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Association of clinicopathological factor with lymph node metastasis in rectal cancer patients: a retrospective cohort study

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Abstract

Introduction Systemic inflammatory response (SIR) indicators serve as predictive factors for lymph node metastasis (LNM) in various cancers. This study aimed to investigate the association of platelet-to-lymphocyte ratio (PLR) and neutrophil-to-lymphocyte ratio (NLR) with LNM in rectal cancer and to identify clinicopathological factors linked to LNM.

Methods We retrospectively analyzed 181 rectal cancer patients who underwent surgical resection. Preoperative NLR and PLR were calculated from blood samples, with optimal cutoff values determined by receiver operating characteristic (ROC) analysis. Associations between NLR/PLR and clinicopathological features were evaluated, risk factors for LNM were analyzed via univariate and multivariate logistic regression.

Results No significant differences were observed between the high NLR (H-NLR) and low NLR (L-NLR) groups in terms of clinicopathological characteristics, including TNM stage, perineural invasion (PNI), lymphovascular invasion (LVI), or serum levels of CEA and CA19-9 respectively ($p > 0.05$).In contrast, the high PLR (H-PLR) group showed significantly higher prevalence of several adverse pathological features: The H-PLR group had a higher positive PNI (54.2% vs.25.0%,$p = 0.04$), greater positive LVI(51.6% vs.28.6%,$p = 0.025$),and more positive TDs (14.4% vs.0,$p = 0.028$), increased lymph node metastasis (52.9% vs.17.9%,$p < 0.001$), more elevated CEA (43.1% vs.14.3%,$p = 0.005$) and more advanced tumor stage (stage II + stage III,81% vs.67.9%,$p = 0.003$).Univariate analysis identified several factors significantly associated with LNM: T stage (OR = 3.156, 95%CI:1.580–6.303),positive PNI (OR = 6.182,95%CI:3.242–11.787),positive LVI (OR = 10.271,95%CI:5.177–20.375),H-PLR(OR = 5.175,95%CI:1.870–14.321),positive TDs (OR = 3.390,95%CI:1.261–9.117),TLN(OR = 1.053,95%CI:1.005–1.103),elevated CEA(OR = 3.313,95%CI:1.655–5.920) and elevated CA199 (OR = 2.248,95%CI:1.012–4.992) were correlated with LNM using univariate analysis, but only positive LVI(adjusted OR = 6.203,95%CI:2.892–13.303,$p < 0.001$) and positive PNI (adjusted OR = 3.086,95%CI:1.341–7.102,$p = 0.008$) were the independent risk factors for LNM using multivariate analysis.

Conclusion H-PLR but not H-NLR may be associated with LNM, positive LVI and PNI were independent risk factors for LNM in RC.

Keywords Rectal, Cancer, PLR, Lymph node metastasis

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Introduction

Colorectal cancer (CRC) is the second most fatal and third most frequently diagnosed of cancer worldwide [1]. Lymph node metastasis(LNM) is a common metastatic pathway in CRC and serves as a critical risk factor affecting the 5-year overall survival [2]. Consequently, there is urgent need for reliable molecular biomarkers to predict lymph node metastasis in clinical practice.

Cancer-associated inflammatory reactions play a key role in disease progression and metastasis [3]. Mounting evidence suggests that inflammatory indicators are strongly linked to poor prognosis in CRC [4]. Hematological markers reflect systemic inflammatory responses, such as neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR). It has been established that a rise in these markers is detrimental to the prognosis of rectal cancer [5, 6].

Research has indicated that NLR may be a strong predictor of LNM in breast cancer [7]. Additionally, it has been identified as a reliable predictor of LNM in head and neck squamous cell carcinoma(HNSCC) and gastric cancer [8, 9]. Conversely, NLR has seldom been used as a predictor of rectal cancer, although studies have shown that a high NLR is associated with a more positive nodal status [10]. Therefore, further investigation is required to ascertain its true predictive significance. The purpose of this study was to investigate whether NLR and PLR is corrected with LNM in patients with resectable rectal cancer and to explore the risk factors for lymph node metastasis.

