi-squared score of LODDS category was higher (OS: 46.162, CSS: 41.178) than that of N stage (OS: 36.215, CSS: 31.583).

Comparison of prognostic performance of N stage and LODDS models

The results of Cox regression univariate analysis for each variable in the study cohort are shown in [Table 1](#). Univariate analyses showed that insurance, race, radiation therapy, T stage, N stage, M stage, TNM stage, and LODDS were potential prognostic

Table 1 Clinical and pathological characteristics of patients and results of univariate analysis for overall survival

Variable	No. of patients (%)	HR	95%CI	P value
Sex				0.488
Female	28 (10.8)	Reference		
Male	231 (89.2)	1.199	0.717-2.006	0.488
Age, yr				0.776
≤ 60	88 (34.0)	Reference		
61-70	112 (43.2)	0.942	0.671-1.322	0.728
≥ 71	59 (22.8)	1.082	0.729-1.606	0.695
Marital status				0.152
Married	187 (72.2)	Reference		
Single	57 (22.0)	1.400	0.996-1.968	0.053
Unknown	15 (5.8)	1.151	0.584-2.266	0.685
Insurance				0.005
Insured	217 (83.8)	Reference		
Uninsured	4 (1.5)	5.272	1.904-14.599	0.001
Unknown	38 (14.7)	0.918	0.608-1.358	0.683
Race				0.087
Hispanic (all races)	19 (7.3)	Reference		
Non-Hispanic American Indian/Alaska Native	2 (0.8)	0.358	0.046-2.762	0.324
Non-Hispanic Asian or Pacific Islander	5 (1.9)	1.229	0.395-3.818	0.722
Non-Hispanic Black	10 (3.9)	2.293	0.987-5.326	0.054
Non-Hispanic White	223 (86.1)	0.962	0.534-1.734	0.898
Grade				0.136
I + II	12 (4.6)	Reference		
III + IV	214 (82.6)	0.978	0.499-1.918	0.949
Unknown	33 (12.7)	0.595	0.267-1.326	0.204
TNM stage				0.000
I	34 (13.1)	Reference		
II	59 (22.8)	1.919	1.031-3.573	0.040
III	130 (50.2)	2.931	1.662-5.168	0.000
IV	36 (13.9)	4.936	2.610-9.334	0.000
T stage				0.048
T1	51 (19.7)	Reference		
T2	30 (11.6)	1.757	0.992-3.112	0.053
T3	164 (63.3)	1.705	1.120-2.596	0.013
T4	14 (5.4)	2.334	1.121-4.861	0.024
N stage				0.000
N0	86 (33.2)	Reference		
N1	100 (38.6)	1.841	1.263-2.682	0.001
N2	47 (18.1)	2.666	1.697-4.189	0.000
N3	26 (10)	3.836	2.316-6.353	0.000
M stage				0.058

M0	246 (95)	Reference		
M1	13 (5.0)	1.809	0.981-3.337	0.058
LODDS				0.000
LODDS1 (4.55 ≤ LODDS ≤ 1.90)	134 (51.7)	Reference		
LODDS2 (1.89 ≤ LODDS ≤ 0.15)	99 (38.2)	1.864	1.353-2.569	0.000
LODDS3 (0.16 ≤ LODDS ≤ 4.27)	26 (10)	4.204	2.656-6.655	0.000
Radiation therapy				0.085
No radiation and/or cancer-directed surgery	67 (25.9)	Reference		
Radiation prior to surgery	162 (62.5)	1.010	0.710-1.435	0.958
Radiation after surgery	25 (9.7)	1.779	1.061-2.983	0.029
Radiation before and after surgery	5 (1.9)	1.672	0.516-5.421	0.392
Chemotherapy				0.719
No or unknown	49 (18.9)	Reference		
Yes	210 (81.1)	1.073	0.730-1.578	0.719

LODDS: Log odds of positive lymph nodes; NOS: Not otherwise specified.

