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Short Communication

Lymph Node Count and Ratio in Assessment of Colon Cancer Surgery

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Abstract

Objective: The purpose of this study was to evaluate the application of lymph node count (LNC) and lymph node ratio (LNR) in the surgical prognostic assessment of colon cancer.

Methods: To analyze the correlation among LNC, LNR, and clinicopathological features including systemic inflammatory response (SIR) in patients undergoing colon cancer surgery. To provide a new evaluation idea for clinicians to evaluate the prognosis of colon cancer surgery. The methods of this study was to retrospectively analyze the clinical data of patients who underwent colon cancer resection at the Affiliated Bozhou Hospital of Anhui Medical University from August 1, 2013 to August 1, 2023. LNC (<12 / ≥12) and LNR (<0.25 / ≥0.25) were analyzed using Chi-square test and logistic regression, as well as clinicopathological characteristics including modified Glasgow Prognostic Score, C-reactive protein and albumin, neutrophil to lymphocyte ratio (NLR), platelet to lymphocyte ratio, and lymphocyte to monocyte ratio. Univariate and multifactorial analyses were performed to analyze the relationship between LNR (<0.25 / ≥0.25) and clinicopathological characteristics and LNC≥12.

Results: In multifactorial analysis, significant differences were found between T stage, N stage, LNR (≥0.25), luminal / open, and COPD (P<0.05). Among patients with LNC≥12 and positive lymph nodes, multivariate analysis showed that elevated LNR (≥0.25) was linked to T stage, NLR, and peritoneal invasion.

Conclusion: LNC and LNR were unrelated with SIR labeling. The LNC and LNR, on the reverse hand, are directly related. In quality surgical and pathologic practice, when compared to N stage, LNR offers a better prognostic value for patients having surgery for colon cancer.The findings of this study demonstrate that LNR is dependent on LNC and has prognostic value in colon cancer patients.

Keywords: inflammation, lymph node count, lymph node ratio, colon cancer

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1 INTRODUCTION

Cancer is responsible for approximately 8 million deaths annually, and colon cancer prognosis depends mainly on clinicopathologic TNM staging criteria. Irrespective of the tumor stage, it has been shown that the number of lymph node resected is related to improved prognosis[1]. Lymph node count (LNC) ≥12 is considered an oncologically reasonable means of surgical resection. LNC appears to have a prognostic value that is reliant on lymph node positivity, as an increased proportion of positive lymph nodes is associated with poorer prognosis, and a cutoff value of 0.25 (1 out of 4 positive lymph nodes) is of particular significance. However, Despite modifications in the lymph node acquisition during surgery, lymph node ratio (LNR) has not yet been included into conventional tumor staging[2,3]. Past studies have found that tumor disease progression depends not only on local tumor factors, but also on the tumor's interaction with the inflammatory response. The modified Glasgow Prognostic Score (mGPS), C-reactive protein (CRP) and albumin, neutrophil to lymphocyte ratio (NLR), platelet to lymphocyte ratio (PLR), and lymphocyte to monocyte ratio (LMR) can all be used for assessing a systemic inflammatory response (SIR), and additionally elevated SIR with elevated LNR is associated with decreased LNC and survival[4]. In response to these studies, SIR may reduce LNC, which would raise LNR and directly effect survival. Therefore, this study's primary goal was to explore the associations between LNC, LNR, and clinicopathologic features, including SIR, in patients experiencing surgery for colon cancer, where fewer studies have been conducted previously on LNC and LNR in combination with SIR.

2 METHODS

Retrospective analysis of patients who underwent colon cancer resection in the Affiliated Bozhou Hospital of Anhui Medical University from August 1, 2013 to August 1, 2023. In this study, there were two main inclusion criteria, i.e., based on preoperative abdominal X-ray tomography and dissection findings, and due to the retrospective nature of the database, patients with cancers associated with inflammatory bowel disease as well as those who underwent palliative resection or partial resection only, or who did not have preoperative measurement of CRP or albumin were excluded in this study, using the eighth edition of the TNM staging of tumors published by the International Union Against Cancer / American Joint Committee on Cancer. According to the current guidelines, it was mainly offered based on the treatment of patients without serious comorbidities who have stage III or high-risk stage II disease. LNC≥12 was used in this study, as reported in the document that LNC≥12 is a suitable and safe criterion for surgical resection. LNR≥0.25 was based on literature reports; LNR≥0.25 is associated with high tumor load and poorer prognosis. Serum CRP, albumin, and differential hematocrit were routinely measured in colon cancer patients inside of 30 days prior to surgery. According to previously descriptions, the mGPS was built (patients with CRP≤10mg/L were scored as 0, CRP>10mg/L were scored as 1, and CRP>10mg/L and albumin <35g/L were scored as 2). Calculations for NLR, PLR, and LMR were made by dividing the first by the second.