Materials and methods

Patients

Patients diagnosed with rectal cancer who underwent curative resection at our institution between May 2015 and December 2022 were included in the study. From an initial pool of 232 potential rectal cancer cases, 181 patients with complete data were selected for analysis; the remaining cases were excluded. All participants underwent CT and pelvic MRI prior to surgery. The surgical procedure was laparoscopic radical resection. This research was carried out in accordance with the guidelines established in the 1964 Declaration of Helsinki and its later revisions and was approved by the Institutional Review Board of Fujian Provincial Hospital (Ethics Approval Code: K2024-07-037). Because this study was retrospective, written informed consent was obtained from all patients who had been diagnosed with rectal cancer.

Including and excluding criteria

Inclusion was determined according to the following criteria: (1) Histologically confirmed rectal adenocarcinoma by endoscopic biopsy; (2) Tumor location within 15 cm from the anal verge as measured by preoperative endoscopy; (3) Eastern Cooperative Oncology Group (ECOG) performance status 0–2; (4) No history of other malignant tumors; (5)No contraindications to major abdominal surgery.

The exclusion criteria were defined as follows: (I) Incomplete clinical or pathological data; (II) Active systemic infection at time of surgery; (III) administration of drugs that increase leukocytes; (IV)Previous neoadjuvant radiotherapy or chemotherapy; (V) Synchronous malignancies in other organ systems; (VI) Presence of distant metastases (including liver, lung, or peritoneal metastases).

Data collection and study design

Within a day of admission, peripheral blood sample (3 mL) was collected from each patient. Counts of neutrophils, lymphocytes, and platelets were retrieved from the hospital information system, and the database variables included age, sex, tumor location, NLR, PLR, TNM staging, perineural invasion(PNI), lymphovascular invasion (LVI), tumor deposits(TDs), examined total lymphnode number(TLN), LNM, CEA, CA199. Tumor staging was performed according to the American Joint Committee on Cancer (AJCC) 8th edition TNM classification system. A comprehensive retrospective review of medical records was conducted.Patients' medical records, including their history, laboratory analyses, radiological reports, and clinical and pathological staging, were retrospectively reviewed.

Calculation of inflammatory ratios

Neutrophil-to-lymphocyte ratio (NLR) = neutrophil count / lymphocyte count.

Platelet-to-lymphocyte ratio (PLR) = Platelet count / lymphocyte count.

The optimal cutoff values for NLR and PLR were determined using receiver operating characteristic (ROC) curve analysis with the Youden index method.

Statistical analysis

Categorical data are shown as proportions(n,%),and were analyzed using Chi-square test.Continuous variables were assessed for normality using the Shapiro-Wilk test. Based on the distribution: Non-normally distributed data (including TLN vs. NLR/PLR relationships) are reported as median (interquartile range [IQR]) and analyzed using the Mann-Whitney U test; Normally distributed data (including TLN vs. LNM relationships) are presented as mean ± standard deviation (SD) and compared using independent samples t-tests.Univariate and Multivariate logistic regression analysis was performed to evaluate the association between lymph node metastasis (LNM) and various clinicopathological characteristics.The

multivariate model was constructed using bidirectional stepwise regression, with variables entering the model if their p-value < 0.1 and retained only if their p-value < 0.05 in subsequent steps. All statistical tests were two-tailed, with $p < 0.05$ considered statistically significant.and all statistical analyses were conducted using GraphPad Prism (Version 8.4.2, San Diego, California, USA) and SPSS (R26.0, Armonk, New York, USA), and a two-sided $P < 0.05$, which was deemed statistically significant.