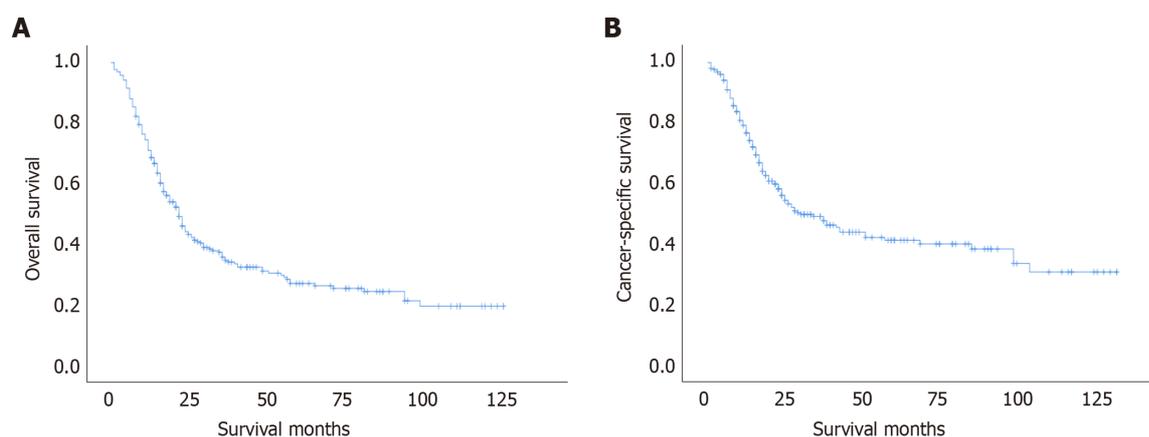


Figure 2 Calculated by the Kaplan-Meier method, the 5-year overall survival and 5-year cancer-specific survival rates were 27.0% and 41.3%, respectively. Kaplan-Meier survival curves of overall survival (A) and cancer-specific survival (B) for esophageal signet ring carcinoma patients after surgical resection.

factors for OS ($P < 0.1$). Afterwards, Cox multivariate analyses were conducted to estimate N stage (Model 1) and LODDS (Model 2). As shown in Table 2, LODDS in Model 2 was an independent prognostic factor for oesophageal SRC carcinoma patients after surgical resection ($P < 0.05$). Conversely, the P value of N stage in Model 1 was 0.122; thus, N stage was not a statistically significant prognostic factor in Model 1.

As shown in the Table 3, Model 2 (LODDS) showed better goodness of fit and discriminatory power than Model 1 (N stage) for all patients (LODDS vs N stage, AIC 1688.824 vs 1697.519, $P < 0.001$, Harell's C-index 0.673 vs 0.656, $P < 0.001$).

Validation of superiority of LODDS over N stage

Variables in the validation cohort included sex, age, marital status, grade, T stage, N stage, M stage, total number of lymph nodes dissected, number of positive lymph nodes, chemotherapy, survival time, and survival status. LODDS, age, grade, and marital status grouping criteria were consistent with previous criteria. In the validation cohort, the Kaplan-Meier curves of overall survival with the N stage and LODDS categories are shown in Figure 4. It can be seen that OS decreased with the

Table 2 Multivariable analysis of overall survival with different classifications of lymph nodes

Variable	Model 1 (N stage)		Model 2 (LODDS)	
	HR (95%CI)	P value	HR (95%CI)	P value
Insurance		0.008		0.100
Insured	Reference		Reference	
Uninsured	5.170 (1.817-14.711)	0.002	3.045 (1.031-8.992)	0.044
Unknown	0.921 (0.602-1.409)	0.705	0.871 (0.570-1.331)	0.525
Race		0.169		0.189
Hispanic (all races)	Reference		Reference	
Non-Hispanic American Indian/Alaska Native	0.537 (0.067-4.315)	0.559	0.441 (0.054-3.577)	0.443
Non-Hispanic Asian or Pacific Islander	2.286 (0.699-7.476)	0.171	2.972 (0.896-9.864)	0.075
Non-Hispanic Black	2.554 (1.062-6.144)	0.036	2.255 (0.900-5.649)	0.083
Non-Hispanic White	1.334 (0.705-2.521)	0.376	1.486 (0.786-2.811)	0.223
TNM stage		0.486		0.030
I	Reference		Reference	
II	1.776 (0.739-4.272)	0.199	2.549 (1.141-5.695)	0.023
III	1.527 (0.399-5.852)	0.537	3.466 (1.518-7.917)	0.003
IV	1.270 (0.173-9.334)	0.814	3.479 (1.197-10.112)	0.022
T stage		0.460		0.402
T1	Reference		Reference	
T2	1.472 (0.644-3.362)	0.359	1.013 (0.493-2.085)	0.971
T3	1.063 (0.494-2.291)	0.875	0.699 (0.370-1.321)	0.270
T4	1.580 (0.521-4.797)	0.419	0.900 (0.372-2.178)	0.815
N stage		0.122		
N0	Reference			
N1	1.759 (0.810-3.817)	0.153		
N2	2.415 (1.029-5.665)	0.043		
N3	4.572 (1.044-20.021)	0.044		
M stage		0.304		0.523
M0	Reference		Reference	
M1	2.027 (0.527-7.799)	0.304	1.354 (0.534-3.433)	0.523
LODDS				0.001
4.55 ≤ LODDS ≤ 1.90			Reference	
1.89 ≤ LODDS ≤ 0.15			1.742 (1.223-2.483)	0.002
0.16 ≤ LODDS ≤ 4.27			3.390 (1.620-7.093)	0.001
Radiation therapy		0.305		0.389
No radiation and/or cancer-directed surgery	Reference		Reference	
Radiation prior to surgery	0.756 (0.503-1.134)	0.176	0.771 (0.515-1.153)	0.205
Radiation after surgery	1.037 (0.571-1.883)	0.906	0.998 (0.557-1.787)	0.994
Radiation before and after surgery	1.540 (0.455-5.218)	0.488	1.491 (0.444-5.008)	0.518