2.1 Statistical Analysis

SPSS 20.0 was used to perform statistical analysis. The associations between LNC and LNR as well as clinicopathological characteristics (including mGPS, NLR, PLR and LMR) wereinvestigated using Chi-square test and logistic regression. A significant difference was defined as a $P<0.05$. For LNC and LNR, all features statistically significant on the Chi-square test were entered into the logistic regression analysis. Clinicopathologic factors associated with LNC and LNR in bivariate analysis were for inclusion in multivariate models.

3 RESULTS

Table 1 illustrated the relationships between LNC (<12 / ≥12), clinicopathologic characteristics, SIR, LNR, and survival in patients who undergone surgery for colon cancer. T stage, N stage, vascular invasion, LNR≥0.25, BMI, luminal / open, and COPD were significantly associated with LNC≥12. Logistic regression analysis was performed for variables significantly associated with LNC (<12 / ≥12) (Table 2). In multivariate analysis, LNC (≥12) was significantly associated with T stage, N stage, LNR (≥0.25), luminal / open, and COPD. The association between LNR (<0.25 / ≥0.25) and clinicopathologic characteristics of operated patients in patients with LNC≥12 and LNR>0 revealed that LNR≥0.25 was significantly associated with T stage, NLR, and peritoneal involvement. Multivariate analysis of variables significantly associated with LNR≥0.25 showed a significant correlation between elevated LNR (≥0.25) and T stage and NLR (Table 3).

4 DISCUSSION

The findings of this study demonstrated that LNR was dependent on LNC and had prognostic value in colon cancer patients. By correlation analysis with mGPS, NLR, PLR, and LMR, this study did not confirm the relationship between LNC, LNR and SIR[5-7]. The suggestion which SIR in colon cancer caused lymph node hypertrophy resulting in LNC decreased and LNR increased, was therefore not supported by the current results. In contrast, the current findings underscored the

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Table 1. Association between LNC (<12 / ≥12) and LNR (<0.25 / ≥0.25) with Clinicopathologic Characteristics of Colon Cancer Patients