Table 1 Baseline characteristics of the patients

	Data(*n*,%)
Age	
≥65	80(44.2%)
<65	101(55.8%)
Sex	
Male	113(62.4%)
Female	68(37.6%)
Location	
≥ 5 cm	144(79.6%)
< 5 cm	37(20.4%)
CEA	
≥ 5ng/ml	70(38.7%)
< 5ng/ml	111(61.3%)
TNM	
I stage	38(21.0%)
II stage	57(31.5%)
III stage	86(47.5%)
PNI	
Positive	90(49.7%)
Negative	91(50.3%)
LVI	
Positive	87(48.1%)
Negative	94(51.9%)
TDs	
Positive	22(12.2%)
Negative	159(87.8%)
Lymph nodes metastasis	
Yes	86(47.5%)
No	95(52.5%)
NLR	
H-NLR	38(21.0%)
L-NLR	143(79.0%)
PLR	
H-PLR	153(84.5%)
L-PLR	28(15.5%)
TLN(median, IQR)	18(15–22)

Abbreviations: LVI: lymphovascular invasion; PNI: perineural invasion; CEA: carcinoembryonic antigen

TDs: tumor deposits; TNM: tumor node metastasis; NLR: neutrophil-to-lymphocyte ratio

PLR: platelet-to-lymphocyte ratio; H-NLR: high neutrophil-to-lymphocyte ratio

L-NLR: low neutrophil-to-lymphocyte ratio; H-PLR: high platelet-to-lymphocyte ratio

L-PLR: low platelet-to-lymphocyte ratio; TLN: total lymphnode number; IQR: interquartile range

Results

Patient characteristics

This study included 232 consecutive patients with resectable rectal cancer. Following the exclusion of incomplete records and patients who were lost to follow-up, 181 patients were included in the statistical analysis. The baseline characteristics of the patients were listed in Table 1. The median age of the patients was 63 years, with 113 (62.4%) males and 68 (37.5%) females.According to the AJCC 8th edition TNM staging system, stage I: 38(21.0%);stage II: 57(31.5%);stage III: 86(47.5%). Additionally, 90 (49.7%) patients tested positive for PNI, 87 (48.1%) for LVI, and 22 (12.2%) for TDs. Furthermore, 86 patients (47.5%) presented with lymph node metastasis.

Association NLR (or PLR) and clinicopathological characteristics

The cut-off values for PLR and NLR were 89.1 and 3.4 respectively.Patients were stratified into high (H) and low (L) groups based on these thresholds for subsequent analysis.As showed in Table 2,none of the parameters differed significantly between the H-NLR and L-NLR groups. However, The H-PLR group had a higher positive PNI (54.2% vs.25.0%,$p = 0.04$), greater positive LVI(51.6% vs.28.6%,$p = 0.025$),and more positive TDs (14.4% vs.0,$p = 0.028$), increased lymph node metastasis (52.9% vs.17.9%,$p < 0.001$), more elevated CEA (43.1% vs.14.3%,$p = 0.005$) and more advanced tumor stage (stageII +stageIII,81% vs.67.9%,$p = 0.003$).

Association LNM and clinicalpathological characteristics

As illustrated in Table 3, The two groups demonstrated comparable baseline characteristics, with no statistically significant differences in age, gender, or tumor location ($P > 0.05$). However, The LNM group exhibited significantly more advanced tumor invasion, with T3/4 stage(82.6% vs. 60.0%,$p = 0.001$).Additionally, the LNM group showed markedly higher rates of adverse pathological features, including PNI(72.1% vs. 29.5%,$p < 0.001$), LVI(75.6% vs. 23.3%,$p < 0.001$), and TDs (63.3% vs. 18.6%,$p = 0.012$). higher elevated CEA levels (53.5% vs. 26.3%,$p < 0.001$) and CA199 levels (27.9% vs. 12.6%,$p = 0.010$) in the LNM group. Furthermore, number of examined lymph nodes was higher in the LNM group compared to non-LNM group (20.2 ± 6.7 vs.18.2 ± 6.2,$p = 0.039$).