LODDS: Log odds of positive lymph nodes.

increasing N stage and LODDS. The log rank chi-squared score of LODDS category was higher (29.593 *vs* 22.830). Cox proportional hazards model was applied to perform univariate analysis of each variable. The result showed that only N and LODDS had *P* values less than 0.1. The AIC and Harell's C-index of the two univariate models are shown in Table 4. LODDS showed better goodness of fit and discriminatory power than N stage in the validation cohort (LODDS *vs* N stage, AIC 766.830 *vs* 770.094 Harell's C-index 0.654 *vs* 0.648).

DISCUSSION

In this study, prognostic analyses of oesophageal SRC carcinoma patients after surgery in the SEER database were performed. We found that LODDS was a better predictor than the current N stage system for prognosis in patients with SRC carcinoma of the oesophagus. Validation in the external data yielded the same result.

Oesophageal SRC carcinoma has a poor prognosis. Many studies have shown that in adenocarcinomas, the presence of SRC indicates poorer clinical outcomes^[22-27]. In this study, more patients with SRC carcinoma had pathological grade III-IV disease, and the TNM stage was III-IV. This finding suggests that, like other SRC cancers, oesophageal SRC carcinoma also has a high degree of malignancy, which is consistent with the conclusions of most previous SRC studies in the other types of cancer.

LODDS is a better lymph node-related prognostic indicator than N stage. As a traditional staging system related to lymph nodes, N stage is the most commonly used method to predict the prognosis of cancer patients based on the number of metastatic lymph nodes. However, it also has limitations, such as the stage migration phenomenon, which occurs when not enough lymph nodes are properly dissected^[11]. As a novel assessment method based on lymph nodes, LODDS takes into account both the number of metastatic lymph nodes and the total number of harvested lymph node. At the same time, for patients without positive lymph nodes but with different total numbers of lymph nodes dissected, LODDS has a certain degree of differentiation for them, which is also theoretically better than N stage. In many studies, LODDS has been shown to be advantageous as a novel prognostic factor in many other types of cancer^[14-16,18,28-30]. Few studies have found this to be controversial^[31]. However, whether LODDS is also a better prognostic indicator for oesophageal SRC carcinoma has not been studied. In our research, after we performed Kaplan-Meier survival analyses of OS and CSS stratified by N stage and LODDS, the log rank chi-squared score of LODDS was higher (OS: 46.162 *vs* 36.215, CSS: 41.178 *vs* 31.583). After multivariate Cox regression analyses of LODDS and N stages, LODDS was still an independent prognostic factor, while N stage was not (Table 2). We also noted that the multivariate prediction model constructed based on LODDS has better goodness of fit and discriminatory power than the model constructed based on N stage, as shown in Table 3. In the subsequent external validation, we reached the same conclusion that LODDS is a better prognostic factor than N stage. Consequently, we conclude that LODDS may be a better prognostic factor than N stage in patients with oesophageal SRC carcinoma after surgical resection. Our study confirmed the predictive value of LODDS for the prognosis of oesophageal SRC carcinoma.