Clinical Pathology	Colon			LNC≥12 and LNR>0		
	LNC<12	LNC≥12	*P*	0<LNR<0.25	LNR≥0.25	*P*
Age (<65 / ≥65)	7 (8.5) / 13 (15.9)	23 (28.0) / 39 (47.6)	>0.05	14 (24.1) / 31 (53.4)	5 (8.6) / 8 (13.8)	>0.05
Sex (F / M)	5 (6.1) / 15 (18.3)	28 (34.1) / 34 (41.5)	>0.05	16 (27.6) / 29 (50.0)	6 (10.3) / 7 (12.1)	>0.05
Elective / Emergency	19 (23.2) / 1 (1.2)	60 (73.2) / 2 (2.4)	>0.05	44 (75.9) / 1 (1.7)	13 (22.4) / 0 (0.0)	>0.05
BMI (L / N / W)	2 (2.4) / 7 (8.5) / 11 (13.4)	8 (9.8) / 26 (31.7) / 28 (34.1)	<0.05	11 (19.0) / 13 (22.4) / 21 (36.2)	2 (3.4) / 4 (6.9) / 7 (12.1)	>0.05
Diabetes (Y / N)	3 (3.7) / 17 (20.7)	14 (17.1) / 48 (58.5)	>0.05	7 (12.1) / 38 (65.5)	2 (3.4) / 11 (19.0)	>0.05
COPD (Y / N)	4 (4.9) / 16 (19.5)	13 (15.9) / 49 (59.8)	<0.05	4 (6.9) / 41 (70.7)	4 (6.9) / 9 (15.5)	>0.05
Surgeries (E / O)	18 (22.0) / 2 (2.4)	56 (68.3) / 6 (7.3)	<0.05	42 (72.4) / 3 (5.2)	12 (20.7) / 1 (1.7)	>0.05
T stage (1)	2 (2.4)	7 (8.5)	<0.05	3 (5.2)	2 (3.4)	<0.05
T stage (2)	6 (7.3)	13 (15.9)	>0.05	10 (17.2)	5 (8.6)	>0.05
T stage (3)	8 (9.8)	22 (26.8)	>0.05	15 (25.9)	3 (5.2)	>0.05
T stage (4)	4 (4.9)	20 (24.4)	>0.05	17 (29.3)	3 (5.2)	>0.05
N stage (0)	5 (6.1)	35 (42.7)	<0.05	22 (37.9)	7 (12.1)	>0.05
N stage (1)	9 (11.0)	18 (22.0)	>0.05	18 (31.0)	5 (8.6)	>0.05
N stage (2)	6 (7.3)	9 (11.0)	>0.05	5 (8.6)	1 (1.7)	>0.05
Vascular invasion (Y / N)	9 (11.0) / 11 (13.4)	15 (18.3) / 47 (57.3)	<0.05	9 (15.5) / 36 (62.1)	3 (5.2) / 10 (17.2)	>0.05
Tangential margin violation (Y / N)	1 (1.2) / 19 (23.2)	3 (3.7) / 59 (72.0)	>0.05	1 (1.7) / 44 (75.9)	0 (0) / 13 (22.4)	>0.05
Peritoneal violation (Y / N)	3 (3.7) / 17 (20.7)	15 (18.3) / 47 (57.3)	>0.05	13 (22.4) / 32(55.2)	2 (3.4) / 11 (19.0)	<0.05
Neoadjuvant therapy (Y / N)	2 (2.4) / 18 (22.0)	13 (15.9) / 49 (59.8)	>0.05	6 (10.3) /39 (67.2)	1 (1.7) / 12 (24.8)	>0.05
mGPS 0	9 (11.0)	27 (32.9)	>0.05	18 (31.0)	6 (10.3)	>0.05
mGPS 1	7 (8.5)	25 (30.5)	>0.05	23 (39.7)	5 (8.6)	>0.05
mGPS 2	4 (4.9)	10 (12.2)	>0.05	4 (6.9)	2 (3.4)	>0.05
NLR<5	17 (20.7)	53 (64.6)	>0.05	39 (67.2)	11 (19.0)	<0.05
NLR≥5	3 (3.7)	9 (11.0)	>0.05	6 (10.3)	2 (3.4)	>0.05
PLR<150	9 (11.0)	21 (25.6)	>0.05	17 (29.3)	5 (8.6)	>0.05
PLR≥150	11 (13.4)	41 (40.0)	>0.05	28 (48.3)	8 (13.8)	>0.05
LMR<2.4	7 (8.5)	19 (23.2)	>0.05	13 (222.4)	4 (6.9)	>0.05
LMR≥2.4	13 (15.9)	43 (52.4)	>0.05	32 (55.2)	9 (15.5)	>0.05
LNR (<0.25 / ≥0.25)	16 (19.5) / 4 (4.9)	55 (67.1) / 7 (8.5)	<0.05	42 (72.4) / 3 (5.2)	12 (20.7) / 1 (1.7)	>0.05

Notes: F=Female, M=Male, L=Low, N=Normal, W=Weight, E=Endoscope laparoscopic, O=Open, Y= Yes , N=No.

Table 2. Relationship between LNC (<12 / ≥12) and Clinicopathologic Features and LNR (≥0.25) in Patients Operated for Colon Cancer

Clinical Information	One-way Analysis of Variance	95% CI			Multifactorial Analysis	95% CI		
	OR	Low	High	*P*	OR	Low	High	*P*
N Stage	0.412	0.305	0.587	<0.05	0.531	0.365	0.874	<0.05
T Stage	0.714	0.598	0.895	<0.05	0.502	0.279	0.763	<0.05
Vascular invasion	0.483	0.312	0.605	<0.05	0.802	0.357	1.286	>0.05
LNR (≥0.25)	2.157	1.358	3.549	<0.05	2.326	1.578	3.947	<0.05
BMI	1.752	1.298	2.692	<0.05	1.563	0.964	2.157	>0.05
Luminal / open	0.315	0.185	0.527	<0.05	0.528	0.335	0.713	<0.05
COPD	0.394	0.315	0.519	<0.05	0.357	0.212	0.564	<0.05