Univariate and multivariate analysis association between clinicopathological characteristics and LNM

As illustrated in Table 4, The results showed that advanced T stage (OR = 3.156,95%CI:1.580–6.303),positive PNI (OR = 6.182,95%CI:3.242–11.787),positive LVI (OR = 10.271,95%CI:5.177–20.375),H-PLR(OR = 5.175,95%CI:1.870–14.321),positive

Table 2 Correlation of clinicopathological characteristics and NLR(or PLR) levels in rectal cancer

Viable	NLR(*n*,%)		*P*	PLR(*n*,%)		*P*
	H- NLR (38,21.0%)	L- NLR (143,79.0%)		H-PLR (153,84.5%)	L-PLR (28,15.5%)	
Age(y)			0.418			0.796
≥65	19(50.0%)	61(42.7%)		67(43.8%)	13(46.4%)	
<65	19(50.0%)	82(57.3%)		86(56.2%)	15(53.6%)	
Sex						0.826
Male	22(57.9%)	91(63.6%)	0.320	95(62.1%)	18(64.3%)	
Female	16(41.1%)	52(36.4%)		58(37.9%)	10(35.7%)	
Location (cm)			0.577			0.888
≥ 5	29(76.3%)	115(80.4%)		122(79.7%)	22(78.6%)	
< 5	9(23.7%)	28(19.6%)		31(20.3%)	6(21.4%)	
TNM			0.515			0.003*c
I	6(15.8%)	32(22.4%)		29(19.0%)	9(32.1%)	
II	11(28.9%)	46(32.2%)		43(28.1%)	14(50%)	
III	21(55.3%)	65(45.4%)		81(52.9%)	5(17.9%)	
PNI			0.442			0.004*
Negative	17(44.7%)	74(51.7%)		70(45.8%)	21(75.0%)	
Positive	21(55.3%)	69(48.3%)		83(54.2%)	7(25.0%)	
LVI			0.172			0.025*
Negative	16(42.1%)	78(54.5%)		74(48.4%)	20(71.4%)	
Positive	22(57.9%)	65(45.5%)		79(51.6%)	8(28.6%)	
TDs			0.730_a			$0.028*_a$
Negative	34(89.5%)	125(87.4%)		131(85.6%)	28(100%)	
Positive	4(10.5%)	18(12.6%)		22(14.4%)	0(0%)	
Lymph nodes metastasis			0.361			< 0.001*
No	17(44.7%)	78(54.5%)		72(47.1%)	23(82.1%)	
Yes	21(55.3%)	65(45.5%)		81(52.9%)	5(17.9%)	
TLN(median, IQR)	19.5 (15.0–24.7)	18 (14.0–22.0)	0.227_b	18.0(15.0–22.0)	18.5(14.0–20.0)	0.283_b
CEA(ng/ml)			0.853			0.005*
≥5	14(36.8%)	56(39.2%)		66(43.1%)	4(14.3%)	
<5	24(63.2%)	87(60.8%)		87(56.9%)	24(85.7%)	
CA199 (ng/ml)			0.823			0.800
≥27	8(21.1%)	28(19.6%)		30(19.6%)	6(21.4%)	
<27	30(78.9%)	115(80.4%)		123(80.4%)	22(78.6%)	

Data are presented as n (%),Bolded p-values indicate statistical significance at $p < 0.05$

Abbreviations: LVI: lymphovascular invasion; PNI: perineural invasion; CEA: carcinoembryonic antigen TDs: tumor deposits; TNM: tumor node metastasis; NLR: neutrophil-to-lymphocyte ratio; PLR: platelet-to-lymphocyte ratio

TLN: total lymphnode number; IQR: interquartile range

using Fisher's exact test or chi-squared test for categorical variables

a P-value was estimated by the Fisher Exact test

b P-value was estimated by Mann-Whitney U test

TDs(OR=3.390,95%CI:1.261–9.117),TLN(OR=1.053,95%CI:1.005–1.103),elevated CEA(OR = 3.313,95%CI:1.655–5.920) and elevated CA199 (OR = 2.248,95%CI:1.012–4.992) were correlated with LNM using univariate analysis, but only positive LVI.