This study is designed to compare the predictive value of LODDS with N stage in the prediction of OS for patients with oesophageal SRC carcinoma after surgery. The study also has its limitations. First, as a retrospective study, selection bias is inevitable. Second, in the SEER database, the scheme of radiotherapy programs, chemotherapy regimens, detailed surgical approach, comorbidities, and other meaningful information on prognosis are not given. These will have a certain impact on the research conclusion. Third, due to the low incidence of the disease, the number of cases that can be included in the analysis is small and it is expected that in the future, prospective multi-centre, large-sample studies will further confirm the conclusion. In the future, there will be more studies on oesophageal SRC cancer, and the treatment and diagnosis of this cancer will be continuously improved.

CONCLUSION

For patients with oesophageal SRC carcinoma who underwent surgery, LODDS has superior prognostic efficacy over the N stage for estimating OS. Therefore, LODDS could be a superior prognostic factor for patients with SRC carcinoma after oesophagectomy compared with N stage.

Table 3 Prognostic performance of different lymph node staging systems for overall survival

Model	C-Index	P value	AIC	P value
Model 1 (N stage)	0.656	< 0.001	1697.519	< 0.001
Model 2 (LODDS)	0.673	< 0.001	1688.824	< 0.001

AIC: Akaike information criterion; C-Index: Harrel's concordance index; LODDS: Log odds of positive lymph nodes.

Table 4 Prognostic performance of log odds of positive lymph nodes and N stage for overall survival in validation cohort

Variable	C-Index	P value	AIC	P value
N stage	0.648	0.030	770.094	< 0.001
LODDS	0.654	0.029	766.830	< 0.001

AIC: Akaike information criterion; C-Index: Harrell concordance index; LODDS: Log odds of positive lymph nodes.