Table 3. Relationship between LNR (<0.25 / ≥0.25) and Clinicopathologic Characteristics of Patients Operated on for Colon Cancer and LNC≥12 with LNR>0

Clinical Information	One-way Analysis of Variance	95% CI			Multifactorial Analysis	95% CI		
	OR	Low	High	*P*	OR	Low	High	*P*
T stage	2.356	1.387	3.856	<0.05	2.362	1.487	3.982	<0.05
NLR	2.429	1.356	5.284	<0.05	2.473	1.295	7.013	<0.05
Peritoneal violation	2.374	0.869	6.543	>0.05				

significance of ensuring optimal evaluation of patients for lymph node metastasis with T stage of colon cancer and high-quality surgery and pathology[8,9].

Evidence now suggested that a postoperative LNC of twelve or more for colon cancer better indicates lymph node status[10-13]. Moreover, an LNC below twelve was associated with a poor prognosis, primarily explained in surgical and pathologic practice. However, there was uncertainty as to whether each sample can be performed according to such lymph node retrieval benchmarks[14,15]. LNR was reported to be a valid influencing factor in patients with lymph node-positive colorectal cancer. However, as demonstrated in this study, LNR depended on the quality of the pathology, especially the number of lymph nodes removed[16]. This study established that the benchmark of twelve or more lymph nodes was significantly associated with T stage, N stage, LNR (≥0.25), luminal / open, and COPD. Given that twelve lymph nodes can now be retrieved in increasing procedures, LNR may be a valid complementary marker for staging patients with colon cancer. Thus, with superb surgical and pathologic testing, LNR had additional prognostic value in colon cancer patients and may be an effective evaluation of adjuvant teeatment for patients. Only T stage and NLR were independent determinants of LNR when the ≥12 lymph node benchmark was reached / detected in lymph node-positive illness. These findings verified the significance of tumor infiltration in lymph node spread and colon cancer staging. So, in the case of poor lymph node recovery after colon cancer surgery, a situation existed where patients with T3/T4 stage should be regarded as having a significant probability of recurrence in some circumstances. As an independent risk factor, NLR could predict lymph node metastasis as one of the clinically valid indicators for predicting the prognostic outcome of colon cancer patients. NLR could be a useful adjunctive diagnostic tool for evaluating lymph node metastasis in colon cancer.

5 CONCLUSION

The reported relationship between LNC, LNR and SIR, as measured by GPS, NLR, PLR, and LMR, has not been confirmed in this study. LNR has a stronger prognostic value than N stage in patients receiving colon cancer surgery in high-quality surgical and pathologic practice. The key weakness of this study is that it is a retrospective analysis. However, research was carried out on a prospectively acquired dataset with a rather large cohort size, which included thorough information about the patients' clinicopathologic characteristics. In conclusion, the findings of this study demonstrate that LNR is dependent on LNC and has prognostic value in colon cancer patients.

Acknowledgements

Not applicable.

Ethical Approval Statement

This study was approved by the Ethics Committee of the Affiliated Bozhou Hospital of Anhui Medical University. Our study used de-identified patient data, adhering to the Declaration of Helsinki for medical research on human subjects. Since this was a retrospective analysis of existing medical data, it did not require additional ethical approval or registration. We prioritized patient privacy and confidentiality, in accordance with legal and ethical guidelines.

Conflicts of Interest

The authors declared no conflict of interest.

Author Contribution

Chen W was responsible for data curation, formal analysis, and drafting the original manuscript. Fan X played a key role in conceptualization, formal analysis, project administration, resource management, supervision, and reviewing and editing the manuscript. All authors contributed to the manuscript and approved the final version.

Abbreviation List

CRP, C-reactive protein
LMR, Lymphocyte to monocyte ratio
LNC, Lymph node count
LNR, Lymph node ratio
mGPS, Modified Glasgow Prognostic Score
NLR, Neutrophil to lymphocyte ratio
PLR, Platelet to lymphocyte ratio
SIR, Systemic inflammatory response

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