(adjusted OR = 6.203,95%CI:2.892–13.303,$p < 0.001$) and positive PNI (adjusted OR = 3.086,95%CI:1.341–7.102,$p = 0.008$) were the independent risk factors for LNM using multivariate analysis.

Discussion

Inflammation facilitates a pro-oncogenic milieu that promotes the spread of cancer [10]. By encouraging the adherence of circulating tumor cells to distant organs, neutrophils promote tumor development [11]. In addition to preventing cell death and distant metastasis, platelets can help tumor cells attach to the endothelium [12].Because lymphocytes prevent tumor cells from proliferating and cause cytotoxic cell death, they

Table 3 Comparative analysis of clinicopathological datas between LNM and non-LNM groups

Viable	non-LNM (95, 47.5%)	LNM (86, 52.5%)	*P*
Age(y)			0.229
≥65	46(48.4%)	34(39.5%)	
<65	49(51.6%)	52(60.5%)	
Sex			0.408
Male	62(65.3%)	51(59.3%)	
Female	33(34.7%)	35(40.7%)	
Location (cm)			0.091
≥5	71(74.7%)	73(84.9%)	
<5	24(25.3%)	13(15.1%)	
T			0.001*
T1–2	38(40.0%)	15(17.4%)	
T3-4	57(60.0%)	71(82.6%)	
PNI			<0.001*
Negative	67(70.5%)	24(27.9%)	
Positive	28(29.5%)	62(72.1%)	
LVI			<0.001*
Negative	73(76.8%)	21(24.4%)	
Positive	22(23.2%)	65(75.6%)	
TDs			0.012*
Negative	89(93.7%)	70(81.4%)	
Positive	6(6.3%)	16(18.6%)	
TLN (average ± SD)	18.2 ± 6.2	20.2 ± 6.7	0.039*
CEA(ng/ml)			<0.001*
≥5	25(26.3%)	46(53.5%)	
<5	70(73.7%)	40(46.5%)	
CA199 (ng/ml)			0.010*
≥27	12(12.6%)	24(27.9%)	
<27	83(87.4%)	62(72.1%)	
NLR			0.371
H-NLR	18(18.9%)	21(24.4%)	
L-NLR	77(81.1%)	65(75.6%)	
PLR			0.001*
H-PLR	72(75.8%)	81(94.2%)	
L-PLR	23(24.2%)	5(5.8%)	

Data are presented as n (%),Bolded p-values indicate statistical significance at $p < 0.05$

Abbreviations: LVI: lymphovascular invasion; PNI: perineural invasion; CEA: carcinoembryonic antigen TDs: tumor deposits;

TNM: tumor node metastasis; NLR: neutrophil-to-lymphocyte ratio; PLR: platelet-to-lymphocyte ratio

TLN: total lymphnode number

using Fisher's exact test or chi-squared test for categorical variables

a P-value was estimated by t test

are believed to have an anti-tumor effect [13]. One study found that patients with rectal cancer who had tumor infiltration of CD4 + and CD8 + cells had a higher chance of survival [14]. The NLR and PLR are two indicators that have been found to be predictive biomarkers in patients with colorectal cancer, and elevated NLR is negative to overall survival (OS) and disease-free survival [15]. Further research indicated that a high NLR was associated with unfavorable survival outcomes in proficient mismatch repair (pMMR) colorectal cancer but not in patients with deficient mismatch repair (dMMR) [16]. Additionally, NLR can serve as a predictor of recurrence in rectal cancer [17]. Poor pathological complete response (pCR) was predicted by the percentage change in NLR from pre-to post-neoadjuvant chemoradiotherapy(nCRT) in locally advanced rectal cancer [18].