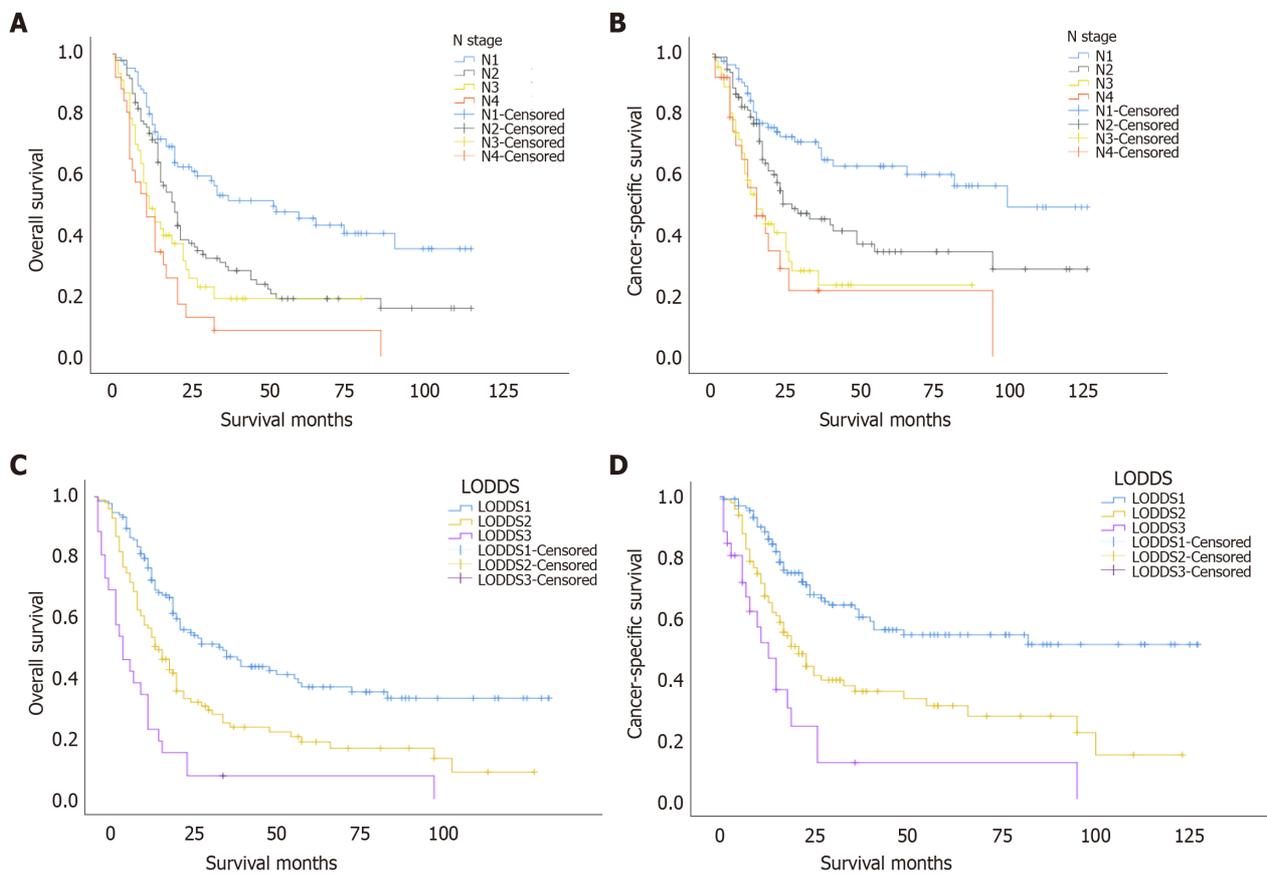


Figure 3 Kaplan-Meier survival curves drawn with N stage and log odds of positive lymph nodes categories as univariates. Kaplan-Meier survival curves of overall survival stratified by N stage (A) and log odds of positive lymph nodes category (C) and cancer-specific survival stratified by N stage (B) and log odds of positive lymph nodes category (D) for esophageal signet ring carcinoma patients after surgical resection. LODDS: Log odds of positive lymph nodes.

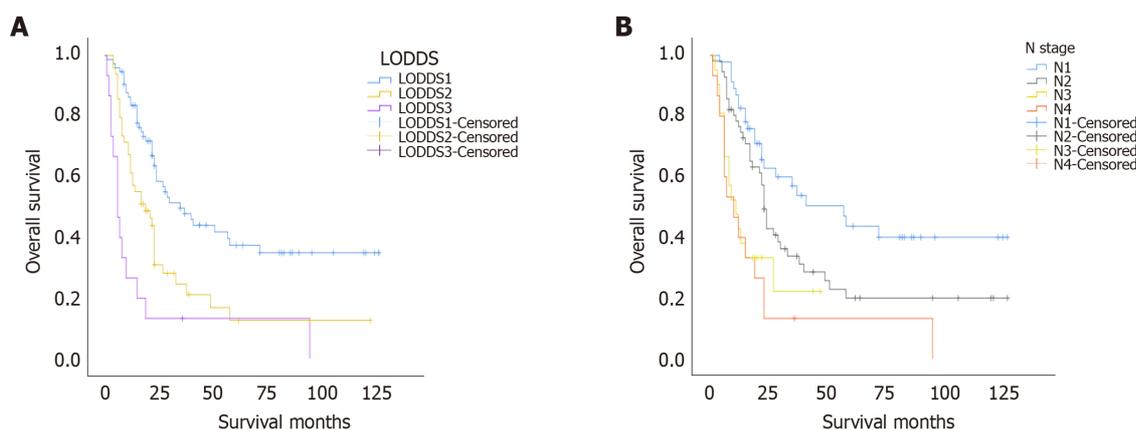


Figure 4 Kaplan-Meier survival curves of overall survival curves with N stage and log odds of positive lymph nodes categories as univariates in the validation cohort. Kaplan-Meier survival curves of overall survival stratified by log odds of positive lymph nodes category (A) and N stage (B) in the validation cohort. LODDS: Log odds of positive lymph nodes.

ARTICLE HIGHLIGHTS

Research background

Oesophageal signet ring cell carcinoma is a rare type of cancer, and log odds of positive lymph nodes (LODDS) may be a better prognostic factor for it.

Research motivation

To investigate the predictive value of LODDS for signet ring cell carcinoma of the oesophagus.

Research objectives

To explore whether LODDS is a better prognostic factor than N stage for oesophageal signet ring cell carcinoma.

Research methods

The prognostic values of LODDS and N stage for oesophageal signet ring cell carcinoma were evaluated by univariate and multivariate analyses. The Akaike information criterion and Harrell's C-index were used to compare the predictive value of the model. External validation was performed to further confirm the conclusion.

Research results

The multivariate Cox regression model showed that LODDS was a significant independent prognostic factor for oesophageal signet ring carcinoma patients. LODDS has better predictive value than N stage. The results of external validation were consistent with those in the study cohort.

Research conclusions

LODDS is a superior prognostic factor for patients with oesophageal signet ring cell carcinoma after oesophagectomy than N stage.

Research perspectives

In the future, it is expected that there will be more studies on oesophageal signet ring cell cancer, and the treatment and diagnosis of this cancer will be continuously improved.

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