A high PLR has been associated with the occurrence of lymph node metastasis; however, it does not affect overall survival or disease-free survival in CRC [19]. Additionally, it may be a useful predictor of lateral lymph node recurrence in patients with rectal cancer [20]. Conversely, another study indicated that NLR did not demonstrate any predictive value regarding nodal status in rectal cancer when subjected to multivariate analysis [21]. Gaudioso et al. found that an NLR greater than 2.12 was the most reliable indicator for identifying occult lymph node metastasis in cN0 HNSCC [8]. Furthermore, the preoperative NLR may prove to be an effective supplementary tool for assessing lymph nodes in patients with gastric cancer [9].

NLR and PLR were readily assessed as they were routinely measured in every patient before treatment. However, elevated levels may also occur in infectious diseases, complicating the distinction between cancer-related inflammation and other conditions. Various NLR thresholds have been reported in numerous retrospective investigations [22], and the cutoff values for NLR can be established through ROC analysis. Mean values have also been employed in certain studies [5, 23].

PLR has demonstrated greater accuracy than NLR in evaluating the depth of invasion in colon cancer. A higher PLR is associated with reduced overall survival (OS) and disease-free survival (DFS) in surgically treated patients, with this prognostic relevance observed in both metastatic and nonmetastatic cases [24]. Additionally, an elevated PLR is linked to poorly differentiated tumors, advanced cancer stages, and lymphovascular invasion [25]. However, the relationship between PLR and lymph node metastasis remains inadequately understood.

lymph node metastasis is closely associated with T staging in rectal cancer. Research indicates that the risk of lymph node metastasis progressively increases from T1 (6–65%) to T2 (11–78%) in early rectal cancer [26]. Furthermore, the odds ratio(OR) for the pT stage is approximately 10 for pT1/2 and > 20 for pT3/4 [27]. In our study, we observed that patients with T3/4 stage had a higher number of positive lymph nodes than those with T1/2 stages, suggesting that T3/4 is a significant risk factor for lymph node metastasis based on univariate analysis,

Table 4 Logistic regression analysis of the relationship between lymph node metastasis and clinicopathological characteristics in rectal cancer patients

Viable	Univariate Analysis OR (95% CI)	*P*	Multivariate Analysis OR (95% CI)	*P*
Age(y)		0.261		
≥65	Ref.			
<65	0.712(0.394–1.287)			
gender		0.409		
male	Ref.			
female	1.289(0.706–2.356)			
location		0.094		
≥5 cm	Ref.			
<5 cm	0.527(0.249–1.115)			
T stage		0.001*		0.604
T1–2	Ref.		Ref.	
T3–4	3.156(1.580–6.303)		1.272(0.512–3.157)	
PNI		<0.001*		0.008*
Negative	Ref.		Ref.	
Positive	6.182(3.242–11.787)		3.086(1.341–7.102)	
LVI		<0.001*		<0.001*
Negative	Ref.		Ref.	
Positive	10.271(5.177–20.375)		6.203(2.892–13.303)	
NLR		0.283		
L-NLR	Ref.			
H-NLR	1.482(0.722–3.043)			
PLR		0.002*		0.063
L-PLR	Ref.		Ref.	
H-PLR	5.175(1.870–14.321)		3.146(0.939–10.538)	
TDs		0.016*		0.831
Negative	Ref.		Ref.	
Positive	3.390(1.261–9.117)		1.142(0.337–3.869)	
TLN	1.053(1.005–1.103)	0.030*	1.016(0.958–1.078)	0.593
CEA (ng/mL)		<0.001*		0.204
<5	Ref.		Ref.	
≥5	3.313(1.655–5.920)		1.684(0.754–3.761)	
CA199 (ng/mL)		0.047*		0.066
<27	Ref.		Ref.	
≥27	2.248(1.012–4.992)		2.529(0.940–6.804)	

Abbreviations: LVI: lymphovascular invasion; PNI: perineural invasion; CEA: carcinoembryonic antigen TDs: tumor deposits;
NLR: neutrophil-to-lymphocyte ratio; PLR: platelet-to-lymphocyte ratio; OR: odd risk
TLN: total lymphnode number

while the advanced T stage was not an indepandent risk factor for lymph node metastasis in rectal cancer.

Preoperative CEA levels have been recognized as an independent risk factor for lymph node metastasis and are associated with metastasis in the lymph nodes at the root of the inferior mesenteric artery (IMA) [28, 29]. Furthermore, CA199 demonstrated a significant relationship with lymph node metastasis in rectal cancer patients and acted as an independent predictor within the clinical model [30]. However, the study concluded that although CEA and CA199 were linked to lymph node metastasis, they did not meet the criteria to be classified as independent risk factors. Further research, especially multicenter prospective studies, is essential to better understand the predictive value of CEA and CA199 in lymph node metastasis of rectal cancer, as such insights would provide enhance clinical applicability.

Perineural invasion has been used as a predictive factor for residual lymph node metastasis in locally advanced rectal cancer after neoadjuvant chemoradiotherapy (nCRT) [31]. Multivariate analysis indicated that lymphovascular invasion was significantly associated with nodal involvement in T1-2 stage rectal cancer [32]. This study also demonstrated that both Perineural invasion

and ymphovascular invasion were independent factors contributing to lymph node metastasis in rectal cancer.

This study has several important limitations. First, the sample size was relatively small compared to similar studies, and the single-institution design may limit generalizability. Second, all surgical procedures were performed laparoscopically, excluding open surgery cases, which may further restrict the broader applicability of our findings.Third, the study lacked radiologic assessment of nodal involvement. The potential additive value of NLR/PLR combined with standard radiologic evaluation remains uncertain and merits further investigation. Future studies could also examine other hematologic markers, such as the lymphocyte-monocyte ratio and platelet counts.Fourth, the exclusion of patients receiving neoadjuvant chemotherapy or radiotherapy may have resulted in underrepresentation of locally advanced rectal cancer cases typically managed with these therapies, introducing potential selection bias.Fifth, unmeasured variables including patients' comorbid inflammatory conditions and BMI could influence NLR/PLR values, potentially confounding our results.Finally, as a retrospective analysis, this study inherits the inherent limitations of such designs, including potential variability in NLR/PLR measurements over time.So, given the inherent limitations of this study's setting and population homogeneity, the generalizability of our findings to other populations or healthcare contexts may be limited, future multicenter studies with diverse cohorts are warranted to validate these results."

Conclusion

H-PLR, but not H-NLR, may be associated with LNM in rectal cancer, however, PLR was not identified as an independent risk factor for lymph node metastasis (LNM). In contrast, both perineural invasion (PNI) and lymphovascular invasion (LVI) may serve as independent risk factors for LNM in rectal cancer.

Abbreviations

SIR	Systemic inflammatory response
LNM	Lymph node metastasis
RC	Colorectal cancer
OS	Overall survival
AJCC	American Joint Committee on Cancer
LVI	Lymphovascular invasion
TD	Tumor deposits
PNI	Perineural invasion
CEA	Carcinoembryonic antigen
NLR	Neutrophil-to-lymphocyte ratio
PLR	Platelet-to-lymphocyte ratio
TLN	Total lymphnode number

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12876-025-03960-6.

Supplementary Material 1

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Not applicable.

Author contributions

Guohua Yang analyzed and interpreted the patient data and designed the plan. Zhijie You and performed the histological examinations. Yangfeng Lin drafted and edited the manuscript. Zhijing Lin and Siming Wang performed the follow-up and collected the patient data. All authors have read and approved the final manuscript.

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Data availability

Data is provided within the manuscript.

Declarations

Ethics approval and consent to participate

This study was approved by the Ethics Committee of the FuJian provincal Hospital. This study was conducted in accordance with the Declaration of Helsinki, Written informed consent was obtained from each patient before receiving the start of the study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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